CHEMICAL, BIOLOGICAL, OR RADIOLOGICAL (CBR) DEBRIS REMOVAL GUIDELINE

US Army Corps of Engineers®

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LIST OF ACRONYMS

AAMP	Ambient Air Monitoring Programs
APR	Air Purified Respirators
CBR	Chemical, Biological, Radiological
CHP	Certified Health Physicist
COC	Chain of Custody
CRZ	contamination reduction zone
CWA	Chemical Warfare Agents
DOT	Department of Transportation
ESF	emergency support functions
FID	Flame Ionization Detector
FRERP	Federal Radiological Emergency Response Plan
FRP	Federal Response Plan
HASP	Health and Safety Plan
ICS	Incident Command System
NCP	National Contingency Plan
NRC	National Response Center
PID	Photo Ionization Detector
PPE	personal protective equipment
PUF	polyurethane foam
RCT	Radiological Control Technicians
RMW	Regulated Medical Waste
SCBA	Self-Contained Breathing Apparatus
SCO	surface contaminated object
SOP	Standard Operating Procedure
TSP	Total Suspended Particulates
UCS	Unified Command Structure
VHP	vaporized hydrogen peroxide
VOC	volatile organic compound

CHAPTER 1. PURPOSE AND OBJECTIVES

1.1 INTRODUCTION

As the United States fights against international terrorist groups, there is increasing concern such groups will retaliate using weapons of mass destruction on our homeland. While thousands could die, millions more will likely suffer psychological impact. Such weapons include biological, chemical, and radiological devices. In an effort to better prepare American resources for the remediation of such attacks, the United States Army Corps of Engineers, Rapid Response Program offers this Weapons of Mass Destruction Guideline. This document presents an overview of biological, chemical, and radiological (CBR) remediation procedures, along with constituent specific examples.

The U.S. Army Corps of Engineers (USACE) Rapid Response Program has a demonstrated and successful history of responding to some of our nation's most challenging environmental emergencies. For example, the USACE's Rapid Response Program was tasked with supporting the United States Postal Service through the development of anthrax plans and procedures, participation as a key member in the USPS Unified Incident Command Center, coordination with numerous other federal, state, and local agencies, and the execution of 284 facility assessments and six emergency facility decontamination operations. Rapid Response has also been tasked with supporting the Department of State in the bleaching of U.S. Embassy's mail rooms in addition to the entire decontamination of the SA-32 Postal Facility. Last, the USACE response network has experience with chemical warfare agents, unexploded ordnance (UXO), high hazard and exotic chemicals, radiological materials, and infectious substances.

This response experience has demonstrated the necessity of having a trained, experienced, and equipped organization of government personnel and contractors, and an established set of operating procedures to support remediation, decontamination, and recovery operations at disasters involving CBR agents. This team has the ultimate goal of reducing the potential for on-site exposure of personnel, containing and limiting the spread of contamination, and ensuring the compatibility with the Federal Response Plan (FRP) and individual agency missions.

1.2 OBJECTIVES

This document was developed as a guideline for consequence management operations following a terrorist event. The objective of this guideline is to provide a clear process, technical procedures, and associated agency responsibilities to facilitate an orderly and rapid mobilization of trained personnel and equipment to support a significant response, remediation, and recovery where a CBR agent has been deployed.

Specifically, this document will focus on issues that are tangent to response; remediation and recovery activities at terrorist incidents that generate a significant volume of potentially contaminated building debris. These guidelines are not intended to replace site, facility, or regional response plans for a CBR incident; instead, they provide information drawn from best practices and identify issues for consideration during the planning activities and deployment during recovery and debris removal operations.

CHAPTER 2. CHEMICAL, BIOLOGICAL, OR RADIOLOGICAL (CBR) EVENT

A terrorist event may utilize a CBR agent or improvised devise with the specific intent to kill humans, restrict access to critical economical or symbolic areas, or initiate widespread epidemics (even at extremely low doses). The intent is often to induce mass suffering and civilian causalities on the population or induce significant economic hardship. The use of CBR agents during attacks is intended to create fear, chaos, and a feeling of vulnerability in the population, which makes them attractive to many terrorist organizations.

Motives for terrorism include, but are not limited to: making a political statement; drawing attention to a cause; undermining a sense of security; undermining confidence in the government; and/or disrupting the economy or infrastructure. It is important to understand that the intent of terrorism is often to kill or injure people, including the public and emergency responders, using unconventional means.

Following the emergency response actions, it is the goal of the unified federal response, within the scope of this document, to control the source of the contamination, limit the spread of contamination, prevent or limit the potential for public exposures, and remediate and remove the contaminated materials from the site in order to facilitate recovery and a prompt return to normal use.

2.1 INDICATIONS OF A CBR INCIDENT

It may be difficult to distinguish between an accidental industrial chemical release and a terrorist attack during the initial phases of the response. Many biological agents are difficult or impossible to detect with the technologies available to the initial responders. First responders should be trained and equipped to recognize the characteristics and evidence that are associated with a terrorist event. Specific precautions should be taken during the initial response to any suspicious event. Initial response and assessment procedures should be designed to detect or rule out the release of CBR materials. Indications of a terrorist event vary greatly depending on the specific CBR agent and the associated dispersion device; however, the following are some general indications that could indicate the possibility of a terrorist event:

- Specific or general threats to a venue, infrastructure, or population.
- Recent terrorist activities in the same geographic areas.
- Specific or general intelligence of an impending attack.
- Involvement of a controversial or high-risk target.
- Timing that coincides with a high visibility event.
- Suspicious hazardous materials releases.
- Unexplained odors, vapors, spills, or plumes.
- Positive readings from CBR monitoring and testing equipment.
- Numerous hospital reports with unusual but similar symptoms.
- Unexplained patterns of illness, injury, or fatalities.
- Subsequent calls or letters from groups or individuals claiming responsibility.

2.2 DISCOVERY

Discovery of a CBR incident should occur during the initial emergency response to an incident. Initial (local) and secondary (state and federal) response organizations should be trained and equipped to first detect potential terrorist attacks, isolate and control the scene (establish work zones), initiate notifications, establish an Incident Command System (ICS), and then confirm and quantify the extent of the agent involved. It is crucial that the information obtained during the initial response be preserved as the response progresses toward the remediation and recovery actions to reduce the need for the "re-collection" of data.

Additionally, initial responders should be trained to preserve all information and images that could be considered evidence during the investigation by local, state, and federal law enforcement agencies, and employ all isolation, site control, and decontamination techniques practical to limit the spread of contamination from the initially contaminated areas.

CHAPTER 3. ORGANIZATION OF THE FEDERAL RESPONSE PLAN

The Federal Response Plan (FRP) is a signed agreement among 27 departments and agencies that supplement federal emergency operations plans developed to address specific hazards and supports implementation of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The FRP provides the mechanism for coordinated delivery of federal assistance and resources to augment efforts of state and local governments overwhelmed by a major disaster or emergency.

The FRP is implemented under the following circumstances:

- In response to an actual event requiring federal assistance under a Presidential declaration of a major disaster or emergency.
- In anticipation of a significant event likely to result in a need for federal assistance.

In particular, the FRP may be implemented concurrently with the:

- National Plan for Telecommunications Support in Non-Wartime Emergencies, which provides a basis for ESF #2 - Communications Operations.
- National Oil and Hazardous Substances Pollution Contingency Plan, known as the National Contingency Plan (NCP), which provides the basis for ESF #10 - Hazardous Materials Operations.
- Federal Radiological Emergency Response Plan (FRERP), which details the federal response to a peacetime radiological emergency.

3.1 EMERGENCY SUPPORT FUNCTION (ESF) #3 – ENGINEERING SUPPORT

The Federal Response Plan (FRP) employs a functional approach that groups support activities under 12 Emergency Support Functions (ESFs) that have identified roles for the type of direct federal assistance that a state or local government is most likely to need. ESF#3, entitled Public Works and Engineering, provides technical advice and evaluation, engineering services, damage mitigation, and recovery activities following a disaster. The USACE is identified by the FRP as the primary agency supporting the ESF #3 mission. At a terrorist event, this mission may include the handling, decontamination/treatment, staging and testing, transportation and final disposal of debris; building evaluation, assessment and stabilization; infrastructure and utility recovery; and a host of other engineering support.

Tasks under the ESF #3 mission must be coordinated using the unified command system (UCS) to assist with other ESF missions including, but not limited to the following:

- ESF#9 Urban Search and Rescue: Deploys components of the National Urban Search and Rescue Response System to provide specialized life-saving assistance in the event of a major disaster or emergency.

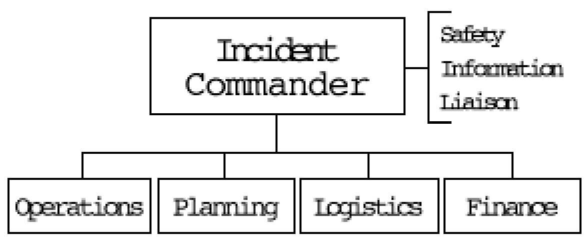
- ESF#10 Hazardous Materials: Provides support to state and local governments in response to an actual or potential discharge and/or release of a CBR agent or other hazardous materials.

3.2 INITIAL ACTIVATION OF THE FEDERAL RESPONSE PLAN AND THE UNIFIED COMMAND SYSTEM

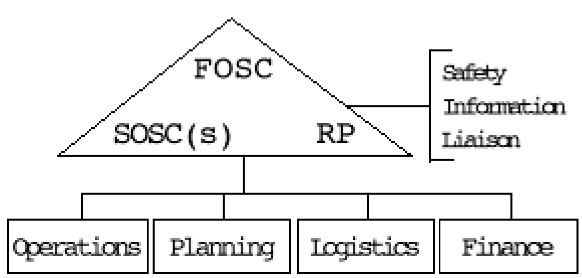
As soon as a credible threat is suspected, the local response system is initiated in accordance with the corresponding facility or community emergency plans. Local law enforcement is responsible for contacting the Regional Office of the FBI and the National Response Center (NRC) 800-424-8802 to initiate the Federal Response.

During the initial response to a CBR incident, the local first responder community will coordinate their efforts under an Incident Command System (ICS) to ensure their actions and resources are integrated into a single, effective response. As the size and scope of the response expands, it is likely that the response will be Federalized requiring the Department of Homeland Security/FEMA to assume specific federal site management roles. The Unified Command System (UCS) should be implemented to adequately coordinate all Federal, State and Local resources and site activities. The following diagrams illustrate the relationship between the local Incident and Unified Command structures.

Incident Command System



Unified Command System



The UCS promotes the coordination of all resources required to support site operations while ensuring there are not counter-productive activities.

CHAPTER 4. SITE LOGISTICS

4.1 ESTABLISHMENT OF SITE BOUNDARIES

The first objective upon responding to an emergency scene is site control. The Incident Commander is responsible for the initiation of work zones prior to initiating other site activities. During a CBR incident, the site must be secured and access must be limited to only qualified personnel. Civilians must be prevented from entering the site area regardless of good intentions or other honorable motivations.

Initial work zones should be established by the first responders arriving on-site based upon many factors that may include: suspected identity and toxicity of the materials involved, local terrain, waterways and structures, real-time air monitoring and multi-media sampling results, suspected presence of CBR agents; meteorology/wind direction and velocity; likelihood of collateral damage or secondary devices; and other site-specific issues. Established work zones should be continually reviewed via the UCS for appropriateness following significant site events or operational accomplishments.

The work zone delineations established during the initial response will typically have to be greatly expanded to accommodate debris staging, decontamination/treatment, and handling; equipment staging and treated debris staging; and maintenance requirements. These changes must be coordinated through the site health and safety representatives within the Unified Command Structure.

Even if no CBR agents are immediately detected, work zone boundaries should be established based on physical and chemical hazards of dusts and chemicals associated with fires, explosions, or building collapse.

Computer modeling of site contaminants or CBR releases, coupled with real-time weather data from portable meteorological stations and real-time area monitoring for specific contaminants, can provide significant insight to the appropriate selection of work zone boundaries and site emergency contingency planning.

4.1.1 Support Zone

Upon arrival at the site, the support zone is established by the initial responders to ensure a safe distance is maintained from the suspected release to areas where unprotected site workers or the general public are located. The purpose of the support zone is to establish staging areas for personnel, vehicles, equipment, supplies, command post operations, and personnel support activities. The support zone should not have any significant contamination present. The appropriateness of the boundaries should be continuously monitored by reviewing multi-media monitoring and sampling results for the area.

As the remediation and recovery operations are being prepared, the support zone will have to be organized and usually greatly expanded to allow the delivery, staging, and movement of heavy excavation and lifting equipment; decontamination/treatment equipment; clean fill;

clean or treated soil and debris staging and sorting; transport trucks; tanks or roll-off containers; scales; and other large pieces of construction-type equipment and materials. This often requires the use of agency and contractor-specific staging areas away from the site. Movement onto the site and out of the decontamination area will require close coordination with the UCS and may require a dedicated group of individuals and communications.

Although these may not be needed for small-scale terrorist incidents, an inventory of available warehouse space and potential staging areas would assist in the response to a large-scale and/or prolonged response and recovery efforts. Specific considerations should be made with regard to the types of materials being stored and transported from and to support-zone staging areas. It is possible that regulatory emergency exemptions may be required for the transport and storage of some materials or wastes.

4.1.2 Contamination Reduction Zone

Once remediation and recovery operations are ready to begin, the contamination reduction corridor must be redesigned to accommodate the decontamination of debris, vehicles, heavy equipment, and personnel and the type and concentration of a CBR agent involved. For large urban disasters, this may require closing a street for over a city block to establish a debris or vehicle decontamination/treatment systems. Planning must consider the logistics of rapidly staging, loading and moving large trucks to remove potentially large volumes of treated or clean debris. These operations also require access to power and water utilities. It may be necessary to design and construct a small water treatment system to contain and treat the decontamination water.

A site-specific decontamination plan should be developed that addresses the following factors:

- Decontamination techniques and solutions.
- Materials handling, size reduction and sorting equipment.
- Containment buildings.
- Water supply, electrical supply, or other utilities that may be required.
- Specific staging areas in and out of the exclusion zone.
- Site-specific SOPs for various types of debris.
- Packaging/wrapping requirements for shipment or storage.
- Final disposition of decontaminated debris.
- Confirmation sampling techniques to determine the effectiveness of decontamination efforts.
- Investigative Derived Waste storage, sampling, and disposition.

As part of a site-specific air-monitoring plan, real-time air monitoring should be conducted in and at the borders of the contamination reduction zone in order to be protective of worker and public health. This is particularly critical in densely populated areas where airborne migration of contaminants or harmful by-products of decontamination could adversely impact the public. For some activities, mobile air sampling laboratories may be appropriate to address public health concerns.

4.1.3 Exclusion Zone

During the incident response, the exclusion zone should be tightly controlled with only authorized personnel entering the zone. The exclusion zone requires all personnel to have the proper identification, training, and medical clearance to wear the personal protective equipment established in the site Health & Safety Plan (HASP). Exclusion Zone access control points should be established before any entries are made into the exclusion zone. Individual entries into this zone should be closely monitored, timed, and documented in order to ensure worker protection. It may be necessary to establish dedicated entry points for heavy equipment, large support equipment and vehicles.

No entry shall be made into this zone without a proper rescue team back-up. Note that, at any particular incident, there may be a need for multiple exclusion zones for various distinct activities and levels of respiratory and skin protection. It is imperative that these zones are strictly monitoring, and access is restricted to only those individuals with the appropriate training and PPE.

4.2 SITE SECURITY

During the initial phases of a terrorist event, securing the site is of vital importance to control the scene, preserve evidence, prevent the spread of contamination, and isolate the contaminated areas from the public, media, and unprotected workers.

4.2.1 Restricting Access

The support zone outer perimeter should limit all public access to site operational areas. This may include shutting down streets, evacuating and locking down adjacent buildings, and setting up a perimeter barricade. This perimeter must also be secured to prevent unauthorized workers from entering the contaminated areas. These zones will prevent further contamination caused by tracking material from foot traffic. Additionally, this will allow investigators unimpeded access to the undisturbed site for evidence collection.

Signs shall be posted to alert personnel of the presence of a source within the exclusion zone.

Additional items to address are power lines, phone cables, water mains, sewer mains, etc. that could complicate the work effort. Water could react with the source and create toxic fumes. Current from phone and electrical lines may ignite the source or create a shock hazard. The CBR incident could involve significant damage to buildings, structures, and utilities requiring engineering support prior to completing source control measures.

4.2.2 Security Clearances for Key Personnel

Following the initial response by uniformed first responders, each member of the response and remediation force should be asked to complete and sign a site questionnaire showing full name, social security number, date of birth, and photo identification. Each member could also be asked to authorize a request to conduct a criminal background check. This information could be used to search a national database for criminal records, which may include review of FBI and CIA watch lists. Refusal to complete a background survey and give authorization for a criminal background check could preclude the individual from entering sensitive sites.

Authorized persons entering the site will be given a site badge with individual's photo and full name, which will usually be controlled through the UCS. Persons not displaying the appropriate badge designated for the site will not be allowed entry into the controlled site. Designated guards at the entrance of the site must approve all persons entering the site. Authorized visitors entering the site must sign in with designated guards and be given an appropriate visitor's badge and assigned an escort. Visitors who are found to be unescorted will be immediately removed from the site and held for questioning as appropriate. Visitors should only have access to the support zone.

Specific high-security facilities, buildings and command centers (e.g., FBI SIOC) also may require higher military security clearances (e.g., Secret, Top Secret, Q). Both government and contractor personnel should have representatives available with these elevated security clearances.

4.3 SITE DOCUMENTATION

Standard logbook protocol should be followed during any incident. All sampling, monitoring, or debris removal activities should be accurately recorded in a bound logbook as a minimum. It is preferable to institute an electronic data management system to instantly transmit all site data, with the associated GPS coordinates, to a central command and control system. This will ensure that an accurate, factual account of site conditions, procedures, and operations can be later reconstructed. Entries should be made or assembled in chronological order and include the following:

- Site name, location, and project numbers.
- Daily site safety meeting.
- Dates and times (based on the 24-hour clock) of all entries.
- Descriptions of all site activities, including site entry and exit times.
- Noteworthy events and discussions.
- Weather observations.
- Site observations.
- Identification and description of samples, including date, time, and location.
- Sample collection techniques.
- Equipment utilized.
- Records of all photographs taken.
- Site sketches of sample locations and/or incident location.

4.4 PHOTOGRAPHIC AND VIDEO DOCUMENTATION

In addition to the written documentation, photographic and video documentation should be conducted during all site activities, as appropriate. In conjunction with all photographs and videotape segments, a written entry should be made in the logbook or on a photograph/video log and maintained in the site files. Responding personnel should take pictures of the site activities, such as sample locations, collection process, decontamination procedures, and site remediation efforts. Electronic images or digital pictures should be managed and routed to provide the UCS with information to support the response decision-making process. Procedures for handling standard film should be established to avoid having the images accessible to only a single agency.

A secure criminal laboratory should be considered for film developing rather than commercial businesses. A Chain of Custody (COC) form should be maintained for all film development to maintain the evidentiary nature and ensure proper handling and tracking of all photographs.

4.5 CRIME SCENE PRESERVATION APPROACH

Following an act of terrorism, the impacted area and surrounding areas should be secured, as soon as reasonably possible. Securing the area consists of cordoning off the site and ensuring that all unauthorized personnel are restricted from entering the site. In order to maintain the integrity of the evidence, sampling personnel must ensure that strict COC protocol is followed.

4.5.1 Evidence Collection

Evidence collection must be conducted in cooperation with any agency conducting an investigation of the incident. All members of the UCS, should be consulted prior to the collection of samples from a crime scene. This will ensure that all necessary steps are taken to preserve the crime scene, and the proper evidence is collected. Evidence should be collected in an expedient and controlled manner to decrease the risk of evidence being altered (e.g., cross-contamination). Additional factors to be aware of when conducting site activities are delivery devices, footprints, fiber, hairs, or blood, all of which may be valuable evidence. Special care should be taken to avoid moving this evidence until adequate documentation can be conducted and the appropriate officials have been notified.

Spatial relationships and orientation of specific types of debris at a crime scene, particularly a crime scene that has involved an explosive device, may provide critical information for the reconstruction of the incident. Considerations should be made for data collection and recording that will preserve spatial components (location and orientation) of certain types of debris. Consultation with law enforcement officials in the earliest stages of an incident response is critical. In addition, data management, access, and control procedures should be clearly established and implemented at the earliest practicable stage of the incident.

CHAPTER 5. SITE ASSESSMENT, CHARACTERIZATION, AND AIR MONITORING

The assessment and characterization of any incident, including a CBR incident, is an on-going process that involves the collection and interpretation of all forms of data. In the early stages of any incident, the data collected as part of the initial assessment drives response decision-making relating to the protection of public and responder health and safety, infrastructure recovery, and minimizing economic impact.

The site characterization is the process of confirming the full range of contaminants, delineating the extent and level of contamination, and identifying distinct areas of similar contamination to support initial recovery planning activities. Site characterization should utilize all available initial site assessment data as a starting point; then, build upon this foundation with the collection of additional site data as the characterization process continues throughout the incident. Whereas site assessment generally considers relatively static conditions (e.g., where the incident has occurred), site characterization considers the more dynamic aspects of an incident (e.g., where a spill or release is going). Specifically, site characterization typically includes information such as concentrations of contaminants, volume of material, and location of contamination. In order to adequately characterize the chemical conditions at any incident, multimedia sampling or monitoring for contaminants of concern is necessary. As stated previously, site characterization should be on-going to address changing conditions.

For chemical contamination including CBR, the site characterization should specifically delineate areas and materials that are "clean" vs. those that require decontamination/treatment. This is vital to avoid the often costly treatment of materials that are not contaminated. Additionally, this data is utilized in other decision-making including establishing the levels of worker protection, type of decontamination necessary, transportation requirements, and disposal of site materials and debris.

For each sampling activity, a brief field sampling plan should be developed that provides a process for obtaining data of sufficient quality and quantity to satisfy data needs. Sampling and analysis plans typically consist of two parts:

- The field sampling plan, which describes the number, type, and location of samples and the type of analyses.
- The quality assurance project plan, which describes policy, organization, and functional activities, and the data quality objectives and measures necessary to achieve adequate data for use in planning and documenting the action or decision.

5.1 OBJECTIVES OF AIR MONITORING

Any potential CBR incident will likely involve a significant air monitoring and sampling effort. For the purposes of this document, the term "air monitoring" refers to use of real-time or near real-time instruments, or the use of laboratory analytical methods to evaluate the concentrations of airborne contaminants, including CBR agents. In many cases, air monitoring is conducted using real-time or near real-time instruments to characterize the potential airborne hazards, with laboratory analysis providing back-up confirmation of real-time results for a sub-set of the overall data set.

It should be noted that some agencies and organizations consider “air monitoring” to include only real-time or near real-time instruments and “air sampling” to include only laboratory analysis. Standardized terminology for these two aspects of evaluating airborne contaminants should be clarified between agencies early on at any incident in order to avoid potential misunderstanding.

Air monitoring is conducted:

- To generally characterize the site where chemical, biological, and/or radiological (CBR) agents may be present or have been identified as being present.
- To confirm initial information during a suspected terrorism incident or post-terrorist act, with the understanding that other unknown releases may occur.
- To “clear” areas where airborne CBR agents may have existed or have the potential to exist.
- To obtain perimeter and/or downwind air contaminate concentrations monitoring during known CBR agent releases to the air.
- To evaluate of the effectiveness of decontamination procedures for areas or objects.
- To verify that the release is a CBR agent and not a release of another hazardous material.
- To ensure protection of public and worker health and safety throughout the incident.

5.1.1 General Air Monitoring

Standard practices for air monitoring during situations involving industrial chemicals vary according to site conditions. During site assessments and removal activities where substantial information about chemical hazards is available, air monitoring programs are tailored for the needs of the site and typically include both real-time and laboratory components. In situations where information of site conditions is limited or unknown, such as during emergency responses to unknown chemical releases, air monitoring generally consists of continuous real-time screening with the following:

- Photo Ionization Detector (PID) or Flame Ionization Detector (FID).
- Explosive Gas Monitor (including oxygen meter and explosimeter).
- Radiation Meter.

- Chemical Specific Monitor.
- Colorimetric Tubes with Pumps.

An air monitoring plan is often developed at longer-term disaster recovery sites that addresses the following:

- Initial screening procedures.
- Continuous monitoring procedures, duration, and locations.
- Sampling methods, procedures, duration, and locations.
- Site-specific action levels for PPE upgrade, ER activation, source identification, and evacuation or shelter-in-place.
- Monitoring processes.
- Sequential screening procedures for potential "hits".
- Specific monitoring equipment.
- Personnel requirements.
- Data management.

A site perimeter monitoring system should be established prior to the initiation of any excavation, demolition, or building debris removal operations. The system should be in operation continually or from 30 minutes before to 30 minutes after debris removal activities begin and end each day. Where chemical PPE is no longer required, perimeter monitoring measures contaminant migration away from the site and enables the team to evaluate the integrity of the site's clean areas. Since the fixed-location samples may reflect exposures either upwind or downwind from the site, wind speed and direction data are needed to interpret the monitoring results.

All information should be logged with a time and date index. Ideally, this would consist of a wireless or automated system that automatically transmits data to a central collection server for easy access for health evaluations and risk assessment modeling.

The sampling systems presented above can be used for fence-line monitoring to collect data to determine if the contaminate has migrated out of site boundaries and ensure worker safety. Depending on the specific hazards and site configuration, multiple monitors may be necessary in and around the work area. Particular attention should be given to perimeter monitoring in order to protect public health, at areas where workers spend significant periods of time and where site operations are likely to generate airborne concentrations of contaminants.

5.2 AIR MONITORING DURING CBR INCIDENTS

Air monitoring should be conducted thoroughly throughout the ambient air, in confining areas, and around the openings of containers with unknown contents. See Appendix A for assistance on evaluation of unknown hazards. As with longer-term hazardous waste sites, an air-monitoring plan should be developed as presented in Subsection 5.1 that includes both real-time instruments and laboratory analysis. The monitoring locations, type of monitoring (real-time vs. laboratory), data objectives, clean-up activities, meteorological conditions, and potential receptors (public, workers, etc.) should all be considered when developing or implementing an air monitoring plan.

Recommended Real-Time Air Monitoring Equipment at a CBR Incident:

- PID or FID.
- Explosive gas monitor.
- Radiation meter.
- Ion mobility spectrometer.
- Disposable chemical agent screening kits.
- Colorimetric detection tubes.
- Biological detection strips or “tickets”.

The specific goals and objectives of air monitoring teams from numerous agencies and organizations at CBR incidents can vary, but it is essential that these monitoring teams be integrated into the existing command system to support the Incident Commander. By evaluating the capabilities, experience, and equipment available to each agency’s monitoring team, the most effective utilization of these resources can be achieved. Focusing monitoring teams by their capabilities, experience, and level of training can assure the most efficient monitoring for: source identification, extent of contamination determination, downwind monitoring, perimeter monitoring, decontamination effectiveness, debris sorting, and worker and public health protection.

Key Points To Remember Relating to Real-Time Air Monitoring:

- Many of the monitoring instruments and kits have interferences and limitations, and should be considered when reading monitoring results. See manufacturer of instrument, kit, etc. for specific interferences.

- When multiple entries are anticipated into the Exclusion Zone, a “clean” table or cart may need to be employed to allow the monitoring equipment to remain in the incident area to reduce the amount of decontamination.

- SCBA breathing air pressure supplies should be tracked closely to allow proper time for decontamination of personnel conducting the air monitoring, especially if intrusive monitoring has occurred.

- Always review the instrument manual and perform required calibrations prior to use to ensure proper air monitoring results.

- Interpretation and evaluation of data collected using real-time air monitoring instruments requires extensive training and hands-on familiarity with the instrument. Only persons trained and experienced in the use of specific air monitoring instruments should perform air monitoring with those instruments.

- Various agencies and organizations calibrate instruments to different standards or span gases in order to suit that agency’s needs. When multiple agencies and organizations are conducting air monitoring at an incident, it is imperative that calibration standards, gases, and span concentrations be documented and evaluated as part of the interpretation of the incoming data. Instruments calibrated to different span gases or span concentrations can have significantly different readings in an identical atmosphere.

5.2.1 Agent Specific Monitoring

Suspected CBR agents can be categorized into one of the following classifications: choking agents, nerve agents, blister agents, blood agents, radioactive materials, and biological agents. For each classification, specific real-time or near real-time air monitoring equipment is desirable due to the increased sensitivity, specificity and quantification capabilities as compared to general survey equipment.

Due to the highly toxic nature of some CBR agents, familiarity with the monitoring equipment is essential to maintain the safety of all respondents involved in the incident. Table 5-1 summarizes some of the equipment that could be used during a chemical, biological, or radiological incident. All equipment, when necessary, shall be calibrated to manufacturer's specifications prior to each entry.

Table 5-1

Monitoring for Specific Agent Groups

AGENT CATEGORY	AIR MONITORING EQUIPMENT AVAILABLE
Choke	**Real-Time:** Colorimetric Tubes or Single gas monitors (chlorine, phosgene) **Near Real-Time:** Sampling with portable Gas Chromatograph/Mass Spectrometer (GC/MS) analysis **Sampling:** Sorbent tubes, filters, impingers, and canisters
Nerve, Blister	**Real-Time:** Ion Mobility Spectrometer Disposable Chemical Agent detection kits (M256A1, etc.) Colorimetric Tubes or Single gas monitors (Lewisite; organic arsenic compounds; organic basic nitrogen compounds; thioether; phosphoric acid esters) **Near Real-Time:** Sampling with portable Gas Chromatograph/Mass Spectrometer (GC/MS) analysis **Sampling:** Sorbent tubes, filters, impingers, and canisters
Blood	**Real-Time:** Disposable Chemical Agent detection kits Colorimetric Tubes or Single gas monitors (hydrocyanic acid; cyanogen chloride; arsine) **Near Real-Time:** Sampling with portable Gas Chromatograph/Mass Spectrometer (GC/MS) analysis **Sampling:** Sorbent tubes, filters, impingers, and canisters
Radioactive	**Real-Time:** Radiation Meters (sodium iodide scintillation; Geiger-Muller; neutron detector; cadmium zinc telluride detector) **Sampling:** Filters
Biological	**Real-Time:** Biological agent test kits **Near Real-Time:** Sampling with polymerase chain reaction (PCR) analysis **Sampling:** Filters, impingers, and impactors

5.2.2 Radiation and Worker Safety

A certified health physicist should be consulted at any incident that involves radiological contamination. Individual exposure tracking and monitoring is required at any radiological incident, and will likely include issuance of Thermoluminescent Dosimeters (a.k.a. TLD badges) to each individual working at the incident. In addition, other actions may be warranted that may include thyroid bioassay, urine bioassay, or whole body counts depending upon the materials involved and the individual exposure. It is imperative that a certified health physicist be consulted to make adequate determinations for worker and public safety as soon as possible at any incident where radiological contaminants are identified.

5.2.3 Additional Environmental Hazards

During debris handling operations, it is important to be aware of additional environmental hazards, such as heavy metals, asbestos, silica, dioxins, volatile organic compounds (VOC), and particulate matter. See Table 5-2 for examples of air monitoring equipment to be utilized during remediation efforts.

Table 5-2

Air Sampling for Additional Hazard

HAZARD	EQUIPMENT AVAILABLE
Asbestos	Air Sampling pumps and filters
Volatiles	Passive Stainless Steel Canisters
Respirable Airborne Contaminants	High Volume Air Sampling Pumps and PM10 or PM 2.5 filters Real-time Particulate Monitors
Semivolatiles	High Volume Air Sampling Pumps and Polyurethane Foam (PUF) filterers
Metals	High Volume Sampling Pumps and Total Suspended Particulate (TSP) filters

5.3 INTERFERENCES AND LIMITATIONS

Cross interference, false positives, and false negatives are possible with all detection devices and methods. It is imperative that personnel collecting and interpreting air monitoring readings be trained and experienced in the use of the specific equipment being utilized. In addition, specific knowledge of the potential interferences, detection limits, and proper calibration, use, storage, and disposal (if necessary) of detection equipment, sampling equipment, and materials is necessary.

5.4 SAMPLING REQUIREMENTS

The objectives of each sampling event need to be identified prior to collection of samples at a CBR agent incident. Because the various agencies, officials, and medical personnel on-site may have different analytical needs, priorities must be established to streamline the sampling approach. Information obtained through laboratory analysis of air samples may be used to: verify real-time air monitoring results; document worker health and safety; confirm public health and welfare; verify the extent of contamination; confirm or quantify decontamination effectiveness; establish confirmation of "clean" areas. In addition to air, a number of other matrices may need to be sampled in order to support decisions or to assess and characterize the incident, including soil, water, wastes, human tissues or fluids, and surfaces.

Specific Standard Operating Procedures (SOPs) and other guidelines should be utilized during a CBR agent incident. These SOPs and guidelines should be followed as closely as possible, but may require adjustments based upon site conditions or equipment limitations. In all instances, the procedures utilized, instrument type, identification number, calibration results, and the operator's name should be thoroughly documented.

CHAPTER 6. SOURCE CONTROL MEASURES

Controlling the source of the CBR agent is imperative to prevent the spread of contamination beyond the initially impacted site areas. General control measures should include limiting access by persons and traffic, prevention of run-off to storm sewers and spillways, and minimizing site activities that promote dust generation or air dispersion of site contaminants. A source can be located in a building, outdoor public area, or at the site of a fire/explosion and the associated building collapse. More in depth control measures are often required to address the specific characteristics of the CBR agent and the associated dispersion method or device.

During recovery and debris removal operations, the source, "ground zero", or contamination hot spot may require more specific engineering controls including physical isolation (e.g., isolation structures, containment foams), chemical fixation, disinfection, or neutralization of contaminants, on-site debris decontamination, or other engineering controls.

6.1 MIGRATION PREVENTION

After securing the site and evidence collection, the source of the attack-related contamination must be controlled from the elements. There are three primary methods of spreading contamination

- Direct contact.
- Run-off.
- Air dispersion.

6.1.1 Direct Contact

There must be limited access to the site to prevent further spread of contamination through physical contact with CBR agents. Low levels of the highly toxic or contagious CBR agents could go undetected while on the unsuspecting person, and potentially be carried and deposited to other locations. This contamination could be lethal when a person comes in contact with the CBR agent without appropriate protection. Access shall be limited by installing physical barriers such as: temporary fencing, sprung structures, concrete vehicle barriers, or physical barriers. Engineering controls such as delineation of specific work zones can also be used to restrict access. Work zones can be used to restrict access to specific areas at the incident to personnel equipped with specified personal protection in order to reduce or eliminate the potential for exposure.

The contamination reduction zone serves as the primary point of control for all materials, vehicles, and personnel entering and leaving the exclusion zone. Site operations may require establishing task or area specific decontamination zones outside of known or suspected highly contaminated areas to limit the spread of contamination through other site areas that have not been fully characterized. This was especially applicable during the recent anthrax remediation efforts. Strict enforcement of personal protective equipment and decontamination procedures effectively reduces the potential for direct contact with CBR agents by unsuspecting individuals.

6.1.2 Run-Off

Run-off has to be controlled during a CBR incident due to the CBR agent's high relative toxicity, potential persistency in the environment, and potential to create an epidemic. There are several conditions that can cause run-off of CBR contamination: rain, application of water in response to a fire or suppression, broken water mains following a building collapse, fire or explosion, or from the CBR agent dispersion devise itself. Routes that are susceptible to run-off, such as sewer drains, curbside drainage, below grade ventilation access points, manhole covers, trenches and/or ditches, must be sealed, covered, diked, or bermed to prevent off-site contamination. Sorbent booms, lined trenches, and earthen berms can be utilized to effectively prevent and contain run-off.

Existing surface water bodies, storm drains, soil, and groundwater should also be sampled to determine the extent of run-off contamination.

6.1.3 Air Dispersion

The critical factor in controlling any CBR agent source is in minimizing or eliminating air dispersion. Wind fields should be monitored with on-site meteorological (weather) stations to predict or model potential the potential dispersion of the agent or its chemical by-products. It should be noted that air dispersion can be difficult to predict or model where there is a wind channeling caused by tall buildings or geographic terrain. Wind shielding or diversion could be utilized to reduce the potential for dispersion and minimize air velocity across contaminated site areas. Dust suppression may be required during debris handling or search and rescue operations. Prior to modeling and complete extent of contamination results, elongated hot zone perimeters in the prevailing wind direction may also need to be established to protect the public based on the contaminants identity and relative concentration or release volume.

If the contamination is in a building, the HVAC system in the effected area and/or the entire building should be shut down as soon as the attack or release is identified. All openings and vents that will not be used during the cleanup should be sealed using duct board, expansion foam, poly sheeting, or other means. Seals should be constructed so as to extend several inches beyond the opening. They should be well caulked, and any potentially fragile materials, such as plastic sheeting, should be covered with plywood or metal to protect against puncture. All seals should be smoke-test following construction to verify performance.

There should be isolation areas constructed of poly sheeting or other materials located between each utilized outside access point and the building interior. These should be constructed with double-walled V-flaps to isolate the contaminated area during entry and egress. If the HVAC system needs to be running, it should be retrofitted with HEPA filtration units or another appropriate treatment system within the HVAC system and at each of its exhaust outputs to the outside environment. Depending upon the CBR agent properties and location of contaminated areas, it may also be necessary to implement HEPA-filtered negative air pressure containment areas to prevent the spread of contamination.

An air-monitoring program will be required to monitor dispersion of contaminants during response and recovery efforts. Refer to Subsection 5-2 for more details on air monitoring.

6.2 SOURCE CONTROL

Once the perimeter is secured, and the agent identification and the crime scene investigation activities are underway or completed, the source can be addressed. Each source type will have unique characteristics requiring a specific response. Please Refer to Appendix B, Source Control for a Flow Chart for assistance.

6.2.1 Chemical Warfare Agents

There is a variety of Chemical Warfare Agents (CWA) that cause a specific toxic effect to the skin, respiratory, and pulmonary functions. All are highly toxic in minute quantities. The types of CWA are:

- Nerve agents (such as VX and Sarin).
- Blister agents (such as Lewisite and Phosgene oxime).
- Blood agents (such as cyanogen chloride and hydrogen cyanide).
- Choking agents (such as Phosgene and Chloropicrin).

The two factors to control this source are volatilization and direct contact. There are several foaming agents available that stabilize, break down, neutralize, or otherwise render the CWA ineffective within a few minutes of application. These foaming agents are general application agents, which is advantageous because they are useful on a wide range of chemical warfare agents. They are readily available and are used in typical applications as a disinfectant. A foaming agent often contains peroxide, surfactant, and a hydrotope (catalyst) to reduce the toxicity of CWA. Foaming agents may also be effective as a dust suppressant.

Chemical agents are not always eliminated through simple HEPA filtration; therefore, it may be necessary to adapt a chemical scrubber or filter onto the HVAC outputs. If this cannot be done, the HVAC system should not be run until the cleanup operation is complete or building ambient air testing shows that no agents are dispersing into the air.

6.2.2 Biological Agents

Biological agents are primarily bacteria (such as anthrax) and viral infectious materials (such as smallpox) that can reproduce independently or regenerate within a host. Additionally, biological toxins (e.g., ricin) may also be included in this general grouping.

The two factors to control this type of source are air dispersion and direct contact. The key to source control of biological agents is both limiting migration and removing any dust that they may be adhered to. The air dispersion control measures discussed in Subsection 6.1.3 are important in controlling a biological release. Since their size is well below the size of respirable dust, these contaminants are highly mobile. Failure to quickly control the incident could result in a significant spread of contamination and escalate the size, cost and complexity of the associated response and recovery efforts.

For relatively small source areas, surfaces may be able to be cleaned using a vacuum equipped with HEPA filtration followed by surfaces decontamination or sanitizing using the appropriate decontamination agent (e.g., a 10% sodium hypochlorite solution). The choice of decontamination agent or disinfectant should be made based upon the potential reactivity of the disinfectant and the agent as documented in technical literature or government-sponsored testing. When disinfecting a small area, spray or wipe down the surface with the designated disinfectant and allow for the solution to sit for at least 60 minutes before removal by either rinsing or neutralization. When utilizing any disinfectant solution, it is important to follow the manufacturer's directions to guarantee effectiveness. Foaming agents are practical for outdoor application where the air dispersion factor must be handled immediately and there is a desire to control chlorine odors.

In outdoor environments, biological agents can also be isolated with containment structures depending on the size of the impacted area and the associated terrain. Outdoor areas with large amounts of contaminated soils or debris may require negative-pressure containment structures for the application of fumigating agents (e.g., chlorine dioxide or methyl bromide) or high-pressure steam.

6.2.3 Radiological Agents

Time, distance, and shielding are the preferred measure to protect workers. HEPA filtration can isolate radioisotopes adhered to and contained in fine dusts and other materials; however, the preferred method of isolation from the public is distance, accomplished through security measures and shielding. Engineering controls should be utilized to handle radiological source materials. The monitoring team shall complete a survey and determine the activity of the radiological source. Table 6-1 lists the surface contamination values. If the survey yields results above the Table 6-1 values, the surface shall be considered contaminated requiring decontamination. If decontamination procedures are not implemented in the short term, a fixative coating should be applied to prevent the source from becoming airborne.

Table 6-1

Summary of Radiological Surface Contamination Values

DOE-STD-1098-99 -- Radiological Control		
RADIONUCLIDE (See Note 1)	**REMOVABLE (dpm/100 cm2) (See Note 2)**	**TOTAL (FIXED + REMOVABLE) (dpm/100 cm2) (See Note 3)**
U-natural, U-235, U-238, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-nat, Th-232, Sr-906, R-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. Includes mixed fission products containing Sr-907.	1,000 beta-gamma	5,000 beta-gamma
Tritium and tritiated compounds	10,000	NA

Notes:

1. Except as noted in Footnote 5 below, the values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.
2. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency (Note: The use of dry material may not be appropriate for tritium). For objects with a surface area less than 100 cm^2, the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.
3. The levels may be averaged over 1 square meter provided the maximum activity in any area of 100 cm^2 is less than three times the values in Table 6-1.
4. This category of radionuclides includes mixed fission products, including the Sr-90, which is present in them; it does not apply to Sr-90 that has been separated from the other fission products or mixtures where the Sr-90 has been enriched.
5. Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination should consider the extent to which such contamination may migrate to the surface in order to ensure the surface radioactivity value provided in this table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply.
6. These values should be applied to total Sr-90/Y-90 activity resulting from processes involving the separation or purification of Sr-90.
7. These values should be applied to total Sr-90/Y-90 activity resulting from the presence of Sr-90 in mixed fission products.

CHAPTER 7. CONTAMINATED MATERIALS/DEBRIS HANDLING & TREATMENT PROCEDURES

Once the source control measures are in place, contaminated debris, soil and other materials must be handled and decontaminated/treated to facilitate final off-site disposal or rendered non-hazardous for on-site re-use. Materials handling and treatment methods and strategies may vary depending upon several factors including:

- The agent involved.
- Size and volume of contaminated materials
- Intended use/reuse of the contaminated materials.
- Interior or exterior contamination zones.
- Physical setting and size limitations associated with the site.
- Potential regulatory restrictions and/or requirements inherent with the agent.
- Re-occupancy requirements.

7.1 DEBRIS HANDLING

7.1.1 Initial Documentation

It is important to identify and document the location of all debris removal activities. These data may be crucial when recreating the crime scene, determining release location of the CBR materials, identifying hot spots or contamination trends, evaluating/modeling potential off-site migration, conducting post-incident investigations, and separating the highly contaminated from clean or less contaminated materials. It is vital to determine the materials that require on-site treatment versus those materials that can be sent directly for final treatment/disposal or reused on site

The site should be delineated into different grids or zones that are anchored in a common GIS coordinate system. Each debris removal activity should be placed into a geospacial representation and database to facilitate tracking all initial debris removal activities. All anomalies or unusual occurrences should be digitally photographed and stored in a single common data management system. Bar coding and field PDA-based technologies should be evaluated so all information including weight, description, location origin, on-site treatment date, and post treatment confirmation sampling, transportation, and final disposition can be integrated into a single data management system.

7.1.2 Size Reduction and Sorting

In many cases, on-site treatment destruction facilities will have constrained size limitations requiring extensive size reduction of contaminated materials along with any expected pre-treatment. Such materials may include impacted equipment, impacted flooring (carpet) and/or wallboard materials, office furniture and equipment, ceiling tiles, and other bulky items.

Size reduction, including grinding, crushing, and sizing using power sieves, should be carefully evaluated before implementation. The nature and toxicity of the WMD contamination may make mechanical agitation undesirable due to the increased likelihood of releasing or aerating the CBR agents involved. Dust control measures are of critical importance to reduce the potential hazards to the public and protected workers.

It may be necessary to erect temporary domes or other containment buildings to conduct materials handling operations prior to or associated with decontamination operations. Depending on the nature of the hazardous constituents involved and the associated potential for release, negative pressure structures may be highly desirable.

7.1.3 Hot Zone Staging

Depending on the scale of the debris removal operation and the concurrent activities (e.g., supporting search and rescue operations), a hot zone staging area(s) may be necessary. The number of staging areas should be limited to the extent practicable. Once contaminants are identified and site characterization is underway or complete, screening and sampling technologies can be employed to further segregate contaminated from uncontaminated materials. Surface liners, run-off prevention measures, and stockpile covering are crucial to prevent the spread and potential off-site migration of the CBR and debris-specific contaminants.

7.1.4 Handling Prior to Decontamination/Treatment

Depending on the volume, size distribution, and composition of the debris or other contaminated material, a variety of hot zone (pre-decontamination) debris handling options can be employed. Conveyors, roll-offs, or physical movement with heavy equipment can be effectively utilized. The planned system should minimize human handling and exposure, and accommodate the debris treatment/decontamination procedure. Ideally, the debris should be moved from its original location directly into an enclosed system that achieves size reduction and sorting, and is directly integrated into the decontamination/treatment process. Depending on the size and scope of the incident, it may be desirable for these procedures to be nearly identical to the handling and feed systems associated with hazardous waste site incineration or thermal treatment projects. Most systems will require a batch approach using loads or roll-off containers; however, conveyor systems can often be rapidly deployed.

7.2 TREATMENT METHODS

For each CBR agent, there may be several treatment methods available. It is important to select treatment methods appropriate to the final disposition of the contaminated materials. If the contaminated materials will be returned to service or use, the treatment methods must be non-destructive to the materials themselves, and must not leave non-removable toxic residues. If contaminated materials will merely be disposed of, they may still require some level of pretreatment in order to render them acceptable for transport or disposal at facilities not accustomed to or permitted to accept materials contaminated with the agent.

For indoor contamination, simply treating and/or disposing of contaminated materials may not be sufficient for re-occupancy of impacted buildings. If the agent is known to have been aerosolized, then it is likely that contamination has been distributed through HVAC systems. In this case, a sampling investigation of the HVAC is warranted and it may be necessary to perform treatment of the entire building interior before re-occupancy is allowed.

In all cases, strict quality control, standard procedures, documentation, and post-treatment sampling will be required to document the attainment of on-site treatment goals that are required prior to transportation off-site for final treatment, disposal, or reuse. Appendix C illustrates the decision logic that may be used to determine appropriate treatment methods.

7.2.1 Materials Intended for Destruction/Disposal

For materials intended for disposal, there may be no pretreatment required. These items, based upon the agent involved, may be merely loaded and transported to an appropriate destruction or disposition facility. In other cases, it may be necessary to pretreat impacted materials; either to reduce the toxicity, eliminate regulatory hurdles, or satisfy destruction facility concerns in handling the contaminated materials "as is". The pretreatment process itself may introduce new regulatory issues such as DOT or RCRA classifications.

In almost all cases, early, effective, and trust-based dialog must be started with potential destruction/disposition vendors so that they may alleviate the concerns of their workers when handling these materials and those of their local communities. Depending upon the agents involved, it may also be necessary to solicit state and/or local approval for any planned disposition strategies.

7.2.2 Materials Intended for Reuse or Recycling

Materials and items that will be detoxified and then either put back into use, or possibly sold as scrap or another recyclable, will require vigorous cleaning, testing, and documentation. These items will need to be decontaminated with the high level of confidence necessary to satisfy the concerns of either the impacted location's employees and intended users or those in another "non-hazardous" work location. The potential end users of the treated items should be allowed to participate in the process development and be provided opportunity to voice concerns and offer improvements. If the potential users of these materials are not informed early on, there is a potential that they will reject the idea of reusing or handling treated items designated as "clean".

The decontamination methods and processes must have central elements, such as:

- Standard Operating Procedures to ensure that all treated materials have been treated in a consistent manner.
- Trained and task-dedicated decontamination workers to provide consistency in treatment processes.

- Complete and full documentation of all treatment processes. This documentation must be able to demonstrate that:
  - Treatment solutions and products were properly prepared.
  - All required solutions were applied and in the proper order.
  - Required contact times were followed.
  - Post-treatment residuals and by-products were properly neutralized/deactivated, rendering all treated materials harmless.
  - Appropriate samples were collected and analyzed to verify treatment effectiveness.
- Strict Quality Control oversight at all points in the process. Documented clearance or release of all properly treated items supported by passing results.
- A fully functioning Corrective Action Plan to respond to failing efforts, and develop, institute, and verify the necessary changes to the process.

Depending upon the number and types of items impacted, it may be necessary to develop multiple SOPs covering different types or groups of like items. In general, porous materials such as cloth chairs and carpeting may not be conducive to most treatment methods and may not be salvageable. Large equipment, fork-lifts, sorting machines, office machinery, and factory equipment may require extensive dismantling and removal of grease and dirt in order to properly treat all contamination. Depending upon the treatment agents there may be significant repair of electrical-wiring and other areas needed to return these items to service. Post-treatment sampling designs for these items must consider user and maintenance worker exposure routes, and should encompass all routinely contacted areas during operation and repair and maintenance. In any case, a process should be implemented that documents the suitability of treatment of particular items or groups of items for re-use versus treatment for disposal. These processes should consider material type, costs, effectiveness of treatment, and desired re-use.

Large quantities of like items should be sorted in lots for treating and testing using the typical quality process testing designs used in industry. This strategy requires that all of the items of a “lot” be a similar item type/construction, and be treated over a continuous and defined timeframe using well-defined and standardized procedures. Representative and random samples of the “lot” are obtained from a small subset of the actual items, and the entire lot is either passed or fails depending upon the results. This process was used successfully to decontaminate large numbers of postal items impacted by the anthrax events of 2001. Table 7-1 illustrates suggested treatment methods/solutions.

Table 7-1

Suggested Treatment Methods/Solutions

Agent Type	Treatment
Chemical Agents	Detergent solutions Foaming agents - Easy DeCon Dilute base (10% caustic) Water/steam rinse
Radiological Agents	Steam wash Detergent solutions Muriatic acid Dilute (1-10%) nitric acid
Biological Agents	10% Bleach1- CDC instructions Amended Bleach1 (10% bleach pH adjusted to 6.8-7.2 with vinegar/acetic acid)- EPA Crisis Exemption for anthrax ▪ Hospital/food grade disinfectants: ▪ Spor-Klenz ▪ Easy-DeCon ▪ Vortex

1 Bleach formulation must not contain sodium hydroxide.

7.2.3 Building Interiors and Permanent Structures

Large interior areas or entire buildings that are impacted may require both physical cleaning of the effected surfaces/materials and a building/area wide decontamination process. This is especially true if the investigation process indicates that the agent entered the HVAC system and was consequently spread through a wide area and may be trapped within the HVAC system. Depending upon the agent, the HVAC system may be decontaminated by replacing all filters and flushing, or possibly removed and replaced to alleviate further contamination and migration. Decontamination may also be accomplished for some agents by purging and removing the contaminant with an attached scrubber system. This process can even be performed on individual legs of the HVAC system.

7.3 POST-TREATMENT STAGING & SAMPLING

Following the initial on-site decontamination/treatment of materials and debris, each batch of treated material will need to be sampled and staged prior to being sent for final disposition or on-site reuse. This is required to ensure the treatment has been effective and the material is safe to legally transport, and meets the final treatment, disposal, or reuse criteria. The sampling and staging requires secure geographical space for each batch of material. The extend of this area is dependent on the volume and size of materials being treated, turnaround time of the analytical data and the treatment process throughput. Strict custody of samples and accurate tracking of treated materials is vital. On larger operations, wireless bar-coding technologies have been successfully employed.

Each batch of material can be released for final disposition once analytical data is received to document successful treatment. Should the analytical data indicate that the treatment was not successful, the material will need to be sent through the treatment process again or sent for alternate final disposal. This process is very similar to the procedures that have been traditionally utilized for on-site hazardous waste incineration ash.

7.4 CBR AGENT-SPECIFIC TREATMENT OPTIONS

7.4.1 Chemical Agent

Chemical agents can be effectively neutralized, diluted to non-toxic levels, or immobilized using widely available chemicals, including those found in disinfectant foams. Treatment agents include peroxides, surfactants, acids and bases, and even water. Some of these chemicals are hazardous, and their use will require proper PPE and worker protection programs. All are applied as wetted or liquid solutions, and may affect porous materials, dyes, and electrical components. Treatment agents should be selected based upon their lack of reactivity with the surfaces/materials impacted whenever possible.

Chemical agents are usually dispersed as fine liquid droplets. These agents can be removed from HVAC systems through rinsing with a decontamination agent. All filters should be removed and disposed of to eliminate any trapped agent droplets from the system.

Treatment residuals may possess hazardous properties along with their chemical reaction by-products, and will require regulated disposition. Failure to adequately remove/neutralize the decontamination agent may result in future users being exposed to the hazardous properties of the decontamination solution; therefore, the decontamination process developed must include neutralization and/or rinsing phase to eliminate the inherent decontamination agent hazards on all treated surfaces/areas. Likewise, the post-sampling program must address both the chemical agent and the hazardous/toxic properties of the decontamination agents. The removal of the decontamination agent can usually be confirmed by simple screening tests using indicating strips (e.g., pH paper, peroxide strips, etc.).

7.4.2 Biological Agent

For small areas, biological agents can be treated using common disinfectants, such as bleach. If bleach is used, a 10% solution of common household bleach should be utilized. The bleach must not contain sodium hydroxide, which is sometimes added to generic bleach formulations. Depending upon the agent and regulatory agency (EPA) involvement, it may be necessary to utilize an amended bleach solution consisting of 10% bleach pH adjusted to neutral (6.8-7.2) with acetic acid (vinegar). Under certain circumstances, this solution may release toxic chlorine gas, and appropriate PPE must be worn. Items/surfaces treated with bleach solutions will require copious rinsing or neutralization with sodium thiosulfate followed by rinsing. Bleach is a corrosive solution, and will corrode metal surfaces and discolor fabric especially with the long (30-60 minute) contact times required for effectiveness.

Alternatives to bleach include several hospital/food grade disinfectants. These are registered foaming agents, fogging agents, and solution concentrates. They must be prepared and applied in strict accordance with the manufacturer instructions in order to guarantee effectiveness and adequately remove toxic residues.

Several of these agents are toxic, and require specific PPE and worker protection programs. These agents are designed primarily for disinfecting non-porous and stainless steel surfaces. As a result, they may damage other metals and discolor fabrics, and may not be conducive to treatment of porous and delicate items.

Biological agents are very virulent, exist in nature, and can be rapidly spread through HVAC systems and personal transport. Due to these properties, impacts from these agents will in most cases require extensive cleanup/disinfecting efforts of not only obviously impacted areas/materials, but also all potentially effected materials/surfaces and in many instances entire affected buildings/structures. Several of these impacted items may not be conducive to typical liquid and foam-based disinfectants. Examples include office files, papers, photographs, and personal items. These materials may be treated in permitted commercial facilities using non-destructive medical/food sterilization methods including gamma-irradiation, e-beam treatment, and ethylene oxide sterilization. These same processes can be used to decontaminate metal and other recyclable materials for sale as scrap if allowed by regulatory parties. Early communication with the facility will be required to determine packaging requirements, and develop adequate quality control and documentation procedures. Shipments to the destruction facility will have to be labeled as Infectious Substances and possibly Regulated Medical Waste, depending upon the state authority.

Materials that cannot be decontaminated or salvaged will require treatment by destructive medical sterilization methods such as incineration and steam sterilization. These processes are typically performed at permitted Regulated Medical Waste (RMW) Destruction Facilities, and the same labeling and RMW requirements as for the salvageable/reusable materials will be in effect. As for the reusable items early communication with the facilities will be required to determine any size reduction and packaging requirements, as well as communicate documentation and QC requirements.

There may be some impacted materials that due to their properties cannot be treated in traditional sterilization/disinfection processes, and cannot be accepted as Infectious Substances at their usual final disposition locations. Examples include Universal Wastes such as fluorescent light bulbs and batteries, and janitorial/household or production chemicals. For these items, it may be necessary to work with disposal vendors and develop cleaning and confirmation sampling/analytical procedures for the outside of impacted materials, along with packaging and destruction procedures that will preclude final disposition facility workers having to be exposed to the “contents” of treated containers/articles.

Biological agent events will almost always require building/area wide fumigation before re-occupancy is allowed. There are several industry-standard interior air fumigants available including chlorine dioxide, vaporized hydrogen peroxide (VHP), and methyl bromide. Each has its own unique characteristics and requirements, and all are usually applied by process patent-owning contractors.

These fumigants can also be highly effective in treating building debris and other large contaminated materials. This would typically require negative pressure structures large enough to accommodate the size of the materials being treated plus the required treatment equipment. These treatment systems may require a series of in-line structures to contain emissions created during sorting, sizing, prep and final fumigation processes. Debris or building fumigation efforts will require extensive Work Plan development, system design, equipment fabrication and discussion with regulatory parties prior to an emergency application. These efforts will also need to involve public protection measures such as an ambient air monitoring programs to detect onsite and off-site levels of fumigant and any reaction by-products. This will ensure the protection of both site workers and the public. An extensive post-fumigation sampling effort, as well as concerted oversight and review by the assembled regulatory committee, will be necessary to achieve re-occupancy status.

7.4.3 Radiological Agent

Materials impacted by a radiological agent will in most cases be surface contaminated, and cleaning will consist mainly of surface contamination removal and/or the removal and disposal of heavily impacted materials. Radioactivity itself cannot be deactivated, but can only be reduced to non-hazardous levels by removal of the radioactive particles from impacted surfaces/materials.

There are various means of removal including HEPA vacuuming, detergent washing, steam washing, and use of dilute acids. Since these methods do not neutralize, but merely remove the contamination, all residuals will require handling as radioactive materials, and should be controlled and collected. If dilute acid is used, it will be necessary to neutralize or rinse the acid off treated materials so that they are not corrosive hazards. Screening strips (pH) should be utilized to confirm that the materials do not contain corrosive residues. If the actual solid/particulate radioactive material has entered the HVAC system, the same methods can be used to remove the particles from the HVAC ducting surfaces, and all filters should be removed and replaced to eliminate any trapped radioactive particles. Additional details on decontamination procedures are found in the DOE technical document DOE-STD-1098-99, “DOE Standard Radiological Control”. Please refer to Table 6-1 for further information.

Trained Radiological Control Technicians (RCT) using survey instruments must perform confirmation testing of all treated materials and surfaces. This should be performed under the oversight and direction of a Certified Health Physicist (CHP). In general, building/area wide decontamination processes will not be required for impacts from these agents; however, extensive survey will need to be performed to ensure that no source material or heavily impacted items/surfaces remain in the building. As a final step to confirmation, dosimeters may be located strategically throughout the impacted area(s) and allowed to collect data for long periods. Building release would be based upon acceptable results from these analyses. If any dosimeter registers at unacceptable levels, further investigation will be required to determine and remove the source followed by an additional testing.

CHAPTER 8. WASTE CHARACTERIZATION AND PROFILING

In almost all cases, there will be waste materials requiring disposal. Specific wastes may include agent contaminated debris, pretreated agent contaminated debris, used PPE, unused treatment agents, treatment residuals, and decontamination liquids.

These materials will need to be properly characterized and profiled to achieve proper disposal, and also determine transportation requirements. This process must be performed by an individual with both proper DOT and RCRA/waste management training or serious regulatory consequences may result. Wastes from CBR cleanup operations may be instilled with characteristics both from the CBR agent itself and any decontamination process. In some instances, wastes may already possess characteristics that require certain regulatory disposal options. This is especially true for office and maintenance chemicals that may have been in the impacted areas (e.g., paints, degreasers, cleaner, thinners, oils, etc.).

In general, the profiling and characterization process includes the following steps:

- First, determine if the CBR agent or residual material is a major constituent in the overall waste. CBR contaminated or pretreated debris should be profiled as debris "contaminated with" the agent or treatment residual.
- Second, determine the physical state of the waste (e.g., liquids, solids).
- Third, determine whether or not the main waste components are RCRA Universal Waste (e.g., fluorescent bulbs, batteries, computers, etc.). If so, there are additional special regulations governing disposal/recycling in specific permitted facilities.
- Fourth, determine the major constituents of the waste.
- Fifth, determine if the waste contains any compounds listed in either DOT or RCRA; if so, the disposal and/or transport requirements will be contained in the regulations.
- Lastly, review any available data, perform strip test screening, or collect samples for lab analysis and determine if there are any potential properties that will dictate classification and/or disposal options. In particular, RCRA Characteristics (ignitability, corrosivity, reactivity, or TCLP) and moisture content may dictate treatment, transport and disposal options.

Once this information is known, a waste profile can be developed for each waste stream. Based upon the waste profiles and inherent characteristics, appropriate disposal options can be determined and potential facilities/vendors contacted. These potential facilities will need additional information for each solicited waste stream, including:

- Volume/weight of waste.
- Waste is in bulk or non-bulk quantities/containers.

- Waste is “pre-treated”.
- Whether the waste has been treated and confirmed not to be impacted by the agent.

8.1 DOCUMENTATION

Once permitted facilities are located, a facility and/or state-specific waste profile must be completed. The facilities will have only tentatively accepted the waste at this time. The facility will not actually accept the waste until it has reviewed the facility/state-specific waste profile documentation. The facility will provide the blank submittal forms for completion. All required portions of the form must be completed. Any characterization data should be attached to the profile and provided at the same time.

The completed profile form should be provided to the generator or other appropriate parties for review and signature. The USACE, EPA, or DHS/FEMA may be required to assume the generator role during a Federalized response and recovery. The “arranger” of disposal is not the individual/organization that signs and certifies the waste profile; the owner/generator of the waste must do so. The facility will review the documentation and, in the case of CBR materials, may also consult with state and/or local authorities. The waste cannot be delivered to the facility until it is approved.

8.2 AGENT-SPECIFIC CHARACTERIZATION/PROFILE ISSUES

8.2.1 Chemical Agents

The common nerve agents, VX and Sarin, are not listed under DOT or as RCRA materials. These agents, due to their action, are poisons and should be characterized as Class 6.1 materials. Residuals from decontamination of these agents may be corrosive. The pH of treated materials and/or residuals should be tested; strip testing is sufficient to determine if corrosivity is an issue. Corrosive solutions and items may be neutralized with weak acid or base solutions prior to disposal. This action can save significant cost and difficulty in final disposition.

The common blister agents, Mustard and Lewisite, are also not listed under DOT or RCRA. These agents are also considered corrosive materials. Neutralized solutions or debris that has been neutralized will require field or laboratory testing to eliminate the need for characterization as corrosive.

8.2.2 Radiological Agents

Radioactive materials are characterized according to the radioactive source elements, radiation type emitted, and total activity. Federal law requires that a trained/qualified person determine the classification and characteristics of radioactive materials. These determinations are made based upon a combination of state, DOT, and DOE regulations and rules.

The activity, state, and make-up of the waste will dictate disposal options and potential facility choices. Each facility has very specific permit requirements concerning not only levels of radioactivity allowed, but also types of waste, size of materials, and source classifications; therefore, waste profiles need to be complete and contain all pertinent information. Approvals may take longer than expected, and the facility may elect to inspect the waste at its own choosing prior to granting approval.

Another potential issue with these materials is the possibility of "mixed wastes" or waste materials that are radioactive and Characteristic Wastes under RCRA. If a CBR event has resulted in the generation of such materials and the radioactive element cannot be adequately removed, the resulting mixed waste will require special handling and regulatory-dictated disposal at a very limited number of permitted facilities using highly specialized disposal and/or storage methods.

8.2.3 Biological Agents

Wastes contaminated with or impacted by biological agents are classified as Infectious Substance, Class 6.2 under DOT. This DOT classification results in severe limitations for disposition and specific requirements for transport. In addition, in most states, as happened in all jurisdictions impacted by the anthrax events of 2001, this classification may result in additional characterization of waste materials as Regulated Medical Waste (RMW) dictating further requirements for storage, transport, treatment, and disposal.

RMW and Class 6.2 materials must be treated and/or disposed of in permitted RMW Treatment and Disposal Facilities. More importantly, materials with such classification cannot be accepted by non-permitted facilities, including RCRA incinerators, landfills, and Universal Waste permit holders. As a result, it is extremely important to determine and characterize the "final disposition" of impacted materials before developing profiles and initiating the disposal process.

Materials that can be "treated " to remove the agent then must be dealt with by other means, i.e., Universal Waste, RCRA materials, must *not* be first characterized as RMW. Doing so will dictate destruction, and, in some instances, the RMW destruction processes may not be possible with these materials due to explosion and/or chemical release hazards. In fact, these materials must not be classified as "waste" until after they are "treated" to remove the agent. If this treatment will be performed in a permitted sterilization facility, the items should be packaged and shipped to the treatment facility as "Infectious Substances". Following treatment and confirmatory testing, the items will no longer be considered as either infectious substances or RMW, and can be characterized, profiled, and final disposed/recycled based upon the non-biological characteristics they possess.

CHAPTER 9. DISPOSAL OF CBR AGENTS

Final disposition options vary for each of the CBR agents. In some instances, these options are limited by and directed by regulation resulting directly from the agent itself; in other cases, the agent can be removed and/or neutralized, allowing for handling and final disposition according to the properties of the medium. Following are some various options for each agent type.

9.1 CHEMICAL AGENTS

The common WMD agents and any residuals are banned from landfill in "open-pit" burial systems, i.e., solid waste landfills. In general, the decontamination processes used for these agents result in rendering unusable porous items such as paper, cloth/fabric, and photographs. The agents themselves or porous materials containing non-deactivated agent must be sized and disposed of in a permitted chemical incinerator. Treated/deactivated materials can either be incinerated or disposed of by landfill in an RCRA-permitted hazardous waste landfill. Materials that are Universal Waste or other regulated classifications should be decontaminated on the outer contact surfaces and disposed of as required. Table 9-1 summarizes this information.

Table 9-1

Chemical WMD Disposal Options

Waste/Material Type	Treatment	End Disposal	Packaging
Agent-contaminated non-salvageable debris that is combustible	RCRA-permitted incineration	NA	Facility specific
Pretreated combustible non-salvageable debris	RCRA-permitted incineration	NA	Facility specific
Pretreated non-salvageable debris	NA	Land disposal in Subtitle C landfill	Facility specific
Decontamination liquids	Permitted wastewater treatment	Discharge to POTW	Bulk shipment
Chemicals and other regulated waste	RCRA-permitted incineration	NA	Lab packed per facility requirements
Universal Waste (batteries, fluorescent bulbs, computers)	Decontaminate and confirm through sampling	Recycling/disposal at permitted UW facility	Per Universal Waste regulations

9.2 RADIOLOGICAL AGENTS

Wastes impacted by radionuclides that require disposal are disposed of according to the activity of specific radionuclides and/or the total response and at differing limits based upon state regulations. Some impacted materials depending upon the agent involved may actually have activities below the landfill limits in some states. Others, especially those materials in close proximity to the source, may require extreme disposition methods such as encapsulation, vitrafication, or even long-term secured storage.

Disposal of radioactive materials is a highly regulated industry, and the various facilities have different permit limitations, treatment/disposal methods, and waste classification types that they may accept. In addition, in order to transport and dispose and/or store materials at some facilities, the generator may be required to obtain state use permits. A trained/qualified person will be knowledgeable of the various facilities and the general limitations of their permits.

9.3 BIOLOGICAL AGENTS

Materials impacted with biological agents are as discussed in previous sections, Infectious Substances, and in some states, RMW. There are limited options for disposal of these materials, and most require sterilization or destruction of the microorganisms prior to final disposition. When utilizing permitted RMW sterilization processes and and/or medical instrument/food irradiation facilities, the treatment criteria may need to be more rigorous if the agent bacteria or spores are more resistant to destruction than the baseline bacteria. There will also be a need for the facility to perform more extensive monitoring and documentation of process parameters and Biological Destruction Indicator performance. Table 9-2 illustrates the disposal options for various waste types.

Following are several processes available at fixed base facilities:

- Medical Incineration has the advantage of complete destruction of the material as needed or providing heat throughout the waste. It is limited to combustible items with weight limitations. Thick stacks of papers or books may not be burned to the center and will require pre-destruction preparation.

- Autoclave units, high-pressure steam sterilization, are not limited to combustible materials only. They also accept much larger and heavier items than the incinerator. The size restrictions will vary according to the dimensions of the unit at the facility and how the packages are transferred into and out of the chamber. To be efficient, the steam generated must be able to saturate the items being treated to carry the heat. Areas that cannot be penetrated by the steam such as file cabinets and desk drawers must be punctured or opened to allow the steam to gain access. Water can also be treated by this method to prepare it for discharge.

- Fumigation by toxic chemicals (e.g., ethylene oxide) provides a non-destructive process after which papers, equipment, scrap metal, can be recovered for continued use or recycling. The shipment packages can be large, but must be placed inside a bag capable of containing bacteria and spores while allowing the toxic gases to enter. As in steam sterilization, access holes must be provided into drawers, file cabinets, and other items. If the treated items are intended for reuse, a holding time could be established to allow the toxic gases to break down or escape from the material treated.

- Irradiation is performed by food/medical facilities using gamma rays or e-beam energy sources. These methods are limited to items that meet the size limitations of the systems, and in many instances strict packaging requirements will need to be followed to ensure adequate penetration of the radiation to all areas of the waste/material treated.

Table 9-2

Biological Agent Disposal Options

Waste/Material Type	Treatment	End Disposal	Packaging
Contaminated non-salvageable and non-combustible debris	RMW or Steam Sterilization (autoclave)	Subtitle D landfill (non-hazardous)	Double bagged - size limitations
Contaminated non-salvageable debris that is combustible	RMW or Incineration	Subtitle E landfill (non-hazardous)	Double bagged - 70 pound limit and size limitations
Salvageable debris including metals for scrap value	Fumigation using Ethylene Oxide (EtO)	Reuse, scrap, or Subtitle D landfill (non-hazardous)	Bagged in special tyvek designed for gas penetration
Salvageable items personal, letters, files	Fumigation- EtO, Gamma-Irradiation or e-Beam irradiation	Return to owner or appropriate locations	Facility specific
Decontamination liquids	Steam Sterilization (autoclave)	Discharge to POTW	Bulk shipment of disinfected wastewater
Non-salvageable large debris items	NA	Land disposal in Subtitle C landfill	Double bag oversize pieces "as is"
Chemicals and other regulated waste	Disinfect and sample to remove infectious substance classification	Disposal by RCRA required means - Incineration, Landfill	Lab packed per facility requirements
Universal Waste (batteries, fluorescent bulbs, computers)	Disinfect and sample to remove infectious substance classification	Recycling/disposal at permitted UW facility	Per Universal Waste regulations

CHAPTER 10. PACKAGING AND TRANSPORTATION OF CBR DEBRIS

The source material removed for disposal must be containerized or packaged in accordance with Department of Transportation (DOT) and RCRA regulations. DOT regulations for packaging are found in 49 CFR 173. RCRA standards for waste transporters are found in 40 CFR 263. NRC requirements for radioactive materials can be found in 10 CFR 71. Following are general guidelines for selecting the appropriate packaging for shipment to a TSDF. Persons completing the manifest are considered the shipper and are required to be familiar with Hazardous Materials Regulations and be trained in the understanding of such regulations (49 CFR 172.704(a)(2), "*Function-Specific Training: Ground*"); therefore, the proper packaging is the responsibility of the shipper. Refer to the Generator's Certification on line 16 of a Hazardous Waste Manifest.

10.1 PACKING AND TRANSPORTATION REQUIREMENTS

Packaging and shipping requirements are specific to the type of CBR agent, matrix (solid, liquid, debris, etc.), concentration, and volume.

10.1.1 Chemical Agents

The chemical agents are primarily packaged as poisonous by inhalation materials, Class 6, Division 1. There are several shipping names and is dependent upon the material. Many of the chemical nerve agents are organo-phosphate derivatives. The proper shipping name must be determined to identify the proper packaging requirements. Class 6.1 materials are poisonous by inhalation. The material must be identified as a Zone A or Zone B inhalation hazard (49 CFR 172.226-227). Refer to applicable sections of the DOT regulations for proper packaging requirements. Bulk packaging of debris contaminated with Class 6.1 materials should be treated prior to disposal. Bulk packaging of Zone A inhalation hazard is not permitted. Inner packaging should not exceed 4 liters. The total amount contained in an outer packaging should not exceed 16 liters.

After decontamination, the waste generated can be considered solid waste for disposal, but not acceptable for solid waste landfill. Information available indicates that a RCRA incinerator is the preferred disposal option. In order to better control any required disposal, we would suggest the material be described as an "Environmentally hazardous substances, solid, n.o.s., 9, UN3077, PGIII. It is important to review regulations of the generating and receiving states since these may be more stringent and may require the material to be considered a hazardous waste. Any material should be shipped in a tarp covered roll-off; but it is suggested that hardtop modals be used for greater security.

Each transport vehicle must be accompanied by shipping papers as described in 49 CFR 172.202, 172.203, 172.204, and 172.604. Should the treated materials have a RCRA characteristic, such as corrosive, then the shipment will require a Hazardous Waste Manifest as described in 172.205.

For bulk shipment of Class 9 material, the identification number on a class 9 placard would be required on front and back and both sides of the motor vehicle trailer.

10.1.2 Biological Agents

Biological agents are primarily packaged as poisons, Class 6, Division 2, "*infectious substances, affecting humans*". The packaging shall comprise of a watertight primary receptacle, a watertight secondary package, and, if the material in the primary receptacle contains liquid, an absorbent material must be placed between the primary and secondary packaging (49 CFR 173.196). The package must withstand drop tests, temperature, and pressure requirements. If the material is a liquid, then packaging must have a means to verify no leakage such as adhesive tape over screw caps. Each outer package is labeled with an INFECTIOUS SUBSTANCE label per 172.400 and must be marked with the words "Infectious substance, affecting humans (Name of Source Material), 6.2, UN2814" and the name and address of the consignor or consignee.

DOT regulations restrict the container size of Infectious Substances shipments. The requirements for transporting infectious substances are contained in the Hazardous Materials Regulations (HMR, 49 CFR Parts 171-180). Emergency exemptions to the 49 CFR 172.101 are available from the USDOT to provide relief from the bulk shipment prohibition. This would be for specific projects requiring a large volume and size of solid materials to be shipped off-site for further treatment and disposal. These exemptions will provide no relief other than specifically stated, and will require the material to be disinfected prior to shipment for sterilization. A closed motor vehicle trailer may be utilized as the bulk outer container with specific requirements for sealing the container for shipment and decontaminating the trailer after delivery. This vehicle will be dedicated to each shipment. The authorized inner packaging of each article will be specified in the exemption. Operational controls to eliminate any contamination on the outside of the inner packaging prior to placing it in the trailer will be specified, as well as emergency plans, shipment papers, training, and incident reporting.

If an exemption is not requested or provided, infectious waste must be packaged and transported following DOT regulations in 49 CFR 173.196. The packaging requires a triple packaging that is capable of meeting the performance requirements in 178.609 and consists of the following components:

- Watertight primary receptacle.
- Watertight secondary receptacle.
- If the material is liquid, sufficient absorbent material between the primary and secondary receptacles to absorb entire contents.
- Outer packaging of adequate strength for capacity, mass, and intended use.
- Itemized list of package contents must be place between the secondary receptacle and the outer packaging.

Biological waste can be shipped on a Non-Hazardous Manifest or a Hazardous Materials Bill of Lading. The paper should include the following information: “Infectious substance, affecting humans (Name of source material), 6.2, UN2814" and quantity shipped. Include the certification:

"This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

Also, include an emergency telephone number that is manned by a person familiar with the material being shipped and with emergency measures to be taken in the event of a leak or other emergency.

The outside of each wall, front, and back of the motor vehicle trailer must be plainly and durably marked "Biohazard" in 2-inch letters and with identification numbers in the manner specified for a bulk packaging in SS172.332. If the shipment has an emergency exemption number, it must also be similarly marked as specified in SS 172.302 (b), (c), and 172.331. No placards are designated for this material.

10.1.3 Radiological Agents

Radiological agents must be identified as hazardous Class 7. The packaging requirements are dependent upon the type of radiological agent. If the source is embedded with debris, the waste shall be handled as a surface contaminated object (SCO). The packaging requirements shall be in accordance with 49 CFR 173.427 requirements. Additionally, requirements of DOT regulations do not replace requirements of 10 CFR 71 of NRC. The type of material must be identified (fissile, Type A, Type B, gamma-emitter, beta or alpha emitter, etc.). The activity levels shall be monitored. Activity readings from within 3 meters of the unshielded outer package containing SCO must not exceed 1 mrem/h (49 CFR 173.427). The package in conveyance must not exceed 100 A_2 of the identified nuclide. The table of A1 and A2 activity levels is found in 49 CFR 173.435.

Materials and waste generated from clean-up activities will have to be evaluated against DOT’s definition of radioactive material. Radioactive material means any material having a specific activity greater than 70 Bq per gram (0.002 microcurie per gram). If the waste satisfies this definition, the waste will have to be containerized and packaged as a Radioactive Material, Class 7, per the DOT classification system. Beyond these fundamental radiological levels, there are numerous other levels of radiological contamination and activity that will trigger additional and more rigorous container and packaging requirements.

The universe of packages is divided between specification packaging and non-specific packaging. Non-specific packaging for radioactive materials in most circumstances can be satisfied through the use of strong tight containers. In these scenarios, the suspect radioisotope must be below their respective A2 values posted in 49 CFR 173.435. Specific packaging for radioactive materials include the following:

- Type A: 49 CFR 173.465
- Type B: 10 CFR 71.71 & 71.77
- Industrial Packaging: 1, 2, & 3 49 CFR 173.41

In addition to selecting the correct container and packaging, the shipper must also maintain the following forms of documentation in relation to the shipping activity.

- Shippers must maintain on file all pertinent information validating Type A, IP I and IP II per 49 CFR 173.411 and 173.415, respectively.
- Shippers must retain a copy of the Certificate of Compliance (COC) associated with the container and/or package utilized. This can be obtained from the manufacturer.
- Shippers must comply with the conditions set forth in the respective COC.
- Shippers must be or utilize a registered user pursuant 10 CFR 71.12.
- Shippers must have Quality Assurance programs pursuant 10 CFR 71 Subpart H.

The handling and transport of radioactive materials is a very highly regulated industry. Requirements for the transporter and generator vary due to the type of radioisotopes, concentration, and material contaminated, as well as the type of packaging employed. Additional training, permit, and safety requirements are required as the hazards become more extreme. A trained/qualified person will be knowledgeable of the additional restrictions on the generator and transporter. Minimum requirements are included below.

To be acceptable for transport, certain criteria must be met prior to and during shipment. These include:

- The radiation level cannot exceed 200 mrem/hour at any point on the external surface of the vehicle.
- The external radiation cannot exceed 1 rem/h at 3 meters from any unshielded material.
- The level of removable contamination on external surface of each package must be as low as reasonably achievable and satisfy 49 CFR 173.433.

10.2 TRANSPORTER QUALIFICATIONS

The transporter must be a certified hazardous materials transporter. The personnel must have the required training including OSHA 29CFR 1910.120 HAZWOPER and DOT Training 49 CFR 172 Subpart H. Transporters of RCRA Hazardous Wastes must meet licensing and other requirements of 40 CFR 263. If the receiving or generating states and receiving facilities have specific permit or license requirements for transporting radioactive materials or the state equivalent, then it must be met prior to transportation.

10.3 NOTIFICATIONS FOR TRANSPORT

Waste, debris, and other materials from CBR cleanup operations will in most cases require packaging and transport to permitted destruction/disposal/treatment facilities. Depending upon the agent involved, DOT and/or state regulations may require advance notification of transport to state and/or local authorities along the planned route. These same regulations also require the submission of a trip plan to the same authorities. The regulations also provide state/local authorities the ability to provide for the escort of said shipments through their boundaries if desired.

Transportation of materials and wastes impacted with chemical agents require no special notification beyond the standard DOT requirements for hazardous waste transport. These include:

- 24-hour access Emergency Contact Information on the Hazardous Waste Manifest.
- Notification to the receiving facility of shipment departure and expected arrival date and time.
- Facility signature acceptance of the shipment.

Most materials from radiological cleanups will not require special notification; however, shipment of any highly impacted materials with activities greater than those listed in the definition of a “highway route controlled quantity” in 49 CFR 173.403 will require notification of state/local authorities along the entire route per DOT regulations. This notification must be completed no more than 24-hours prior to the shipment’s leaving the site. It should be initiated through a call to each state’s DOT hotline. The hotline will then either handle all other necessary notifications or direct the caller to the additional entities within the state that will require contact. When calling, the following information should be provided:

- Name and Address of Generator.
- Name of Transporter.
- Name and Address of Disposal Facility.
- Schedule of Transportation.
- Point of Contact.

All bulk shipments of infectious substances and especially Regulated Medical Waste will also require notifications to state and/or local authorities prior to shipment.

CHAPTER 11. POST INCIDENT PROCEDURES

The Incident Commander must properly terminate the CBR incident to ensure the safety of response personnel, to facilitate a transition from the emergency phase to the restoration and recovery phases, and to identify lessons learned that might benefit personnel at future incidents.

11.1 POST-DECONTAMINATION SAMPLING (RE-OCCUPANCY VERIFICATION SAMPLING)

Final post-decontamination sampling is conducted inside and outside of the exclusion zone to verify that the originally contaminated environment has been sufficiently decontaminated to allow re-occupancy of the area without the use of PPE. Aggressive sampling techniques should be used to maximize the possibility of detecting the agent on surfaces and in the air. Aggressive sampling techniques are modeled on EPA's guidance for clearing facilities for re-occupancy after asbestos decontamination. While the area is under negative pressure, all surfaces are aggressively agitated, and air is continuously disturbed while samples are collected. Aggressive sampling techniques (using fans and leaf blowers) should be done only within the confines of the exclusion zone that was established to prevent the spread of contamination. If possible, previously contaminated and subsequently cleaned HVAC systems and machinery in the area should be operating during final post-decontamination sampling.

Final sampling and analysis should be reviewed against stringent QC requirements established in the site-specific QAPP or Sampling Plan. The number and type of samples should be reviewed to ensure that the sampling was representative regarding area, situation and material types being sampled. Any building-wide decontamination effort will also entail the development and performance of an Ambient Air Monitoring Program for the decontamination agent and any potentially toxic by-products.

It is usually desirable to model the data to identify data gaps and identify additional sampling locations. Multi-dimensional modeling will display isopleths of contamination that can be compared to the clean-up standards established through the UCS.

11.2 BUILDING REOCCUPANCY CONSIDERATIONS

Re-occupancy of an impacted building or area will be contingent on a series of engineering and health considerations. From an engineering standpoint, the impacted structure or area (ground zero) and surrounding structures or areas must be free of harmful contamination and physical hazards, structurally sound, accessible to the occupants, and have operational utilities and support infrastructure.

Clean-up goals and re-occupancy standards are often based on site-specific health or risk-based levels established by State health department, the Center for Disease Control, and other members of the UCS. Occupancy and use practices, work shift or occupancy duration, and building construction use are usually significant factors in the determination new occupancy practices or restrictions.

As previously discussed, a thorough sampling plan will be required to demonstrate that the established clean-up goals have been attained. It should be noted that many potential CBR agents require a clean-up goal of non-detect or natural background levels. It is also possible that sufficient technologies do not exist to achieve the health-based clean-up goals. In this case, the building or area may need to be carefully decontaminated, demolished, and sent off site for final treatment and disposal.

A technical counseling program may be required to convey the sampling results and relative risk of re-occupancy to the returning employees. Symptoms of exposure and related reporting protocols may also need to be presented. It will be necessary to relate the criteria that were used to determine areas that were decontaminated versus those that were not. There may be a strong reluctance by former occupants to re-enter a building following successful treatment/decontamination operations. Psychological counseling may be required depending on the magnitude of the catastrophe.

11.3 POST-INCIDENT ANALYSIS

The post-incident analysis is a reconstruction of the incident conducted to accomplish the following:

- Establish a clear picture of events.
- Ensure the incident is properly documented.
- Determine who is financially responsible.
- Lay the groundwork for any formal investigations, legal proceedings, or future training that may be necessary.

The post-incident analysis should focus on key topics such as command and control, tactical operations, resources, support services, plans and procedures, and training.

11.4 CRITIQUE

The main purpose of a critique is to develop recommendations for improving the emergency response system. It should be conducted in a positive manner, with emphasis on identifying what works and what doesn’t (e.g., roles, responsibilities, systems, and procedures), not on finding fault with individual performance.

CHAPTER 12. HEALTH AND SAFETY

As always, the health and safety of site personnel and the public takes precedence over all other considerations in dealing with CBR agents. Entry into known or suspected contaminated areas will be conducted only when such entry is required to protect human life or to gather information not obtainable by any non-entry means. The amount of time spent in the exclusion zone and contamination reduction zone (CRZ) should be as short as possible.

The purpose of this chapter is to provide an overview of health and safety considerations for workers and other individuals potentially exposed to CBR agents.

12.1 TRAINING

A site-specific training program ensures that workers receive the hazard awareness training they need to work safely.

First responders are likely to be involved in the initial crisis management phase of a CBR event. These personnel typically provide the first line of public defense in the response to releases of hazardous substances. These personnel are not typically required to maintain training in accordance with 1910.120(e); however, they are required to maintain a level of training in accordance with 1910.120(q) or section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003). Under 29 CFR 1910.120(q), emergency first responders can be trained to one of 4 levels of capability. These are:

- **Awareness** – The most basic level of hazardous materials training, this training is sufficient to allow the recognition of the presence of hazardous substances and to initiate the local response mechanism to adequately address the situation. Awareness level personnel are not adequately trained to conduct activities that could bring them into contact with hazardous substances, and should remain in support zone functions.

- **Operations** – Commonly a level of training provided to most firefighters and EMS personnel who may be called upon to respond to incidents that involve hazardous substances, this level of training provides the individual with the ability to recognize the presence of hazardous substances, to initiate the local emergency response mechanism, and to perform defensive activities to mitigate a release of hazardous substances. These personnel can often perform support functions in the contamination reduction zone or the support zone that may require some level of personal protective equipment and could include booming, diking/berming, patient care, or possibly personnel and equipment decontamination. Operations level responders are not adequately trained to directly contact hazardous substances, and should be limited to support functions outside of the exclusion zone that have minimal or no risk of contacting contaminants.

- **Technician** – Technician level is the highest level of hazardous substance response training typically obtained by most local or county hazardous materials response team members. Technician level training provides the responder with the knowledge and skill basis to respond to, enter, and mitigate releases of hazardous substances and perform offensive mitigation activities. Technician level responders are trained to: enter hazardous environments; select appropriate levels of PPE; select, utilize, and interpret readings on air monitoring equipment; and perform other activities as necessary.

- **Specialist** – A specialist level responder is typically a Technician level trained responder with additional skills, knowledge, or training in a specialized aspect of hazardous substance response. These responders typical perform the same functions as technician level responders.

At sites where OSHA's HAZWOPER standard applies, the health and safety training program should be based on the job hazard analysis in the HASP and other relevant OSHA requirements. The training elements required by HAZWOPER include:

- Initial hazard awareness training for site workers and supervisors.
- Exceptions to initial training requirements.
- Site-specific hazard awareness briefings for visitors and workers.
- Refresher training.
- Qualification of trainers.
- Training certification.
- Emergency response training.

All employees who work on a HAZWOPER cleanup site (not limited to cleanup crew) where they are exposed to hazardous substances, health hazards, or safety hazards must have training that meets the requirement of 29 CFR 1910.120(e) or have equivalent experience and/or training.

The four levels of training for employees who work on cleanup operations are listed below:

- General site workers.
- Workers on-site only occasionally for a specific limited task (unlikely to be exposed over limits and not required to wear respirators).
- Workers regularly on-site in monitored and fully characterized task areas (unlikely to be exposed over limits and not required to wear respirators).
- Managers and supervisors.

Each level requires employees to have sufficient training or to have equivalent experience and Certification of Training is required.

The required elements of training are:

- Names of personnel and alternates responsible for site safety and health.
- Safety, health, and other hazards present on the site.
- Use of PPE.
- Work practices by which the employer can minimize risks from hazards.
- Safe use of engineering controls and equipment on the site.
- Medical surveillance requirements including recognition of the symptoms and signs that might indicate exposure to hazards.

A site-specific training program ensures that workers receive the training they need to work safely. Workers must receive all training required by applicable OSHA standards. This training may be included in the HAZWOPER curriculum.

Examples of relevant training required by other standards include:

- Hazard communication.
- PPE.
- Respiratory protection.
- Emergency action plan.
- Fire prevention plan.
- Emergency response.
- Lockout/tagout.
- Observing working surfaces.
- Noise.
- Fall protection.
- Confined space entries.
- Excavation.

CBR-specific hazard awareness training should help workers understand the health hazards associated with such work and appropriate personal protective techniques and engineering controls.

Specific topics might include:

- Signs and symptoms, and medical conditions that could place them at increased risk (e.g., compromised immune systems).
- Where contamination has been identified at the incident, and the status of decontamination of those areas.
- How to minimize the risk of exposure through specific standard operating procedures and controls (e.g., engineering controls, work practices, housekeeping,

or PPE), and whether specific measures are expected to be temporary or permanent.

There are additional training requirements for workers preparing contaminated materials or other hazardous materials for transportation to a treatment or disposal facility. These requirements can be found in the federal hazardous materials transportation regulations at 49 CFR Part 172, Subpart H.

12.2 HEALTH AND SAFETY PLANS (HASP)

OSHA's HAZWOPER standard (29 CFR 1910.120) applies to each of the employee working at a CBR-related response, and the associated remediation and recovery. Each individual arriving on-site must read, understand, and acknowledge (by signature) the site safety plan. For logistical purposes, many controlled copies of the HASP should be made available to allow the time for an appropriate review time. For remediation and recovery operations at a terrorist site, this standard requires a written Health and Safety Plan (HASP), which identifies site hazards and appropriate controls to protect employee health and safety. The elements of the HASP are described in the OSHA standard and include the following:

- Organizational structure.
- Site characterization and job hazard analysis.
- Site control.
- Training.
- Medical surveillance.
- Personal protective equipment (PPE).
- Exposure monitoring.
- Heat stress.
- Spill containment
- Decontamination procedures.
- Emergency notifications.
- Standard Operating Procedures.

In general, a HASP is organized as a single document, with component sections and appendices covering all tasks, operations, and contractor/subcontractor issues. A site plan also promotes efficiency and enhances completeness, clarity, and coordination among all affected parties. It should be noted that significant additions to the standard HASP may be necessary to cover each unique task involved with debris removal, including debris movement, treatment/decontamination, sorting and staging, air monitoring, and loading/transportation to off-site interim or final storage, treatment, or disposal sites.

12.3 DAILY SAFETY MEETINGS

All personnel involved in the debris removal process or related tasks (e.g., search and rescue) should participate in a daily safety meeting at the beginning of each work shift. The meeting should review the tasks to be performed, task-specific safe work practices, exposure symptoms with the chemical and CBR agents impacting the site, and emergency safety procedures and emergency evacuation procedures. The meetings, topics of discussion, and attendees should be documented in the site logbook.

12.4 PERSONAL PROTECTION

PPE shields or isolates workers from health and safety hazards in the workplace. In a site where a CBR may be present, PPE protects workers from exposure to respiratory and skin hazards, and prevents the spread of contaminants to uncontaminated areas. PPE can also be used to protect workers from additional hazardous substances such as those being used for the decontamination process; however, PPE is not a substitute for sound engineering, work practice, or administrative controls. PPE complements these controls to protect employee health and safety in the workplace.

The level and type of PPE should be based on the job hazard analysis in the HASP. Use of excessive PPE may actually increase a worker's risk of injury or illness through heat stress, accidents caused by tripping or limited vision, and difficulty communicating with other workers. Because conditions will vary from site to site, specific PPE requirements should be specified by the IC and outlined in the on-site HASP. Information regarding hazard assessment and PPE selection is provided in 29 CFR 1910.132.

Workers should be trained to know when PPE is necessary, what type to use, how it should be worn, what its limitations are, and how long it is likely to last. Workers should also be trained in the proper maintenance and disposal of PPE. If more than one type of PPE will provide adequate protection, employers may choose the type they prefer.

Employers should certify in writing that the training has been provided and that employees have successfully completed the training. The certification should show the name of each employee trained, and the dates and types of training provided. In addition, appropriate personnel decontamination and contamination containment procedures are needed for workers using PPE to prevent exposure. In general, these procedures are similar to those for asbestos abatement, and include isolating contaminated areas, negative pressure ventilation, and a multi-staged decontamination line with showers for equipment and personnel, and appropriate waste disposal.

12.4.1 Skin Protection

Wearing protective clothing not only protects the skin, but also can prevent the transfer of contamination off-site. Based on the conditions at the site, the IC or the Site Health and Safety Officer should determine the appropriate level of skin protection, which should also be outlined in the HASP. Tyvek or equivalent coveralls should be used as a minimum level of protection. It is important to remember that, in addition to protection from contact with a CBR agent, PPE must also protect the worker from contact with chemicals used in the response and other natural environmental hazards or exposures at the site.

The appropriate level of skin protection for specific tasks to be carried out at any incident should be identified by the Site Health and Safety Officer, and should be clearly identified in the site health and safety plan. Enforcement of the appropriate levels of protection should be implemented through the use of work zone access control and policing as required.

12.4.2 Respiratory Protection

Inhalation hazards pose the greatest threat to personnel; therefore, respiratory protection is a necessary component of any PPE program. The OSHA respiratory protection standard (29 CFR 1910.134) requires that employers establish and maintain an effective respiratory program and that employees must comply with the program. Requirements include program administration, work site-specific procedures, respirator selection, employee training, quantitative fit testing, medical evaluation, and respirator use, cleaning, maintenance, and repair. Some emergency response operations may require that first responders wear a Self-Contained Breathing Apparatus (SCBA) as part of their normal HazMat response ensemble. There may be cases where the use of Air Purified Respirators (APR) could be adequate protection.

The appropriate level of respiratory protection for specific tasks to be carried out at any incident should be identified by the Site Health and Safety Officer and should be clearly identified in the site health and safety plan. Enforcement of the appropriate levels of respiratory protection should be implemented through the use of work zone access control and policing as required. It is quite possible that various levels of respiratory protection may be appropriate at any particular incident and may be employed at any one time. It is imperative that work zone delineation is adequate to provide a sufficient "buffer" between various levels of respiratory protection, and that levels of respiratory protection are strictly enforced within a particular work zone. It is inappropriate to permit the use of lower levels of respiratory protection in close proximity to or downwind of areas requiring higher levels of respiratory protection. In addition, real-time air monitoring and confirmatory air sampling requirements for various levels of respiratory protection can be significantly different.

APPENDIX A

HAZARD EVALUATION FLOW CHART FOR UNKNOWNS

Hazard Evaluation Flow Chart for Unknowns

<u>Early Considerations</u>!!

Evaluate scene & situation, Potential explosives should be evaluated by the local bomb squad, Cordon off area, Isolate, Evacuate, Disable HVAC, Seal doors and cracks, Delineate hotzone (wind direction and intensity), Turn on radiation meter while preparing entry, Approach uphill/upwind/upstream, Follow H&S plan, Sampling plan, & Decontamination procedures for personnel/sample conatiners/equipment, consult with Incident Commander and law enforcement (if on-scene)

↓

Calibrate instruments/Collect background samples

↓

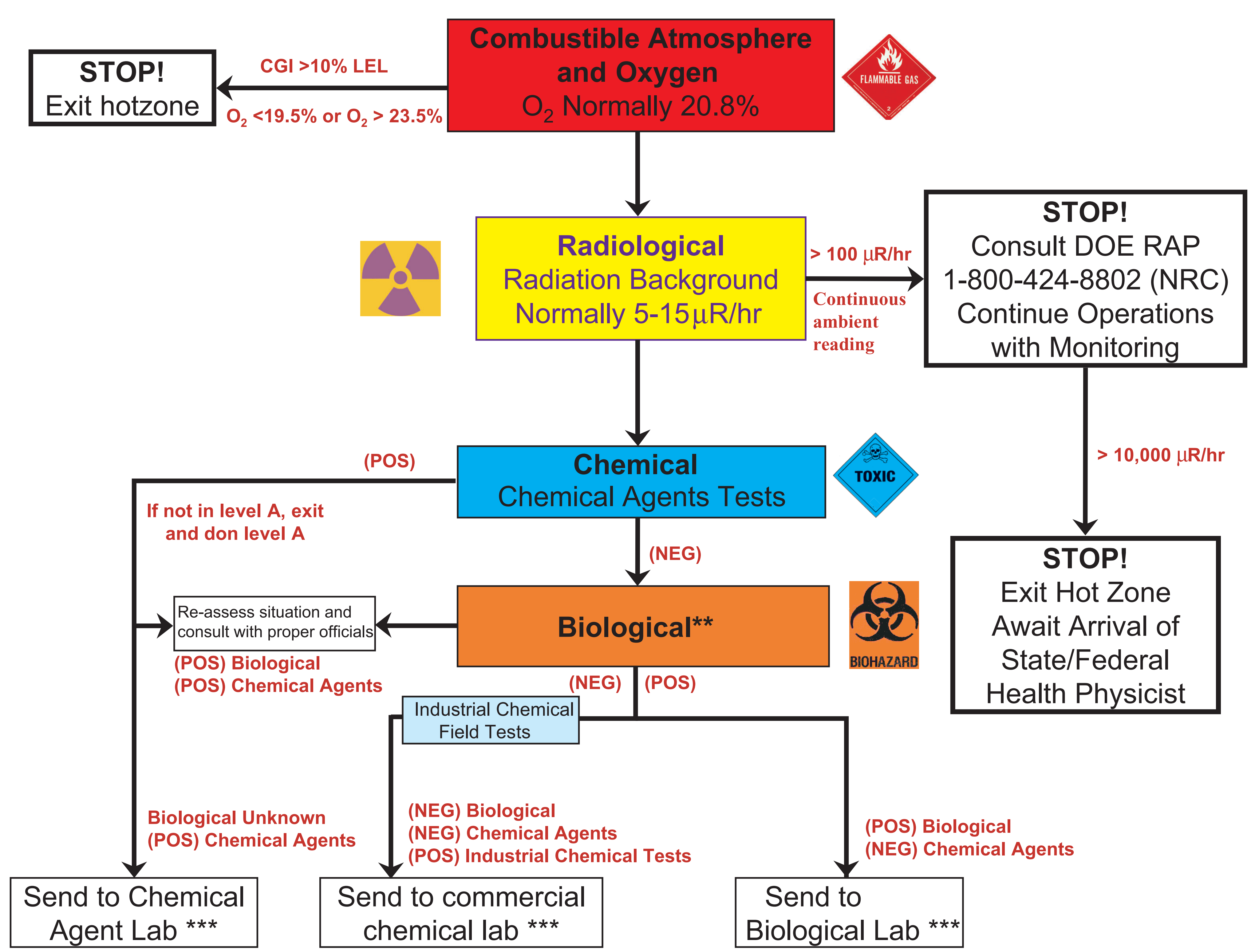
Team dons Level A or B PPE (consult with H&S Manager)

↓

Team enters hot zone (Photo/video documentation)

Air	Liquid/Solid
<u>1st Entry</u>: CGI/O_2*, Radiation Meter, PID/FID, APD 2000/AP2C	**<u>1st Entry</u>:** CGI/O_2*, Radiation Meter, PID/FID, pH, APD2000/AP2C, M8/M9 paper, digital/ Polaroid Camera, Video Camera
<u>2nd Entry</u>: Drager Tubes, SAM 935, Exploranium, Particulate Monitor (RAM)	**<u>2nd Entry</u>:** Biological Test Kits, Solubility, M256 Kit, Drager Tubes, SAM 935 and/or Exploranium, Pancake Probe (alpha and beta)
<u>Additional Monitoring</u>: Portable GCMS, PCR, FTIR	**<u>Additional Monitoring</u> :** Portable GCMS, PCR, FTIR, Chemical HazCat Tests

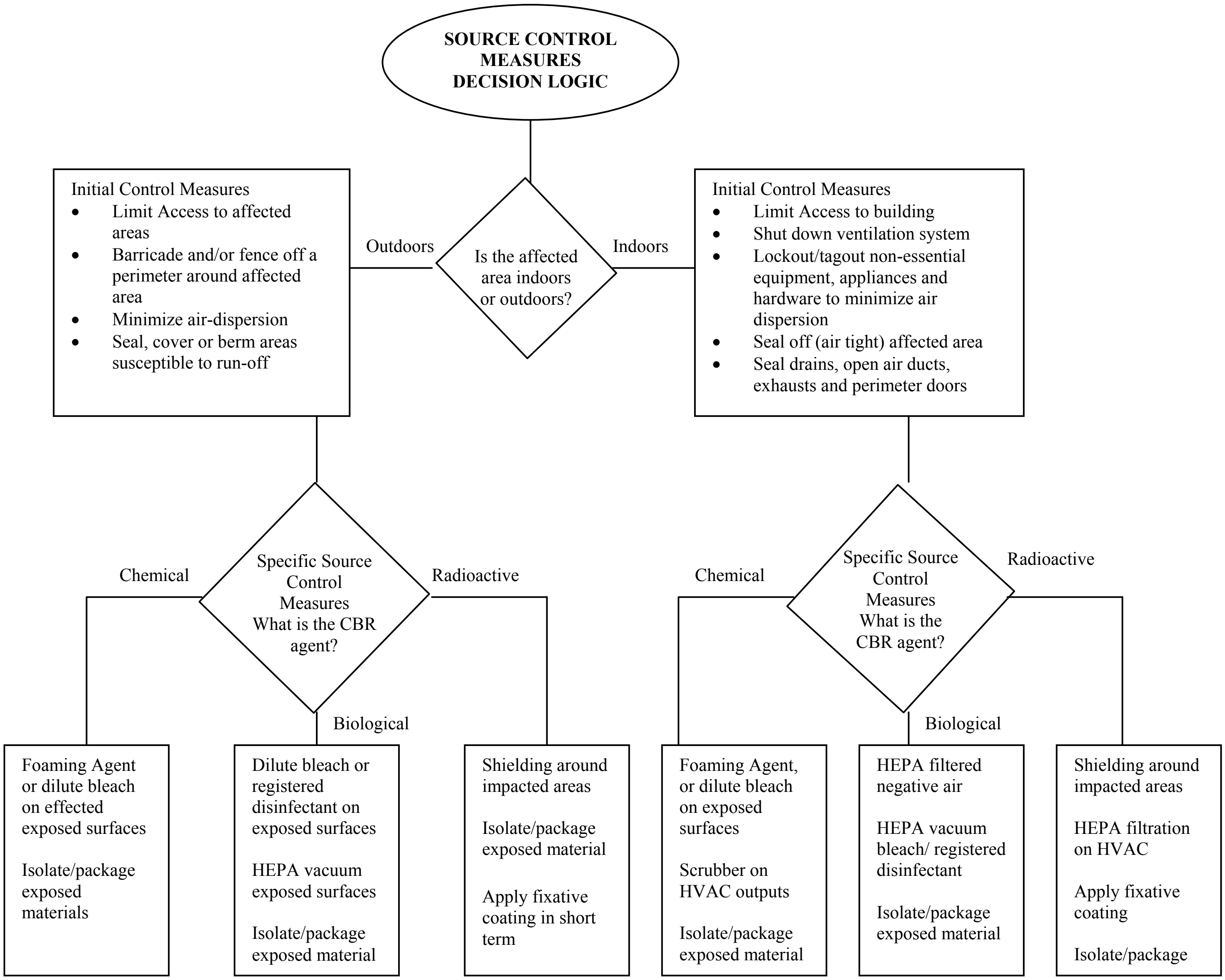
* **intrinsically safe**



** If the situation is suspicious send samples to biological lab even if biological tests are negative.
*** Send to lab if Radiation is less than 3 times background. If above, consult with laboratory prior to shipping.

APPENDIX B

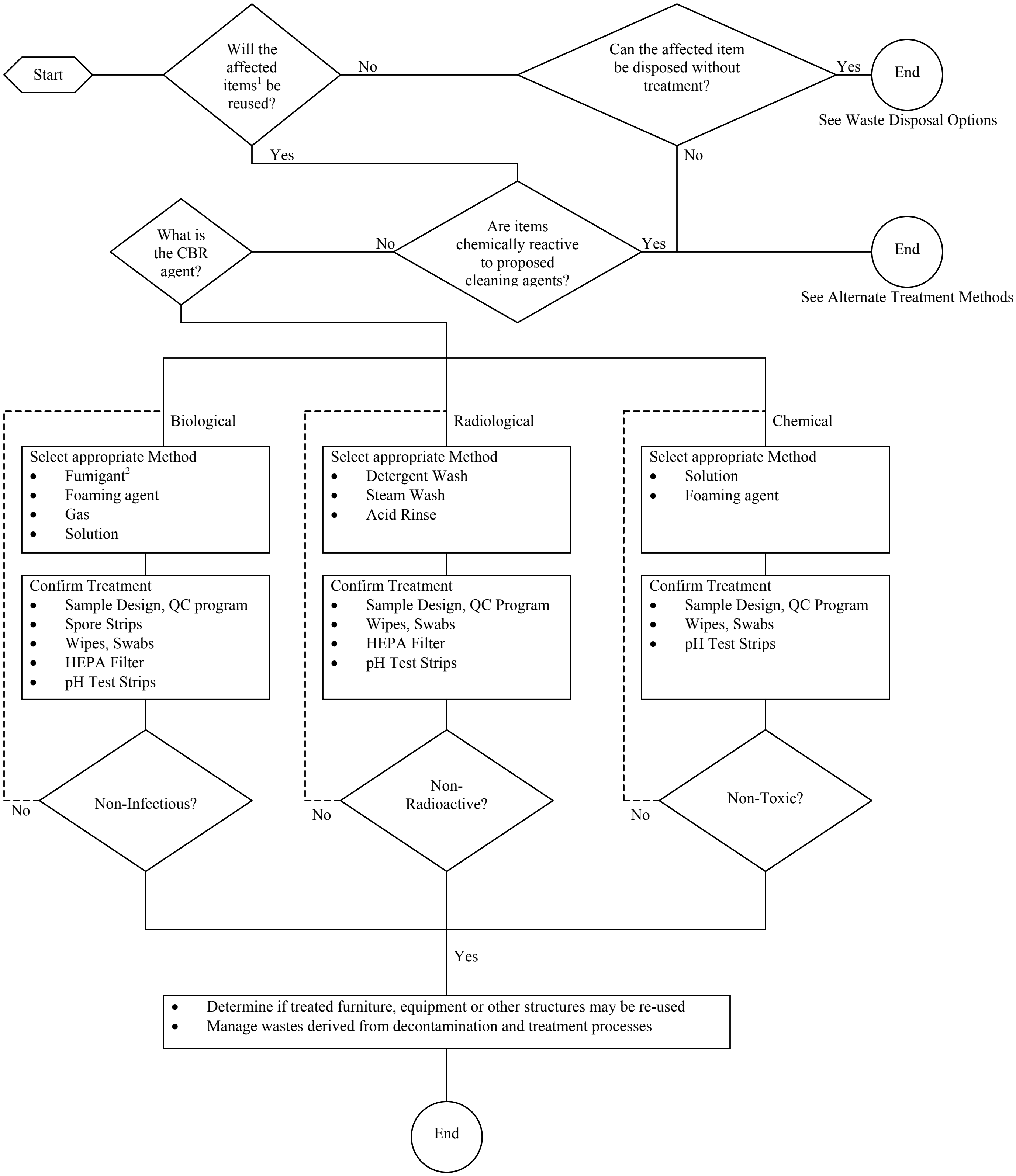
SOURCE CONTROL FLOW CHART FOR CBR AGENTS


SOURCE CONTROL MEASURES DECISION LOGIC
Is the affected area indoors or outdoors?
Outdoors
Indoors
Initial Control Measures
• Limit Access to affected areas
• Barricade and/or fence off a perimeter around affected area
• Minimize air-dispersion
• Seal, cover or berm areas susceptible to run-off
Initial Control Measures
• Limit Access to building
• Shut down ventilation system
• Lockout/tagout non-essential equipment, appliances and hardware to minimize air dispersion
• Seal off (air tight) affected area
• Seal drains, open air ducts, exhausts and perimeter doors
Specific Source Control Measures What is the CBR agent?
Chemical
Radioactive
Biological
Specific Source Control Measures What is the CBR agent?
Chemical
Radioactive
Biological
Foaming Agent or dilute bleach on effected exposed surfaces
Isolate/package exposed materials
Dilute bleach or registered disinfectant on exposed surfaces
HEPA vacuum exposed surfaces
Isolate/package exposed material
Shielding around impacted areas
Isolate/package exposed material
Apply fixative coating in short term
Foaming Agent, or dilute bleach on exposed surfaces
Scrubber on HVAC outputs
Isolate/package exposed material
HEPA filtered negative air
HEPA vacuum bleach/ registered disinfectant
Isolate/package exposed material
Shielding around impacted areas
HEPA filtration on HVAC
Apply fixative coating
Isolate/package

APPENDIX C

CBR TREATMENT METHODS

CBR Treatment Methods
Decision Logic



[1]Items can be furniture, equipment, supplies, inventory, chemical stocks, janitorial cleaning supplies, office supplies, files, photos, decorative ornaments, hard and porous surfaces including wood, metal, plastic and fabric, and personal items.
[2]This flowchart does not cover building fumigation for airborne contaminants.