Administrative Changes to AFPAM 10-219, Volume 3, *Civil Engineer Contingency Response and Recovery Procedures*

OPR: AFCEC/CXX

References throughout to "AFI 10-2501, *Air Force Emergency Management (EM) Program Planning and Operation*," are hereby changed to "AFI 10-2501, *Air Force Emergency Management Program*."

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Operations

CIVIL ENGINEER CONTINGENCY RESPONSE AND RECOVERY PROCEDURES

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This volume provides information and guidance for the execution of civil engineer (CE) contingency recovery activities. It describes procedures for a rapid transition from routine, day-to-day operations to an emergency response posture. Using the disaster and attack planning and preparation measures of Volumes 1 and 2 as its basis, this volume addresses how CE executes tasks to ensure recovery and continued operation of the installation during and after a crisis. This publication applies to all Air Force (AF) active, Air Force Reserve Command, and Air National Guard CE units. This pamphlet implements Air Force Instruction (AFI) 10-210, *Prime Base Engineer Emergency Force (BEEF) Program* and AFI 10-2501, *Air Force Emergency Management (EM) Program Planning and Operation*. Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Form 847s from the field through the appropriate functional chain of command and Major Command (MAJCOM) publications/forms managers. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with (IAW) Air Force Manual (AFMAN) 33-363, *Management of Records,* and disposed of IAW the Air Force Records Disposition Schedule (RDS) in the Air Force Records Information Management System (AFRIMS). The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the AF.

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(DOD) directive publications, units may modify the actions, directions, tasks, and worksheets to suit their needs.

SUMMARY OF CHANGES

This interim change revises AFPAM 10-219V3 by (1) changing Unexploded Explosive Ordnance (UXO) reporting procedures in paragraph 5.5.6.1, and (2) changing Table 5.3 to reflect Explosive Ordnance Disposal (EOD) 9-Line Report criteria per Air Force Tactics, Techniques and Procedures (AFTTP) 3-2.12, *Multi-Service Tactics, Techniques, and Procedures for Unexploded Ordnance*. A margin bar (|) indicates newly revised material.

Chapter 1

CE CONTINGENCY RESPONSE AND RECOVERY

1.1. Background. The unpredictable nature of war and disasters requires a great degree of flexibility by the CE force during emergency response and recovery operations. CE units must maintain contingency response and recovery capabilities to restore operations, save lives, mitigate human suffering, and minimize damage during and after a crisis incident on or near the installation. While the CE Contingency Response Plan (CE CRP) and other base plans should be followed to ensure a coordinated response, no plan can cover all possible scenarios. Therefore, all elements of the CE team must be able to adjust quickly to changing circumstances. Immediately after a disaster, attack or other crisis, civil engineers typically operate in the reactionary mode to eliminate life-threatening hazards rapidly. In later phases of the recovery, the engineer force begins a more deliberate effort. Even though the environment can still be chaotic and there may still be many immediate actions to take, the overwhelming dangers that prevailed during the onset of the emergency may have passed. The effort to identify and quantify the damage, assign repair priorities, and determine recovery strategy then begins. Engineering knowledge, experience, and common sense become crucial to base recovery efforts.

1.2. Scope. The information in this pamphlet supports implementation of Air Force Policy Directive (AFPD) 10-2, *Readiness*. It builds upon lessons learned and doctrinal precepts outlined in AF Doctrine Volume 5, *Support*, AF Doctrine Annex 3-34, *Engineer Operations*, current AF policy, and other related and relevant CE publications. This relationship is illustrated in **Figure 1.1**. See **Attachment 1** for a complete list of references and supporting information.

1.2.1. Volumes 1 and 2 of this pamphlet series address CE planning and preparedness for natural or manmade disasters and installation attack. This volume, coupled with information in Air Force Pamphlet (AFPAM) 10-219, Volume 4, *Airfield Damage Repair Operations*, address measures that support an effective CE contingency recovery capability. Specifically, this volume addresses base and unit level CE recovery actions associated with the following areas:

1.2.1.1. CE Unit Control Center (UCC) operations

1.2.1.2. Damage assessments

1.2.1.3. Auxiliary fire fighting and search and rescue

1.2.1.4. Explosive ordnance reconnaissance (EOR)

1.2.1.5. Expedient facility and utility repair processes and strategies

1.2.1.6. Operation and maintenance (O&M) and follow-on repairs

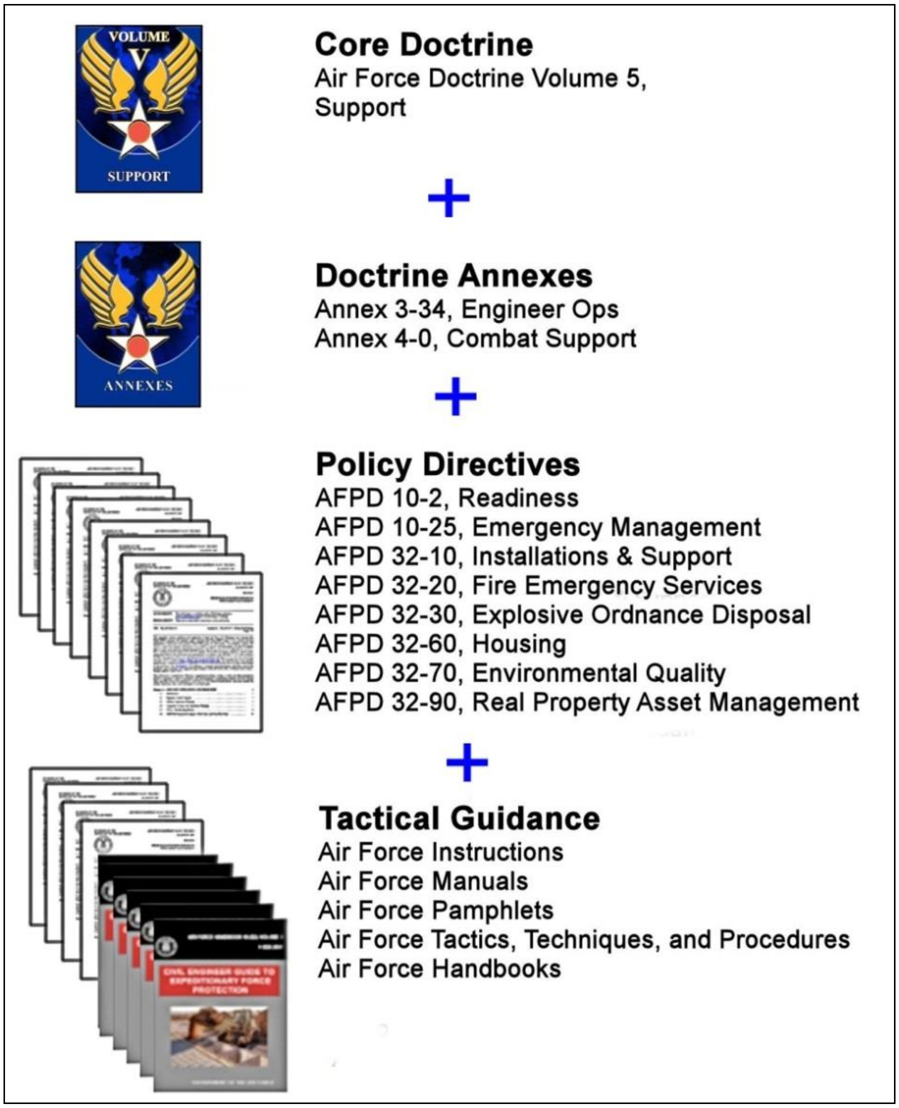
1.2.1.7. Self-protection and work party security

1.2.1.8. Base denial procedures

1.2.2. For comprehensive contingency response and recovery activities related to Emergency Management (EM), FES, and EOD, users should refer to AFI 10-2501; AFI 32-2001, *Fire Emergency Services (FES) Program*; AFI 32-3001, *Explosive Ordnance Disposal (EOD) Program*; and relevant AFMAN 10-2500-series and AFPAM 32-2000-series publications.

See **Attachment 2** for hyperlinks to AF and Joint publications, other references, and reach-back resources.

Figure 1.1. Core Doctrine and CE Policies and Guidance



1.3. Roles and Responsibilities. Most CE unit functions are heavily involved with base response and recovery operations after a disaster, attack, or other major crisis. These CE operations include fire fighting and rescue, damage assessments, hazard mitigation, airfield and facility repair, critical infrastructure restoration (e.g., power, water and sewerage), CBRN monitoring, response and control, unit recovery management, and emergency contracting, to name a few. The following paragraphs provide a brief overview of CE roles and responsibilities associated with emergency response and recovery operations. For additional information, consult the references in **Attachment 1** and for reach-back support, contact the Air Force Civil Engineer Center (AFCEC) Reach-Back Center (RBC) at 1-888-232-3721 (toll free), 1-850-283-6995 (comm), Defense Switched Network (DSN) 312-523-6995, or via email at **AFCEC.rbc@us.af.mil.**

1.3.1. **The Base Civil Engineer (BCE)/CE Unit Commander.** The BCE/CE Commander and engineer staff advises the installation commander and other installation officials on contingency response and recovery operations. They are also responsible for providing trained forces and available equipment and materials to return the installation quickly to a condition where the primary mission can be executed. When an incident or crisis occurs and the Emergency Operations Center (EOC) is activated, the BCE representative to the EOC is the command and control (C2) link between the EOC and the CE force. From the EOC, the BCE representative provides direction to airfield damage repair (ADR) crews and damage assessment and response teams through the CE UCC. At high-threat locations, the BCE and members of the minimum airfield operating surface (MAOS) selection team typically operate from the EOC during airfield recovery. Engineering and Operations Management specialists may also be attached to assist with CE response and recovery management activities. Other CE personnel operating from the EOC may include representatives from the Readiness and Emergency Management (R&EM) Flight, FES Flight, EOD and Operations Flights.

1.3.2. **R&EM.** The role of R&EM is to help ensure force survivability, expeditious installation recovery and mission continuation in all threat environments. The R&EM Flight provides support to the EOC, Incident Commander (IC), mobile communications capability, and specialized teams during incident response and recovery. Flight responsibilities also include CBRN detection, warning, and notification, advising commanders on operations in contaminated environments, and managing installation contamination control operations. R&EM roles and responsibilities are further defined in AFI 10-2501, AFMAN 32-1007, *Readiness and Emergency Management (R&EM) Flight Operations*, and AFMAN 10-2503, *Operations in a Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive (CBRNE) Environment*.

1.3.3. **FES.** The primary role of FES during and just after an emergency is to rescue survivors, keep loss of life to a minimum, and extinguish or prevent the spread of fire. Emergency services include aircraft rescue fire fighting, structural fire fighting, technical rescue, emergency medical support, and hazardous materials (HAZMAT) response. Due to the limited numbers of firefighters, fire vehicles, and equipment, firefighter availability may be limited for ancillary tasks such as area contamination control processes.

1.3.4. **EOD.** EOD response and installation recovery capabilities after an attack or disaster include: responding to aircraft and explosive mishaps; identifying, evaluating, rendering safe, recovering, and disposing of any explosive threat to include abandoned munitions, unexploded ordnances (UXOs), and improvised explosive devices (IEDs); performing chemical, biological, radiological, and nuclear (CBRN) detection, identification, sampling, warning, and reporting; recovering airfields denied by ordnance; and assisting mortuary services in remains processing.

1.3.5. **CE UCC.** Generally, UCCs are activated to support installation response and recovery operations after a crisis incident. The CE UCC controls and coordinates unit response activities, arranges support from other organizations, and serves as the commander's communications conduit for assigned personnel. It is normally staffed with highly experienced and knowledgeable CE specialists from various elements of the operations flight. See **Chapter 2** for additional CE UCC information.

1.3.6. **Installation and Unit Specialized Teams.** Civil engineer units along with other assigned units, provide specialized teams to the installation DRF. These specialized groups are key elements of the DRF and provide essential support during response and recovery operations. Teams include the Emergency Management Support Team (EMST) (formerly the Readiness Support Team), Shelter Management Teams (SMTs), Contamination Control Teams (CCTs), and Post Attack Reconnaissance (PAR) Teams. See AFI 10-2501 for their description and composition. In addition to presenting specialized teams to the DRF, CE units also organize other multi-shop, response teams to respond to major incidents.

1.3.7. **CE Response Teams.** While many peacetime emergencies can be handled without forming CE multi-shop response teams, a major natural disaster, major accident, or base attack will require special teams in addition to standard shop support. These response teams help keep the installation operational during the disaster or attack response period, reduce the loss of life, prevent property damage, and identify damage and initiate repairs following an emergency. **Table 1.1** lists potential CE response teams not previously addressed in this chapter. See AFPAM 10-219, Volume 1, *Contingency and Disaster Planning*, for potential composition and organization of CE response teams. These teams are usually formed by assigning specific tasks or groups of tasks to various CE shops or flights. Individuals selected for positions on these teams should be highly skilled in their specialty and possess the maturity, level-headedness, and physical stamina to operate effectively in the chaotic and demanding environment that accompanies all catastrophes. The availability of qualified personnel at the time of a disaster or attack will be a prime determining factor in how these teams are structured. Furthermore, potential threats and manning differences at Continental United States (CONUS) and outside CONUS (OCONUS) locations can affect how CE response teams are formed.

1.3.7.1. CONUS CE Response Teams. Due to the varying sizes and compositions of CONUS engineer organizations, the number of response teams, and number of team members for each installation can vary. It is incumbent on each BCE to evaluate assigned personnel strengths and build the needed response teams. The response teams may be filled by military, civilian, or a combination of these forces.

1.3.7.2. OCONUS Theater CE Response Teams. By nature of their location, response teams at overseas locations have a greater likelihood of facing an attack situation than their CONUS counterparts. However, natural disasters cannot be ruled out as a potential occurrence. At overseas installations having a peacetime United States Air Force (USAF) engineer presence, theater emergency crews for natural disaster response are likely based on standard manning document authorizations, at least for the initial stages of response. As with the CONUS response teams, military personnel, civilian employees, or a combined force may fill team positions. They could be augmented for disaster recovery activities if damages exceeded in-house capability to any great extent. For overseas locations with no in-place USAF engineer force, deployed Prime Base Engineer Emergency Force (BEEF) units would form CE response teams. In an attack situation, Prime BEEF forces should be in-place prior to commencement of hostilities, thereby forming an integral part of the theater emergency response force by either augmenting in-place forces or performing as an independent unit. Teams are based on the anticipated availability of Prime BEEF forces addressed in the CE Force Module construct.

Table 1.1. Potential CE Response Teams

Teams	Description
Airfield Damage Assessment and UXO Team	Locates, identifies, reports damage and UXO on the airfield following an attack. If combined with UXO Team renders safe, disposes and removes UXO on airfields.
CBRN Reconnaissance Team	Teams detect hazards and determine extent of contamination on base
Damage Assessment Response Team (DART)	Conducts facility and utility damage assessment and isolates/safes damaged utility systems
ADR C2 Team	Provides on-scene control and guidance for the ADR efforts to minimize the total repair time to bring the airfield back to a mission ready status
ADR Crater Repair Teams	Repair craters located on the primary and secondary pavements of the operating airfield
ADR Batch Plant Team	Produces hot-mix asphalt for ADR Repair Crews
ADR Spall Repair Teams	Repair spalls and minor pavement damage to airfield and taxiways
ADR Warehouse and Haul Team	Tracks and delivers repair material to ADR Repair Crews
ADR Debris Removal Team	Clears debris from the minimum operating strip (MOS) and taxiway access routes to permit resumption of aircraft operations as soon as the crater repairs are complete
Minimum Airfield Operating Surface (MAOS) Marking Team	Paints airfield markings for new MAOS and paints over old markings that would conflict with the new markings; places edge and threshold markers
Aircraft Arresting System Installation Team	Installs aircraft arresting systems (Mobile Aircraft Arresting System [MAAS] and Mobile Runway Edge Sheaves [MRES]) for the MOS
Emergency Airfield Lighting System (EALS) Installation Team	Installs approach, threshold, and edge lights; distance-to-go, arresting system, and obstruction marker lights; and precision approach path indicator lights for the MOS
Engineering Team	Provide engineering design, oversight and management functions for assessments, evaluation, contingency construction solutions, and contract actions
Facility Repair/Utility Repair Teams	Accomplishes emergency and expedient repairs to damaged facilities and utilities; performs other emergency repairs as required
Housing Management Team	Provide information and management in the event that disaster victims require housing

Chapter 2

CE COMMAND AND CONTROL

2.1. Overview. The CE UCC is the BCE's C2 conduit for unit personnel. It is an essential focal point within the CE organization during and after major accidents, attacks, or natural disasters. The UCC relays information to and from unit personnel, provides engineering expertise to the EOC or IC, and leverages unit resources to respond to and mitigate incidents. From the UCC, key supervisors coordinate, monitor, and direct CE recovery activities, including emergency notifications, personnel accountability, damage assessment, and repair, and other related activities. The following paragraphs address key factors related to CE UCC operations, including activation and management. For additional information on CE UCC staffing, organization and operation beyond what is addressed in this pamphlet, consult AFPAM 10-219, Volume 1.

2.2. UCC Activation. Unit commanders activate their UCCs and initiate unit personnel accountability; however, the EOC Director determines which UCCs remain activated. The CE UCC is one of several UCCs that may be activated to respond to emergencies. From a CE point of view, the responsibilities of the CE UCC are similar to those of the EOC. The difference lies in the level of responsibility. The CE UCC monitors and coordinates CE recovery actions related to installation damage assessment, decontamination, damage recovery and repairs, and other CE CRP tasks. Activation involves staffing, facilities, and communications.

2.2.1. **Staffing.** Although CE strategies and priorities are determined in the EOC, most of the actual engineer functions are controlled or coordinated by the CE UCC. The UCC is usually managed by the CE chief of operations and predominantly staffed by operations management personnel (Air Force Specialty [AFS] 3E6X1) and senior supervisors from select infrastructure support elements of the operations flight (e.g., electrical, water and fuels systems, pavements and construction, structural). While usually assigned in the EOC, FES and EOD representatives may also be on the staff. The typical CE UCC staff generally ranges between 7-11 personnel.

2.2.1.1. Operations managers are central to UCC operations and C2. They perform many tasks to standup and maintain the UCC; such as, keeping status of personnel, equipment, and vehicles; scheduling jobs; allocating resources; and coordinating information between the EOC and other unit UCCs. Other duties may include the following:

2.2.1.1.1. Personnel recall/accounting and identification of UCC team members/alternates

2.2.1.1.2. Gather and maintain required documents, directions, maps, equipment/asset listings, base plans, and checklists

2.2.1.1.3. Establish and maintain a permanent log of events

2.2.1.1.4. Post status boards and coordinate sharing of information between control centers

2.2.1.1.5. Monitor and report on the availability of specialized skills and required equipment

2.2.1.1.6. Site, manage, and operate an alternate UCC

2.2.1.2. Engineering specialists (AFS 3E5X1) are sometimes added to the staff to assist Prime BEEF supervisors in directing and controlling overall recovery operations in the CE UCC. The UCC staff may also include civilian personnel in a natural disaster response. If available during wartime, civilian personnel may also be used; however, workaround plans should exist that take into account the possibility these civilian employees may not be available.

2.2.2. **Facilities.** It may be advantageous to setup the CE UCC facility within walking distance of the CE shops. This makes communications easier if phones or radios are limited or not available. In addition, a backup power source should be provided to support operations during power outages. In case the primary facility is lost, an alternate or backup UCC facility should be ready for immediate occupancy. For wartime threats and disaster precautions, units should strive to establish their alternate UCC at a site that is unlikely to be included in the same hazard cordon affecting the primary location. Regardless where UCC facilities are located, the configuration, layout, equipment, and supplies are usually prearranged according to base and unit plans.

2.2.3. **Communications.** The UCC is essential for passing information up, down and across the chain of command in response to changing installation recovery situations or strategy. To be efficient, UCC communications should be reliable, simple, clear-cut, and understood by everyone involved. The CE UCC uses various methods to communicate recalls and process vital information, including land-line phones, cell phones, radios, pagers, facsimiles, computers, runners, and other means. Operations managers should perform operational checks (preferably monthly) on primary and alternate communications devices in the UCC. These operational checks must include verification of key contact numbers for both landline and cellular devices. Also, verify computer software is current and able to access the base network. The following paragraphs highlight basic practices for maintaining effective operational communications.

2.2.3.1. Operations and Communications Security. Personnel should always practice good operations security (OPSEC) and communications security (COMSEC) procedures, especially when classified or sensitive C2 information and resources are involved. Make sure to protect sensitive information using SECRET Internet Protocol Router Network (SIPRNet) and other specified security/encryption measures when required. Shred discarded paperwork, establish, and use designated call signs, duress codes, authentication codes, and passwords as necessary.

2.2.3.2. Telephones. Operations managers should specify which telephone connections are available in the UCC and list phone numbers for the various positions. Also, identify cellular phone numbers and assignment. When landline or hard-wired telephones must be used to relay classified information, use secure telephone equipment (STE) devices. When available, STE devices provide secure multimedia communications: digital telephone, secure voice, transfer of secure fax and data files, and other capabilities. The lead operations manager should consult with the unit security manager on clearance requirements for assigned operations management personnel.

2.2.3.3. Radio Assets. Maintain strict control over assigned tactical radios and/or land mobile radio (LMR) assets. Operations managers in the CE UCC should only be required to operate and manage communication devices under their direct control. FES, EOD, and

R&EM Flights typically manage their own systems and assets. Inventory, recall, and assign handheld radios to response teams as necessary. Radio assets should be kept fully serviceable and ready for immediate use; pay close attention to recharging batteries. Several dead batteries causing partial loss of communications when performing recovery actions can severely reduce the efficiency and effectiveness of repair and damage assessment crews. This immediately affects the speed at which the installation's mission capabilities are reestablished. Quickly replacing lost or damaged radios during contingencies or wartime is virtually impossible. Some basic steps to managing radios are listed in **Table 2.1**.

Table 2.1. Managing Radios

Basic Steps for Managing Radios	
Maintain an accurate inventory of assigned radio assets	☐
Assign radios to CE response teams using an AF IMT 1297, *Temporary Issue Receipt*, or other approved method; electronic receipts are commonly authorized	☐
Recall assigned radios for redistribution according to operational requirements	☐
Setup and operate the UCC base station	☐
Keep radio batteries/spare batteries charged	☐
Collect and redistribute radios for normal use after the emergency has ended	☐

2.2.3.4. Radio Discipline. The key to effective radio communications is to ensure all personnel use proper radio discipline, designated call signs, good enunciation, and brevity when communicating. Avoid clogging the networks with unnecessary chatter so transmissions can be devoted to communicating and coordinating mission critical activities. Refer to AFPAM 10-219, Volume 2, *Civil Engineer Disaster and Attack Preparations*, for more information on setting up emergency communications.

2.2.3.5. Radio "Dead Zones." Ensure CE personnel using radios know the location of radio dead zones (if applicable) and understand how to minimize their effects. The installation communications officer and intrabase radio personnel can assist in identifying dead zones. Once identified, it is a good idea to annotate the information on the UCC's installation layout map. Make it a practice to advise all new or infrequent radio users of these locations and ways to minimize their effects. To minimize the effects of radio "dead zones" or areas of high interference, use message-relaying techniques, change location, or move closer to the UCC.

2.2.3.6. Alternative Communications. During emergencies, viable alternatives to landline phones and radio communications should be available. Cell phones, computers, fax machines, mobile data devices, and runners may be good alternatives. However, it may be impractical to use runners if great distances are involved. When using cell phones or other non-secure communication methods, users should always be cognizant of COMSEC and OPSEC requirements.

2.3. UCC Operation and Management. Once activated, the CE UCC collects and reports damage inputs, directs recovery activities, and operates the CE communications network to coordinate around-the-clock recovery operations as directed by the BCE/CE unit commander and EOC. Additionally, as the CE communications pipeline, the UCC disseminates threat and emergency action information, incident cordon and evacuation instructions, protective measures, and other emergency information to all organizational elements. The following paragraphs address some specific CE UCC contingency response and recovery activities.

2.3.1. **Maintain Essential Data and Documentation.** The CE UCC should have on hand all essential data and documents to support recovery operations. Control center managers and supervisors should review and maintain current copies of contingency plans and checklists applicable to the crisis, maintain an events log, and establish or maintain other essential data and documentation as necessary.

2.3.1.1. Contingency Plans and Checklists. Operations managers should have available and review (preferably semiannually) copies of applicable unit checklists, operations plans, support plans, and base plans that CE supports (**Table 2.2**). Ensure the plans are complete and current so the CE UCC is operating on the same information as the other operations and communications centers (e.g., EOC, Base Defense Operations Center [BDOC], Emergency Communications Center [ECC]). Unit checklists are important tools for effective consequence management and should be comprehensive and current. These checklists provide CE personnel the means to respond quickly to a variety of events with little or no delay.

Table 2.2. Examples of Contingency Plans and Checklists

Plans:
Major accidents, natural disasters, enemy attacks.
Civil Engineer Contingency Response Plan (CE CRP).
Medical Contingency Response Plan.
Facility Response Plan.
Mortuary/Services Search and Recovery Plan.
Spill Prevention Control and Countermeasures Plan.
Installation Emergency Management Plan (IEMP) 10-2.
Integrated Defense Plan.
Checklists:
Major accidents, natural disasters, enemy attacks.
Maps.
Communications Equipment.
Alternate UCCs.
Recall Rosters.

2.3.1.2. Log of Events and Support Activities. Establish and maintain a permanent log of events and unit support activities using methods prescribed by the owning MAJCOM or unit, whichever is applicable. Either electronic/computer-generated logs or manual forms are usually permitted. Regardless of the means used, event logs typically have information fields similar to those shown in **Figure 2.1**. Maintaining an accurate log of events will not only improve continuity and information flow between shifts; it is also the basic information reference for after-action reporting. Regularly provide event logs to the alternate UCC (preferably no less than each shift change) for continuity in case the primary UCC becomes unavailable. When filled out, these logs are an official record of unit events and should be maintained IAW AFMAN 33-363.

Figure 2.1. Example Log of Events

RECORD OF EVENTS LOG				DATE 10 July 2014	PAGE 1 OF 1 PAGES		
FACILITY 968 CES UCC B-1117				REVIEWED BY			
NAME	INITIALS	TIME ON	TIME OFF	NAME	INITIALS	TIME ON	TIME OFF
MSgt Federico James	FBJ	0710					

TIME	CLASS	RECORD OF EVENTS
0710	U	BCE orders activation of CE UCC /Events log initiated by MSgt James.

2.3.1.2.1. Include in the log all significant events and notifications along with other incident or contingency support activities. Be sure to note changes relating to unit posture and preparedness; response/repair team capabilities; mitigation activities; receipt of critical correspondence or information; significant facility, equipment, communications, vehicle, and personnel changes; and other events required by installation or unit plans and instructions.

2.3.1.2.2. In addition to the log of events, maintain any data or documents that may be pertinent to the unit's response and recovery activities (e.g., correspondence, work orders, receipts, and photographs). These items may be an important part of the record of events, especially if documenting damage or when contracting for equipment, supplies, or repair work.

2.3.1.3. Status Charts. Easily viewable status charts and boards are usually posted when certain information requires close monitoring by the UCC staff. Consider displaying the status of personnel, prepositioned equipment and materials, key facilities and shelters, vehicles, response and repair teams, damage assessment and repair, and/or other critical information (**Table 2.3**). The exact style and configuration of status charts or boards will likely vary between units and bases due to specific mission requirements. See AFPAM 10-219, Volume 2, for sample charts.

Table 2.3. Potential UCC Status Charts

CE STATUS CHARTS	
Personnel	List unit strength numbers (military and civilian; casualty status) and status of key personnel, including: • Position, AFS, and contact method • Shift/Team assignment and availability
Facilities	List location of base priority facilities and other key areas, e.g.: • C2, aircraft maintenance, medical, fire fighting, etc. • Casualty collection points (CCP) • Shelters and contamination control areas (CCA)
Vehicles	Vehicle status charts should indicate: • Type, registration number, and quantity • Location/assignment • Serviceability and repair status
Generators	Identify type, location, serviceability, run data, refueling schedule, and repair status
Specialized Equipment	List location and serviceability of specialized equipment, e.g.: • Aircraft arresting system • Pumps and compressors • Chain saws • Floodlight sets, light carts, airfield lighting, etc
Critical Infrastructure/ Activities Damage Assessment and Repair	List location, description and repair status (include damage report number and repair priority) of the base's priority facilities and critical infrastructure/ activities, e.g.: • Airfields and roads • Facilities, including heating, ventilation, and air conditioning (HVAC) • Electrical generation and distribution • Fuels and natural gas storage and distribution • Water production, storage, and distribution

Prepositioned Supplies and Equipment	List type/location/quantity of critical materials and equipment, e.g.: • Class IV construction materials • Electrical and plumbing equipment and parts • Aggregate stockpiles
Staging Areas	List staging areas used to support plan execution
Unit Posture/ Preparedness	List installation/unit alert conditions: • Force protection condition (FPCON), mission-oriented protective posture (MOPP), defense condition, Alarm condition, etc. • Natural disaster condition (hurricane, severe weather, etc.)
Radios	List call signs and frequencies (include vehicle-installed radios) List tactical/intrabase radio nets and the locations of the base stations and any relay sites. Identify any other unit(s) using the same net

2.3.1.4. Installation Maps and Drawings. Appropriate maps (e.g., base grid maps, airfield maps, GeoBase maps, and overlays) of the installation are necessary in the CE UCC for coordinating and plotting response activities, infrastructure damage, and the location of known hazards. Maps should depict information such as that shown in **Table 2.4** and any other required or relevant data. GeoBase maps and overlays are critical to establishing and maintaining situational awareness and the Common Installation Picture (CIP) or Common Operational Picture (COP). As a backup, maintain hardcopies of all relevant drawings, base maps, and airfield maps. Operations managers should ensure maps are reviewed appropriate Superintendents and shop NCOICs (preferably monthly) and updated by GeoBase or other CIP/COP stewards when required.

Table 2.4. Potential Information Displayed on UCC Maps

Incident Information on Maps
Unit areas of responsibility
Location of UXOs and Contaminated areas
Location of damage areas
Structures (highlight key facilities and shelters)
Utilities layout (electrical, gas, water, and sewer systems)
Location of resources and recovery/repair teams
Shelters and assigned occupants
Routes (primary and alternate) for assessment and response teams

2.3.2. **Gather and Disseminate Information.** During a crisis, collecting and disseminating vital information for unit personnel, response teams and the EOC is a key function of the CE UCC. It helps facilitate the common operational picture and enhances contingency response and recovery operations. Even though the UCC is the CE communications conduit, all CE personnel have an essential role in information collection and dissemination. The ability to communicate important information quickly and efficiently is vital to successful installation recovery. Information the CE UCC collects and reports up, down, or laterally across the chain of command may include personnel status and accounting; threat and protective measures; unit alert condition and emergency notifications; incident cordon and evacuation instructions; damage, casualties, and mission capability reports; response and recovery direction; mitigation efforts, activities and status; availability of specialized skills; required equipment/resources, and other emergency action and crisis response information.

2.3.3. **Personnel Accountability.** A fundamental task of all UCCs is accounting for assigned personnel. In the aftermath of a major disaster or an attack, it is doubtful the full complement of CE personnel will be available to respond. Individuals may be on leave, temporary duty (TDY), a casualty of the incident, or otherwise unable to respond or reach the installation. The recovery effort cannot wait until these personnel return or are backfilled; it will have to proceed with available manpower. For this reason, an accurate accounting of personnel present for duty is essential so CE management can make assignments to vital installation recovery functions. Personnel accountability procedures will vary from installation to installation. Therefore, adherence to locally established procedures is important to provide an accurate count of personnel to those responsible for making installation recovery decisions. The following paragraphs address typical methods used for personnel accounting. They include personnel recall, strength reporting, personnel rosters, including team/billeting assignments. For additional information on personnel accounting and reporting responsibilities during a crisis, refer to AFI 36-3803, *Personnel Accountability in Conjunction with Natural Disasters or National Emergencies*.

2.3.3.1. Personnel Recall. An accurate unit recall roster with concise reporting instructions is essential for contacting and accounting for personnel during emergencies. Units should also maintain a communications-out (comm-out) recall rosters in case local communications become overloaded or inoperative. Notwithstanding how personnel are notified, reporting instructions should always be clear and thorough, including who reports where, when, to whom, and with what equipment. See the CE CRP for specific information on unit personnel recall methods and procedures. **Note:** The sign-in procedures may be accomplished in a number of ways such as sign-in sheets for each AFS or a vertical plotting board with sections for the various AFSs.

2.3.3.2. Personnel Strength Reporting. When designated by disaster plans or recall checklists, personnel strengths are reported from assembly locations to the UCC. The UCC compiles the information and compares it to the Alpha Roster, verifies information as necessary through the unit orderly room, and forwards the required data to the EOC. Some UCCs prefer to track/monitor this information using an easily viewable chart within the UCC (see **Table 2.5**).

Table 2.5. Sample Personnel Strength Chart

Unit Personnel Strength	
Assigned	236
Leave/authorized absence	10
TDY	12
Casualties	0
Unaccounted for/status unknown	0
Present for duty	214

2.3.3.3. Key Personnel Rosters and Team Assignment. Personnel accounting also includes identifying people that fill key positions related to CE response and recovery activities. Personnel rosters with contact information (phone, billeting, etc.) enable rapid notification, response and improved unit coordination. Operations managers should provide a roster of key CE personnel to the EOC. Likewise, keep a roster of key EOC personnel inside the CE UCC. When CE response teams and crews are organized, establish team rosters to help expedite, track and manage team response and repair activities. Operations managers should regularly (preferably monthly) review and update Key Personnel Rosters and team assignments. See AFPAM 10-219, Volume 2 for examples of personnel and team rosters.

2.3.4. **Direct, Coordinate, and Monitor.** With BCE/CE unit commander direction, supervisors, and operations managers within the CE UCC coordinate, monitor, and direct unit resources to respond quickly and appropriately to a myriad of emergencies and tasks. The UCC staff should work closely with other internal elements such as EM, EOD, FES, and the ECC to avoid potential conflicts in tasking and activities. Once activated, the CE UCC may direct, coordinate, or monitor a number of activities including, fire fighting; UXO clearance; contamination control operations; damage assessments; repair of airfields, roads, facilities, and utilities; shelter management; moving unit personnel and equipment; dispersal, prepositioning and staging operations; spill response operations; base denial operations, and other response, mitigation and recovery activities.

2.3.5. **Team Dispatch and Control.** Damage and destruction is an unfortunate byproduct of major accidents, natural disasters, and enemy attacks; consequently, when these situations occur, CE teams are dispatched to help mitigate the circumstances. CE response teams are usually organized based on the specific mission needs and threat condition. Besides first and emergency responders, CE response teams perform a number of tasks including, PAR, damage assessment, hazard and spill response, contamination control, ADR, engineering, MAAS and EALS installation, facility, and utility repair, and other emergency recovery activities. Once activated; and with EOC direction, the CE UCC staff dispatches emergency engineer teams when situations warrant their specialized skills and equipment. Engineer officers, superintendents, and operations managers in the CE UCC direct the repair efforts of the teams and provide functional expertise where needed. The staff also tracks progress and status of engineer teams so accurate information is relayed to the BCE, EOC, and/or IC, as appropriate.

2.3.6. **Continuity of Operations (COOP) and Mission Support.** Helping to ensure COOP and mission support requirements during emergencies is a vital CE function. In addition to performing primary functions such as FES, EOD, and EM; repairing airfields, roads, and facilities; maintaining alternate command centers (e.g., alternate EOC, mobile communications vehicle and alternate CE UCC), CE forces also perform other actions that help ensure COOP and mission support during a crisis. Some of these actions are highlighted in the following paragraphs, including pre-designating alternate engineer leadership for EOC and UCCs; conducting thorough change-over briefings during shift changes; dispersing and recalling personnel and equipment, and prepositioning or staging assets for rapid response. While certain activities are performed during the planning and preparation phase before an emergency, others may need to be accomplished after the onset of the emergency or incident.

2.3.6.1. Pre-designated Personnel. Provision should be made for the continuity of engineer leadership in both the EOC and the UCC. Although, the establishment of alternate command centers aids in solving part of the problem, the possibility exists that key personnel assigned to serve in either the primary or alternate command centers may become casualties or unable to perform their primary duties. Other engineer personnel should be pre-designated to fill in for these key individuals. This pre-designation should be done in advance of any hostilities, and sufficient training and C2 familiarization should be provided so that a smooth transition can occur, if required.

2.3.6.2. Change-Over Briefings. Because of "round-the-clock" operations, the quality of shift changeover briefings can influence COOP and mission support. In effect, continuity is affected every time there is a shift change. The amount of professionalism and effort put into changeover briefings is directly proportional to the degree of operational and mission continuity maintained. These briefings should be in sufficient depth and scope to make individuals on the next shift conversant on all major recovery activities underway and those programmed to start during the shift. Fancy eyewash slides are not necessary nor worth the time to produce; however, just passing the logbook will not cut it either. Brief oncoming shift personnel as you would wish to be briefed.

2.3.6.3. Disperse and Recall Equipment/Personnel. Equipment and personnel are dispersed to protect them from damage or destruction so they are available for restoring operations after the crisis. Usually, when the disaster or attack is imminent, commanders will review dispersal plans and determine how they apply to the current situation. One of the most crucial factors in conducting an effective dispersal operation is time. The greater the warning before an emergency, the more attractive dispersal becomes as a resource protection option. Therefore, installation leadership will evaluate carefully all warnings regarding potential disasters or enemy actions and whenever possible, make early decisions regarding the feasibility of dispersal. The decision as to whether assets should be dispersed depends upon the perceived impact of the threat and estimates regarding the time available for dispersal. A prudent and judicious process of weighing one risk against the other is necessary to determine if the benefits of dispersal outweigh the costs. For example, dispersing resources may increase protection, but the manpower required to transport those assets may seriously undermine personnel strengths. To illustrate further, dispersing personnel and equipment to high ground across a river may protect these assets from the effects of a flood; but if the flood washes out the connecting bridge, these assets may not be immediately available to support the recovery effort. If commanders anticipates regrouping at another location following the emergency, this could be a strong motivating factor for dispersing some of those assets during the pre-disaster or attack phase. The best dispersal plan is only effective if it is tempered by the conditions existing at the time of an emergency. If dispersal is necessary, the following actions should be taken:

2.3.6.3.1. Assemble and organize dispersal forces and provide them with a comprehensive briefing of actions to be taken. Any changes to preplanned dispersal activities should be emphasized. Especially important are changes in dispersal locations, dispersal assets, and dispersal methods. If dispersing off-base, be sure personnel have current maps with alternate routes back to the base marked in case primary routes are blocked.

2.3.6.3.2. Organize dispersal assets and arrange the necessary transportation. This step includes all activities necessary for mobilization of dispersal assets; loading trucks with equipment and materials; fueling equipment that will be driven to the dispersal location; organizing convoys for land movements to dispersal sites off base, arranging airlift support for long-range dispersal; and changing dispersal routes as needed to reflect the current situation.

2.3.6.3.3. Move resources to dispersal sites. Transport assembled assets to the dispersal location as expeditiously as possible. This is especially important to ensure that valuable resources are not exposed, or concentrated in a single location, when the catastrophe strikes.

2.3.6.3.4. Establish and maintain communications with appropriate command center. Dispersed forces must maintain contact with the command center. The command center must be advised of any factors that affect the capability of the dispersed forces to accomplish their post-disaster or post-attack mission. Remember to provide mobile generator support to dispersal sites for powering base station radios, battery chargers, and lighting. Also, include a means of refueling the generators nothing elaborate; portable fuel containers should be sufficient.

2.3.6.3.5. Protect dispersed assets. It is vital that dispersed resources be secured and protected from the effects of a disaster or enemy actions. Otherwise, the purpose of the original dispersal will be defeated and the force could be ineffective in responding when recalled. Depending upon the type of emergency, protective measures could range from boarding up windows and sandbagging to construction of standoff revetments. Plan accordingly; if time will not permit accomplishment of protective measures once arriving at a dispersal location, complete the hardening tasks as one of your preparation actions for disasters or attacks.

2.3.6.3.6. Recall dispersed equipment and personnel. Commanders assess the possibility of a threat recurrence before recalling dispersed assets for recovery actions. He or she may decide to recall only those assets needed for sustained operation of critical functions.

2.3.6.4. Prepositioning Assets. Maintaining COOP after a disaster or attack relies heavily on the availability of assets that support installation response and recovery operations. When there is adequate time to anticipate actions for emergency operations, unit leadership considers prepositioning needed assets (e.g., supplies, equipment, vehicles, and support materials) in primary/alternate locations for immediate use in emergencies. These assets provide the CE force with a rapid response capability during consequence management and are needed to protect or sustain personnel, repair damaged infrastructure, and restore operations. Assets may also be prepositioned to support commander-directed base denial operations. The type of prepositioned assets can sometimes affect where they are located. The following paragraphs highlight some examples of prepositioned assets.

2.3.6.4.1. Shelter Assets and Supplies. Whether planned for assigned personnel or an incoming augmenting force, eventually shelter assets and supplies will be prepositioned inside shelter areas. Items could include water, food, bedding, first aid supplies, and hygiene kits for potential occupants. Although water and power for shelters may be readily available through the normal infrastructure, if those utilities are damaged during the event, then bottled water and generator power may be needed. Both of these items should be prepositioned before the need arises. Also, consider having storage containers (e.g., lockers, cabinets, shelving) in the shelters for occupants' clothing and personal gear.

2.3.6.4.2. ADR Assets. ADR equipment and materials are sometimes prepositioned at main operating bases to increase the crater repair capability at that location. These ADR assets are typically located at theater installations vulnerable to attack but may be staged at less vulnerable bases for potential deployment to other sites, if needed. Prepositioned ADR assets should be dispersed around the installation to help ensure availability after an attack (**Figure 2.2**). The number of dispersed locations selected depends on the quantity of ADR assets and resources, airfield location/orientation, enemy threat to the airfield, and the anticipated repairs.

Figure 2.2. ADR Equipment Convoying from Dispersed Location to Crater Repair Sites

2.3.6.4.3. CBRN Warning and Detection Assets. CBRN warning and detection assets provide units with the ability to detect and protect against a number of CBRN agents. When CBRN threats are present, prepositioning available detectors and alarms in key locations around an installation, (threat detection grid) may permit accurate and early detection of CBRN agents and provide commanders more time to implement protective measures. Commanders may also employ warning and detection assets in the aftermath of an attack involving CBRN materials to relay or determine the location of contaminated or uncontaminated areas. Review AFMAN 10-2503 for additional information on CBRN warning and reporting, and detection assets.

2.3.6.4.4. Class IV Construction Materials. Construction materials and supplies for recovery operations may be prepositioned at installations or locations either as minimum stock levels or as separately stored stockpiled items. Adequate security and protection of these materials is essential to ensure they are available when needed. This is especially true for materials placed in open storage or dispersed locations. See **Chapter 7** for more information on storing and stockpiling recovery materials.

2.3.6.5. Staging Assets. Generally, staging is the process of assembling, holding, and organizing arriving personnel, equipment, and sustaining materiel in preparation for onward movement. Understandably, the size and scope of staging operations vary and will likely be governed by a number of wide-ranging factors. Staging large forces and equipment for war or response to major disasters is different from staging CE resources for a much smaller, installation or unit emergency response. Furthermore, plans for staging assets may be developed well in advance of a potential crisis or accomplished immediately prior to or after an incident occurs. Regardless, when and how staging is planned or accomplished, engineers are usually heavily involved in the endeavor.

2.3.6.5.1. For major operations, expect the staging process to require a significant amount of preplanning, coordination, and effort, especially if large areas are needed to support huge groups of people and materiel. Large-scale staging operations usually involve all units on an installation and can include activities such as marshaling and lay-down areas, Security Forces (SF), personnel and equipment reception/staging areas and facilities, personnel support, billeting, transportation, material handling equipment, maintenance, general supply and subsistence support, contracting support, communications support, and medical services.

2.3.6.5.2. In contrast to large-scale staging operations, unit commanders can stage CE teams and resources in response to a heightened potential for attack or for an actual event on or near the installation. Furthermore, commanders may consider staging CE assets at dispersed or protected locations before a disaster strikes or an attack to increase their survivability and readiness during recovery operations. In any case, staging assets can enhance recovery capabilities and help ensure COOP after a crisis.

2.3.6.5.3. In emergencies, sometimes hastily developed staging areas are used to accommodate responding forces during the initial incident response phase. These staging areas should be checked for potential hazards prior to or immediately after the arrival of initial response forces to help ensure the staging area and entry control points are free of hazards. CE forces, including FES, EOD, and EM play a significant role in establishing hazard- and contamination-free staging areas. Refer to AFMAN 10-2502, *Air Force Incident Management System (AFIMS) Standards and Procedures*, and your installation's IEMP 10-2 and CE CRP for specific staging guidance.

Chapter 3

DAMAGE ASSESSMENTS

3.1. General Information. Performing damage assessments is the first step toward restoring critical installation facilities, utilities, and infrastructure to service after an attack or disaster. Specialized damage assessment response teams (DART) and airfield damage assessment teams (ADAT) perform assessments. DARTs help determine the location, type, and extent of damage to most installation facilities and utilities (**Figure 3.1**), and have a responsibility to isolate damaged utility systems whenever it is possible and practical to do so. During wartime, DARTs report the location, type, and quantity of UXOs discovered following an attack. They also make a quick inspection of ADR equipment and stockpiles; reporting the results of their findings to the ADR Officer-In-Charge (OIC). DART damage assessment reports are forwarded to the CE UCC where they are analyzed and prioritized IAW the installation recovery strategy developed by the EOC. Similar to DARTs, ADATs check and report the condition of the installation's airfield (i.e., runways, taxiways, ramps, and supporting infrastructure). Since the condition of the airfield has a fundamental and immediate impact on the flying mission, ADATs report their findings directly to the EOC (not CE UCC), to ensure senior leaders and those responsible for Minimum Operating Strip (MOS) selection have instant visibility on airfield condition. Whether DARTs or ADATs; speed and accuracy is essential during damage assessments to help ensure timely base recovery and restoration of installation operations; including flying operations.

Figure 3.1. DARTs Assess Damage to Installation Facilities and Utilities

3.2. Overview. This chapter addresses general damage assessment methods and processes; DART organization, leadership, and equipment requirements; and damage assessment recording and reporting. Airfield damage assessments and ADATs receive only cursory mention in this chapter, and readers should refer to AFPAM 10-219, Volume 4, for specific ADAT and airfield damage assessment information.

3.3. Assessment Methods. In the aftermath of a peacetime disaster, major accident, wartime and terrorist attack, or other crisis incident, the approach or method of damage assessment is vital to meeting the goals of the recovery effort. For example, wartime damage assessments are usually conducted and analyzed with an eye on prioritizing expedient repairs of critical facilities to restore installation operations quickly. Also during periods of war, repair times may be considered more critical than repair costs, and non-mission critical facilities will likely be completely bypassed during the repair/restoration process. Conversely, when conducting peacetime damage assessments, the focus may be on developing priorities and determining costs of permanent repairs to all facilities damaged during the disaster or accident. Both types of assessments are addressed throughout this chapter.

3.3.1. Installations with active flying operations differentiate airfield damage assessments from facility/infrastructure damage assessments. Airfield damage assessments involve a rapid appraisal of the airfield for damage, including checks of runway surfaces, taxiway surfaces, and other facilities that directly support aircraft operations. On the other hand, facility and infrastructure damage assessments evaluate damage to all other installation infrastructure, including facilities and utilities. Resources permitting, both assessments should be conducted simultaneously and depending on the situation, may be of equal importance.

3.3.2. Damage assessment methods are usually categorized as Preliminary (Phase I) and Detailed (Phase II) assessments. For preliminary assessments, an initial evaluation of the installation is made to quickly locate areas of UXO and major facility and utility damage. The results of this preliminary survey are used to obtain a general idea of overall installation damage and update the preplanned damage assessment routes. A detailed damage assessment requires a more accurate location and description of problems than the preliminary or rapid assessment since these reports will form the basis of repair crew sizing, material and vehicle allocation, damage repair cost estimates, and, to some degree, prioritization of efforts. During detailed assessments, DARTs follow UCC-directed travel routes from their shelter locations to various critical facilities and utilities throughout the installation. The DART reports the severity of damage along these routes and, in particular, at the predetermined critical facilities. DARTs also note and report all hazards; such as, dangerous breaks in gas, electrical, water and sewer lines; road perils; UXOs; etc. All affected areas should be recorded on a base map maintained in the CE UCC. See **paragraph 3.5** for a closer look at preliminary and detailed damage assessment practices, priorities and reporting procedures.

3.3.3. In addition to the damage assessment procedures addressed in this section, UFC 1-201-02, *Assessment of Existing Facilities for Use In Military Operations*, is a good source of information for performing preliminary and detailed facility assessments. It provides contingency personnel with procedures to assess facilities to determine if buildings meet the minimum life safety and habitability requirements to permit occupancy in support of military operations. It also provides options for mitigating risks when deficiencies exists.

3.4. DART Organization, Leadership, and Equipment. The number of DARTs established depends, for the most part, on the size of the installation to be surveyed. Three teams should be sufficient for an average size installation. While manpower assets from Prime BEEF teams configured in a warfighting force posture can support a three-team requirement, the number of teams required for damage assessment should be based upon factors such as:

- Facility type/size
- Type/size of utility systems
- Number of facilities
- Geographical separation of facilities

3.4.1. **Organization.** Reflected in **Table 3.1** is an example of basic DART composition. Do not hesitate to tailor the skill mix and number to the installation's facility and utility situation. For example, if the installation has a large petroleum, oils and lubricants (POL) complex and tank farm, consider adding or substituting a Water and Fuels System Maintenance (WFSM) person for another craftsman on one of the teams. If a civilian work force is available, use to fill needed positions on teams or to field additional teams. For safety reasons, DARTs should never have less than two qualified individuals at all times. See AFPAM 10-219, Volume 1 for more information on the composition of DARTs and other CE response teams.

Table 3.1. Example of Basic DART Composition

DART Composition		
AFSC	**Title**	**# Personnel**
3E371	Structural Craftsman	1
3E071	Electrical System Craftsman	1
3E471	WFSM Craftsman	1

3.4.2. **Leadership.** The senior military member or civilian assigned to the DART is responsible for organizing and directing the team's assessment operation. Ideally, individuals chosen to head DARTs should be knowledgeable of the type damage to be assessed (e.g., electrical, mechanical, and structural). Team leaders ensure DARTs:

3.4.2.1. Maintain communication with the UCC.

3.4.2.2. Survey incident/accident sites and compile preliminary and detailed damage assessment survey data. When incidents involve multiple locations/facilities, establish survey sequence using the installation's facility priority list.

3.4.2.3. Report immediately to the UCC all situations posing an immediate threat to public safety (e.g., downed power lines, gas leaks, collapsing structures, fires).

3.4.2.4. Survey assigned areas, record damage on damage assessment worksheet(s) and transmit survey data information to the UCC.

3.4.2.5. Complete initial isolation or shutdown of utilities to prevent further damage or injury if within the capabilities of the DART.

3.4.2.6. Return to the UCC when directed and provide detailed damage assessment data. Also, maintain all worksheets/photos for the detailed damage assessment and for historical purposes.

3.4.2.7. Request any non-CE support through the UCC.

3.4.3. **Equipment.** Equipment for DART support should be assembled during the attack preparedness phase. The specific types and quantities of support equipment depend on installation requirements and how the assessment will be conducted. Dedicated vehicle support for assessment team operations is virtually mandatory; however, the possibility exists that assessment may have to be accomplished on foot if many vehicles are destroyed or roads are seriously blocked. In such cases, teams will be severely limited in what they can perform in the way of utility isolation, and their assessment time will be greatly lengthened. Although not all-inclusive or mandatory, **Table 3.2** lists typical equipment and supplies for personnel performing DART tasks. **Note:** Items in this list do not constitute new purchase requirements. Consult with unit POCs for specific DART requirements, funding and logistics authority.

Table 3.2. Typical DART Equipment and Supplies

DART Support Equipment
Personal protective equipment (PPE) and/or individual protective equipment (IPE): (e.g., hard hats, gloves, safety glasses, rubber boots (flooded areas), reflective vests, chemical warfare ensemble, helmet, body armor)
Data recording/reporting equipment (mobile device/computer w/GIS data loaded, small digital camera, if provided), priority facility list, base map/installation grid maps, utility drawings, damage assessment worksheets/forms, clipboards, writing implements, radios w/spare batteries
Binoculars and night vision devices
Utilities isolation tools and gear such as electrical hot sticks, fuse pullers, and valve keys
Global positioning system equipment/directional compass
Miscellaneous equipment such as explosion-proof, plastic-cased flashlights, hand tools, nonmetallic measuring tapes, surveyors tape (multiple colors), flags, UXO markers, utility shutoff markers, and first aid kit

3.5. Assessment Practices, Priorities and Reporting. DARTs begin attack or disaster recovery assessments when directed by the commander (usually through the EOC or UCC after declaration of "Alarm Black" condition or "All Clear"). Upon notification, DART members should report to their designated assembly area or an alternate location as directed by the UCC. Conduct preliminary and detailed damage assessments as indicated below. For additional, comprehensive facility assessment procedures and checklists, see UFC 1-201-02.

3.5.1. **Preliminary Assessment (Phase I).** The purpose of the preliminary damage assessment is to assess the recovery environment quickly and identify areas of major utility and facility disruption. The preliminary assessment should also identify any readily apparent life safety hazards. **Note:** If possible, preliminary damage assessments during peacetime should be completed within the first few hours of daylight that it is safe to have personnel out following the disaster.

3.5.1.1. When making preliminary reports, exact damage descriptions and measurements are not expected, so information should be of a general nature (e.g., roof damage, broken windows). Preselected observation posts can provide information on visible facility and utility damages using expedient modes of communication (e.g., radio/telephone contact with UCCs and the EOC). The preliminary damage assessment will set the pace for the recovery effort. During preliminary assessments, DARTs should:

3.5.1.1.1. Perform a rapid and safe base assessment

3.5.1.1.2. Identify damage by building category and general description

3.5.1.1.3. Use locally approved DART worksheets to document assessments (See **Attachment 3** for examples of preliminary damage assessment worksheets)

3.5.1.1.4. Report limiting factors for emergency response vehicles (e.g., blocked road, bridge)

3.5.1.1.5. Provide inputs to the UCC

3.5.1.2. In addition to DART preliminary reporting, the CE UCC should expect installation-wide reports and inputs from personnel who are not trained or familiar with damage assessment reporting requirements. Much of the information received will be inaccurate; therefore, UCC personnel will have to be prepared to ask the right questions and clarify any contradictory inputs. Expect to receive damage inputs from all types of communications modes—runners, the installation telephone system, other C2 centers, and the EOC.

3.5.1.3. During wartime assessments after an installation attack, the UCC should be prepared for plenty of confusing UXO reports. Many personnel do not have an EOR background or experience. Most inputs will probably be in terms of generalities, so close questioning will have to be done to ascertain the type of munitions that will be encountered. The CE UCC will use the UXO information and other data obtained during the Phase I initial reconnaissance to adjust DART routes as appropriate. Afterwards, Phase II assessments begin.

3.5.2. **Detailed Assessment (Phase II).** Once preliminary damage assessment is complete and the UCC has a rough estimate of overall base damage, the next step is to perform a detailed assessment of damaged facilities. The Phase II damage assessment can be highly dangerous and perhaps time-consuming, depending upon the extent of the damage and size of the installation. In both attack and disaster recovery environments, DARTs serve as the eyes and ears of the UCC. The interface between these two functions should be close since the entire installation recovery effort; from a facility and utility aspect, hinges on their efficiency and effectiveness. The following paragraphs address both peacetime disasters and installation attacks, unless otherwise noted.

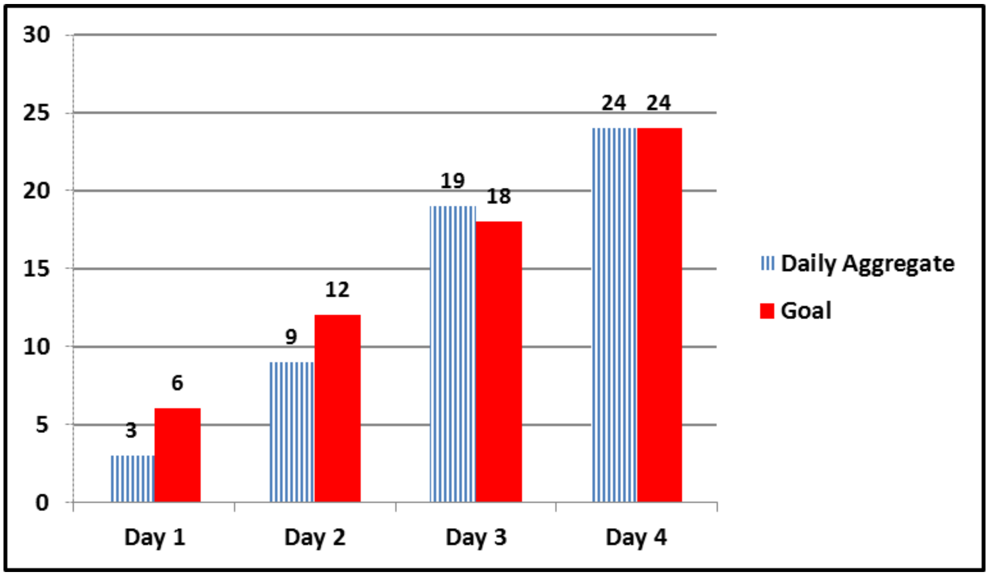
3.5.2.1. DARTs should physically inspect and record the damage to each facility using locally developed, pre-formatted DART worksheets. Worksheets serve as source documents for what the DART has observed (See **Attachment 3** for examples of damage assessment worksheets).

3.5.2.2. If safety permits, DARTs should inspect accessible areas of facilities. Damage to built-up roofs, remote storage facilities and other locations not readily visible could go undetected for days unless inspection criteria are clearly defined. Comprehensive worksheets and checklists can help ensure DARTs inspect all required areas within the facility. Any damage detected should be reported in units (e.g., windows, doors), square footage (e.g., roofs, exterior/interior walls), or linear footage (e.g., piping, ductwork, fencing), as applicable.

3.5.2.3. To ensure required facilities are inspected by DARTs, the UCC should set goals and chart completion of inspections. Records from previous incidents or lessons learned may help provide realistic timelines and goals. Since it is important to know how well the detailed damage assessment process is proceeding, it may be helpful to post a chart in the

UCC indicating progress or status of assessments. Table 3.3 is a notional chart indicating daily progress or achievement.

Table 3.3. DART Detailed Facility Assessments Progress (Notional)



3.5.2.4. During peacetime, damage assessment goals are to develop repair priorities and determine the cost of repairing all facilities damaged in the disaster. While an installation's immediate priority following any natural disaster will rightfully be centered on rescuing personnel and stabilizing facilities to protect against further damage; typically, the debris will have barely settled before the first requests for a damage estimate arrives. The sooner an installation can provide a substantiated damage estimate, the sooner it can expect emergency funding for disaster repairs. Data provided by DARTs is vital to estimating repair costs and authenticating overall damage estimates.

3.5.2.5. Sometimes, due to DART inexperience or lack of practice, initial damage assessment reports may not contain all the information needed to prepare a complete cost estimate. As a result, DARTs may need to return to some facilities to collect additional information for cost estimators. However, repair costs are not the immediate concern during wartime; the unit's main objective is to restore installation operations quickly. On the other hand, during peacetime, a complete cost estimate after a disaster is vital to gaining the necessary funds to repair or replace damaged infrastructure. For this reason, consider having DARTs submit assessment data to cost estimators in the UCC after initially performing only one or two assessments. Once the information supports accurate repair cost estimates, set the number of facilities DARTs should assess before submitting them to the UCC. For example, consider having DARTs submit damage assessment data after completing 5 to 7 facility assessments at a time. This may help minimize lost time revisiting damaged facilities to collect additional information.

3.5.2.6. Using the data from the DART worksheets, trained estimators compute the dollar estimates for each facility damaged. For peacetime disasters, repair costs should present a realistic appraisal of the damage done by the disaster. All damage caused by the disaster should be included, but the cost should not include any problems caused by age, change of use, or other outside factors. Repair costs are provided to the MAJCOM and HQ USAF and should be complete, accurate, timely, and justifiable.

3.5.3. **Typical DART Attack Recovery Actions.** Damage assessments performed after an installation attack have a different focus than peacetime, they can also be more challenging due to a multitude of wartime effects and threats; e.g., CBRN hazards, UXOs, major fires, bomb-damaged infrastructure, additional attacks, and personnel/equipment attrition. These types of wartime challenges must be considered when executing DART activities. The typical sequence of DART actions following an attack is as follows:

3.5.3.1. The UCC gathers initial damage reports and annotates appropriate information on grid maps. Based on these initial reports, UCC personnel make a preliminary analysis of where major utility and facility damage has been inflicted. Tentative utility cutoff locations are also identified.

3.5.3.2. The UCC updates previously developed damage assessment routes as necessary, and assigns routes to the appropriate DART based on the technical expertise resident on each team.

3.5.3.3. The UCC directs DARTs to assemble and proceed to the UCC. The DART chiefs pick up their assigned damage assessment routes and receive an overview of present conditions from the UCC staff to include known hazards (including CBRN agents), route updates, and information relative to probable utility shutoff requirements.

3.5.3.4. DART chiefs then brief their teams on assessment routes and known hazards or problems and begin their damage assessment activities. A communications check is made prior to leaving the UCC area. When assessment teams are dispatched, the UCC notifies the engineering representatives in the EOC of this action.

3.5.3.5. DARTs report major problems and hazards (major utility breaks, fires, UXO fields, etc.) as they travel their routes. These major items are also plotted on installation grid maps carried by assessment teams. Radio discipline is critical and should be maintained—report only the necessary information back to the UCC—do not report trivial items. Remember, several assessment teams are operating concurrently plus the UCC is also monitoring ADR and fire fighting operations—the information flow into the UCC will be staggering. There is also a possibility that DARTs will encounter casualties while performing their damage assessment activities. The buddy care and first aid home station training learned during peacetime becomes important here. To the extent practicable, assessment teams should assist wounded personnel and perform rescue actions if within the capability of their teams. If possible, casualties should be turned over to their units for transport to the nearest installation CCP. If this cannot be done, the UCC should be informed of the casualty's location so the appropriate unit can be contacted through installation C2 channels. While damage assessment is the assessment team's primary task, they cannot ignore giving aid to others—team chiefs are responsible for making all decisions with regard to keeping the balance between life-saving/rescue actions and damage assessment responsibilities.

3.5.3.6. DARTs assess each designated critical facility/utility along their routes. At those locations where damage is found, develop repair/demolition estimates. Transmit estimates back to the UCC for each critical facility/utility visited, and make hard copies of estimates. Data radioed back to the UCC should contain only the most important information (e.g., type and extent of damage, major materials, and equipment needed, crew size and most critical AFSs, time for repair/demolition, and obvious safety hazards). The written copy covers more detail such as additional materials needed and further scope of damage. If a critical facility or utility has suffered little or no damage, this information should also be transmitted to the UCC. The UCC, in turn, should inform the engineering representatives in the EOC of all major damage assessment results as they are reported.

3.5.3.7. At locations where damaged utilities are found, DART members attempt to isolate the problem but only if it can be done safely and is within the technical expertise of the team. Once a utility has been isolated, it is reported to the UCC. If a serious utility problem cannot be isolated, it is also reported to the UCC so a specialized team can be assigned the task. Remember, these specialized teams are few in number and in the case of Power Production personnel, will spend most of their time after an attack attending emergency generator problems. Therefore, assessment teams should make every reasonable effort to handle such situations without assistance.

3.5.3.8. At those locations where UXOs are found, DARTs should perform the standard EOR function locate the munitions, identify the type, report findings back to the UCC, and mark the area with ropes and appropriate signs. Under no circumstances should assessment team members attempt to move a UXO even if it interferes with utility isolation or facility damage assessment. The UCC will submit the UXO findings data to the EOC who will, in turn arrange for EOD support. Once the munitions are reported and roped off, the team should continue with their assessment run. When the munitions are eventually cleared, the UCC will decide when the assessment team will be sent back to assess damage to the affected facility or utility system.

3.5.3.9. As each damage assessment route is completed, DARTs provide the UCC copies of their assessment reports and await further taskings. At this point, if follow-on attacks are unlikely, the UCC normally has three options to consider for employing DARTs. It can assign additional damage assessment actions predicated on the most recent damage inputs from other installation personnel, task assessment team members to coordinate on-scene recovery efforts, or assign team members to specific repair crews for emergency repair activities.

3.5.3.10. If follow-on attacks are expected soon, DART members should report to their original shelters and reestablish team integrity. Assessment team vehicles are again dispersed and “resupplied” with any equipment, tools, or materials that may have been expended during earlier assessment runs. The UCC updates the damage assessment routes and grid maps with all known damage and danger areas so that duplicate reports are not received during subsequent damage assessment runs and assessment teams are knowledgeable of all known problem areas prior to their next assessment tasking.

3.5.4. **Priorities.** The routes DARTs take during damage assessment cannot be haphazardly determined. They should be preplanned with the highest priority areas looked at first. During wartime, assessment routes should also be planned around CBRN sectors as much as possible to reduce transition points during split-MOPP operations, DARTS would then be prepositioned one per sector (if viable). If not, it could greatly increase travel/response time of DARTs.

3.5.4.1. The facility priority list contained in the CE CRP should be used as a guide. In this way, key facilities and systems on the installation will be checked and damage that has been previously unreported will be found. Another tool available for facility prioritization is the Prioritized Asset List (PAL) if the installation has one. If a wartime location does not have a predetermined facility priority list, the facilities listed in **Table 3.4** can be used as a starting point when setting DART priorities and schedules.

Table 3.4. Prospective Priority Facilities

Priority Facilities
Installation C2 node and other C2 facilities directly related to combat flying squadrons (e.g., squadron operations building)
Communications facilities
POL/munitions facilities
Fire stations
Medical facilities
Utility plants and distribution stations

3.5.4.2. Although damage assessment routes should be determined in advance, this does not mean they cannot be altered to meet the real-world situation. They should be updated from the data received from initial damage reports. For example, if debris or a UXO field is blocking an access route, simply change the access route. Once the routes have been determined and updated, they are assigned to specific damage assessment teams. Common sense and a bit of quick analysis are required here. Routes with known power outages and major electrical damages should be assigned to the assessment team containing an electrical systems specialist. A route with known POL problems should be assigned to the team containing a WFSM specialist if one has been placed on a team. The basic thrust is to match the specific skills contained on a particular assessment team with the types of damages expected to be encountered along the assessment route.

3.5.5. **Damage Recording and Reporting.** Once damage is assessed, it should be recorded and immediately transmitted back to the CE UCC for plotting, repair prioritization, and repair team selection. The speed of reporting depends on the complete understanding of the information being relayed and adherence to proper radio discipline by DARTs and UCC personnel. Communications operators and plotters in the UCC should be personnel with engineering backgrounds if possible. This lessens the chance of miscommunication and saves time in perhaps the most demanding and hectic period of the installation recovery process.

3.5.5.1. Damage Assessment Reports. There is much more to damage reporting than just calling in the visual damage inflicted upon a facility or utility; several other factors should be addressed by DART members. For example, assessment teams should make a determination of repair feasibility. This is an initial decision on whether a facility or utility component can realistically be repaired. During wartime, if the damage is so great that repairs cannot be made quickly or without huge expenditures of manpower and material, the facility or utility will normally be abandoned or demolished. The choice between abandoning and demolishing will usually be made based on safety. If a serious hazard does not exist, abandon the facility or utility component in place and attend to it after installation recovery has been accomplished; if the condition of the facility or utility poses a major hazard, demolition will likely be necessary. Remember, the safety hazard determination should be based on its effect on the primary installation mission. For example, a structurally unstable open storage shed in the back of the supply yard, while posing a serious hazard to anyone entering it, would have little effect on the flying mission; therefore, abandon it for now. On the other hand, a structurally unstable maintenance shop adjacent to an aircraft fuel cell maintenance area and major taxiway will most likely need to be torn down; therefore, a demolition estimate from the DART would be needed. If, however, the decision is made that a facility or utility component is repairable, a repair estimate should be made in terms of time, materials, personnel, and equipment.

3.5.5.2. Repair Estimates. In developing damage repair estimates, DART members should be aware of the following factors:

3.5.5.2.1. Repair times are critical during wartime. The quickest, least effort and least material-intensive repair should be identified. Workarounds are very acceptable if a facility/utility can be satisfactorily put back in service via such methods. Remember, the goal is to make the facility or utility usable once again, not to put a "peacetime" fix on it. After the threat of further attack is over, repairs that are more permanent can be made, if necessary.

3.5.5.2.2. Accuracy is important. DARTs are purposely configured with experienced personnel with varied expertise. This expertise should be used in determining what has to be done. Any safety hazards that may have to be contended with during repair should be emphasized and highlighted by damage assessment teams in their reports.

3.5.5.2.3. Familiarity with available equipment and materials is necessary. Repair estimates should be made considering what resources are readily available—it cannot be assumed that resources can be immediately obtained through supply or contracting channels. Besides knowing the going-in position on equipment and materials, DARTs should also be aware of the status of major equipment and material items. This information comes from the UCC staff and is vital in terms of developing solutions to repair problems involving workarounds and quick fixes. In a wartime situation, it is prudent to rely only on what materials and equipment are known to be available on the installation—chances are other sources of supply will not be available or not very responsive during those first few hours after an attack or widespread disaster.

3.5.5.2.4. Knowledge of AFS capabilities is required. Repair estimates should also include an indication of work crew size. DART members should be familiar with the task capabilities of the various engineering AFSs, the multi-skilling aspects of engineer AFSs, and the general nature of the repairs to be accomplished. Specific repair taskings cannot be over manned—manpower; especially in wartime situations is a precious resource.

3.5.5.3. Demolition Estimates. In those cases where repair of damaged facilities or utilities is not feasible and a demolition action is called for, demolition estimates are then required. The reason for the demolition action in the first place is to alleviate a serious safety hazard—this hazard must be made perfectly clear in the estimate so personnel are not placed in any more danger than they are already facing in doing the job. DART members should consider the following when preparing demolition estimates:

3.5.5.3.1. Safety is paramount. Demolition actions need only be carried out to the point where the safety hazard no longer exists—final cleanup can usually wait. Do not worry about what the work site looks like; installation beautification is not a concern during a major disaster or wartime.

3.5.5.3.2. Crew size and time required for the task should be realistic and reasonably accurate. Again, like the repair estimate, the demolition task should not be over-manned. Use the multi-skilling features of engineer forces—many people can drive a dump truck.

3.5.5.4. Estimating Repair Costs. When determining the actual dollar estimates, it is important to be consistent with estimation and computation tools. Use any pre-identified or pre-costing formulas or tools your unit may have to estimate costs quickly and to assist in speedy reporting of facility damage estimates. Keep all reference data together and on the fewest number of forms. The UCC will consolidate completed DART worksheets and maintain them for future reference.

3.5.6. **EOC Reports.** Collecting, analyzing, and reporting damage assessment information to the EOC is a key function of the CE UCC. The installation leadership uses damage assessment information when making decisions about installation recovery, mission operations, personnel safety, and other important issues. The UCC should up-channel DART preliminary damage assessment reports quickly so unit leadership and decision makers have a comprehensive picture of the damage done to the installation following a disaster or attack (**Figure 3.2**). In addition to the preliminary reports, the EOC and Wing leadership expects to receive damage assessment updates continuously in order to continue making well-informed decisions, assimilate base information, and to forward essential elements to joint force, theater, and MAJCOM command centers. For these reasons, the CE UCC must remain steadfast and continue to report damage assessments to the EOC expeditiously. As previously addressed in Chapter 2, the CE UCC uses any number of methods to communicate vital information to the EOC. These methods can include landline phones, cell phones, radios, facsimiles, computers, pagers, runners, etc. Because certain information may be sensitive, personnel should be cognizant of and always practice good COMSEC and OPSEC procedures.

Figure 3.2. Quickly Up-Channel Preliminary Damage Assessments to EOC

3.5.7. **Higher Headquarters (HHQ) Reports.** Certain incidents and events must be reported to AF HHQ. These reports are completed and forwarded by the appropriate installation C2 node; however, some reports require input from the CE force, especially when damage assessment activities are conducted. While a detailed discussion of each report is not necessary here, information the BCE provides for certain reports are addressed in the following paragraphs. More detailed information regarding HHQ reporting requirements are contained in AFI 10-206, *Operational Reporting*.

3.5.7.1. Event/Incident Report (OPREP-3). This report uses installation C2 node channels to notify commanders immediately of any significant event or incident that rises to the level of MAJCOM, HQ USAF, or DOD interests. The report is submitted in accordance with AFI 10-206 to the AF Operations Center in the Pentagon and other addressees, depending on the category of the report. Typical incidents that could trigger an OPREP-3 report include major fire, installation attack, major natural disaster, terrorist attack, and major environmental contamination. The range of information that could be included in the OPREP-3 is extensive. However, for those events that result in significant damage to USAF installations, the items in **Table 3.5** should provide adequate information from civil engineers. The DARTs are not responsible for supplying all of the information listed, but familiarization with the data that the BCE may have to supply for this report will facilitate the collection of essential information during assessment activities. The UCC will provide specific instructions to the DARTs if it requires information beyond a team's normal report.

Table 3.5. Civil Engineer OPREP-3 Information

CE-Supplied Information For Event/Incident Report	
Extent of Damage	Structures Airfield Pavements NAVAIDS Utility Systems WRM Assets Fire Emergency Services Vehicle Capability Command, Control, Communications, and Computer Facilities and Equipment
Support Factors	Status of Housing and Dining Facilities Status of POL Storage and Distribution Systems Status of Medical Facilities
Other Information	Restoration Actions in progress or anticipated Estimate of repair costs Indication whether the repairs will be accomplished in-house or by contract Estimated recovery date and time Assistance required (Prime BEEF, RED HORSE, etc.) Impact on combat readiness status of Prime BEEF teams

3.5.7.2. Commander's Situation Report (SITREP). Once initial emergency situation information is submitted using the OPREP-3 report, follow-on status is normally provided in the Commander's SITREP. Engineer data are usually included in the logistics portion of the report and address only major engineer problems/shortfalls. Reports generated at unit level are sent to the major command and the parent joint command.

3.5.8. In summary, damage assessments form the foundation for prompt and effective installation recovery actions. Engineering DARTs concentrate on airfield pavements and installation facilities and utilities. The DARTs initially follow predetermined routes to survey damage. If damage is found, repair or demolition estimates are developed and transmitted to the UCC. These assessment team inputs provide the baseline data needed for assembling and tasking engineer facility and utility repair crews. The DARTs should be comprised of qualified, experienced personnel; be provided adequate communications, transport, and protective equipment; and be completely knowledgeable of damage assessment procedures. To round out the damage assessment process, engineers serving in installation C2 centers should be aware of and participate in the preparation of the electronic reports to HHQ.

Chapter 4

AUXILIARY FIRE FIGHTING AND SEARCH AND RESCUE

4.1. Overview. Preventing fires is always the best line of defense; however, fires caused by an installation attack may be unavoidable. In fact, in a conventional wartime environment, it is very plausible that FES personnel and their vehicles/equipment could be thoroughly engaged in mission priority crash rescue and fire suppression tasks involving aircraft and weapons systems. In such demanding situations, lesser priority structural and vehicle fires could be left unattended. To prevent or at least reduce damage to essential CE installation recovery assets if the situation arises, each Prime BEEF team should have a limited, internal fire fighting capability. Thus, all non-fire protection (non-AFS 3E7X1) team members should be taught basic fire fighting skills to be able to intervene in the early stages of a fire. However, employment of these skills must not constitute a safety hazard to Prime BEEF team members. At installation level, the fire chief ensures any required contingency-related fire fighting training is provided at the proper scope and depth to all non-FES personnel. This chapter briefly reviews CE auxiliary fire fighting and search and rescue concepts and fundamentals. Personnel should consult with local FES personnel beforehand, when planning for potential auxiliary fire fighting.

4.2. Auxiliary Fire Fighting. If the need arises and FES is fully engaged elsewhere, Prime BEEF team members not engaged in other, higher priority work can perform auxiliary fire fighting duties. Most fires can be controlled in the initial stages with immediate and proper application of water or other appropriate extinguishing agent. In many cases, a well-trained auxiliary fire fighting team, with an attack plan and an adequate amount of water should be able to either extinguish or contain most small fires. However, the lack of technical knowledge, protective clothing, and breathing apparatus will usually limit the role of auxiliary fire fighting teams to that of preventing the spread of an existing fire. Nevertheless, regardless of the extent of involvement, personnel performing auxiliary fire fighting must be aware of basic fire fighting concepts and fundamentals addressed in this pamphlet to function effectively and safely. They include understanding fire behavior, the types of fire and fire extinguishers, and basic techniques for controlling and/or extinguishing small fires. Success or failure may depend on their knowledge and ability to apply basic fire fighting methods.

4.2.1. **Fire Behavior.** The fire tetrahedron (**Figure 4.1)** is the best way of explaining the components necessary for a fire to occur; they include fuel, oxidizing agent, heat, and a self-sustaining chemical reaction. When placed together in the right concentrations and conditions, these components can produce combustion—chemical chain reactions creating heat and sometimes light (fire). Combustion can be slow and non-flaming (smoldering) or rapid and flaming (fire). Removing any one of the components illustrated in the fire tetrahedron will extinguish the fire. In other words, a fire can be put out by simply reducing the temperature of the fuel below that needed to support combustion, eliminating the source of fuel, withdrawing the oxidant (e.g. oxygen, chlorine gas, hydrogen peroxide), or interrupting the chain reaction by other methods. Examples of these methods are addressed in the following paragraphs. In any case, it is important to know what type of fuel is burning to select the correct extinguishing agent or method.

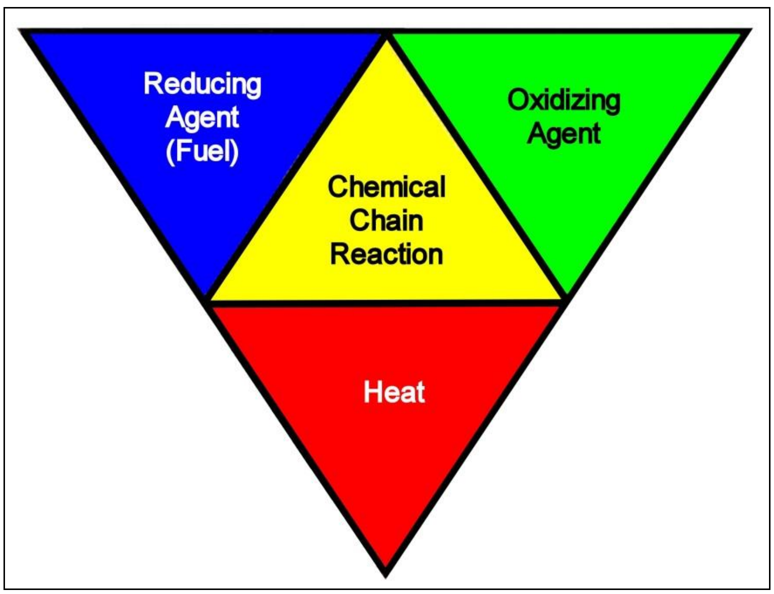
4.2.1.1. Heat. One of the most common methods employed to extinguish a fire is to cool it with water. This approach is predicated upon reducing the temperatures of the fuel until it does not produce enough vapors to continue burning.

4.2.1.2. Fuel. In some instances, it is easier to extinguish a fire by removing its source of fuel, which, for example, is the intent of making firebreaks when there is a forest fire. This approach would also apply where liquid or gaseous fuel is involved, particularly when it is being sourced from a pipeline. A good example of this technique took place in Kuwait after the 1991 Iraq war when hundreds of oil wells were ablaze. Early in the recovery effort, a number of the fires were quenched by simply shutting off the flow of crude oil.

4.2.1.3. Oxidant. In certain situations, it is more advisable to extinguish a fire by reducing the oxygen concentration. This can be done by introducing an inert gas (e.g., Carbon dioxide or Halon) or by separating the oxygen from the fuel. Many fire extinguishers work on this principle.

4.2.1.4. Chemical Chain Reaction. Fire resulting from a self-sustained or self-propagating chain reaction during combustion will continue to burn until the fuel, oxygen is depleted, or an extinguishing agent is applied in sufficient amounts to interrupt the chain reaction. Fire extinguishers with dry chemical or halogenated agents are effective at stopping or interrupting the chemical chain reaction that produces fire.

Figure 4.1. Four Components of Fire Tetrahedron



4.2.2. **Classes of Fires.** Fires are classified according to the type of fuel that is burning. Most fires will generally fall into one of five classes or types described below:

4.2.2.1. Class A: Ordinary Combustible Materials. These are fires involving ordinary materials, such as wood, paper, cloth, rubber, and many plastics. The preferred method for extinguishing fires involving these materials involves using water to reduce the temperature of the burning material (or fuel) below its ignition temperature.

4.2.2.2. Class B: Flammable Liquids or Gases. These fires are often fueled by gasoline or diesel fuel, oil, solvents, propane or natural gas. Removing the oxygen or interrupting the chemical chain reaction is the most effective means of extinguishing these types of fires. Carbon dioxide or dry chemical fire extinguishers work well on these types of fires.

4.2.2.3. Class C: Energized Electrical Equipment. These are fires with energized electrical equipment including wiring, fuse boxes, circuit breakers, machinery, and appliances. Dry chemical and CO_2 extinguishers usually works well on these types of fires. As a general practice, de-energize the circuits first before attempting to extinguish a fire involving electrical equipment. Afterwards, treat the remaining flame as a structural or flammable liquid fire, depending upon the fuel that is involved.

4.2.2.4. Class D: Combustible Metals. These types of fires involve burning metals, such as magnesium, titanium, lithium, sodium, and potassium. They present special challenges for any firefighter because they can react violently to moisture. Therefore, water or water-based fire extinguishing agents should not be used on these fires. Even small amounts of moisture may produce reactions that increase fire intensity. In addition, standard dry chemicals are not effective because the high heat generated by the burning metal simply consumes the agent.

4.2.2.5. Class K: Cooking Oils. These are fires involving animal or vegetable based cooking oils, fats, and greases. Larger quantities of these fuels are used in commercial cooking media usually located in large, industrial-size kitchens, but smaller quantities are also found in many private homes. Wet chemical extinguishers containing a potassium acetate-based extinguishing agent are used to extinguish these types of fires.

4.2.3. **Portable Fire Extinguishers.** Portable, pressurized fire extinguishers are the first line of defense for small fires. They can usually be found in most base facilities and are designed for use on specific types of fires. The type of fire, their common extinguishing agent, and fire disruption method is shown in **Table 4.1**. Shown in **Table 4.2** are common fire extinguishers and their designated uses. Be sure the extinguisher used is intended for the type of fire that is being fought. Using the wrong fire extinguisher or extinguishing method on a fire can easily make matters worse. See **Attachment 4** for a list of pros/cons of these fire extinguishers.

Table 4.1. Portable Fire Extinguisher Symbols and Extinguishing Agents

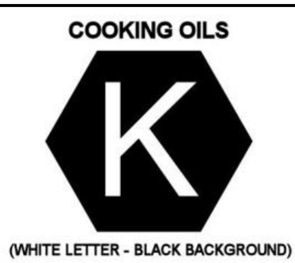
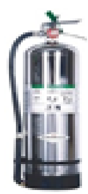
Extinguisher Classification Symbols		Extinguishing Agent	Method
		Water	Removes heat (cooling)
		Dry Chemical	Separates fuel from air and interrupts chain reaction
		Foam	Removes air (oxygen depletion) and heat
		Carbon Dioxide (CO_2)	Removes air and cooling
		Dry Chemical	Separates fuel from air and interrupts chain reaction
		CO_2	Removes air and cooling
		Dry Chemical	Separates fuel from air and interrupts chain reaction
		Dry Powder	Separates fuel from air; dissipates heat (heat transfer cooling)
		Wet Chemical	Separates fuel from air; vapor suppression

Table 4.2. Common Fire Extinguishers

Type:	Designated Use:
Air-Pressurized Water (APW) 	APW extinguishers are used on Class A fires involving ordinary combustibles. They extinguish fire by taking away the "heat" element of the fire triangle. These large SILVER colored extinguishers stand about two feet tall and weigh about 25 pounds when full. They are usually filled with ordinary tap water and pressurized air.
Carbon Dioxide (CO_2) 	CO_2 fire extinguishers are effective against Class B fires. CO_2 is a non-flammable gas that when used in sufficient quantity, extinguishes the fire by taking away the "oxygen" element of the fire triangle. They may be ineffective against Class A fires because it may not displace enough oxygen to put out the fire and smoldering materials may reignite. Extinguishers are colored RED and come in a variety of sizes ranging from five to 100 pounds.
Dry Chemical (DC) 	DC fire extinguishers can be used on Class A, B, or C fires and are usually label "ABC" for all three classes or "BC" for Class B and C fires only. They extinguish the fire by coating the fuel source with a thin layer of dust, therefore separating the fuel from the air. The powder also works to interrupt the chemical reaction of the fire. They are effective on electrical equipment fires. They are colored RED and come in sizes from five to 20 pounds.
Dry Powder 	Dry Powder extinguishers are used only on Class D fires containing burning metal. The type of extinguishing agent in these units depends on the type of metal fuel involved. No single agent will control or extinguish all metal fires, so users should read the extinguisher label for specific contents, rating, and application.
Wet Chemical 	Wet chemical fire extinguishers are intended for use on Class K kitchen fires involving cooking greases, fats, and vegetable/animal oils. They extinguish fires by suppressing vapors and combining with cooking oils to create a foam surface to help smother the fire and prevent reigniting.

4.3. Basic Fire Fighting Concepts and Techniques. The primary objective of auxiliary fire fighting is to properly deal with small fires in their early stages, including locating the fire source, rescuing trapped victims when possible, and extinguishing or containing the fire until professional help arrives. In all likelihood, auxiliary fire fighting operations will be most prevalent immediately following an installation attack or natural disaster. In the period between the all clear notification and the assignment of installation recovery taskings, engineering personnel should survey their immediate areas for local fires, the presence of UXO, the amount of damage sustained, and the status of recovery vehicles, equipment, and supplies. Those personnel that are not required for damage assessment, recovery asset reconnaissance, or local C2 should be prepared to perform auxiliary fire fighting tasks until ordered to commence more pressing installation recovery efforts. Review AFH 32-2005, *Fire Fighting Guide for Contingency Operations*, for additional information on auxiliary fire fighting.

4.3.1. **Team Composition and Duties.** An auxiliary fire fighting team has no set number of personnel. When the need for auxiliary fire fighting arises, the ranking person should assume the responsibility of team chief. Team assignments will depend on the number of personnel available to fight the fire(s). The fire attack must be fully coordinated to be successful and firefighters should follow the team chief's directions precisely—deviations could be counterproductive and disastrous. In any event, remember that the auxiliary fire fighting role is a very restricted one. With limited training and little access to professional fire fighting tools, the auxiliary fire fighting role should be confined to only coping with small fires in their earliest stages of development. Teams should avoid sacrificing their safety in dangerous fire fighting situations. Team duties include but are not limited to the following:

4.3.1.1. Deploying and operating fire extinguishers and hose lines

4.3.1.2. Carrying and operating other tools and equipment

4.3.1.3. Performing rescues

4.3.1.4. Assisting other team members as required

4.3.2. **Using Fire Extinguishers.** When using portable fire extinguishers to put out a fire, hold it in an upright position and operate the extinguisher within its effective range. The "PASS" acronym is an easy way to remember how to activate and discharge extinguishers. It stands for: *Pull* the pin; *Aim* at the base of the fire (not the flames); *Squeeze* the top handle to release extinguishing agent; and *Sweep* from side to side until the fire is out. In addition to the efficient use of appropriate fire extinguishers, auxiliary fire fighting personnel trained to use fire hoses/nozzles and fire pumps can either extinguish or contain most small fires. However, safety is paramount and personnel should be careful not to exceed their capability or training.

4.3.3. **Structural Fires.** Structural fires can be extremely dangerous and again, the need for safety is of utmost importance. Generally, non-FES personnel should not enter or remain in a burning building to fight a fire. However, if fire is discovered in the early stages of development and can be safely engaged, use available fire extinguishers, water hoses, or other appropriate extinguishing methods to put out the fire. The lack of protective clothing and breathing apparatus make it doubly important for auxiliary fire fighting personnel to adhere to safety precautions and work in pairs when performing fire fighting operations. If the fire cannot be safely extinguished or contained, promptly evacuate the structure. When fighting a structural fire, auxiliary fire fighting teams should:

4.3.3.1. Always be aware of the location and operation of fire extinguishers

4.3.3.2. Fight small fires within the limitations of extinguishers and personal training

4.3.3.3. Always operate using the buddy system, work in teams

4.3.3.4. Maintain fire escape route to your back and NEVER allow fire to get between you and your way out

4.3.3.5. Evacuate immediately if fire goes beyond the emerging stage or is out of control and try to contain the fire to the building from the outside or limit the spread of fire to adjacent structures

4.3.4. When using a fire extinguisher or water hose in a direct attack on a structural fire, the most effective method is to direct a penetrating stream at the base of the fire. Always be watchful for potential hazards such as:

4.3.4.1. Falling debris or possible structure collapse

4.3.4.2. Fire moving in behind, below, or above your position

4.3.4.3. Kinks in or obstructions to the hoseline (if using standpipe or small hose systems)

4.3.4.4. Holes or trip hazards

4.3.4.5. Hazardous materials or highly flammable gases or liquids in the area

4.3.4.6. Electrical hazards

4.3.5. If the fire cannot be engaged with a direct approach inside the structure, auxiliary fire fighting personnel with proper training can utilize hose streams from the exterior in an indirect attack; such as through a window or door if possible, to help control the spread of fire. Be mindful of the hazards discussed above.

4.3.6. When attacking the fire from the exterior using the indirect approach, if the hose nozzle settings can be adjusted, use a range between penetrating and a moderate angle fog and direct the water stream at the gases at ceiling level, rather than the base of the fire. In addition, the water should be swept back and forth to ensure good coverage. Once the fire is under control, the hoseline can be advanced to extinguish any remaining hot spots with the direct attack approach discussed previously.

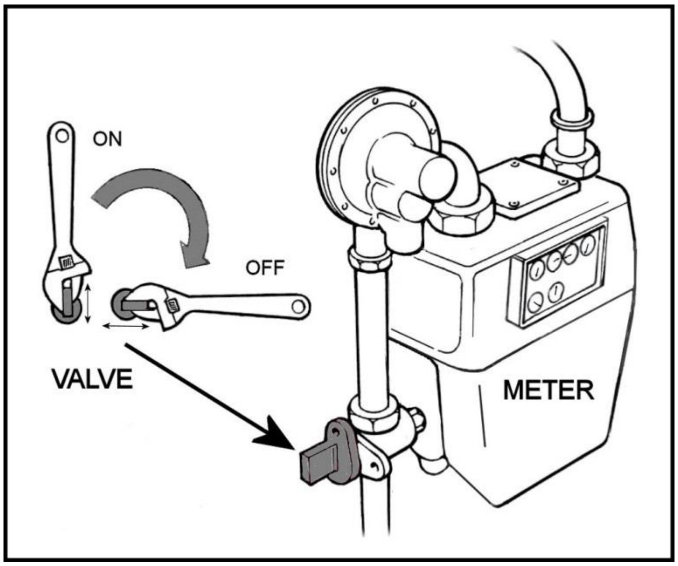
4.3.7. **Vehicle Fires.** Generally, auxiliary fire fighting for vehicle fires would be limited to small trucks and passenger-type vehicles rather than large equipment such as tank trucks or tractor trailers. In a small vehicle fire, a fuel ignition can usually be extinguished easily by using a portable fire extinguisher. If a water hose is available, burning fuel leaking from the vehicle should be flushed clear of the area with water and then extinguished with a portable extinguisher or sand. If a ruptured fuel tank is burning, use a steady stream of water to put out the fire and keep the fuel tank cool to avoid further combustion. Once the fuel portion of the fire is out, the remaining flames can be handled as a structural fire. If, in addition to the fire, occupants are trapped inside, try to protect trapped passengers from the flames using water spray until they can be rescued by firefighters having the appropriate tools and equipment.

4.3.8. **Fires Involving Utilities.** Utilities should only be shut off when it is necessary and safe to do so. For obvious safety purposes, auxiliary fire fighting teams must be able to cut off the utility supply (electricity and gas) to a facility. They must know the location and shutoff procedures for main switches and circuit breakers and safely remove fuses. They must also know how to locate and close gas shutoff valves using the proper tool.

4.3.8.1. Electrical Fires. In a structural fire, from a safety standpoint, power should normally remain on as long as possible to provide lighting and ventilation for fire fighting and rescue operations. However, when the building becomes damaged to the point that electrical hazards exist, the power should be immediately shut off by throwing the main switch or disconnecting a fuse at the main service box. Fires in electrical equipment can be handled with relative ease once they are de-energized. As mentioned earlier, once the power has been eliminated, electrical fires are usually treated in the same fashion as a structural fire.

4.3.8.2. Gas Utilities. Facilities with gas utilities should have the gas turned off as soon as possible. The meter and cutoff valve are usually located outside the building. The flow of gas into the building may be stopped by turning the cutoff valve to the closed position, which will be at a right angle to the pipe, as shown in **Figure 4.2**. Gas fires should not be extinguished until gas flow can be shut off.

Figure 4.2. Typical Gas Shutoff Valve



4.3.9. **Fires at Austere Beddown Locations.** The basic principles of fire fighting used for modern, built-up installations also apply to austere beddown locations. However, the type of construction and primitive living conditions of a bare base environment make the possibility of fire more pronounced. Most tents burn more readily than standard construction; consequently, a fire is prone to spread at an alarming speed in a tent city. An adequate water supply could also be a problem—a bare base water system may not be sufficient to support a sustained fire fighting effort. By the time an alternative water source is obtained, the entire compound could be engulfed in flames. The best course of action (COA) in a bare base fire may be to stop the fire from spreading to unaffected assets. One quick way of accomplishing this is to drop all tentage near the tent that is on fire. Another effective COA; assuming water is available, is to hose down the other tents in the area.

4.3.10. **Ground Cover Fires.** These include fires in weeds, grass, brush, and similar vegetation. Fighting ground cover fires can be very dangerous. Many firefighters have lost their lives or been seriously injured while trying to control this type of fire. As with all fire fighting efforts, auxiliary fire fighting teams must thoroughly consider the situation before engaging ground cover fires on the installation. Even in the early stages, a ground cover fire may burn rapidly. Three main factors affecting ground cover fires are the types of fuel, weather, and terrain. Attacking a ground fire is based on perimeter control. The control line can be established at the edge of the fire for a direct attack or at varying distances from the fire to form an indirect attack. Remember, regardless of the fire fighting technique used; always make personnel safety a prime concern.

4.3.10.1. Direct Attack. The direct attack is action taken directly against the flames. If a water source is available, hose lines can be used in conjunction with backpack water extinguishers to extinguish the fire. Hand tools can also be used to throw soil on the fire, to beat the fire out, and to cut down or remove fuel in the fire's potential path.

4.3.10.2. Indirect Attack. The indirect attack is taken at varying distances from the fire. This method is used when the fire is too hot, too big, or moving too fast to use a direct attack. With this approach, the idea is to stop the fire by removing fuel from its path. Accomplished this by cutting fire breaks with hand tools or heavy equipment (**Figure 4.3**). When appropriate, consider using natural fire breaks such as roads and streams. The FES should have a map of all environmentally protected areas of the installation and avoid indirect attack methods in those areas.

Figure 4.3. Engineers Using Heavy Equipment to Cut a Fire Break

4.3.11. **Fire Rescue Techniques.** Attacks on an installation can result in multiple burning and collapsed facilities, downed electrical power lines, damaged vehicles, and trapped and injured personnel; possibly leading to an urgent need for widespread rescue operations. Although FES and emergency medical services (EMS) personnel may be fully engaged in emergency operations and unable to respond to all potential emergencies simultaneously, CE auxiliary fire fighting teams must temper their response to situations by considering their training, skill, and available personal protection before attempting a rescue operation. Furthermore, they must carefully evaluate each potential rescue situation in terms of the probability of making a safe and successful rescue before attempting such an activity. Most importantly and whenever possible, leave it to the professionals because they possess the training, equipment and tools to do the job.

4.3.11.1. Burning Buildings. Probably the most hazardous duty professional firefighters perform is fire fighting and rescue operations inside a burning building. Even in a wartime environment, CE personnel performing auxiliary fire fighting should not enter a burning building to fight a fire. Before entering a burning building to attempt a rescue, auxiliary fire fighting team members must first consider their own personal safety. Under no conditions should auxiliary fire fighting teams attempt a rescue in a burning building above the ground floor. Although the basic combat helmet, body armor, M50 mask, work gloves, and boots used by most CE personnel provide a limited measure of protection, they are not effective against the heat and toxic gases produced by an intense fire. Chemical protective masks do not protect the user from oxygen deficient environments and should not be used during fire fighting operations.

4.3.11.2. Collapsed Buildings. The difficulty in rescuing people from bombed or collapsed structures depends to a large degree on where they are located. During war, the situation may be aggravated by the possible presence of UXO in the rubble. Again, unnecessary chances should not be taken. The situation may dictate that rescue efforts be limited to helping only those victims that are readily accessible or slightly trapped.

4.3.11.3. Electrical Contact. When rescuing a victim who is touching electrically energized wires or equipment, always take precaution to protect yourself and others. It is essential that all electrical wires and conductors be treated as if they are energized. If the wire is not entangled with the victim's body, a wooden pole with a hook on the end should be used to drag the victim clear of the wire. Under no circumstances should the rescuer or their clothing touch the wire or victim during the rescue operation. Sometimes it is more practical to remove the cable from the victim. This can be done by throwing one end of a rope over the line. Both ends of the rope are then tied together and the wire is carefully pulled away.

4.3.11.4. Vehicles. Vehicle rescues and extrications can be complex and demanding. Auxiliary fire fighting teams are limited in their ability to perform these tasks because they lack the FES training or power tools to execute difficult vehicle rescues or extractions. However, if FES and EMS teams are engaged in other attack response tasks and unavailable to respond, CE personnel may be able to render assistance by stabilizing the vehicle, performing basic first aid and helping injured, movable victims from vehicles. As with all rescue operations, safety during a vehicle rescue is essential. If safety is disregarded, both the victim and the rescuer may be placed in further danger. The first action in a vehicle rescue is to ensure the vehicle is stabilized before entering. If the vehicle is on its side or upside down, it should be stabilized by placing wedge boards, rocks, or other debris under the vehicle. If no material for this purpose is readily available, improvised methods can be tried such as using tire jacks and ropes, or opening the trunk and hood. After the vehicle is stabilized, select the easiest way to enter the vehicle—doors are the first choice. If they are jammed, a window may have to be used. If a window must be broken, start with the rear window; provided it gives a larger opening and glass will not fall on the victim. The goal is to gain access to the victim, stabilize, and protect this individual until extrication is possible. If the victim is trapped in the vehicle by the steering wheel, seats, or dashboard, stabilize the person until professional help (EMS or FES personnel) arrives. If the victim is conscious, coherent, and not completely entangled in the vehicle, removal operations can start. First, wounds should be bandaged, fractures splinted, and the body immobilized to reduce the chance of further injury. Once the victim has been properly prepared for removal, cover sharp edges in the vehicle and pad the opening through which the victim will be moved with blankets or similar materials. When removing the victim, travel as smoothly as possible and try to avoid any jerking or sudden movements.

4.4. Search and Rescue (SAR) Concepts. SAR operations are a crucial function during contingencies. Whether the emergency is the result of a major aircraft accident, a natural disaster, or an enemy attack, there may be scores of injured personnel who must be located, treated, and evacuated (**Figure 4.4**). SAR missions must be carried out promptly by trained personnel with the proper equipment, or it is highly probable that casualties will increase dramatically. In the aftermath of a major disaster or attack, FES personnel are ready to perform SAR. If called upon, augmenting CE forces should also be ready to assist with SAR activities. The following paragraphs address potential CE involvement in SAR operations.

Figure 4.4. SAR Team Removes Wounded Victim from Rubble

4.4.1. **CE Involvement in SAR.** CE personnel may be involved in SAR operations in several ways. Depending on the type and extent of the emergency, CE SAR support may range from minimal to very extensive. Firefighters and rescue personnel would undoubtedly be very involved in the rescue of survivors from an aircraft crash or other major accident on the base, but would provide little, if any, SAR support for a group of campers lost in a nearby forest. The rescue of the campers would probably be handled by a local agency and civil engineers would provide support only if requested and authorized. The following areas outline possible CE responses to SAR requirements.

4.4.1.1. FES. Highly trained FES personnel are the most qualified to conduct SAR operations. Not only do most of them have advanced life saving training and the skills and equipment to rescue persons trapped because of a disaster, but also they will always be the first to respond to a major aircraft accident on the air base. Once at the scene, they use their resources to control fires and extract survivors from the aircraft.

4.4.1.2. Augmentees. In a demanding attack recovery environment, the installation can be faced with numerous fires, extensive damage, and injured personnel requiring emergency rescue and medical care. Getting to fires and rescue locations may be complicated by the presence of UXOs, craters, pavement damage, and scattered debris caused by bombs and other ordnance. Fire fighting and rescue is accomplished with fixed numbers of professional firefighters, equipment, and materials. Attrition can be expected to steadily decrease the availability of professional firefighters, fire vehicles, and rescue capabilities. In such a challenging scenario as this, the FES flight may not have the resources to simultaneously respond to and extinguish all fires; respond to all rescue situations, and support all aircraft incidents. Commanders decide which fire to fight, which fires to let burn, which people to rescue and which people to leave to buddy care. These and other decisions will affect the launch and recovery of aircraft, the response to returning battle-damaged aircraft, and the operation of both fixed and mobile aircraft arresting systems. Augmentees may be needed to perform SAR operations that professional firefighters and emergency medical responders are unable to attend. Therefore, CE personnel, along with other combat support forces, must possess the basic knowledge and skills to help save lives and mitigate human suffering. These skills include self-aid and buddy care or combat lifesaver skills (**Figure 4.5**). The severity of the emergency will dictate the number of persons needed to perform SAR duties, but efforts should be made to select individuals with some of the following qualifications:

4.4.1.2.1. Good physical condition. The physical demands of SAR operations are likely high

4.4.1.2.2. First aid training (survivors may need first aid to prevent serious complications)

4.4.1.2.3. Advanced emergency medical care

4.4.1.2.4. Specialized rescue equipment experience

4.4.1.2.5. Familiarity with the geography of the SAR area

4.4.1.2.6. Knowledge of area search methods and survivor extrication procedures

Figure 4.5. SAR Augmentees Should Possess Basic Lifesaving Skills

4.4.2. **Site Access Support.** CE heavy equipment operators' skills can be invaluable in clearing access to the site of a major disaster. When rescue vehicles are unable to reach and remove the survivors of an aircraft crash in a heavily wooded area, CE earth moving equipment can clear a road or create a path to the crash site. Following an earthquake, an engineer crane could be used to remove the fallen beams of a collapsed building, allowing rescuers to reach survivors trapped beneath the rubble.

4.4.3. **Rescue Equipment.** The type of equipment employed by a SAR team will depend on the type of emergency and the location of the rescue effort. Medical equipment and supplies are normally carried in fire rescue vehicles or ambulances to aid the injured during an on-base disaster and to an aircraft accident in a remote region. If an off-base area precludes vehicular travel, medical supplies may be carried in by SAR personnel or delivered by air. A team going into a wilderness area would also require navigational aids, food, water, portable shelters, and other items to operate in an inhospitable environment. The following general categories of equipment should be considered when equipping SAR teams for missions:

4.4.3.1. Communications. Portable hand-held or backpack-type transceivers should be used for radio communications between team members, the staging installation (when established), and SAR aircraft, if used.

4.4.3.2. Navigation Equipment. Detailed maps of the search area showing all terrain features, landmarks, and water sources are a necessity. A global positioning system, reliable compasses or other direction-finding equipment are required for rescue operations in remote areas.

4.4.3.3. Operational Equipment. Select equipment appropriate for the type of SAR operation the team is expected to perform. A SAR operation centered on an area of demolished structures on the installation requires crowbars, shovels, rope, and similar items to assist in freeing people entrapped in the debris. Conversely, if the operation's goal is to reach a downed aircraft in a snow-covered mountain area, snowshoes, mountaineering equipment, and portable litters should be among the team's equipment.

4.4.3.4. Food and Water. Food and water will only be carried by teams operating in off-base remote areas. Teams should carry adequate quantities to sustain an operation lasting 48 to 72 hours. If the mission goes beyond these limits, the team should be resupplied.

4.4.3.5. Photographic Equipment. A simple, reliable camera is needed for missions involving aircraft crashes. Photographic evidence of aircraft wreckage, instrument panels, aircraft controls, and terrain disfigurations is useful for accident analysis. On-base disasters requiring photography should be provided by installation photographers.

4.4.3.6. Loud Hailer (Bullhorn or Portable Loudspeaker). This item is used for coordinating team actions at the rescue scene.

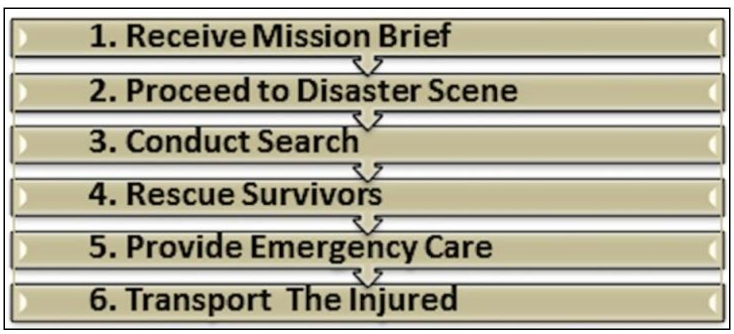
4.4.3.7. Survivor Extraction Equipment. Metal cutters, ax, knife, body splint, litter, pry bar, and a hydraulic rescue kit are typical items used by FES for situations involving extraction of survivors from downed aircraft.

4.4.4. **SAR Operations.** SAR operations can be limited in scope, involving small search parties that cover the area on foot, or a massive effort covering thousands of square miles of land or sea, and involving ships, aircraft, and personnel of other services and governmental agencies. Engineer SAR operations will generally be limited to installation disaster response and, when required, operations support in the local community.

4.4.4.1. Installation SAR. Probably the most common SAR operation on the installation involves a major aircraft accident. In such a situation, firefighters/rescue personnel are responsible for containing any resulting fire and promptly removing survivors from the wreckage. A systematic search of the surrounding area may also be required to locate persons thrown from the wreckage by the impact. In most aircraft accidents on an installation, the crash site will be defined and team efforts will concentrate on the immediate rescue of personnel rather than search of the surrounding area. Other installation SAR operations result from earthquake, flood, hurricane, or enemy attack. Under these conditions, several search teams should be assigned to search the installation for survivors. Searches of this type require precise coordination and require all teams be thoroughly briefed on designated search areas, techniques, rescue procedures, communications protocol, reporting requirements, and availability of medical support for survivors. The SAR operation should ensure the entire disaster area is covered with no duplication of effort, which could result in delays in reaching survivors.

4.4.4.2. Off-Installation SAR. CE involvement in off-installation SAR efforts will probably be limited to heavy equipment support for access to a disaster site and augmentation of search teams. CE resources should not participate in off-installation operations if there is a high probability they will be needed for installation recovery or rescue operations. Regardless of the location, basic SAR operations generally follow the sequence shown in **Figure 4.6**.

Figure 4.6. SAR Sequence of Operations



4.4.4.3. SAR Debriefing. The debriefing should occur as soon as the SAR team returns from the search area to determine if the team has information affecting the outcome of the SAR mission. This is particularly important for teams assigned to a mission still in progress. In addition to providing first-hand information about the results of the SAR mission, the debriefing can supply knowledge of support requirements to other SAR teams and suggestions for improvements to the ongoing effort.

4.5. Summary. The likelihood the FES flight will be engaged in higher priority tasks immediately following an attack on the installation or other major incident is real; for that reason, other CE forces should be prepared to respond to smaller fires affecting important CE resources with the intent of stopping such fires in their early stages of development. CE forces should also be capable of performing limited personnel rescue and first aid activities. However, personal safety must be a primary consideration before performing any of these tasks. Personnel performing auxiliary fire fighting duties must not exceed their capability or training and supervisors should be aware of the personnel skills and equipment required for engaging small fires and the SAR effort.

Chapter 5

EXPLOSIVE ORDNANCE RECONNAISSANCE (EOR)

5.1. Introduction. Undoubtedly, UXOs are a consequence of warfare and they can be a dangerous threat to mobility, personnel, equipment, and facilities. During an installation attack, the enemy could use a combination of munitions; some that detonate on impact, others with delay-fuzes, and possibly anti-personnel/material devices. The enemy's use of these methods could drastically hinder aircraft launch and recovery efforts by blocking rapid access of surviving aircraft to usable aircraft pavements, impeding the movement of recovery crews to their equipment and materials, interfering with the response of repair and rescue crews to damage sites, and instilling fear and hesitation into all installation personnel due to the inherent danger of random or inadvertent munitions detonations. Under these situations, rapid and accurate EOR becomes critical so EOD personnel can prioritize their efforts and determine areas of the installation that may be relatively safe to traverse. Since CE recovery tasks require access to virtually all areas of the installation, our forces must be capable of identifying, reporting, and marking UXOs properly so we can quickly make our way to the job site and ensure our EOD personnel respond to the highest priority needs first.

5.2. Overview. Primarily, this chapter is relevant to non-EOD personnel and relates to their actions with respect to EOR. Mostly, it addresses common types of UXO they may encounter and their role in EOR. To a lesser extent, this chapter addresses engineer support provided to EOD teams performing UXO clearance operations. Reducing or clearing UXO threats, including IEDs, is an EOD responsibility. It is critical that ONLY EOD personnel conduct clearance of UXO threats (**Figure 5.1**). Non-EOD personnel and PAR team members should be trained to identify, mark, and report UXO threats using procedures outlined in paragraph 5.5.6 and Table 5.2. The EOD flight is responsible for providing area of responsibility-specific EOR training to base personnel to supplement AF EOR web-based training, when required. For specific EOR information and requirements, refer to Air Force Tactics, Techniques and Procedures (AFTTP) 3-2.12, *Multi-Service Tactics, Techniques, and Procedures for Unexploded Ordnance*.

Figure 5.1. Only EOD Personnel Render-Safe or Destroy UXOs

5.2.1. During certain emergency conditions, UXOs can be a significant issue limiting the progress of base recovery operations. Explosive ordnance problems will primarily affect overseas theater air bases, but cannot be ignored by the CONUS bases since terrorist attacks or munitions accidents could place them in a similar predicament. The major steps in any operation involving potential hazards from UXO are EOR, explosive ordnance safing, and explosive ordnance removal/destruction.

5.2.2. Non-EOD personnel are not directly involved in UXO render safe operations, but they should be prepared to assist EOD personnel in other aspects of these operations when required. Additionally, during recovery operations, EOD teams may need to be augmented by engineer forces trained as EOD augmentees. The two primary tasks for EOD augmentees in operations involving explosive ordnance are assisting EOD personnel in UXO reconnaissance and aiding in the removal of UXO that have been rendered safe and designated for removal.

5.3. Types of Explosive Ordnance. Weapons manufacturers are constantly making numerous types of explosive ordnance in all shapes, sizes, and lethality. Knowing the type of munitions that could be encountered during EOR is essential to individual safety and accurate reporting of UXOs. According to AFTTP 3-2.12, explosive ordnance is generally grouped into four main types: dropped, projected, thrown, and placed.

5.3.1. **Dropped Ordnance.** Regardless of its type or purpose, dropped ordnance is dispensed from an aircraft. There are three subgroups of dropped ordnance: bombs, dispensers, and submunitions (mines, bomblets, and grenades). Consider all bombs and submunitions to have magnetic/seismic or anti-disturbance fuzing. Simply stated, this means approaching them could detonate the ordnance.

5.3.2. **Projected Ordnance.** Projected ordnance is fired from some type of launcher or gun tube. It can be projectiles, mortars, rockets, rifle grenades, or guided missiles. Projectile bodies can be one piece of metal or multiple sections fastened together.

5.3.3. **Thrown Ordnance.** Commonly known as hand grenades, classification of thrown ordnance is by use as follows: fragmentation (also called defensive), antitank, smoke, and illumination. Moving, jarring, or otherwise disturbing this ordnance may cause it to explode. Never pick up or disturb a hand grenade, even if the spoon and safety pin are still attached. Consider all grenades to have anti-disturbance or anti-removal devices.

5.3.4. **Placed Ordnance.** Placed ordnance is commonly referred to as land mines. Land mines are hidden, buried, or placed on the surface, and often cannot be seen. Visual detection of land mines is often difficult. Consider all mines to have anti-disturbance or anti-removal devices. Mines equipped with magnetic or seismic influence fuzes may detonate when disturbed. Conduct all observation of this ordnance with binoculars at the greatest distance that still allows gathering of required information. Placed land mines can destroy vehicles and inflict casualties on personnel who step on or drive across them. There are three basic types of land mines: antitank, antipersonnel, and chemical.

5.4. Classes of Explosive Ordnance. Explosive ordnance may be defined as bombs and warheads; guided and ballistic missiles; artillery, mortar, and rocket ammunition; anti-personnel/material and land mines; demolition charges; pyrotechnics; grenades; torpedoes and depth charges; and all similar or related items or components, explosive in nature, designed to cause damage to personnel or material. Excluding IEDs, **Figure 5.2** through **Figure 5.6** depicts the class, shape, and size of various types of explosive ordnance from Air Force Visual Aid (AFVA) 32-4022, *USAF Unexploded Ordnance (UXO) Recognition and Reporting Chart*. Each class of explosive ordnance could be encountered on an installation after an attack.

Figure 5.2. Class A (Bombs and Dispensers) and Class B (Rockets and Missiles) UXOs

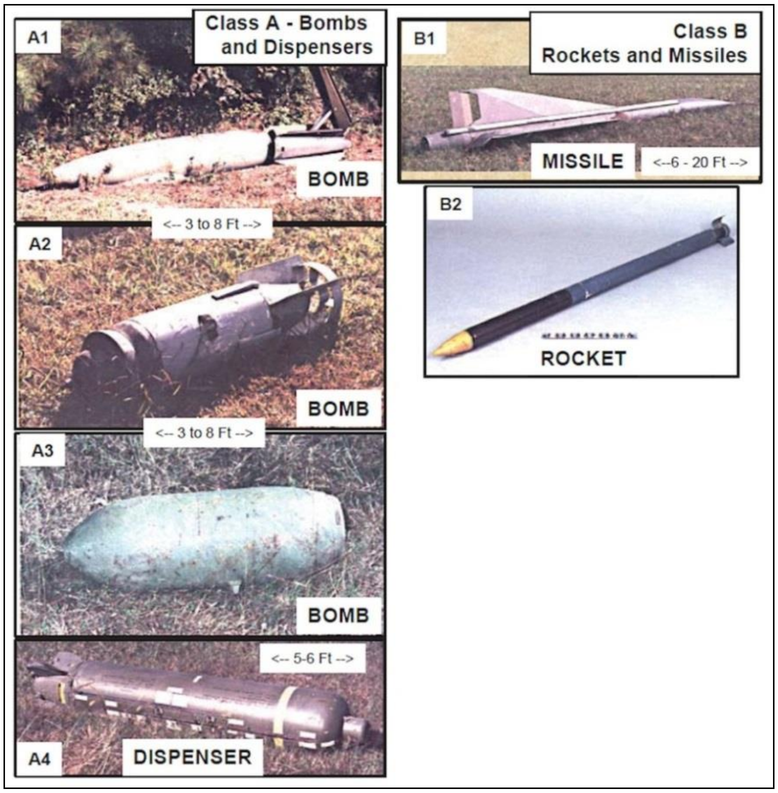


Figure 5.3. Class C UXOs (Projectiles and Mortars)

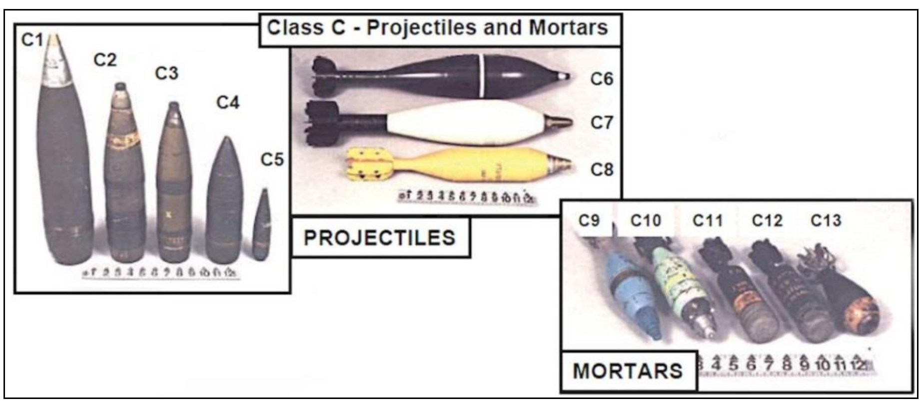


Figure 5.4. Class D UXOs (Land Mines)

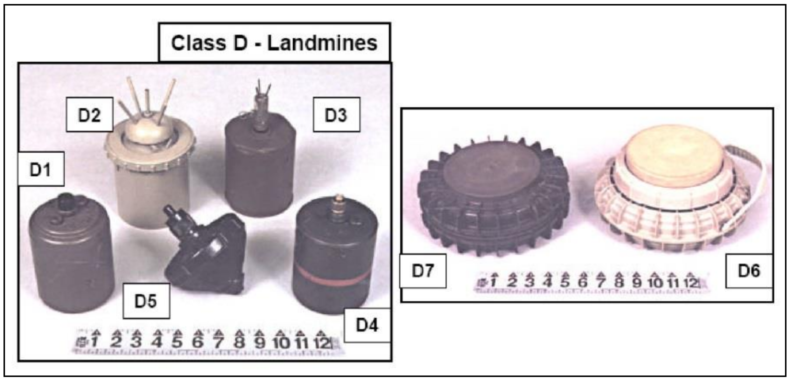


Figure 5.5. Class E UXOs (Bomblets)

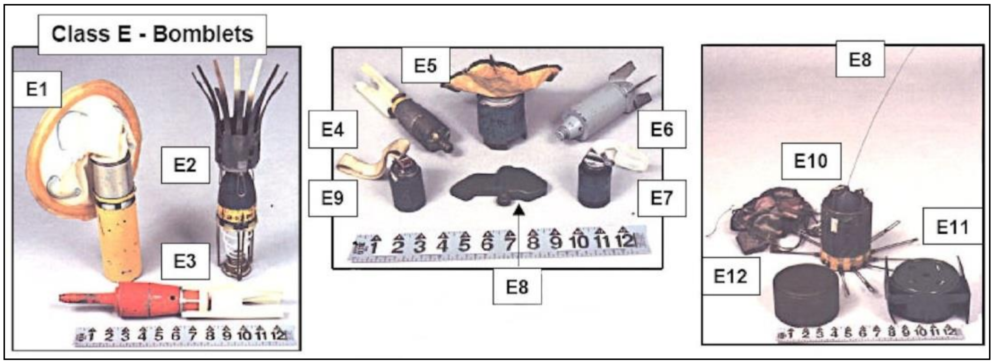
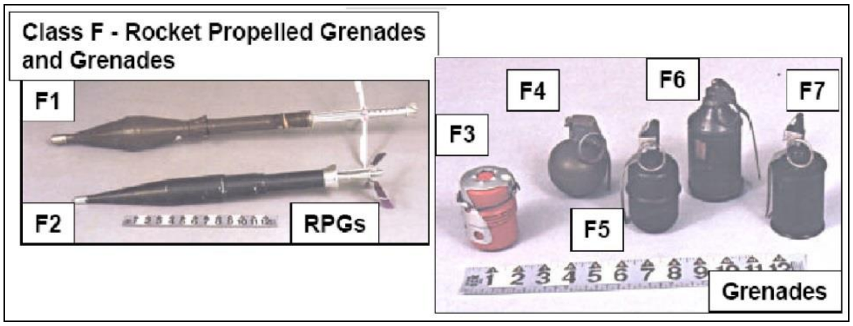


Figure 5.6. Class F UXOs (Rocket-Propelled Grenades and Grenades)



5.5. EOR. The accomplishment of EOR activities is vital to installation recovery. AFI 32-3001 defines EOR as the investigation, detection, location, marking, initial identification, and reporting of suspected UXO, by EOR-trained personnel, in order to determine the need for further action. The initial step in dealing with UXOs is reconnaissance. Although unit PAR teams and other installation crews perform EOR, CE personnel are usually in a unique position to do much of the EOR effort after an enemy attack because engineer damage assessment and emergency repair teams are often the first on the scene after an attack. During the initial damage assessment of the installation, engineer teams can provide first-hand information on the presence of UXOs.

5.5.1. **Difficulties and Complications.** EOR can expose engineer forces to very hazardous situations. Add the potential presence of a CBRN environment and the EOR task becomes more difficult. In addition to the obvious hazards and complexities involved with EOR, CE leadership should expect some confusion from the misidentification of UXOs by personnel with limited ordnance recognition experience. It should also be expected that different crews or people would likely report the same item of ordnance multiple times. Locating and identifying buried or hidden ordnance may also be a problem. Supervisors should anticipate and make allowances for these and other difficulties and be prepared to adjust accordingly.

5.5.2. **Personal Protection.** Personnel performing EOR duties on foot (dismounted) should wear protective body armor if available. If performing mounted EOR operations, armored vehicles can reduce the risk from some, but not all UXO threats. Personnel performing EOR operations in non-armored vehicles face nearly the same risk from UXOs as dismounted personnel because the protection afforded by non-armored vehicles is negligible. Commonly used armored vehicles include the Up-Armored High Mobility Multipurpose Wheeled Vehicle (aka HUMVEE), and the Mine-Resistant, Ambush-Protected (MRAP) vehicle (**Figure 5.7**). Although conventional vehicles are sometimes modified with protective armor, they likely do not afford the upgraded protection of purpose-built armored vehicles such as the MRAP.

Figure 5.7. MRAP Armored Vehicle

5.5.3. **Basic Safety Precautions.** Safe operations are especially important during EOR operations. Careless actions near a UXO can result in death or injury of personnel as well as serious damage to adjacent equipment and facilities. Personnel performing EOR must be aware of the dangers involved and never touch or tamper with any UXO not rendered safe by EOD personnel. Basic safety practices when performing EOR include:

5.5.3.1. Maintain Safe Distance. Personnel performing EOR should observe (with binoculars if necessary) potential UXOs from the safest distance that still allows the gathering of required reporting information. Be sure to keep adequate frontal and overhead protection. If an item is discovered that is believed to be a UXO, additional reconnaissance for the sole purpose of a complete report is not performed until EOD has arrived.

5.5.3.2. Disturbances. Do not touch or disturb the UXO or associated components, including loose wires or parachutes. Disturbances, either mechanical or otherwise, may cause the item to detonate.

5.5.3.3. Chemical/Biological Hazards. Assume the presence of chemical agents when there is the presence of liquid droplets, dead animals, dissolved paint, or peculiar odors. Put on protective equipment immediately.

5.5.3.4. Radio Transmit Hazard. If reporting by radio or cellular phone, transmit from a minimum safe distance for handheld or vehicle radios according to AFMAN 91-201; otherwise the signals may cause some UXOs to detonate. Generally, the distances are 10 feet for cellular phones, 25 feet for handheld radios, and 100 feet for vehicle radios.

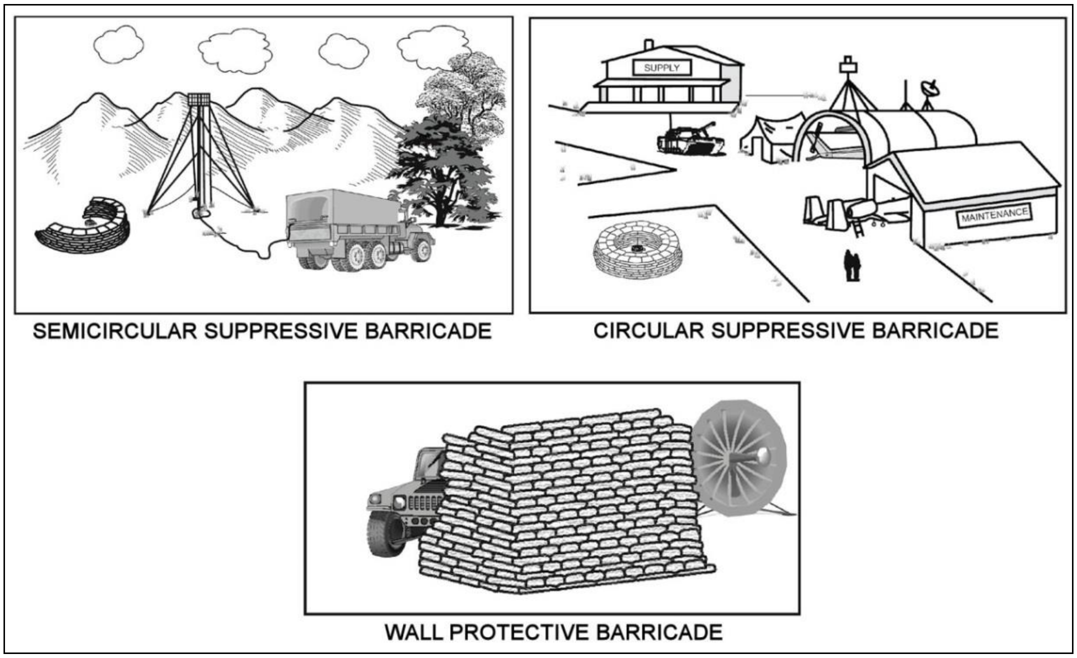
5.5.4. **Protective Measures near UXO Threats**. When operating in an environment with UXO threats, employ protective measures to help ensure the safety of personnel and critical equipment. There are three basic methods to protect personnel and equipment when UXO threats are discovered; evacuate, isolate, or barricade.

5.5.4.1. Evacuate. Upon identification of UXO, a decision must be made to either shelter in place or evacuate/retreat to a safe distance. PAR teams must be trained to recognize when it is appropriate to evacuate or shelter in place. If the decision is made to evacuate, the safe stand-off distance will depend upon the size of the UXO and the type of structures in the area. Small UXO/sub-munitions may not require total evacuation, only to a safe area of the facility. Refer to AFTTP 3-2.12 for recommended evacuation distances. After evacuating all personnel and equipment, movement within the area should only be allowed for mission essential operations.

5.5.4.2. Isolate. Sometimes, for mission-related, operational, or other reasons, personnel and/or equipment cannot be evacuated or leave a particular area. When this happens, it may be necessary to isolate either your assets (personnel, equipment, and operations) from the UXO or isolate the UXO from your assets by establishing safe areas and limiting exposure within the threat area.

5.5.4.3. Barricade. Personnel and equipment that cannot be moved can sometimes be protected with barricades. A barricade is an artificial barrier that provides limited protection by channeling the blast and fragmentation away from the threatened area. Barricades are usually constructed using a circular, semicircular, or wall design (**Figure 5.8**). The type of design used depends on the UXO threat and area needing protection. Suppressive barricades are constructed to isolate an explosion, to deflect the thermal/shock wave, and absorb low-angle, high-speed fragments. Protective barricades are constructed around exposed resources to shelter from overpressure and impact of high-angle, low-speed fragments, which can escape over the top of suppressive barricades. Sometimes, local terrain features can form natural barricades providing adequate frontal and overhead protection. If natural barricades are judged inadequate, construct artificial barriers according to AFTTP 3-2.12. Constructing barricades can be very time-consuming and may require soil-filled containers, earth-moving equipment, or a large number of sandbags. If earth-moving equipment is available, consider building earth barriers in place of sandbag barricades. While building barricades, personnel should not disturb the UXO and should wear all protective equipment (to include Kevlar helmets and vests). Depending on the size of the UXO, build suppressive barricades around the UXO to protect the entire area, or build protective barricades next to non-evacuated personnel or equipment to shelter from overpressure and impact of high-angle, low-speed fragments of exploding ordnance. Priority should be given to evacuation of resources and building protective barricading.

Figure 5.8. Barricade Examples



5.5.5. **EOR Equipment.** The equipment used by personnel performing EOR depends on the severity of the attack and the availability of materials. Although not all-inclusive, **Table 5.1** lists typical equipment and supplies for personnel performing EOR tasks:

Table 5.1. Typical EOR Equipment

EOR Equipment	
Base grid map (or geospatial site-mapping information and services)	AFVA 32-4022
UXO Marking Kit/threat markers	AFTTP 3-2.12
Radios w/extra battery	Flashlight w/extra battery
Binoculars	Surveyor's Tape/Marking Tape
Body armor (dismounted)	First Aid Kit
Armored vehicle (mounted)	Admin supplies (pencils, markers, clipboard, etc.)
IPE	Backpack or Carrying case
Chemical Agent Detection/Decon Equipment	Sandbags

5.5.6. **UXO Recognition and Reporting.** The recognition of a UXO threat is the initial and most important step in reacting to a UXO threat. United States (US) personnel have been casualties of UXOs in virtually every conflict or contingency in which the US has participated. This can be attributed primarily to unfamiliarity with UXO countermeasures and avoidance procedures. Personnel operating in a contingency environment should be able to recognize and react safely to UXO threats. The hallmark of good EOR is proper identification, marking, and reporting of suspected UXO, which is accomplished by following five basic actions: Confirm, Clear, Cordon, Check, and Control (**Table 5.2**). These basic actions are referred to as the “5-C’s.”

Table 5.2. Recognition and Reporting Steps

CONFIRM, CLEAR, CORDON, CHECK, and CONTROL	
Confirm	The presence of UXO from a safe distance
	Behind cover using spotting equipment (binoculars and scopes)
	Identify the UXO features: size, shape, color, and condition
	Report the UXO to your UCC
Clear	Clear personnel to a safe position and distance
	If evacuation is impossible, isolate or barricade the area to restrict access
	Leave the area the same way you entered
Cordon	Cordon off the area around the UXO
	Prevent unauthorized personnel from entering the site
	Use standard UXO or mine markers or other available materials to mark the UXO
	Ensure markers are visible in all directions and at night
Check	Check the immediate area for other UXO;s
Control	Control the area surrounding the UXO
	Only emergency services (medical, fire fighting, or EOD) should be allowed to enter the cordon area

5.5.6.1. Confirm. Proper identification of UXOs assists EOD in understanding the threat in order to provide commanders with the best COA to mitigate the threat. Determine and confirm class, shape, and size of explosive ordnance using the UXO identifications addressed in **paragraph 5.4**. Following an enemy attack, UXO can potentially be at any location on the installation. However, if UXO exists, it may be concentrated in those areas of the installation heaviest hit by attacking forces. The general search area for UXOs and the possible type of UXO in the area can be determined from the effects of the munitions that did explode. The extent of damage to the area or facility can give personnel performing EOR an indication of the size and type of munitions used and provide valuable clues regarding the identification of UXO. Once all the information regarding the UXO is obtained report the information to your UCC. Timely and accurate UXO reporting is crucial to installation recovery after an attack. CE personnel performing EOR should report UXOs to the UCC or EOC by the fastest means available, using the EOD 9-Line Report provided in **Table 5.3**. The following additional factors may provide clues to the possible types of UXOs present and the potential damage or injury that could occur if the ordnance detonated.

Table 5.3. EOD 9-Line Report

EOD 9-Line Report Sample		
Line	**Description**	**Example**
Line 1.	**Date-time Group (DTG)**: DTG telling when the item was discovered.	131200LAUG10 (13 Aug 15, 1200 hours local)
Line 2.	**Reporting Activity**: Unit identification code and location (8-digit grid of explosive threat).	366th Medical Squadron
Line 3.	**Contact Information**: Radio frequency, call sign, point of contact, and telephone number, email/chat.	A1C Hood, 283-5215, Radio Frequency 5 call sign "Broken Foot".
Line 4.	**Type of Explosive Threat**: 1. Method of emplacement: Dropped, projected, thrown, placed, or unknown or possible improvised explosive device (IED). (Use AFVA 32-4022, UXO Identification Chart) If possible, provide the total number of items. 2. Description: Without touching, disturbing, or approaching the item, include details about its size, shape, color, and condition (e.g., intact or leaking). 3. Method of Discovery	Three Possible Dropped Bombs Cat A, Green color, larger than a cooler and seems to be intact. The item was discovered by the facility recon team during patrol after an attack.
Line 5.	**CBRN Contamination**: Be as specific as possible (include visible and physiological effects).	NO
Line 6.	**Resources Threatened**: Report any threatened units, equipment, facilities, or other assets.	Item is located 15 feet from main entrance of the hospital.
Line 7.	**Impact on Mission**: Provide a short description of your current tactical situation and how the presence of the explosive threat affects your status.	Vehicle traffic to air emergency room halted.
Line 8.	**Protective Measures**: Describe any measures taken to protect personnel and equipment.	Area cordoned by 500' and personnel in hospital moved to left wing away from front entrance.
Line 9.	**Recommended Priority**: Recommend a priority for response by EOD technicians.	Immediate.

5.5.6.1.1. Blast Effects. The visible blast effects from ordnance that exploded in the area can be a relatively accurate prediction of damage that could occur to adjacent facilities if accidental detonation of the UXO occurred.

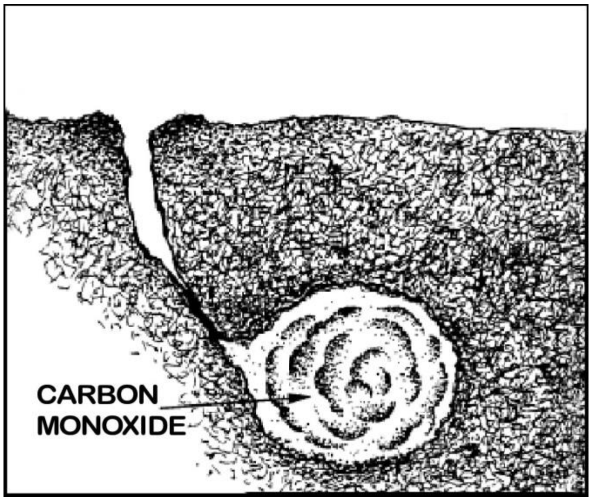
5.5.6.1.2. Fragmentation. An examination of fragments in a destruction zone should indicate the type UXO that may be present. The presence of fragments from clustertype bombs should alert the team to smaller explosive devices, which may have been widely scattered from the initial point of impact.

5.5.6.1.3. Incendiary. Incendiary ordnance can be especially destructive because it feeds fires and compounds initial damage. Evidence of incendiary ordnance should be included in the EOR report to the EOC so FES support can be positioned to contain the flames if incendiary UXO detonates.

5.5.6.1.4. Craters. The size of bomb craters is a good indication of the size ordnance involved and is an indication of the radius of damage to be expected if UXO of the same type detonates.

5.5.6.1.5. Camouflets. The camouflet is the result of an underground burst of a bomb (**Figure 5.9**). In areas where camouflets are numerous, personnel performing EOR should be especially observant for evidence of buried UXO. Camouflets can collapse and are full of poisonous gases, void of oxygen.

Figure 5.9. Deep Burst (Camouflet)

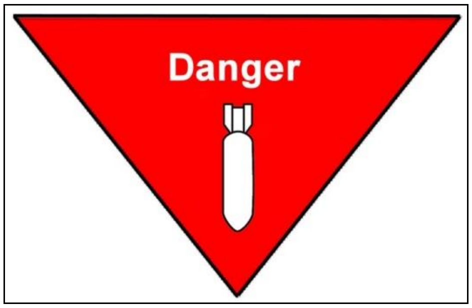


5.5.6.1.6. Buried UXO. Aircraft-delivered ordnance, which does not explode, is likely to be completely or partially buried due to its impact force with the surface. Personnel conducting EOR must be familiar with the visible evidence of buried UXO as well as the methods for locating and identifying the ordnance. The most common evidence of buried UXO is the entry hole. An entry hole, crater, or related damage is a good indication that buried UXO may be present. The specific location of buried UXOs can be determined by the use of mine or metal detectors by qualified EOD technicians.

5.5.6.2. Clear: To ensure the safety of all essential and nonessential personnel in the immediate area, it is important the area surrounding the UXO(s) be cleared of all personnel. Refer to AFTTP 3.2-12 for guidance on the proper safe separation distance (SSD) based upon the type and size of the UXO. If evacuation is impossible, isolate or barricade the UXO and any surrounding facilities if necessary. Follow steps provided in paragraph 5.5.4.2 and 5.5.4.3 above. Always remember to leave the area the same way you entered.

5.5.6.3. Cordon. Cordon off the area surrounding the UXO with some type of physical material such as rope or bright yellow "UXO Marking Tape." It is recommended that a light source such as a cyalume glow stick be used so the UXO is visible during the night. It is important that unauthorized personnel be kept away from the UXO. All UXO discovered by personnel conducting EOR should be clearly marked as hazardous areas. Use the standard UXO marker identified in **Figure 5.10**, or other materials as improvised UXO markers. This marking serves two purposes. First, it identifies the location of the UXO to the EOD team entering the area to disarm the UXO. Ensure the markers are visible in all approach directions, at day or night. Second, the marking warns other persons of the location of the UXO so that it may be avoided. Reduce the risk of unintentional entry into the threat area by evacuating and controlling the area as addressed in **paragraph 5.5.4**.

Figure 5.10. Standard UXO Marker



5.5.6.4. Check. Ensure you check the immediate and surrounding area for other UXO. Some UXO may be laying on the surface or buried in the ground. Visible and obvious holes or disturbed earth may indicate that a UXO did not detonate and is buried in the ground.

5.5.6.5. Control. Control the area and make certain that only emergency services personnel, such as medical, FES, and EOD are the only ones allowed to enter the cordon.

5.6. Support to EOD UXO Operations. As previously discussed, personnel should not attempt to disarm UXOs or move ordnance not rendered safe by EOD personnel. Doing so could cause additional facility destruction or fatal injury to personnel. CE support to EOD UXO operations could take the form of constructing protective berms around the danger zone during disarmament operations and providing equipment support for access to or removal of the UXO. Civil engineers might be called upon to rope off areas around UXOs, provide protective reinforcement to adjacent structures and heavy equipment to remove debris for access to the UXO, isolate major utilities in the area, or remove ordnance that has been rendered safe.

5.7. Summary. Understanding the various types of UXO that may be encountered in a wartime situation and the engineer's role in EOR is essential to installation recovery after an attack. In addition to locating and accurately identifying UXOs, those selected to perform EOR duty must also know how to properly mark and report UXOs. These activities and other support tasks allow EOD personnel to respond more quickly, permits other engineers to get their wartime taskings accomplished faster, and, perhaps most importantly, protects the lives of our personnel and other important resources.

Chapter 6

EXPEDIENT FACILITY AND UTILITY REPAIRS

6.1. General Information. Immediately following a disaster or an attack by hostile forces, CE personnel begin to repair damage and restore vital services necessary for the installation to continue its assigned mission. The primary concern will be in repairing runway and taxiway damage that prevents the launch and recovery of mission aircraft. Other repairs, such as those to restore critical installation facilities and utilities, should proceed at a rate commensurate with available resources and priorities established by the command element. It may not be feasible to delay main base repairs until all runway and taxiway repair activities are complete. For example, if ruptured POL lines pose hazards to C2 facilities, the installation population, or aircraft servicing operations, immediate response may be required to defuse the threat. A damaged or burning facility may require immediate assistance by CE forces to extract entrapped personnel. Ideally, there would be adequate personnel and materials available to do simultaneous recovery tasks. However, the more likely situation will find the BCE making some very prudent and judicious decisions to assign repair priorities to a wide range of damaged facilities and utilities whose restoration is critical to mission support.

6.2. Overview. This chapter briefly examines processes relating to emergency facility and utility repairs during contingency operations. Specifically, it addresses expedient repair processes and strategies, repair considerations, and a brief review of CONUS versus OCONUS theater repair operations. Additional expedient repair information is provided in AFPAM 10-219, Volume 7, *Expedient Methods*. ADR principles and concepts are addressed in Volume 4 of this publication series and will not be discussed here. For comprehensive expedient repair procedures, consult applicable Technical Orders (T.O.) or Technical Manuals (TM).

6.3. Expedient Repair Processes and Strategies. AF engineers have the responsibility for emergency repairs using expedient methods on USAF installations. The US Army has responsibility for major restoration and emergency repairs beyond AF organic capability. In this regard, however, US Army forces may not be immediately available; therefore, the BCE will likely plan repairs accordingly. If expedient repairs are to be accomplished in a timely manner following a catastrophe, it is important that the recovery effort be well organized and coordinated. The following is a brief examination of processes and strategies for accomplishing expedient installation repairs.

6.3.1. **Repair Processes.** Starting with the initial damage assessment, all activities are structured to reflect the existing situation. Damage assessment teams are manned with personnel having experience in the major structural- and utility-related engineering trades and are instructed on the type of information needed for repair planning and response. The UCC uses the damage assessment inputs from the assessment teams to build an installation recovery strategy. As damaged areas are identified, expedient repair efforts are organized to restore vital installation infrastructure. Repairs are concentrated on three major areas: runway ancillary equipment, crucial installation utility systems, and key installation structures.

6.3.1.1. Runway ancillary equipment includes aircraft arresting systems, airfield lighting, NAVAIDS, and supporting utilities. These systems are critical to the launch and recovery of combat aircraft and therefore receive high priority for repair efforts.

6.3.1.2. Installation utility systems include electrical, water, POL, natural gas, HVAC, sewer, and drainage. Expedient repairs to these systems generally include isolation of the systems or quick fixes such as clamps and splices, but in some cases, a new source of the utility must also be provided. Installation of mobile generators and construction of shallow wells with the accompanying water treatment equipment may be necessary.

6.3.1.3. Expedient repair of mission-critical structures is generally limited to shoring and patching activities. In some situations, demolition is required to eliminate major safety hazards.

6.3.2. **Basic Repair Strategies.** Repair work following a disaster or hostile attack will go much smoother if the following basic strategies and procedures are considered:

6.3.2.1. Parts and Materials Substitution. Under some circumstances, damaged utilities, particularly foreign systems, may be repaired more efficiently by modifying the original system and substituting other materials and equipment. For example, prime item replacement parts for foreign electrical or water systems may not be available but the system can be restored to operation by using approximate size or capacity US standard parts. The extent of damage and available local stocks of repair parts and materials are governing factors.

6.3.2.2. Repair Time. Since time is normally a limiting factor in repairs made during installation recovery, rapid completion of the job is more important than economy of labor, materials, and equipment. In making improvised repairs, any suitable material or equipment available is used to meet immediate needs. A repaired broken water main does not have to be leak-proof to be functional. Expedient repairs are improved as time and supplies permit.

6.3.2.3. Cannibalization. Systems having identical or similar components may be restored by robbing parts from some damaged units to repair others.

6.3.2.4. Local Materials and Supplies. Local materials should be used whenever possible to reserve shipping space for more essential items.

6.4. Expedient Repair Considerations. There are a number of important considerations when planning and performing expedient facility and utility repairs during contingency operations, including personnel and work safety, extent and priority of repairs, repair strategy, support lighting, and potential civilian contractor assistance.

6.4.1. **Safety.** Safety is an important consideration when accomplishing any type of repair, but it is especially important with regard to expedient repairs following an emergency. The very nature of the disaster or attack recovery environment makes repair activities inherently dangerous. Structures may be weakened; live electrical wires may be down; explosive gas vapors may be present; CBRN contamination may be present; and UXOs may litter the installation. Installation medical facilities may be crowded with casualties and CE manpower may be at critical levels. These conditions will make it essential limited resources are not further strained by injuries caused through neglect of safety practices. It is the responsibility of every member on the repair crew to perform recovery tasks with the utmost concern for safety. Personnel must be knowledgeable of technical and operator manual safety requirements before performing operations or using equipment.

6.4.1.1. Because of its lethal nature, working around energized circuits is of particular concern. Arc flash protection must be provided for all AF operations exposing personnel to energized parts greater than 50 volts. Protective clothing required, if any, shall be based on the procedures outlined in Unified Facilities Criteria (UFC) 3-560-01, *Electrical Safety*, *O&M* and AFI 32-1064, *Electrical Safe Practices*. Additionally, Arc Flash warning labels (**Figure 6.1**) must be present on switchgear, switchboards, panelboards, disconnect switches, industrial control panels, meter socket enclosures, and motor control centers IAW UFC 3-560-01.

6.4.1.2. Every repair job or operation has its own particular safety hazards and work crews must follow proper safety procedures to prevent injury or illness. In addition to wearing required PPE, workers must adhere to basic safety rules for specific CE operations and equipment IAW AFI 91-203, *Air Force Consolidated Occupational Safety Instruction*. See **Attachment 5** for a list of basic safety rules for CE operations and equipment.

Figure 6.1. Arc Flash Warning Label

6.4.2. **Extent of Repairs.** The efforts of AF civil engineers in the period immediately following an emergency should be limited to minimum emergency repair of crucial facilities and utilities. All work should be done expediently, concentrating on functional rather than cosmetic repairs. A primary consideration when determining what repairs should be made is the function of the damaged facility or utility. Those damaged activities which are not essential to the installation mission and do not present a hazard should be left as they are until time and resources permit conventional repairs.

6.4.3. **Repair Priorities.** Immediate repair priorities should be established following a disaster or hostile attack. These priorities are usually based on previously developed CRPs, as well as from reports on the extent of damage following the emergency and the immediate operational requirements facing the installation. Generally, lifesaving operations and damage repair to the runway and taxiway system (if the installation supports flying operations) should be considered as the most essential. After lifesaving operations and runway repairs, the prioritized activities listed in **Table 6.1** should be considered for repair efforts. These priorities are not "set in concrete." It would be impossible for any priority listing to be inflexible considering the variations that may occur from the CONUS to overseas theater operations and from disasters to enemy attacks. Look upon these priorities as general guidance, realizing that the actual contingency situation will dictate the commander's specific repair priorities.

Table 6.1. General Guidance for Repair Priority

Repair Priorities	
1	**NAVAIDS/Runway Lighting.** NAVAIDS and runway lighting are vital to the operation of aircraft in continuing the installation mission. CE efforts at these facilities will consist of repairs to electrical power systems, mechanical repairs, and structural repairs.
2	**C2 Facilities.** The various C2 facilities coordinate installation flying and non-flying activities and are essential for effective operations following a disaster or hostile attack. CE support will consist of structural and utility repairs as well as continued expedient maintenance to ensure that these critical facilities remain in operation.
3	**Communications Facilities.** Reliable communications are required for coordination of rescue and recovery efforts following a disaster and for the effective management of combat resources after an enemy attack. In either case, the civil engineer's function will be to provide utility and structural repairs to communications facilities and any assistance that might be required for the communications repair crews.
4	**POL/Munitions Facilities.** Adequate supplies of POL for both aircraft and ground vehicles will be required during an emergency. Repairs to these facilities will generally be performed by fuel specialists, but the CE force should be prepared to lend its expertise as required. Repair of munitions facilities will be crucial following an enemy attack to support future combat operations. If these facilities are damaged during a disaster, repairs can probably be delayed unless essential for the installation mission.
5	**Fire Station.** Following certain disasters or an enemy attack, there are likely to be conditions that will contribute to the start and spread of fires. Additionally, during any emergency, there will be requirements for the specialized rescue skills of FES personnel. Since the fire station must continue to function to manage these diverse activities, restoration of structural integrity and basic utilities will be essential.
6	**Medical Facilities.** The numerous injuries that will occur during an emergency require that medical facilities receive a high priority in contingency repairs.

6.4.4. **Support Lighting.** The damage following any major contingency is likely to dictate a requirement for portable lighting. ADR operations performed at night will require substantial lighting for the repair operations taking place on the MOS and access taxiways. Damage repair to other areas of the installation may require lighting and electrical power for hand tool operations. Performing many force beddown tasks during hours of darkness would be virtually impossible without some type of lighting. To provide lighting for these operations, three common options are available.

6.4.4.1. Temporary Lighting. Using standard electrical repair materials and a small generator such as that included in the Prime BEEF team kit, temporary lighting can be fabricated in the field to serve small area projects and needs.

6.4.4.2. Portable Floodlight Set. The ADR equipment package and WRM force beddown equipment sets include portable lighting sets, which are most adaptable to our recovery requirements. Similar units are also part of the Prime BEEF team kit. All lights are fully adjustable and operate simultaneously or individually.

6.4.4.3. Aerospace Ground Equipment (AGE) Units. At air bases, maintenance personnel will use AGE lighting units during aircraft repair and servicing operations. Borrowing such units from the maintenance complex could provide lighting support for recovery situations. This option, however, should be viewed as a fallback position since there is no guarantee that AGE units will be immediately available to engineer forces when needed.

6.4.5. **Use of Civilians.** Civilian contract assistance, if available, can be a valuable asset during installation recovery efforts. Military authorities should emphasize the extent of repair work to be done to prevent rehabilitation beyond immediate military needs. If the work is being done following a hostile attack; especially at overseas locations, civilians must be carefully selected to avoid possible sabotage.

6.5. CONUS versus OCONUS Theater Repairs. Natural and man-caused disasters can affect both CONUS and overseas theater installations causing similar damage and necessitating similar repairs. Much of the damage associated with a conventional enemy attack at an overseas theater installation could be duplicated at a CONUS location by an earthquake, tornado, or terrorist attack. The CONUS and overseas theater expedient repair techniques may differ largely due to the local environment, availability of resources, and the type of systems needing repair. The following paragraphs will highlight some typical differences between CONUS and OCONUS theater repair operations, keeping in mind that many of the basic repair techniques will be the same regardless of location.

6.5.1. **CONUS Repair Operations.** The primary advantage of conducting repair operations at a CONUS location is that the CE repair team is generally working with standard American tools, equipment, and materials. Replacement parts and materials obtained from a supplier or salvaged from damaged facilities will likely be a standard size and require less field modification to complete an expedient repair. Manpower support is also much more reliable. A core of civil service employees with years of experience and knowledge is normally available at each installation for disaster response activities. Experience has also shown that contractors working on an installation will often times readily assist in disaster response measures. Lastly, support from off-base sources, both with respect to manpower and materials, is likely to be more readily available than in certain OCONUS theater locations.

6.5.2. **OCONUS Theater Repair Operations.** Repairs at an overseas theater installation following a disaster or attack can be more complex than the same repairs at a CONUS location. Differences in parts and equipment, utility systems, supplies and material, or low levels of host nation support can all affect expedient repair capability and how quickly the installation can recover.

6.5.2.1. Differences in Equipment and Materials. Metric sizing of various components is common in overseas areas, and the repair team's tools may not be ideally suited for every piece of equipment. Building materials and other supplies obtained from local vendors may be of non-standard sizes or of different qualities than those available in the US.

6.5.2.2. Electrical systems at OCONUS theater installations are a major area requiring adjustment of repair methods. Although power systems should always be checked to determine voltages, 220 volts, 50-cycle current is common throughout the world with a few exceptions such as the US and Saudi Arabia. The differences that may exist between the CONUS and overseas theater systems should not deter theater CE personnel in their repair efforts. Even the most diverse systems or materials can be made to work together using innovative field expedient methods. For example, American-made and European-made pipe of slightly different sizes could be connected by welding, with makeshift rubber gaskets fitted to ensure a tight seal. As another illustration, damaged components of an older European heating system, requiring custom-made replacement parts, could be repaired by using field-fabricated components or parts cannibalized from a similar system.

6.5.2.3. Host Nation Support. The degree of host nation support at overseas theater locations also impacts the ability to perform emergency repair taskings. At some locations, host nation support will be plentiful, equaling the capabilities of CONUS locations. At other sites, host nation support may be essentially non-existent. Host nation support for expedient repair activities could range from provision of well-trained military units and contractors with substantial amounts of materials and equipment to supply of only the bare essentials in the way of basic construction materials and unskilled labor. The differences in host nation support capabilities make every theater installation a unique operating location in terms of expedient facility and utility repair.

6.6. Summary. As an interim measure, expedient methods will be required to repair installation damage resulting from a natural disaster or enemy attack. The ability to restore operations across the installation depends heavily on the level or extent of the damage and the repair priorities following the emergency. Expedient repairs are generally considered complete when major damage has been eliminated and most systems are capable of performing their basic functions. CE forces now turn their efforts to a more permanent upgrade of these makeshift remedies and the organization of resources for the continuing operations and maintenance required to sustain the installation mission.

Chapter 7

OPERATION AND MAINTENANCE (O&M) AND FOLLOW-ON REPAIR

7.1. General Information. Expedient repairs are completed, and the threat of continued enemy activity or a recurrence of the natural phenomenon that caused the disaster is minimal. This is not the time, however, to stop and rest. The BCE now guides efforts from the expedient mode to a more deliberate mode of operation and maintenance (O&M) as well as taking action to facilitate improved repairs. With a complete understanding of agreements between other DOD engineering forces and AF units regarding the degree of support that will be provided, the BCE makes the most effective use of all resources during this damage repair period. Using information from early damage assessments, follow-on visits to damage locations, and knowledge of the installation mission, a work plan should be developed. The plan should define what work needs to be done and when, and suggests methods of accomplishment.

7.2. Overview. After expedient repairs are made, O&M focuses on upgrading previous temporary repairs to allow for extended O&M of sustained flying operations. As in the initial recovery phase, identification of required work is essential. Additionally, safe, alternate transportation routes should be established, diminished supplies should be replenished, and remote stockpiling should be considered. This chapter outlines general procedures for identifying and documenting follow-on work requirements. Information is also included, which outlines CE options for accomplishing O&M work. For tasks within the capability of in-house forces, guidance is provided on making repairs that are more durable and better support the installation's mission. Later sections of the chapter deal with alternate transportation routes for use during and after emergencies. Maintenance and repair of existing routes are emphasized with design and construction of new routes covered briefly as a last resort measure. Finally, resupply of diminished stocks needed for operations, maintenance, and upgrade of repairs is addressed. Consideration for dispersed stockpiling of materials is also included.

7.3. O&M Safety Considerations. After the urgency of the immediate disaster recovery phase has passed, safety is still a critical consideration. Personnel will likely be experiencing a state of mental and physical exhaustion unlike any other previously experienced. Safety is everyone's concern, but supervisors should be especially observant and cautious. Watch for signs of excessive fatigue, and do not allow personnel to overextend themselves. Carelessness usually accompanies fatigue. Shortcuts taken when people are tired and not thinking clearly can have disastrous results.

7.4. The O&M Concept. The concept of O&M is a process for accomplishing work. It is a familiar theme for AF CE units in that their peacetime responsibilities are centered on the procedures and requirements associated with O&M taskings. Many similarities exist in the O&M concepts for both peacetime and wartime or contingency disaster recovery situations; however, several differences are also present. We will examine these differences as the steps for accomplishing O&M work are addressed. For our purposes here, the O&M concept will be addressed according to the six basic steps listed in **Table 7.1**.

Table 7.1. O&M Concept

O&M Concept	
Step 1	Identify the work that needs to be done.
Step 2	Estimate the work requirements. Each job should be quantified in terms of man-hours, materials, and equipment necessary.
Step 3	Assign work priorities. These priorities will aid in developing a work strategy.
Step 4	Develop a work plan or strategy capable of sustaining the sortie rate necessary for combat operations.
Step 5	Assemble resources. Action must be taken to acquire the resources estimated in Step 2.
Step 6	Do the work. The final and most important step is to complete the work identified.

7.4.1. **Work Identification (Step 1).** As addressed in **Chapter 3**, damage assessment teams are dispatched during the initial recovery phase to identify and quantify damage. Due to the urgency of immediate repair response after a disaster, assessments are necessarily limited to those requirements that most impacted launch and recovery of combat mission aircraft. Some damages were repaired during this initial recovery period using expedient methods, others were isolated, and others were ignored. In the disaster recovery O&M period, it is time to identify all repair requirements, irrespective of scope and importance to the primary installation combat mission. Expedient repairs should be replaced with permanent fixes, isolated utilities should be reinstated, and problem areas that were originally put aside should be corrected. Regardless of what repair actions were taken during the immediate aftermath of a disaster, all follow-on work should be identified in enough detail to convey the specific requirements of the job. For example, a general statement of work to repair the electrical service to a building is not enough information to allow a repair crew to do the job effectively. Details such as replace 25 kVA transformer and replace the service drop to the facility should be provided. A detailed description of work will ease detailed estimating and possibly save valuable repair time. Personnel chosen to perform the work identification should also be capable of determining, at least in a preliminary sense, how the work will be accomplished; e.g., by in-house forces, by contract, by Army engineers, etc. This will aid in the performance of the next step, work estimating, in that different levels of detail are required for the different methods of accomplishment.

7.4.2. **Estimate Work (Step 2).** Estimating work is quantifying work in terms of the manpower, materials, and special equipment required. For in-house work, rough man-hour estimates are provided for each craft required on a particular repair. Materials are specified by description, quantity, and if in stock, by the stock location. Special equipment should be addressed, particularly if its requirement is not made obvious by reading the work description. This is most helpful when equipment must be rented or acquired from another agency. For non-in-house work, initial estimating should be of sufficient scope to allow contract programmers to produce costing and programming documents. MAJCOMs should also be informed of the fiscal requirements and work scopes so contract monies and inter-service support can be obtained.

7.4.3. **Assign Work Priority (Step 3).** At this stage of the disaster recovery effort, the assignment of work priorities is crucial to generating and maintaining a sortie rate adequate to sustain the combat mission. Similarly, prudent appropriation of available manpower and resources is the key to the expeditious recovery of the installation and the resumption of the full flying mission. All work will fall into one of the categories used for peacetime O&M purposes. As compared to peacetime operations, however, more priority ones and twos will probably be identified since facility, utility, and airfield pavement damages will cause many mission hindrances, safety hazards, and perhaps even health hazards. Expect to see work that is normally a low priority in peacetime become a higher priority in the disaster recovery period. Drainage work is a prime example. In peacetime, such activity is usually a routine maintenance function but in the disaster recovery environment, if flight line area flooding is caused by drainage system blockage, repairs will rapidly become critical. Also, be sure to maintain a combat mission mindset when assigning work priorities. What are considered safety deficiencies in peacetime may well be acceptable risks in the disaster recovery period. Furthermore, be wary of assigning too high a priority to quality of life features at the expense of direct mission support requirements. The pressure will be on to do this, and therefore it is imperative to maintain a balanced perspective. The work priorities listed in **Table 7.2** will be used in the disaster recovery timeframe:

Table 7.2. Disaster Recovery Work Priorities

Work Priorities	
Priority I	Work done in direct support of the mission
Priority II	Work done to provide adequate security or to eliminate hazards
Priority III	Work done to prevent a breakdown of essential operations and services
Priority IV	Work not qualifying for a higher priority

7.4.4. **Develop a Work Plan (Step 4).** Now that the first three steps in the preparation phase are completed, the transition from preparation to execution can begin. So far the requirements have been identified, labor and materials estimated, and a rough priority listing established. Now the task calls for arranging the work by order of importance and making the final determination of how it is to be accomplished (in-house or otherwise). Several factors influence the development of a disaster recovery work plan, and many of them interact with each other. Only after each of these factors has been considered can a work plan be deemed complete.

7.4.4.1. Scope of Work. The scope of identified work requirements should be closely considered to preclude overloading various trades. Such action causes a bottleneck in task accomplishment and subsequent slippages in work completions. Look closely at contract support for tasks that are large in scope, require unique skills or expertise not normally available in a typical military engineer unit, or require many man-hours of a particular trade as compared to others.

7.4.4.2. Material Availability. To a large extent, the availability of materials will determine which of the highest priority tasks will be performed first. Maximize use of whatever special levels and WRMs are remaining; they are there to support contingency and wartime situations. Materials being held for peacetime O&M requirements are also another source of supply support. Cannibalization from lower priority damaged facilities or utilities should likewise be considered, particularly for items that traditionally have long lead times. Put higher priority systems back into full service this way and let lower priority systems wait for the supply system to provide the necessary materials. Do not overlook the value of local purchase for repair materials. In many cases, much of an engineer unit's peacetime supply overseas comes from local sources. Any standing contracts or purchase orders from local vendors should be increased to obtain as much material as possible.

7.4.4.3. Manpower Availability. The majority of disaster recovery O&M actions will be accomplished by in-house forces simply due to their immediate availability. If engineer units from other services are in place, however, they should be incorporated into the disaster recovery O&M work strategy as well. Use these units wisely. Assign major restoration tasks associated with critical facility and utility requirements to these units. Do not waste their talents on low- priority jobs or tasks that do not utilize their full engineer capability. At some locations, the local economy may be able to furnish contractor support for O&M requirements. Work with installation contracting personnel to line this support up for tasks that do not require a detailed design effort. Another avenue of manpower support that should be investigated is that of local civilian over hires. Historically, much of the civil engineer's wartime and contingency labor support has come from this source. Not only will in-house skilled personnel be freed up for more technical tasks, but the potential also exists for adding additional semi-skilled personnel to the O&M workforce. Lastly, remember that some of your work force will be required to provide day-to-day operations support and will not be fully available for repair taskings. Account for this in your planning but do not over-man this area—go with a minimum manning concept.

7.4.4.4. Timing Constraints. Disaster recovery O&M efforts will be greatly affected by timing constraints, which, in turn, steer the development of the overall work, schedule. Mission support is the driver for work scheduling, and all activities should be aimed at satisfying these taskings first. Additionally, do not be hesitant to mix in-house forces with contractors or other engineer units. Work your manpower assets together toward a common goal of bringing the most critical portions of the installation back up to standard.

7.4.4.5. Funds Availability. Keep your MAJCOM informed of your funding requirements for supply, civilian pay, and contract support. To some extent, each installation can keep the supply lines flowing by reallocation of local O&M funds, but few installations will have the ability to fund any sizable contract support or civilian pay increases. As disaster recovery O&M efforts progress, the need for additional funding will increase since requirements will become more defined.

7.4.5. **Assemble Resources (Step 5).** Gathering of work materials, equipment, and assigning manpower to the various tasks are the first steps in the execution phase of the disaster recovery O&M effort. Follow your work plan priorities as closely as possible and exploit the various avenues of supply and manpower support mentioned earlier to build your O&M capability.

7.4.6. **Accomplish Work (Step 6).** Accomplishing the work is the final and most important step in the execution phase and the O&M concept. This final step brings civil engineers closer to fully recovering the installation and sustaining the flying mission. As more and more repairs are made to installation facilities and utilities, be prepared to transition an increased portion of your work force to an operations mode.

7.5. Airfield Ancillary Equipment O&M. O&M of ancillary airfield equipment is critical to the operation of the airfield. Items such as aircraft arresting systems, airfield lighting, and NAVAIDS, which were installed or expediently repaired immediately following the emergency, should now be maintained to support continuing aircraft operations. Any upgrade repairs that can be made to these systems without degrading the operational capability of the installation should be attempted at this time.

7.5.1. **Aircraft Arresting Systems.** In a wartime situation where only a MOS has been made available for aircraft launch and recovery, a MAAS has most likely been installed. Routine servicing and inspection of the system must be maintained throughout its period of use. Refer to T.O. 35E8-2-10-1, *Arresting Systems, Aircraft, Mobile,* for MAAS operation and maintenance procedures. In all likelihood, however, once the threat of re-attack is over, efforts will intensify to bring the full runway surface back into operation. This, in turn, will permit permanently installed arresting systems to be reinstated into service. Once such permanent barriers are put into use, servicing and inspection efforts should be devoted to these systems. The mobile system then should be removed, reconditioned as necessary, and placed back into standby storage. In the event that airfield damages were such that the permanently installed systems could still be used during the disaster recovery period, particular attention should be paid to any expedient repairs that were made on the systems. All repairs made by substitution should be identified. A listing of the materials required to restore the system to full operational capability and alleviate the parts substitution condition should be developed. These materials should be immediately ordered and installed once they are received. Additionally, any stockpiled replacement parts that were expended during repair efforts should also be replenished. Repairs beyond component replacement are usually beyond the capability of the in-house work force and should be identified to the parent major command so that appropriate repair support can be arranged.

7.5.2. **Airfield Lighting System.** If a MOS was established, an emergency airfield lighting system (EALS) was probably installed to support night and adverse weather flying requirements. Make daily checks of the system according to in-use preventative maintenance guidelines. Refer to T.O. 35F5-3-17-1, *Lighting System, Airfield, Emergency A/E82U-2*, for EALS operation and maintenance procedures. As repairs to runway pavement surfaces are being made, concurrent repairs to the permanently installed airfield lighting system should be accomplished with the intent of having the system operational when the full runway is brought back into service. If damage conditions permitted the permanently installed airfield lighting system to be used in lieu of a mobile system, it is still likely that some expedient repairs had to be made immediately after the attack or disaster ended. The objective now during the O&M phase of recovery operations is to upgrade these repairs to meet normal standards as quickly as possible and perform the maintenance necessary to keep the system fully operational.

7.5.2.1. If the power supply to the airfield lighting vault has been interrupted, restoration of this primary power should receive emphasis. Repair crews will have two major taskings:

7.5.2.1.1. Operate and maintain the backup generator. Increased running time requires more frequent inspection and maintenance.

7.5.2.1.2. Pursue actions necessary to restore primary power to the airfield lighting vault. This could mean running new underground cabling to the vault or permanently repairing previously made expedient connections.

7.5.2.2. If the problem is with the underground system supplying each lighting circuit, sometimes it can be corrected by merely replacing damaged sections of underground direct burial cable or by repairs of a duct system. Replacement of direct burial cables is a simple task that can be accomplished by in-house forces if materials are available. Before a decision is made to make a repair in-house, first consider the impact the work will have on available resources and how it affects your capability to do other work.

7.5.2.3. In-house forces should make daily inspections of the lighting systems. Check for inoperative lights, damaged splices, and damaged surface run cables. Daily tasks include replacing burned out lights/damaged fixtures and repairing or replacing damaged splices.

7.5.3. **NAVAIDS.** The type and number of NAVAIDS and the support given these aids by civil engineers will vary. You may be required to repair the metal frame for the wind sock or perform daily operational checks of the generator providing power to the Tactical Air Navigation (TACAN) facility. Any facility or utility damage that directly affects the operation of critical NAVAIDS should be repaired immediately. Likewise, the identification and completion of repairs required to restore the facility or supporting utility system should carry a high priority.

7.6. Utility Repairs. The early expedient repair of utility systems is critical to preserve life, eliminate hazards, and support the operational mission. It pays dividends to upgrade the expedient repair to a more permanent repair as soon as possible. Expedient repairs are temporary at best, the longer they are left without upgrade, the greater the chances for repeated breakdown and failure. Increased incidents of failure drain resources and degrade the mission capability of the installation. The BCE should identify, quantify, and set the priority for all repair requirements. The COA selected will depend on how the work will be done; whether accomplished in-house, by contract, or by some type of work force augmentation.

7.6.1. **Electrical System.** All damage as well as all expedient repairs should have been documented during initial recovery phases. Use this information as a departure point to determine required actions. Still another, perhaps more comprehensive damage survey should be made to identify the total scope of needed repairs. Discussing repair requirements with electrical and power production personnel will further clarify and quantify the repair effort. During the survey and especially during follow-on repair efforts, remember, the dangers associated with working on the electrical system make it imperative that the techniques and procedures outlined in AFI 32-1064 be applied at all times.

7.6.1.1. Power Generation Plants. If moderate to heavy damage to power production plants has been sustained, it is likely that expedient repairs will not have been possible. Major restoration efforts will be necessary, and contract action is probably the only answer. If damages were only slight, however, repairs to electrical production systems will have initially included maximum cannibalization and the use of spare parts to get all possible units back on line and in full production. In some cases, wrecking and shoring actions may have been taken to make the facility housing the power production units structurally safe. Automatic control and monitoring systems that could not be repaired may have been bypassed and replaced with whatever was available for a “makeshift” manual operation. Now is the time to determine to what extent upgrade repairs can be made and what maintenance operations are required.

7.6.1.1.1. Where makeshift manual controls are in use, ensure that all equipment is operating within the correct tolerances and that the appropriate output is being achieved. Otherwise, further damage to production equipment can occur or, in the case of incorrect output, the result can be damaged distribution equipment or worse. Ensure that replacement control panels are requisitioned.

7.6.1.1.2. Check and monitor fuel lines supplying the generators for serious leakage. Arrange for permanent repairs to be made thereby eliminating any potential fire or safety hazards.

7.6.1.1.3. Make any facility repairs that are needed to permanently weatherproof the power units and switchgear.

7.6.1.2. Individual and Mobile Power Units. In most situations, individual or mobile generators were expediently repaired either through cannibalization/spare part use or by total replacement if damaged beyond immediate repair. Repair upgrade actions should be relatively minimal with the exception; perhaps, of repairing splinter protection features (i.e., steel bin revetments, sandbags, earth berms, concrete revetments, etc.). Of more importance is the O&M of these units and the dedicated effort necessary to keep them functional. These generators should be checked at least daily and refueled as required. Fuel consumption data and the size of the tank should give an indication of how often a unit must be refueled. A refueling and services inspection schedule should be developed and strictly followed.

7.6.1.3. Distribution System. Depending upon the nature of the disaster, repairs to the distribution systems may vary from simple to very complex. If manpower and needed materials are available, most installations have the technical capability to make permanent repairs to the overhead distribution system. Some repairs, such as straightening leaning poles and adjusting line sag, will require no materials at all. However, the electrical distribution system at most installations is at least underground, and survey of such a system is a more difficult task. The underground system supports critical operations and is usually located in operational flying areas around the flight line. All manholes should be checked for structural damage as well as damage to the distribution system. Extreme caution should be exercised when entering or working on underground systems. Manholes can become settling points for combustible and/or extremely noxious gases. Most installations have the capability to check for potential line insulation breakdown. This should be done so that lines can be replaced before a failure occurs that could be detrimental to the installation mission.

7.6.1.3.1. If damage to the distribution system is heavy, it is likely that the distribution system off the installation has also sustained damage. In this situation, the local power company cannot be relied upon for assistance. This is the point where disaster planning efforts start to pay dividends. If there are electrical contractors in the local area that are capable of delivering the assistance needed, they were identified in local CRPs. The value of negotiating a requirements (on-call) contract during the contingency planning phase becomes evident now in the form of a critical time savings.

7.6.1.3.2. Typical electrical distribution system upgrades and repair actions to be taken during the O&M phase of installation recovery include the activities in **Table 7.3**.

Table 7.3. Typical Electrical Distribution Upgrade and Repairs

Upgrade/Repair Actions
Replacement of temporary ground-level distribution lines with permanent lines either above ground level or below ground as appropriate
Installation of new service drops to repaired facilities
Replacement of damaged power poles
Repair of structural damage to vaults, switching stations, and security fencing
Repair of damaged transformer banks

7.6.2. **Water System.** The water system is extremely important. It is needed not only for consumption, but also for fire fighting, food preparation and hygiene, decontamination, and a great many other uses. System components are normally categorized as source, treatment, storage, and distribution.

7.6.2.1. Source. If the source has remained intact or has been repaired, determine whether it is still adequate to meet current needs. This determination will be based upon quantity and usability. The quantity can be calculated based on number of personnel, fire fighting requirements, and any other special considerations resulting from the contingency and recovery effort. Usability means potable. For fire fighting and many other uses, this is not so critical. The source should be treated periodically to ensure that it is free of contaminants. If the source is not adequate and supplementary wells have been developed, they should be inspected daily to ensure a sufficient water level for the installation could be maintained. Pumps also should be checked and serviced to ensure proper running conditions.

7.6.2.2. Treatment. If water treatment facilities were only lightly damaged by the attack or disaster and expedient repairs subsequently made, initial efforts should be concentrated on bringing the plants back up to the standards they were at before the disaster.

7.6.2.2.1. Typical O&M phase taskings would include:

7.6.2.2.1.1. Replacement of automatic controls and monitoring systems that was initially damaged and bypassed.

7.6.2.2.1.2. Repair of structural components to ensure weather protection and security.

7.6.2.2.1.3. Repair of any piping that was bypassed in an attempt to keep at least a portion of a plant operating.

7.6.2.2.1.4. Replacement of any auxiliary or backup pumps and motors that were damaged.

7.6.2.2.2. If, on the other hand, treatment facilities were heavily damaged, chances are repairs will be of the magnitude that a contract or major construction effort would be required. Water treatment in such a situation would have to be provided using several mobile water purification units. Such units require considerably more operating attention than a normal water treatment plant; therefore, an engineer squadron having to contend with this type of operation will have to expect an additional demand on available manpower.

7.6.2.3. Storage. Loss of storage capacity will place an additional demand on production of water. This would be a particularly severe problem if the installation developed a critical shortage in fire fighting requirements. If an installation has lost a sizable portion of its water storage capacity, one of the initial tasks once aircraft launch and recovery have been established should be to locate and develop an alternate source of non-potable water for fire fighting resupply.

7.6.2.3.1. Heavily damaged water storage tanks, reservoirs, etc., will likely be beyond repair or at least beyond the in-house repair capability of the typical base CE unit. Restoration of such facilities will have to be a contract effort. In the interim, consider using flexible storage bladders positioned at critical locations around the installation. Tank trucks are another alternative.

7.6.2.3.2. Minor damage to water storage structures can usually be repaired by draining the tanks and patching any punctures that have been sustained and replacing the necessary components of any measuring gauges that may have been damaged. Ground-level and above ground-level tanks should be checked daily to verify structural soundness. Damaging effects from blast pressures and ground shock may not show up immediately.

7.6.2.4. Distribution. In all probability, the bulk of CE water system repair taskings after an attack or disaster will be associated with the distribution system. This is due to the widespread nature of the piping network and its subsequent vulnerability to collateral damage. During the O&M phase of the installation recovery effort, the amount of damage received on the distribution system will dictate the repair methodology. If heavy damages were incurred, contract and/or construction battalion support will definitely be required. In fact, even if damages initially appear light, some outside support will probably be necessary since water distribution systems are extremely fragile and problems tend to continually surface long after the threat of attack or natural disaster has passed. On the other hand, the importance of the water distribution system for maintaining and sustaining overall installation operations will mean that some in-house repair efforts will always be needed. Typical repair tasks that can be expected for in-house accomplishment include the activities listed in **Table 7.4**.

Table 7.4. Typical In-House Water Distribution Repairs

Repair Actions
Replacement of expedient aboveground lines with permanent below-ground piping
Replacement of damaged or bypassed valves
Reconnection of lines that were capped
Replacement of pipe sections that were cracked or fractured
Replacement of damaged pumps in pumping stations

7.6.2.5. Safety and Hygiene. As permanent repairs and upgrades to the water system are being accomplished, engineer personnel should be conscious of standard safety and health practices. Ground conditions are less stable after an attack or natural disaster due to such physical effects as shock propagation and soil saturation. It is likely that shoring for deeper excavations will be necessary and many more barricades and similar marking devices will be required due to the greater than average numbers of line breaks incurred. Pay special attention to water quality. Many underground distribution system problems will initially remain hidden, and the potential for external contamination of water supplies through these undiscovered line breaks is great. For this reason, the importance of disinfecting water systems before returning them to service cannot be overemphasized. Furthermore, once the distribution system is generally operational, water quality checks should be taken at various points on the installation on a scheduled basis to ensure purity standards are maintained. Water quality checks should be performed in concert with bioenvironmental engineering (BE) personnel.

7.6.3. **Sewage System.** It will be during the O&M phase of the installation recovery operation that the majority of repairs to the sewage treatment and distribution system will be accomplished. As with the other utility systems, surveys should be made to identify what expedient repairs were made following the disaster and what permanent upgrade and replacement actions should be undertaken. While repairs to the sewage system are ongoing, care should be taken to ensure that expedient repairs or other workarounds are kept serviceable. Pumps and flexible lines being used as lift station or blocked main bypasses should be frequently checked and serviced as needed. If porta-potties, chemical toilets, or other self-contained sanitary facilities are used, provisions should be made to collect, transport, and properly dispose of the human wastes.

7.6.3.1. Treatment Plants. Sewage treatment plants do not lend themselves very well to expedient repair. Such repairs would be generally limited to minor piping repairs, control system bypassing, and patching of berms around ponds and lagoons. If a treatment plant was damaged sufficiently enough to take it completely out of service, it is probable that a contract effort would be required for restoration purposes. Although a vulnerable facility, it is unlikely such a facility would be a primary target, and its normally remote location decreases its chances of receiving collateral damage.

7.6.3.2. Distribution Systems. O&M efforts with regard to distribution systems usually involve repairs to distribution mains and valves, manholes, and lift stations.

7.6.3.2.1. Repairs to sewer mains are needed when they are fractured, collapsed, or blocked. Stoppages are normally obvious and may be corrected by routine maintenance procedures. Hidden fractures can go unnoticed for some time. Fractures or stoppages caused by collapsed mains will require excavation so the damaged main section can be replaced. Valve repairs are normally accomplished by replacing the entire valve assembly.

7.6.3.2.2. Besides pipe collapse, stoppages to sewer lines can also be caused by structural damage to manholes. Repair of manhole damage can vary from merely clearing debris from the hole to replacing the entire structure. Replacing the manhole may be beyond the capability of in-house forces; therefore, be prepared to ask for contract or construction battalion support. On the other hand, clearing debris is relatively easy, requiring a minimal demand on resources. Once debris has been cleared, remember to mark off or barricade the manhole area as a safety precaution.

7.6.3.2.3. If a lift station received sufficient damage to put it out of service, a portable pump and flexible bypass hoses are normally used as an expedient repair measure. Because of the importance of lift stations in moving sewage away from inhabited areas, a permanent fix by in-house forces is usually called for. Such a fix would entail total replacement of pumps, repair of associated piping, and repair of any structural damage to the lift station facility.

7.6.4. **Heating Systems.** The need to upgrade heating system repairs depends largely on prevailing weather conditions. A large central heating system, like the electrical system, can sustain a range of damage varying from simple to complex.

7.6.4.1. Major Plants. Expedient repairs to a heat production plant will initially include repairs to supporting utilities such as electrical and water service. During expedient repair operations, damaged automatic controls may have been bypassed with manual controls. Parts may have been cannibalized to get as many boilers operating as possible and some wrecking and shoring may have been done. These repairs may be well documented, but the plant will probably have to be surveyed again to determine the total scope of what is needed to attain a fully operational status. Discussion with plant operators will help clarify repair needs.

7.6.4.1.1. Where automatic controls and monitoring systems have been bypassed and manual controls substituted, care should be taken to ensure that all equipment is operating within safe ranges. If this is not done, damage to the heat-generating equipment is likely to occur and personnel could be severely injured. Any feasible permanent repairs of these components should be accomplished.

7.6.4.1.2. Expedient repairs to the distribution system will probably have been limited due to the operating limits required for distribution. Now is the time to attempt repairs that will return the distribution system to its original configuration. Fractures are relatively easy to locate by the obvious venting of steam. Steam pits should be surveyed for structural damage as well as for mechanical damage to piping and valves. Local construction contractors may be an excellent source for not only renting excavation equipment but also providing additional skilled labor for repairing underground distribution system breaks.

7.6.4.2. Individual Facility Systems. Many installation facilities will have individual heating systems or package units installed. Like major plants, initial repairs to these smaller systems will usually involve restoration of supporting utilities (electrical and water). Other repairs would include replacement of damaged major components obtained through either special level support or cannibalization of similar units. In the case of damage to individual heating systems serving high-priority facilities, the quickest expedient fix would have been to install a mobile heating system attached to the building using flexible ductwork. From an O&M viewpoint, personnel will have to be assigned the task of periodically checking, servicing, and refueling these units. From a practical perspective, it is unlikely that a building will suffer major damage to the individual heating system without also suffering serious damage to other utilities and the structural components of the facility. In this case, repairs most likely will have to be accomplished as part of a facility repair or restoration project.

7.6.5. **Gas System.** Hidden gas leaks may occur underground and flow undetected until a thorough survey of the system is conducted.

7.6.5.1. Expedient repairs have a tendency to require additional repairs. Where service was rerouted to provide gas to a critical facility, that service should be checked periodically for damage or leaks until permanent repairs can be made. If portable sources (bottled) are used, they must be refilled periodically.

7.6.5.2. Repairs should never be attempted until the gas supply has been turned off. Be sure to allow gas to dissipate to safe levels before attempting excavation or repairs. Upgrading of repairs varies from the simple task of installing a clamp on a low-pressure line to replacing medium-pressure valves and pipe sections. Regardless of how complex or simple the job, safety is paramount. Good planning and a thorough survey of the gas system are needed to identify and quantify repairs that must be made.

7.6.6. **POL Systems.** POL storage and distribution systems could be prime targets for potential attackers. The systems can also be severely damaged by natural disasters such as earthquakes or collateral effects occurring from attacks on other facilities. Any damage to the POL system will be compounded by the volatile nature of the system contents. The combustion of fuels leaking from a fracture in a pipe, valve, or tank can cause irreparable damage and devastation to the surrounding area. POL systems are critical to the recovery and continued operation of the installation because the POL resources are necessary for the operation of aircraft and ground support vehicles.

7.6.6.1. Many POL systems are constructed with a certain amount of redundancy. If part of the POL system is left undamaged, isolation and valving may result in a partially operational system that can be used to support the flying mission. Additionally, the rapid utility repair kit (RURK) and a future procurement repair system (i.e., Water and Fuels Expedient Repair Systems [WaFERS]) provide a means to quickly repair valve and line failures resulting from an attack or disaster. Whether isolation or expedient repair methods have been used, it is critical that frequent checks of the system be made to ensure continued system operability. This includes inspections of isolation points, temporary repairs, and the remaining serviceable portions of the system.

7.6.6.2. A physical survey is required to identify all work required for permanent repairs. Due to the exacting nature and critical skills needed for POL system permanent repair, plan in advance to acquire at least partial contract support. Any major amount of damage to the POL system will quickly outstrip the capabilities of in-house forces.

7.7. Facilities and Services. Upgrading of expedient repairs to critical facilities and expanding the level of required services are main features of the BCE's O&M effort after an attack or natural disaster. Because of the potentially large scope of these efforts, plan on using contract and joint force construction support for at least a portion of this requirement.

7.7.1. **Facilities.** Recovery actions on facilities are done according to the priority of the facility. Efforts are directed towards upgrading expedient repairs and demolishing buildings presenting a danger to personnel. The BCE's efforts regarding facility repair should begin with a thorough inspection of facilities so the scope and depth of needed repairs can be determined. Use the CE CRP and Facility Priority List as guides to the inspection order and check other facilities that are known to have sustained damage. Minor permanent repair actions should be identified for in-house accomplishment. Facility restoration beyond in-house capabilities should also be identified and forwarded to the major command for allocation to contract or troop construction efforts. Typical tasks that in-house forces should be prepared to perform during the disaster recovery O&M phase include tasks listed in **Table 7.5**.

Table 7.5. Typical In-House Disaster Recovery O&M Tasks

In-House Disaster Recovery O&M Tasks
Replacement of expedient plastic sheeting and canvas patches with plywood or plexi-glass patches
Upgrade of shoring for facilities that will be repaired by other than in-house forces
Isolation of damaged electrical circuits in a facility that would permit the remainder of a facility to be restored to electrical power
Repair of utility service lines to critical facilities
Restoration of structural integrity to facilities that are only slightly damaged
Repair of security fencing/entry gates to critical resource areas
Demolition of severely damaged facilities (salvage usable materials)
Sectioning off of damaged portions of a facility to allow use of the remainder of the facility

7.7.2. **Garbage and Refuse Disposal.** Regardless of disaster recovery conditions, garbage and refuse will continue to accumulate, and methods for handling these items must be devised. Unfortunately, damage to collection equipment or incinerating equipment may temporarily impair or halt collection and disposal efforts. Installation garbage and refuse are usually disposed of by sanitary landfills, incineration, sale, or contract. In most cases a contract service is used, however, it is likely that such service will be interrupted after a disaster has occurred, and particularly after an installation attack. During this period, in-house forces will have to perform the task. Keep in mind that any disposal method must adhere to theater-specific waste management guidance and procedures. Once contract support has been reestablished, a joint effort may still be necessary. Although additional costs may be incurred, contractors should be instructed to use all available transportation for collection and disposal and to assist in removal of installation-wide debris.

7.7.2.1. If off-base disposal sites are out of service or inaccessible, on-base locations must be identified. At these sites, garbage, refuse and debris can either be buried, burned, or a combination of both. Although it is important to consider all available methods of solid waste disposal, keep in mind there are usually severe restrictions imposed on open air burn pits. They should only be used as a short-term solution during contingency operations and must be operated in a manner that prevents or minimizes risks to humans and the environment. Personnel should consult DODI 4715.19, *Use of Open-Air Burn Pits in Contingency Operations*, for specific guidance on the use of burn pits in contingency operations. In areas with a high population density, such as base housing, occupants might be allowed to burn or bury their own refuse until adequate disposal facilities are made available. Common burial pits can be established for this purpose. Plan to monitor closely any type of "self-help" operation—uncontrolled refuse disposal can lead to serious fire and sanitation hazards. If on-base locations are created for garbage and refuse disposal, ensure a stringent pest control program is instituted to alleviate the danger of disease spread.

7.7.2.2. If there is a potential for recovery operations in a CBRN environment, follow procedures established for contaminated refuse disposal. Refer to AFMAN 10-2503, for specific guidance on contaminated waste control and disposal procedures.

7.7.3. **Snow Removal and Ice Control.** Removing snow and ice from airfield pavements is as important as repairing damaged airfield pavements. In the disaster recovery environment, however, more care must be taken in some areas. For example, standard snow removal techniques may not work on repaired runway areas. It is likely that plow blades will catch the edges of anchored mats and perhaps other temporary repairs, thereby damaging the repair and probably the plow as well. A lot of handwork and a carefully operated front-end loader may be necessary to clear crater repair areas. Additionally, snow removal equipment operators will have to be observant of the mobile arresting system location since it will likely be positioned differently than the permanently installed barriers. If the runway has not been totally opened and a MOS is still in use, the situation is even more complicated. Equipment operators will also have to avoid the temporary airfield lighting and edge markers around the operating strip.

7.7.3.1. At the onset of heavy snow conditions and the ceasing of flying operations, it may be advisable to further mark the boundaries of the operating strip with flags or cones so that its outline is discernible once snow removal operations begin. If this is not feasible due to weather conditions, it may be necessary to identify the edges of the operating strip immediately prior to rolling the snow removal equipment to the airfield. It would also be advisable to mark the boundaries of any repaired areas since even a little snowfall will mask their locations.

7.7.3.2. At most locations, snow and ice removal will occur simultaneously on the airfield and installation thoroughfares. The following is a general list of the more important areas requiring snow and ice removal in an attack recovery environment:

7.7.3.2.1. Runway, primary taxiways, and alert parking areas

7.7.3.2.2. Aircraft parking areas and shelter entrances

7.7.3.2.3. Access route to aircraft maintenance hangars

7.7.3.2.4. Access roads to munitions storage areas

7.7.3.2.5. Safe routes to mission-critical facilities

7.7.3.2.6. Access routes to POL dispensing points

7.7.3.2.7. Primary installation thoroughfares

7.8. Transportation Routes. Refueling and rearming of aircraft, evacuation of personnel, and other emergency responses require usable travel routes. The BCE is responsible for maintenance and repair of all traffic routes, including making alternate routes available. Alternate routes are needed when the primary route has been interdicted or travel on the primary route would be hazardous (e.g., downwind of a toxic substance source).

7.8.1. **Alternate Route Development.** AF installations are normally constructed with an adequate network of roads affording sufficient opportunity for development of alternate routes. If all possible access routes have been damaged, the first option is to go around the damage by removing surface obstacles such as curbing, directing traffic onto the unpaved area around the damaged portion of the street, and then back onto the street once the damage has been cleared. If possible, try to tie parking lots into the diversion route since this will provide at least a partially paved surface. Also, be aware of overhead clearances. Building overhangs, electric and telephone lines, and tree limbs can quickly hinder traffic flow. Check that utilities, especially water, gas, and sewer, are not running close to the surface in the diversion route area. If they are, choose another location for the route or ensure that a hard surface such as AM-2 matting is placed over the lines to distribute vehicle weights better. When supplies are readily available; cover the diversion route with crushed rock or similar material to produce a better, weather-resistant travel surface.

7.8.2. **Transportation Route Repair.** If going around the damage is not possible, the only other option is to repair the damage. This can be done expediently in a manner similar to airfield damage repair. Expedient road repair consists of removing debris, backfilling the crater, and compacting crater fill material. Difficult repairs, like shoring up a bridge superstructure or applying a surface course, should be avoided. Rely on contractors or other troop construction units to do this type of work. Permanent road repairs should not be attempted until the crisis is past and permanent recovery actions are well under way.

7.9. Resupply and Stockpiling. By now much, if not all, of your stockpiled materials have been used up, damaged, or destroyed. To upgrade repairs and continue operation, steps should be taken for resupply and possible stockpiling of essential materials.

7.9.1. Any preplanning efforts that have been taken pay off now since it is not necessary to "build from scratch" a listing of needed materials. Many have already been identified during the preplanning process. This compilation, coupled with bench stock lists, shop stocks, special levels, WRM, and material identified because of damage assessment surveys, will produce a large shopping list.

7.9.2. Once a materials requirements' listing is assembled, the acquisition process begins, normally through base supply and the installation contracting office. Contingency and wartime resupply usually comes from two sources—the CONUS and the local economy. The

CONUS effort oftentimes is initiated via a "push" system where materials are shipped prior to actual ordering by units in the field. The items shipped are common materials that traditionally have been needed for engineer support during wartime. In this way, the materials identification and ordering time delay is eliminated at least for the initial resupply action. Follow-on stocks based on requisitions from the field flow later. For planning purposes, assume a 60-day transit time for both initial resupply and the follow-on stocks. This essentially means you will have to rely on whatever you have on hand and the local economy to support your efforts for at least the 60-day period following the start of hostilities.

7.9.3. Exploit the local economy as much as possible as a source of supply. One of your initial tasks upon arrival at your beddown location should be to identify local contractors and material vendors. Visit their locations and see what is available in terms of both scope of items carried and quantities normally in stock. Provide this source information to base supply and contracting when you place orders. If worse comes to worst, also arrange for transportation of materials if this is posing a problem.

7.9.4. As materials are received, every effort should be made to control and track use of the materials. This will be particularly difficult in the chaotic recovery environment. As materials are used and stocks dwindle, material control should take action to replenish stocks on a regular basis. The goal should be to develop a supply flow that meets recovery needs and avoids excessive delays while at the same time does not flood the installation with more materials than will ever be required. Particular care should be taken to order only what is needed and not grossly inflate requirements. On the other hand, ensure that emergency stocks such as special levels that have been depleted are also replenished. Even though such stocks may not be immediately needed, it is only prudent to rebuild on-hand material quantities to levels existing prior to the disaster. Do not forget to incorporate "lessons learned" into your stockage requirements. If additional critical items are necessary to support disaster recovery conditions, add them to your emergency stockage lists.

7.9.5. Because the quantity of resupply material may be greater than available warehouse space, it could become necessary to stockpile material elsewhere. Remote stockpiling of resources (**Figure 7.1**) at or near a proposed job site can increase efficiency through reduction of waste and material handling time. Additionally, such stockpiling serves as a dispersal measure thereby affording some added protection from the effects of future attacks. Open and dispersed storage of materials has drawbacks that should be countered. Adequate security is a primary consideration to prevent weather damage, pilfering, or vandalism. This will present the need to inspect and segregate materials as they arrive. Items that are weather sensitive must be stored under cover (**Figure 7.2**). Materials that have high value such as copper wire should likewise be secured under cover. Items that are good "trading stock" such as plywood and lumber should be at least fenced in with concertina wire.

Figure 7.1. Relocate Construction Resources Near Job Site to Increase Efficiency

Figure 7.2. Store Weather-Sensitive Materials Under Cover

7.10. Summary. Making a smooth transition from the expedient repair mode to a more sustained mode of O&M with permanent repair upgrades is important. Even when the conditions of the emergency have subsided somewhat, the installation is still in a recovery mode. Carefully consider your options concerning specific repairs and the O&M requirements for various installation utility systems and facilities. Develop a restoration plan that includes total requirements, considers priorities, and assesses avenues available (work agencies) to effect repairs. Do not forget to include essential services such as refuse disposal and snow and ice control and make provisions for an effective resupply program. Maintenance and repair of transportation routes will play a key role in enhancing other repair operations. Be aware that a clear differentiation is established between Army and AF responsibilities concerning the attack recovery and restoration effort. However, differentiation on paper does not mean anything if those forces are not available when needed. Bottom line, be flexible, and ensure effective employment of those resources you control.

Chapter 8

PROTECTION, SECURITY, AND DEFENSIVE PROCEDURES

8.1. Overview. Civil engineers routinely perform tasks that are important to successful installation operations—these tasks become more vital under threat of attack or other hostile acts. When necessary to help safeguard their personnel and secure mission assets and resources from enemy action, CE teams must be able to execute certain basic protection, security, and defensive procedures. This chapter briefly examines individual and team defensive measures, convoy security operations, work party security **(Figure 8.1)**, owner/user security procedures, and base defense augmentation.

Figure 8.1. Work Party Security Help Safeguard CE Work Crews

8.2. Basic Defensive Combat Skills for Self-Protection. The concept of self-protection in this section refers to understanding and employing basic defensive combat skills and techniques that provide individuals and work crews with a better chance of survival when confronted with a hostile situation while, at the same time, ensuring task accomplishment and air base survival. These defensive skills could be critical during work site security, base defense, and convoy dismounted operations.

8.2.1. **Cover, Concealment, and Camouflage.** If the enemy can see you, they can hit you with weapons fire. So you must be concealed from enemy observation and have cover from enemy fire. When the terrain does not provide natural cover and concealment, prepare your cover, and use natural and man-made materials to camouflage yourself, your equipment, and your position.

8.2.1.1. Cover. Cover gives protection from bullets, fragments, and some CBRN agents. Natural or man-made cover can also conceal you from enemy observation. Natural cover includes things such as logs, trees, stumps, ravines, and hollows (**Figure 8.2**). Man-made cover includes such things as fighting positions, trenches, walls, rubble, and craters. When in a defensive posture, a fighting position is normally constructed using natural cover from the surrounding terrain. To get protection from enemy fire when moving, use routes that put cover between you and the places where the enemy is known or thought to be. Use ravines, gullies, hills, wooded areas, and walls to keep the enemy from seeing and firing at you. Avoid open areas, and do not skyline yourself on hilltops and ridges.

Figure 8.2. Natural Cover Provides Hasty Protection From the Enemy.

8.2.1.2. Concealment. Concealment is anything that hides you from enemy observation; however, it does not protect you from enemy fire. Similar to cover, concealment can be natural or man-made. Natural concealment includes items such as bushes, trees, grass, and shadows. Man-made concealment includes airman battle uniforms, camouflage nets, face paint, and natural material that have been moved from its original location. To be effective, man-made concealment must blend into the natural concealment offered by the terrain. Contributing to concealment are three other factors that should be considered—light discipline, noise discipline, and movement discipline.

8.2.1.2.1. Light discipline is controlling the use of lights at night such as not smoking in the open, not walking around with a flashlight on, not using vehicle headlights, and using vehicles' blackout capability, if equipped.

8.2.1.2.2. Noise discipline is taking action to deflect sounds generated by your unit (such as operating equipment) away from the enemy and, when possible, using methods to communicate that do not generate sounds (arm and hand signals).

8.2.1.2.3. Movement discipline includes such things as not moving about fighting positions unless necessary and not moving on routes that lack cover and concealment. Movement draws attention. When you give arm and hand signals or walk about your position, your movement can be seen by the naked eye from long distances. When in a defensive posture, stay low and move only when necessary. If movement is necessary, do so only on covered and concealed routes. A note of caution darkness alone cannot hide you from enemy observation. Night vision devices will detect you in darkness.

8.2.1.3. Camouflage. Camouflage is anything used to keep yourself, your equipment, and your position from looking like what they are, e.g., breaking up outlines to blend in with your surroundings. Both natural and man-made material can be used for camouflage. When natural material is used, over time it will often die, fade, or otherwise lose its effectiveness and should be changed frequently. Likewise, man-made material may wear off or fade. When this happens, you and your equipment or position may no longer blend with the surroundings making it easy for the enemy to spot. Some camouflage considerations include the following:

8.2.1.3.1. Shine. Shine may attract the enemy's attention. In darkness, it may be a light such as a burning cigarette or flashlight. In daylight, it can be the reflection from a polished surface such as shiny mess gear, a worn helmet, a windshield, a watch crystal or even exposed skin. To reduce shine, cover your skin with clothing and face paint. Also, dull the surfaces of equipment and vehicles with paint, mud, or camouflage material.

8.2.1.3.2. Shape. Shape results from an object's outline or form. The shape of a helmet and human body are easily distinguishable. Use camouflage and concealment to break up shapes and blend them with their surroundings. Be careful not to overdo camouflage and concealment techniques, it could create unnatural results, and draw unwanted attention to your location.

8.2.1.3.3. Colors. Colors can also be a "dead giveaway." The colors of your skin, uniform, and equipment may help the enemy detect you if they contrast with the background. For example, a green uniform will contrast with snow-covered terrain. Camouflage yourself and your equipment to blend with the surroundings (**Figure 8.3**).

Figure 8.3. Effective Personal Camouflage Blends With Surrounding Terrain

8.2.1.3.4. Dispersion. Dispersion is the spreading of personnel, vehicles, and equipment over a wide area. It is usually easier for the enemy to detect individuals when they are bunched—so, spread out. The distance between you and another person will vary with the terrain, degree of visibility, and enemy situation.

8.2.2. **Individual Movement Preparations and Precautions.** Use the following individual movement preparations and precautions prior to and during an encounter with an enemy force:

8.2.2.1. Camouflage yourself and your equipment.

8.2.2.2. Wear soft, well-fitting clothes.

8.2.2.3. Exercise good noise discipline. Methods include:

8.2.2.3.1. Tape your dog tags together and to the chain so they cannot slide or rattle

8.2.2.3.2. Tape or pad the parts of your weapon and equipment that rattle or are so loose that they may snag (the tape or padding must not interfere with the operation of the weapon or equipment)

8.2.2.3.3. After finished taping, test for noise by shaking

8.2.2.4. Do not carry unnecessary equipment. Move from cover position to cover position (taking no longer than 3 to 5 seconds between positions).

8.2.2.5. Stop, look, and listen before moving. Look for the next position before leaving a position.

8.2.2.6. Look for covered and concealed routes on which to move.

8.2.2.7. Change directions slightly from time to time when moving through tall grass.

8.2.2.8. Cross roads and trails at places that have the most cover and concealment (large culverts, low spots, curves, or bridges).

8.2.2.9. Avoid steep slopes and places with loose dirt or stones.

8.2.2.10. Avoid cleared, open areas and tops of hills and ridges.

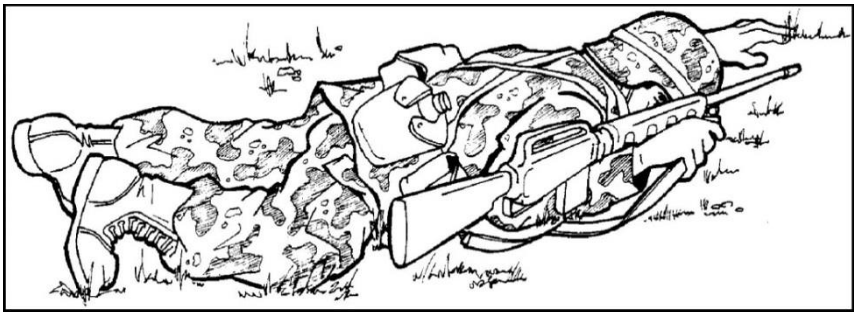
8.2.2.11. If you alarm birds or animals, remain in position and observe briefly.

8.2.2.12. Take advantage of distractions provided by noise.

8.2.3. **Individual Movement Methods.** In addition to walking, four other movement methods may be utilized—low crawl, high crawl, rush, and spider crawl. Bear in mind, these movement methods are meant to be used to keep you out of enemy contact, allow you to reach a covered, concealed position, or withdraw from an area safely. There is no intent to have engineer personnel move toward an enemy force for the purpose of offensive maneuvers or actions.

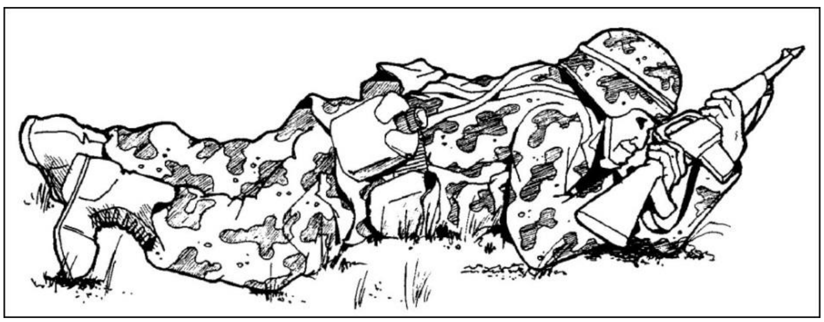
8.2.3.1. Low Crawl. The low crawl (**Figure 8.4**) provides the lowest silhouette. Use it to cross places where the concealment is very low and enemy fire or observation prevents you from rising from the prone position. Keep your body flat against the ground. With your firing hand, grasp your weapon sling at the upper sling swivel. Let the front hand-guard rest on your forearm (keeping the muzzle off the ground), and let the weapon butt drag on the ground. To move, push your arms forward and pull your firing side leg forward. Then pull with your arms and push with your leg. Continue this action throughout the move.

Figure 8.4. Low Crawl Provides the Lowest Silhouette



8.2.3.2. High Crawl. The high crawl (**Figure 8.5**) lets you move faster than the low crawl and still give you a low silhouette. Use this crawl when there is good concealment but enemy fire prevents you from moving in an upright posture. Keep your body off the ground and resting on your forearms and lower legs. Cradle your weapon in your arms and keep its muzzle off the ground. Keep your knees well behind your buttocks so your body will stay low. To move, alternately advance your right elbow and left knee, then your left elbow and right knee.

Figure 8.5. High Crawl Permits Faster Movement and Low Silhouette

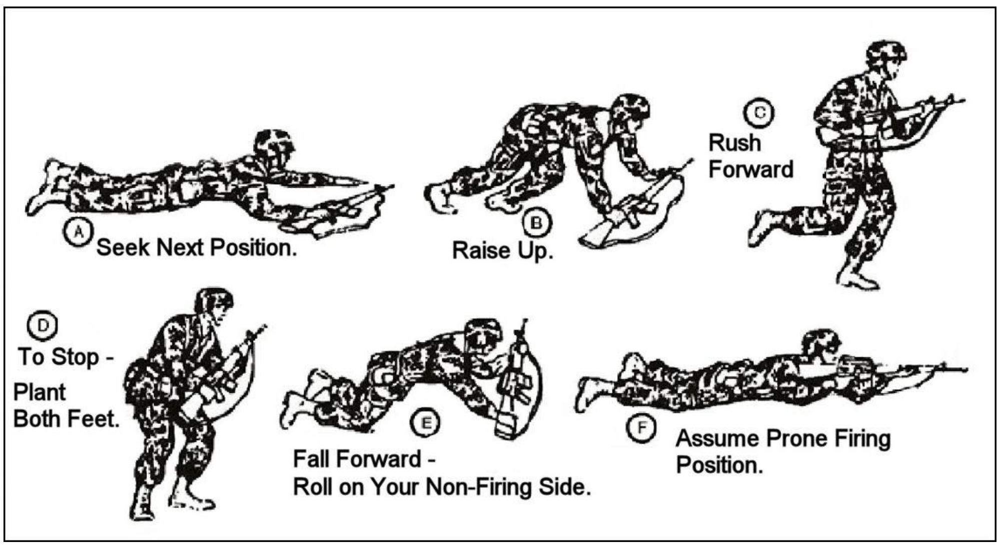


8.2.3.3. Short Rush. The short rush is the fastest way to move from one position to another. Each rush should last from 3 to 5 seconds. Rushes are kept short to keep enemy machine gunners or riflemen from tracking you. However, do not stop and hit the ground in the open just because 5 seconds have passed. Always try to hit the ground behind cover. Before moving, pick out your next cover and concealed position and the best route to it. Make your move from the prone position as explained in **Table 8.1** and illustrated in **Figure 8.6**.

Table 8.1. Short Rush Procedures

Short Rush Movement
Slowly raise your head and pick your next position and the route to it
Slowly lower your head
Draw your arms into your body (keeping your elbows in)
Pull your right leg forward
Raise your body by straightening your arms
Get up quickly
Run to the next position
When you are ready to stop moving, plant both of your feet
Drop to your knees (at the same time slide a hand to the butt of your weapon)
Fall forward, breaking the fall with the butt of the weapon
Go to a prone firing position

Figure 8.6. The Short Rush Method

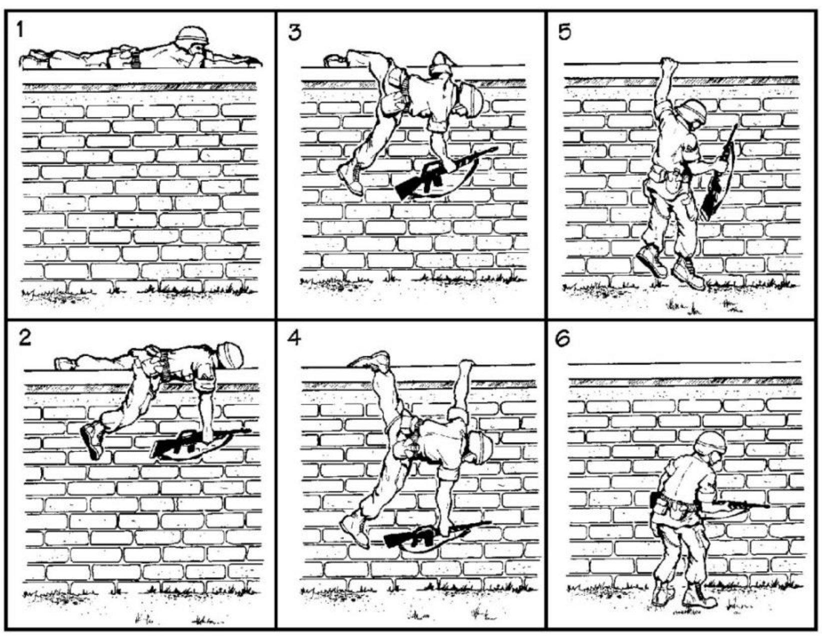


8.2.3.4. Spider Crawl. At times, it may become necessary to descend to the ground quickly from an elevated position or to move over an obstacle. To jump to the ground may cause injury due to unfamiliarity with the terrain or height of the obstacle. The "spider crawl" is used in these circumstances to avoid injury and to reduce your silhouette while going over an object. Perform the "spider crawl" as explained in **Table 8.2** and illustrated in **Figure 8.7**.

Table 8.2. The "Spider Crawl" Technique

Spider Crawl	
1	As you move along the obstacle or structure, you must maintain a low profile to reduce the silhouette; place your weapon in your lead hand
2	Your leading hand and foot are extended over the edge of the obstacle in a "spread eagle" position while your trailing hand and foot is pressed firmly against the top of the obstacle
3	Your lead hand and foot are slowly extended down the vertical face of the obstacle until only your trail hand and foot is on the top
4	Your trail foot is released, closely followed by your trail hand using your lead hand as a pivot to control the drop
5	You should land on the balls of your feet, with your legs spread approximately shoulders width; your knees should be flexed and your body should be in a slightly crouched position hugging the obstacle
6	The "spider crawl" should be practiced for both right-handed, as well as left-handed descent; the placement of your lead hand will determine which direction you will be facing once you hit the ground

Figure 8.7. "Spider Crawl" Movement



8.2.4. **Team or Small Group Movements.** For those occasions when engineer personnel have to move into an unsecured or potentially hostile area remote from the main installation or at a location off the installation, small group movement techniques may be necessary. In such situations, organizing personnel into fire team formations may provide the best defense. See Field Manual (FM) 3-21.8, *The Infantry Rifle Platoon and Squad*, for additional information. Fire teams normally consist of four-man groups. Each team member is identified by number (1, 2, 3, and 4). **Note:** For our purposes, all members are riflemen with the number four man being the team leader.

8.2.4.1. The wedge (**Figure 8.8**) is the basic formation for a fire team. The interval between personnel is normally 10 meters (approx. 33 feet). The wedge expands and contracts depending on the terrain. When rough terrain, poor visibility, or other factors make control of the wedge difficult, fire teams modify the wedge. The sides of the wedge can contract to the point where the wedge resembles a single file formation (**Figure 8.9**). When moving in less rugged terrain, where control is easier, personnel expand or resume their original positions.

Figure 8.8. Right and Left Wedge Formations

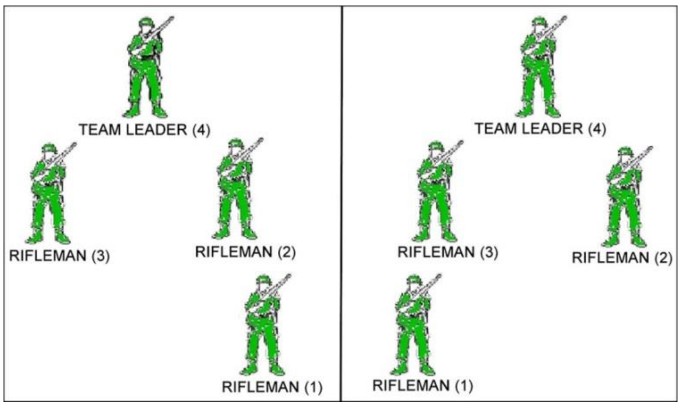
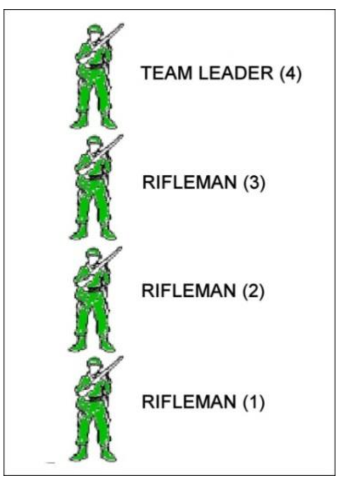
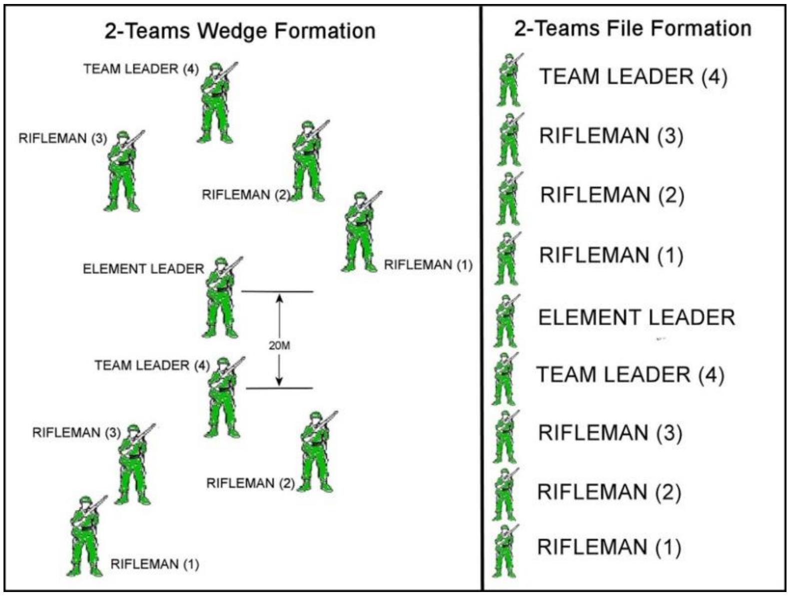


Figure 8.9. File Formation



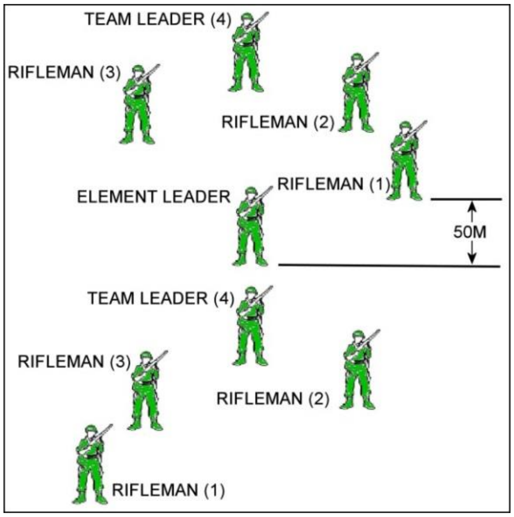
8.2.4.2. If two or more fire teams are to be traveling together, the wedge or file formations are used (**Figure 8.10**). Usually an element leader is also present. A 20-meter (approx. 66 feet) separation between the element leader and the second fire team is normally maintained if contact with an enemy force is not likely.

Figure 8.10. Two Fire Teams in Wedge and File Formations



8.2.4.3. If contact with an enemy force is possible, however, the formation is altered somewhat. The element leader and the second fire team fall back to a 50-meter (approx. 164 feet) separation from the lead fire team (**Figure 8.11**). This formation is called traveling overwatch.

Figure 8.11. Two Fire Team Traveling Overwatch Formation



8.2.4.4. If fired upon during movement, **Figure 8.12** and **Figure 8.13** illustrate the pivoting techniques used for positioning a wedge formation to respond to attacks from the flanks.

Figure 8.12. Left Pivot Movement

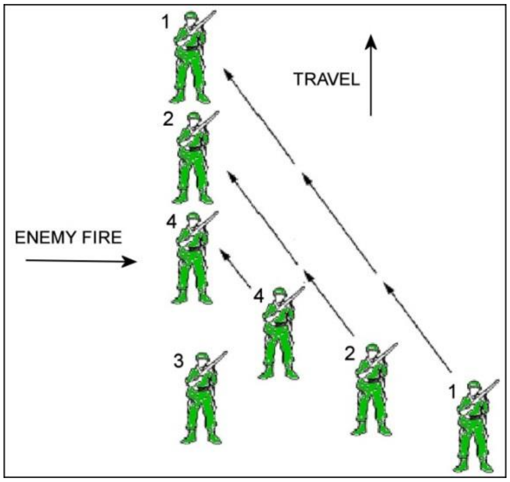
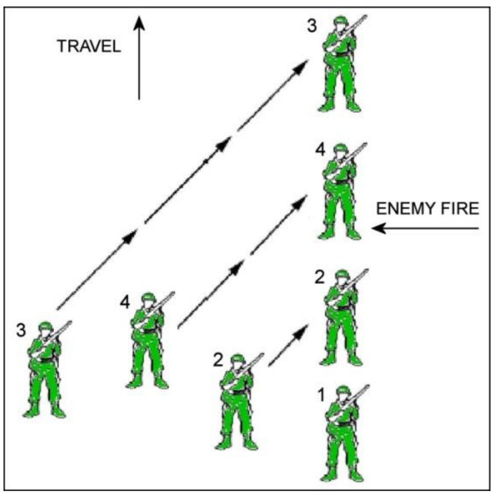


Figure 8.13. Right Pivot Movement



8.3. Convoy Security. Convoys have historically been targets of choice for enemy ambush; therefore, defensive tactics do become an item of keen concern. Admittedly, if dedicated air cover is available, the possibility of ambush is markedly reduced—but even then not entirely eliminated. In today's expeditionary battlefield environment, dedicated air cover does not negate the deadly effectiveness of an enemy's use of IEDs or VBIEDs to disrupt convoys. These threats make it essential to utilize and practice current, battlefield-tested convoy defensive tactics—it can mean the difference between success and failure. Moving personnel and equipment from one place to another is a necessity in most peacetime and wartime military operations. Troops and goods must get to the right place, at the right time, and arrive in good condition. Frequently, road travel in the form of a convoy is the most desirable method of movement. As can be expected, convoys are always organized for a specific purpose and according to a specific plan. However, the general approach to convoy use during peace and war is somewhat different.

8.3.1. **Peacetime Operations.** During times of peace, convoys serve as an efficient way to control the movement of items in mass from one point to another. Logically, in this situation little regard is given to defensive tactics. Things such as keeping the convoy intact, under positive control, and on schedule are at the forefront of concern.

8.3.2. **Wartime Operations.** During periods of conflict, the convoy continues to be an efficient way to move items (**Figure 8.14**). Common AF applications may include transporting items from installations to airports of embarkation and moving WRM from prepositioned sites within a theater to an installation of intended use. Probably a less common use, the convoy may be the logical way to move resources and personnel as part of a base denial effort. Additionally, AF personnel often participate in convoy operations with other services. Regardless of the reason for the convoy movement, wartime military operations expose our convoys to increasing types of threats, including roadside improvised explosive devices (IEDs), vehicle-borne improvised explosive devices (VBIEDs), small arms fire, rocket propelled grenades, sniper attacks, ambushes, and other threats. In this type of threat environment, convoy operations are virtually synonymous with combat operations. Therefore, personnel assigned to convoy duty must be able to respond appropriately to these threats. Refer to AFTTP 3-2.58, *Tactical Convoy Operations*, for specific information on convoy tactics, techniques, and procedures (TTP). In addition, a review of current AF lessons learned at **https://www.jllis.mil/apps/** may provide up-to-date information on convoy procedures in ongoing expeditionary operations.

Figure 8.14. Air Force Engineers on a Convoy Mission in Iraq

8.4. Work Site Entry. Arrival at a work site can cause a letdown in security consciousness since travel has finally been completed. This should not be allowed to happen since an enemy force could be waiting at the work site area just for such a situation. If the work site is not familiar or is known to be in an area that could be frequented by enemy forces, a clearly defined plan should be followed for ensuring access to the area is relatively safe. Although there may be other options to accomplish this, one method uses three fire teams from the convoy procession to perform an area sweep. The convoy stops short of the work site and convoy personnel dismounts and establishes a 360-degree security cordon around the convoy vehicles IAW "short halt" dismount procedures in AFTTP 3-2.58. The three fire teams approach the work site in file formation. Fire team A secures the entry road on the left and fire team C secures the right side of the road. Fire team B enters the work site in wedge formation and walks (sweeps) the site to its forward edge (**Figure 8.15**). When the sweep is completed, fire team A enters the work site and expands to the left. Fire team C then enters the site and expand to the right. Fire team B returns from the forward edge of the work site perimeter and joins with team A and C forming a 360-degree secure area. The remainder of the convoy personnel then remounts their vehicles and quickly enters the work site (**Figure 8.16**). From this point, the commander/leader of the work party has two tasks to perform—establish work party security measures and accomplish the work task itself.

Figure 8.15. Work Site Sweep

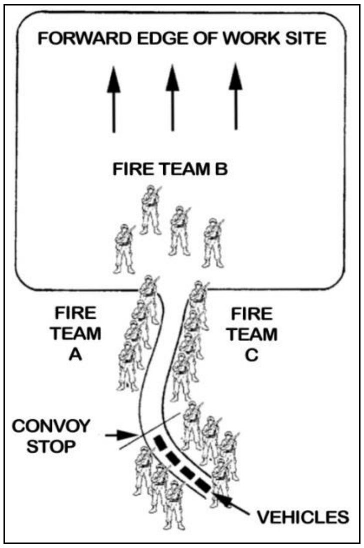
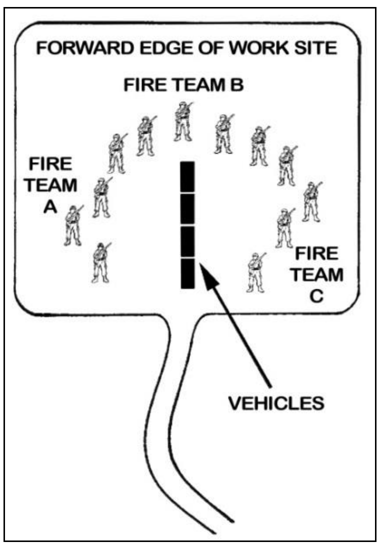


Figure 8.16. Work Site Entry.

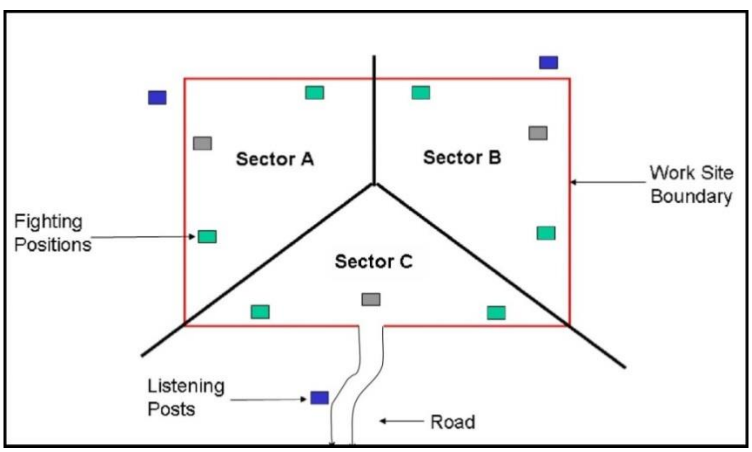


8.5. Work Party Security. Work party security is typically provided by two or three individuals posted on the perimeter of the work area to provide early warning of any impending hostile action. If the work party is fired upon, these individuals will determine the direction of fire; estimate the type, size, and apparent intent of the hostile force; direct the work party to take defensive cover, and call BDOC for SF assistance. Defensive cover, as used in this context, means the occupation of either hasty or deliberate (prepared in advance) defensive fighting positions that take maximum advantage of the terrain at or in the vicinity.

8.5.1. **Defense Sectors.** Upon arriving at a work site, establishing proper security requires more than just posting guards at random locations. To best defend the entire work site, defense sectors should be established. This task requires several actions to be taken. The first action is to establish the exact boundary of the work site. Once this is done, the work party leader/commander and personnel who will be serving as sector commanders walk the perimeter of the work site and establish sector boundaries. Normally the number of sectors is kept between three and five and they need not be all the same size. The size of the sector will depend on the terrain and what resources are within the sector. The important thing to ensure when setting up sectors is that the boundaries between sectors are well defined. This allows personnel defending a sector to know exactly where their terrain defense responsibilities start and end. Refer to AFH 31-109, *Integrated Defense in Expeditionary Environments*, for information on fire control measures and setting up sectors of fire. Once sector locations and boundaries are determined, sector commanders site fighting positions in locations that have clear lines of fire toward the work area perimeter. These positions should be at least the equivalent of a hasty fighting position. If the work site will be occupied continuously for several days or longer, consideration should be given to constructing deliberate positions. Manning of the sector fighting positions should be by pre-established fire teams if possible—this maintains team integrity and pre-identifies a leader "in the trenches."

8.5.2. **Listening Posts.** The purpose of going to a work site is to perform an engineer construction task of some sort. Security, while obviously important, cannot be allowed to consume most of your resources all the time. Normally, a small number of troops are placed on security duty while the remainder performs the engineering task. These security troops will not be sufficient to man all the fighting positions, but a "trip wire" system of listening posts can be used. These listening posts are positioned outside the work site perimeter but close enough to allow individuals to return quickly (**Figure 8.17**). If an enemy force is encountered, the troops manning the listening posts bring the information back to the work site, construction work is ceased, fighting positions are manned, and SF support is immediately requested.

Figure 8.17. Sectors, Fighting Positions, and Listening Posts



8.5.3. **Fighting Position Construction.** When providing defense, personnel need cover from fire and concealment from observation. Cover and concealment are best provided by some type of fighting position. This may be an existing hole, a hastily dug prone shelter, or a well-prepared position with overhead cover. The time available for preparation determines how well you build your position. The basic requirements of a fighting position are that it must allow you to fire and protect you from observation and direct and indirect fire. For detailed information on the construction of defensive fighting positions, refer to AFH 10-222, Volume 14, *Civil Engineer Guide to Fighting Positions, Shelters, Obstacles, and Revetments*, and Graphic Training Aid (GTA) 90-01-011, *Joint Forward Operations Base (JFOB) Force Protection Handbook, Sixth Edition* (FOUO).

8.5.4. **Recognition Code Systems.** A system of constantly changing passwords, number codes, and duress words is an essential part of the security of any military activity during periods of conflict. Code systems afford guards a quick means of identifying both friendly and enemy personnel, even when restrictions prevent visual confirmation. In addition, codes can be used as a spontaneous alerting signal.

8.5.4.1. Passwords. These codes aid a sentry by helping to prevent unauthorized persons from infiltrating the work area perimeter. Passwords are normally given in two parts and changed daily, usually at 1200 hours. They take the form of a challenge (e.g., Papa November) and a counter sign (e.g., Papa Tango). The use of letters from the phonetic alphabet as challenges and counter signs is an agreed North Atlantic Treaty Organization (NATO) procedure and may be used when forces of two or more nations are in the same formation.

8.5.4.2. Number Codes. Number codes are often used in place of passwords. They are normally less than 20 to make response easier and faster. For example if the number code is 15, a challenge could be 9 with a counter sign of the number 6. The challenge and counter sign may be spoken, written, or transmitted visually using hand signals. You may want to avoid using numbers that are half the challenge number because an enemy could simply mimic your gesture or number and be accurate.

8.5.4.3. Duress Words. A duress word is one word used to alert a friendly listener that the transmitting party is in duress. When selecting and using such a code, consider the following:

8.5.4.3.1. Select a word that is not subject to routine use yet is also not exotic. The words chow and serendipitous are either too commonplace or exotic to be effective, whereas, the words boot or belt may well prove effective.

8.5.4.3.2. Use the word in casual dialog so it is not obvious; this allows the listener to take action without alerting the enemy.

8.5.5. **Radio Communication.** Radios are the most frequently used means of communication. They are particularly suited for use when you are on the move and need a means of maintaining C2. Small handheld or backpacked radios that communicate for short distances are ideal for small unit use. As the need grows to talk over longer distances and to more units, the size and complexity of radios increase. To put radios to good use, first look at some of the things that affect radio communications.

8.5.5.1. To communicate with each other, radios must have a common frequency. They must also be able to transmit and receive the same type of signal. Most Prime BEEF radios are frequency modulation (FM) and will not communicate with amplitude modulation (AM) radios. Squelch settings on radios must also be set correctly.

8.5.5.2. Factors that affect the range of radio equipment are weather, terrain, antenna, power, and the location of the unit itself. Trying to communicate near man-made objects such as bridges and buildings may also affect radio transmissions. Interference in the form of static often occurs when you use radios near power lines or electrical generators. Interference may also come from other radio stations, bad weather, or enemy jamming. Many of the things that cause poor radio communications can be corrected by using common sense. Such things as making sure that you are not trying to broadcast from under a steel bridge or near generators and power lines, using the best available antenna, and selecting the proper site will help ensure more reliable communications.

8.5.5.3. Using COMSEC denies or delays unauthorized personnel from gaining information of value from telecommunications. Below are some common COMSEC practices:

8.5.5.3.1. Use authentication to ensure the other communications station is a friendly one

8.5.5.3.2. Designate periods when all radio equipment is to be turned off

8.5.5.3.3. Restrict the use of radio transmitters (monitoring radio receivers/listening silence)

8.5.5.3.4. Enforce net discipline and radio procedures

8.5.5.3.5. Use proper site selection, minimum power, and minimum transmission times

8.5.5.3.6. Use directional antennas when possible

8.5.6. **Visual Communications.** Radio jamming enhancements are causing more emphasis to be placed on visual communication for C2. Visual signals include arm and hand signals, pyrotechnics, smoke, flashing lights, and panel markers. Obviously, the effectiveness of any signal will depend upon a set of prearranged meanings. Assign prearranged meanings to visual signals for both senders and receivers so both have the same understanding of what a particular signal means. Generally, a listing of prearranged messages using these signals is included in a unit's operating instructions. Visual signals, however, have some shortcomings that limit their use. For example, visual signals can be easily misunderstood, limited by poor visibility such as night or in dense terrain, and can be intercepted by the enemy and reused to create confusion.

8.5.7. **Sound Communications.** Sound signals, like visual signals, depend upon a set of prearranged meanings. Sound signals include the use of the voice, whistles, horns, weapons, and other noise-making devices to transmit simple messages over short distances. In addition, like visual signals, sound signals are vulnerable to enemy interception and use and susceptible to misinterpretation. Their best application is as installation C2 warning alarms. The prearranged meanings for sound signals are usually established by local commanders and are listed in the unit operating instructions.

8.5.8. **Wire Communications.** Wire communication will not often be used during a work party undertaking. However, since it does have an application with other Prime BEEF activities such as beddown, it will be briefly addressed here. Wire is another type of communication used during ground operations. Although installing a wire network takes more time than installing a radio, wire lines are usually more secure. In general, a wire network gives better communication because it is less subject to interference from weather, terrain, and man-made obstacles. Wire lines also protect you from enemy electronic warfare actions such as jamming. However, wire lines are subject to breakage by vehicular traffic or enemy offensive action—a major drawback.

8.5.9. **Messenger Communications.** Unlike other field communications, messengers are a means of transmitting large and bulky items such as maps and documents as well as oral and written correspondence. Messengers are the most secure means of communications, but there are also negative aspects with using messengers. Specifically, they are subject to enemy action, require more time than radio or wire communications, and do not afford "real time" writer-to reader exchanges. If messengers are used routinely, do not forget to vary their movement schedules and routes periodically.

8.5.10. **Weapons Accountability.** Firearms are prone to theft. Certain military-unique types, because of their great casualty potential and their non-availability in commercial markets, are particularly susceptible. Recognizing this, the DOD has established precise and exacting standards for protecting firearms against pilferage. AFI 31-101, *Integrated Defense*, outlines requirements for protecting firearms.

8.5.10.1. Protection Philosophy. All commanders and supervisors must give continuing special attention and emphasis to protecting firearms. Weapons must only be removed from a designated storage area for as short a time as possible and in as small a quantity as is needed to support specific missions or projects. Other requirements include:

8.5.10.1.1. Only government-owned facilities will be used to store government-owned firearms.

8.5.10.1.2. The SF chief provides staff supervision over the firearms protection program IAW AFI 31-101.

8.5.10.1.3. All firearms must be continuously attended or guarded when they are removed from approved storage areas. Persons issued or in the possession of arms, ammunition, and explosives are responsible for protecting their items while entrusted with their care. They must make sure that all items are under positive control at all times.

8.5.10.1.4. Mobility weapons in storage should be placed in containers configured and clearly identified by a Prime BEEF team to allow ease of issuance. Be sure proper numbers of supplementary items such as cleaning kits and holsters are appropriately packed with the weapons. When weapons are in transit, stored in depots or warehouses, or held for contingencies, the containers must be banded or locked and sealed.

8.5.11. **Protecting Firearms off the Military Installation or Under Field Conditions.** When deployed in the field for actual or exercise purposes, firearms must be under continuous positive control. Depending on the threat situation in the immediate area, commanders may elect to consolidate firearms in a central location to make surveillance easier. Weapons are never left unattended or unsecured. Personnel charged with custody of stored weapons should be armed and must have the capability to sound an alarm if a forceful theft is attempted. An armed response force must be established with the capability of responding within a reasonable time (normally 15 minutes). When traveling off the installation with weapons during deployments (ground transport in secure area) or when obtaining commercial air transportation, weapons must be placed in locked, banded, or sealed containers. Ammunition will be placed in containers in accordance with shipping or security regulations, follow Transportation Security Administration or United States Transportation Command guidance for proper shipping or labeling of firearms and munitions. AFI 31-101 outlines requirements for protecting firearms under field conditions.

8.6. Augmentation of the Base Defense Force. As outlined in AFI 31-101, "Effects-based integrated defense (ID) is a fundamental battle competency for all Airmen, regardless of location, and requires active participation by all to ensure success." The degree of participation by base units and personnel is usually predetermined in the ID plan (IDP). Normally, CE forces will be assigned to protect an engineer resource (owner/user security) or augment SF in a specific sector. When performing in the base defense mode on AF installations, CE personnel will typically be under tactical control (TACON) of the SF Commander or Defense Force Commander (DFC). Detailed procedures for engineer units supporting ID efforts should be prepared and included in the CE CRP. See AFH 31-109, *Integrated Defense in Expeditionary Environments*, and AFPAM 10-219, Volume 2, for specific base defense preparations and ID measures.

8.7. Owner/User Security Procedures. CE unit owner/user security procedures are an integral part of base defense. Unit ID efforts should integrate with installation ID operations. Owner/user security involves using a unit's own resources to protect its essential facilities and equipment assets. Good pre-planning and training are necessary to ensure engineer response to a threat to base security is timely and organized. When initiating owner/user security measures, personnel should be informed of exactly where to report and what to do. An officer should be placed in charge of engineer fire teams and maintain constant contact with SF representatives. Shifts should be established and supervisory personnel should make checks on all manned positions at least hourly. Plan to staff all defensive positions with two personnel each and provide all personnel staffing these positions with the following minimum information.

8.7.1. Location of shift leader and how to make contact

8.7.2. Expected/probable direction of enemy attack or infiltration

8.7.3. Area of responsibility, i.e., what ground to watch over

8.7.4. Location of adjacent posts

8.7.5. Location of listening posts if forward of defensive position

8.7.6. Location of friendly forces forward of defensive position if any

8.7.7. Procedure for challenging (work closely with SF on rules of engagement and techniques)

8.7.8. Password and password change times (coordinate with SF on use of recognition codes)

8.7.9. Shift change times and procedures

Chapter 9

BASE DENIAL PROCEDURES

9.1. General Information. Base denial measures are intended to prevent or obstruct enemy use of installation facilities, systems, equipment, and resources. It may involve the functional destruction of certain base infrastructure and equipment, evacuation and contamination of resources, and the destruction of residual supplies. Generally, base denial is an overseas theater task and is implemented when the theater commander directs base evacuation and the follow-on destruction of selected air base systems, military equipment, and supplies. The priorities and extent of asset denial is decided by the theater commander, taking into account any potential value to the enemy.

9.2. General Responsibilities. Once the order is given, the denial of military equipment and supplies is the responsibility of the user. Denial of the air base infrastructure, in large part, will be a CE responsibility. While the need to implement base denial actions may be rare, everyone involved in base denial must know what his or her responsibilities might be and common methods that can be used to physically accomplish their specific base denial task. Normally, not everyone in an organization will play a role in base denial. In fact, the vast majority of the base population will usually be directed to evacuate before consequential denial actions commence. However, if time permits, base denial activities can be expanded to include a large percentage of the base population, but such situations would be the exception rather than the norm. Realistically, only a very limited number of personnel, those assigned and trained as members of the base denial team, will remain behind to perform this vital role. A good rule of thumb to follow when determining denial target responsibilities is to use the same areas of responsibility that exist under peacetime operations. In other words, if you are required to maintain or operate it during peacetime, expect to be the one responsible for denying it to an enemy during wartime.

9.3. Base Denial Team. The actual size and composition of the denial team will be dictated by a number of factors such as the amount of resources identified for destruction, types of items to be destroyed, and the methods of destruction to be employed. Many base denial team assignments will be dictated by AFS. For example, it only makes sense to have CE electrical personnel accomplish base denial actions on electrical systems since they are, as a matter of course, the ones who are intimately familiar with what type of action will best incapacitate the system. The same would also apply to HVAC personnel, heavy equipment operators, WFSM personnel, and FES personnel. Since CE personnel implement most infrastructure denial actions, they will likely be a significant portion of the base denial team.

9.4. CE Activities for Base Denial. Time is usually very short once the order for emergency evacuation and base denial is received. Our CE forces must understand their role and be prepared to carry out denial operations by both explosive and non-explosive methods. As addressed in AFPAM 10-219, Volume 2, there are four conventional methods to accomplish base denial: evacuation, component removal, destruction, and the use of obstacles. Each method may have a place in the overall base denial scenario and planners should select methods that produce the desired results with the least amount of effort. The following paragraphs address some of the more substantial CE-specific base denial responsibilities and measures.

9.4.1. **Airfield Pavement, Railways, Drainage Systems, and Support Equipment.** Pavements and construction equipment personnel will be accountable for roadway, railway, drainage system, and airfield denial. Airfield pavements denial most often will be brought about using a combination of obstacles and explosives. However, to a large degree, the method employed and the extent of damage inflicted will be dictated by how soon and even if we can anticipate regaining physical control of the property. If it is not unreasonable to expect to lose control of the assets for only a short period and enemy use of the airfield during that time will be insignificant to the total battle effort, it may be counterproductive to extensively damage the airfield surfaces. The final decision to seriously deny use of airfield pavements will be made at senior command levels, and the BCE verifies the scope of pavement denial requirements before issuing orders to commence denial operations. Methods for performing denial of pavements, railways, drainage systems, and supporting equipment can take several forms. Below are examples of techniques that can be applied, singularly or in combination, to effect denial actions:

9.4.1.1. Use destroyed vehicles and aircraft, concrete blocks, or any kind of material that is readily available to create obstacles on the runway.

9.4.1.2. Fill 55-gallon barrels with concrete and place in the aircraft landing area/runway.

9.4.1.3. If the airfield has asphalt overlay, saturate selected areas with fuel to severely damage the surface area.

9.4.1.4. Use heavy equipment such as bulldozers and pavement breakers to scar the surface of airfield pavements and damage pavements at intersections and choke points.

9.4.1.5. Place destroyed NAVAIDS, distance-to-go markers, and towers on the runway surface.

9.4.1.6. Block open drainage ditches with rubble, debris, and ADR fill material to cause flooding conditions.

9.4.1.7. Use cement to block major drain areas and break primary drainage piping, particularly in those locations that would cause major airfield flooding.

9.4.1.8. Destroy fiberglass and metal ADR matting by driving over it with a bulldozer until severe deformity occurs. Place this damaged ADR matting on the airfield surfaces. Destroy any ADR component kits in the same manner.

9.4.1.9. Weave barbed tape/concertina wire around any obstacles placed on pavement surfaces.

9.4.1.10. Rip up railroad spurs with heavy equipment, burn crossties, and bend rails. However, be careful with timing, because rail movement could be used as a means of personnel and equipment evacuation.

9.4.1.11. Destroy and abandon on airfield surfaces any equipment not being evacuated by draining the oil and running the equipment.

9.4.2. **Electrical Systems and Power Production.** Personnel in the electrical systems AFS will be responsible for destruction of the base power grid and its associated support complexes. This will normally include primary and secondary distribution systems, major transformer substations, and airfield lighting systems. In addition, power production individuals will be responsible for denial activities involving prime power plants, portable generators, and aircraft arresting systems. Methods for physically accomplishing denial of electrical systems are relatively straight forward. Use sledge hammers to destroy regulators, transformers, insulators, gauges, and shop equipment. Use chain saws to cut utility poles and barrier tapes. Vehicles and heavy equipment can be used to pull over towers (e.g., communications, radar, and approach control) and destroy arresting barrier facilities. Generators and arresting barrier units can be destroyed by draining engine oil as the units are running. Lastly, key items in bench stocks, special levels, and WRM can be destroyed using some of the same methods as above.

9.4.3. **Mechanical Systems.** HVAC personnel will be responsible for disabling all critical base mechanical systems. At some theater locations, this may also include cold storage and ice plant facilities. WFSM personnel should take necessary steps to deny the use of both their system and product. The actual physical destruction of the pipeline itself may not be the easiest and most effective way of denying this crucial asset to an enemy. Instead, efforts should concentrate on contamination of bulk storage supplies and the destruction of key distribution system control components such as automatic valves and pumps. Denial of mechanical systems is most easily done by physically destroying the components. Use sledge hammers to break coils, motors, condensers, pumps, gauges, heaters, cooling units, automatic valves, and system control devices. Use cutting torches to destroy boiler units, heavy metal, and spare parts. Contaminate bulk fuel storage facilities by adding water, used oil, or similar substances to the fuel supplies. Due to the extreme hazard posed by some liquid fuels, draining the fuel out of the storage tanks is not recommended. However, burning of tank farms upon evacuation from the installation is a viable denial method.

9.4.4. **Structures and Utilities.** Structures and utility systems personnel have the primary responsibility of destroying buildings and the water and sewage distribution systems. Structures individuals should obtain technical assistance from fire fighting personnel in burning facilities and any other bulk materials such as lumber and paint supplies. They should also use their skills with cutting torches to damage metal support structures like bridges and aircraft shelter door rail systems. WFSM personnel should direct their efforts toward disabling both the potable water and sewage distribution systems. Some of the key areas to concentrate on here include deep well pumps, pumping stations; storage tanks, chlorination equipment, and sewage lift stations. Numerous methods of denying facilities and supporting utility systems are available. Some of the more useful ones include the following:

9.4.4.1. Collapse facilities by using vehicles and cables to remove load-bearing members.

9.4.4.2. Use cutting torches to cut out supporting beams to buildings such as warehouses, aircraft hangars, and maintenance areas.

9.4.4.3. Use sledge hammers/jack hammers to breakup bricks, concrete block, and concrete walls.

9.4.4.4. Place debris in major drain areas to cause facility flooding.

9.4.4.5. Set fire to facilities that are constructed from easily burned materials.

9.4.4.6. Flood facilities that have belowground utility rooms and basements or are underground.

9.4.4.7. Use sledge hammers to break up pumps, motors, and main water lines within pump houses and water plants.

9.4.4.8. Destroy fire hydrants using heavy construction equipment.

9.4.4.9. Drain and puncture water storage facilities.

9.4.4.10. Use cutting torches to cut supporting members of elevated water towers.

9.4.4.11. Pour cement and debris into main sewage lines and manholes.

9.4.4.12. Cut up, burn, or otherwise destroy shop stocks and construction materials.

9.4.5. **Fire Demolition.** FES personnel will be looked upon to provide technical assistance during base denial activities primarily with respect to burning of base facilities and supplies. They should also expect to assist in flooding of any base facilities, if necessary. FES vehicles should be included as part of the evacuation contingent and should be loaded with as much fire fighting equipment as possible. Any vehicles left behind should be stripped of parts and components, and any fire fighting supplies that will not be taken should normally be destroyed.

9.4.6. **Explosive Demolition.** Except in extreme cases, traditional engineer crafts personnel will not actively conduct explosive demolition. The task falls within the scope of responsibility of EOD personnel and RED HORSE Squadron (RHS) demolition teams. Some engineer forces, particularly construction equipment operators, can expect to be tasked to support EOD operations if earthwork, excavation, berming, etc., need to be accomplished as part of the demolition process. Major critical facilities and airfield pavements are the prime candidates for explosive demolition. Procedures for explosive demolition are contained in T.O. 11A-1-66, *General Instructions, Demolitions*.

9.4.7. Regardless of specific responsibilities and techniques, effective implementation of any base denial activity requires a team effort. As has already been brought out, expect time to be very limited and the workload to be excessive. You must follow the priority listing; there is a distinct possibility that limited time or resources will not allow you to complete all desired tasks. Safety is no less important than during peacetime, even in this hectic environment. Just because haste is a prime consideration, do not become a casualty of carelessness. Always let common sense and good judgment prevail. Since accomplishing your mission may be a monumental undertaking, the bottom line is teamwork. Each team member must be totally capable—knowing what to do, how to do it, and when to do it.

9.5. Withdrawal and Evacuation. The final phase of base denial involves withdrawal and evacuation of base denial team personnel and equipment. As explained in AFPAM 10-219, Volume 1, these activities are preplanned during the attack preparation phase of the contingency.

9.5.1. At the onset of base denial efforts, several key actions must be taken to ensure all personnel are aware of their responsibilities and requirements with respect to withdrawal and evacuation once physical base denial missions have been completed. As a minimum, all personnel must be informed of the following items:

9.5.1.1. Anticipated time available for base denial actions.

9.5.1.2. Assembly location(s) for departure convoys.

9.5.1.3. Convoy method (rail, vehicle, etc.).

9.5.1.4. Personnel accountability procedures.

9.5.1.5. Preplanned withdrawal routes and end-point locations.

9.5.1.6. Personal gear requirements.

9.5.2. While physical base denial actions are ongoing, another group of individuals must be designated to prepare the departure convoy for movement. In all likelihood, this group will encompass personnel from several base organizations; however, you can plan on having many engineer personnel involved as well due to the unique nature of much of the engineer equipment that will be evacuated (e.g., fire vehicles, heavy equipment). These individuals are responsible for accomplishing the following tasks:

9.5.2.1. Gathering and loading supplies and materials to be evacuated on transport vehicles

9.5.2.2. Setting up the convoy Order of March

9.5.2.3. Fueling and servicing of convoy vehicles

9.5.2.4. Preparing route maps for convoy drivers

9.5.2.5. Gathering and checking communications equipment

9.5.2.6. Reconnoitering the route to be taken checking for obstacles, choke points, proper traffic signs, etc.

9.5.2.7. Coordinating with destination point personnel to ensure support for evacuating personnel.

9.5.2.8. Arranging for en route SF escort support if necessary

9.5.3. In summary, the destructive work associated with the execution of base denial procedures requires skill and resourcefulness. Since the employment of explosive demolition methods; a most effective means for destruction of denial targets, may not be possible for a variety of reasons (shortage of EOD personnel or explosives; numerous taskings in too short a time frame; requirements to conceal our intentions; etc.), highly effective conventional, non-explosive denial methods should be available for used by the CE organization. Once physical base denial actions have been accomplished, an orderly withdrawal and evacuation complete the base denial process.

JUDITH A. FEDDER, Lieutenant General, USAF
DCS/Logistics, Installations and Mission Support

Attachment 1

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Abbreviations and Acronyms

ADAT—Airfield Damage Assessment Team

ADR—Airfield Damage Repair

AFCEC—Air Force Civil Engineer Center

AFH—Air Force Handbook

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPAM—Air Force Pamphlet

AFPD—Air Force Policy Directive

AFRIMS—Air Force Records Information Management System

AFS—Air Force Specialty

AFTTP—Air Force Tactics, Techniques and Procedures

AFVA—Air Force Visual Aid

AGE—Aerospace Ground Equipment

APD—Advanced Portable Detector

APW—Air-Pressurized Water

BCE—Base Civil Engineer

BDOC—Base Defense Operations Center

CAF—Compressed Air Foam

C2—Command and Control

CAT—Crisis Action Team

CBRN—Chemical, Biological, Radiological, and Nuclear

CBRNE—Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive

CCA—Contamination Control Area

CCP—Casualty Collection Point

CCT—Contamination Control Team

CE—Civil Engineer

CIP—Common Installation Picture

CO_2—Carbon Dioxide

COA—Course of Action

COMSEC—Communications Security

CONUS—Continental United States

COOP—Continuity of Operations

COP—Common Operational Picture

CRP—Contingency Response Plan

CW—Chemical Warfare

DART—Damage Assessment Response Team

DC—Dry Chemical

DFC—Defense Force Commander

DOD—Department of Defense

DRF—Disaster Response Force

EALS—Emergency Airfield Lighting System

ECC—Emergency Communications Center

EM—Emergency Management

EMS—Emergency Medical Services

EMST—Emergency Management Support Team

EOC—Emergency Operations Center

EOD—Explosive Ordnance Disposal

EOR—Explosive Ordnance Reconnaissance

FES—Fire Emergency Services

FM—Field Manual

FPCON—Force Protection Condition

GIS—Geospatial Information Systems

GTA—Graphic Training Aid

HAZMAT—Hazardous Material

HHQ—Higher Headquarters

HVAC—Heating, Ventilation, and Air Conditioning

IAW—in accordance with

IC—Incident Commander

ID—Integrated Defense

IDP—Integrated Defense Plan

IED—Improvised Explosive Device

IEMP—Installation Emergency Management Plan

IMT—Information Management Tool

IPE—Individual Protective Equipment

JFOB—Joint Forward Operations Base

LMR—Land Mobile Radio

MAAS—Mobile Aircraft Arresting System

MAJCOM—Major Command

MAOS—Minimum Airfield Operating Surface

MOPP—Mission Oriented Protective Posture

MOS—Minimum Operating Strip

MRAP—Mine-Resistant, Ambush-Protected

NATO—North Atlantic Treaty Organization

NAVAIDS—Navigational Aids

O&M—Operation and Maintenance

OCONUS—Outside Continental United States

OPR—Office of Primary Responsibility

OPSEC—Operations Security

PAR—Post Attack Reconnaissance

POL—Petroleum, Oils and Lubricants

PPE—Personal Protective Equipment

PPM—Parts per Million

Prime BEEF—Prime Base Engineer Emergency Force

R&EM—Readiness and Emergency Management

RDS—Records Disposition Schedule

RHS—RED HORSE Squadron

RURK—Rapid Utility Repair Kit

SAR—Search and Rescue

SF—Security Forces

SIPRNet—SECRET Internet Protocol Router Network

SMT—Shelter Management Team

STE—Secure Telephone Equipment

TACON—Tactical Control

TACAN—Tactical Air Navigation

TDY—Temporary Duty

T.O.—Technical Order

TTP—Tactics, Techniques, and Procedures

UCC—Unit Control Center

UFC—Unified Facilities Criteria

UMD—Unit Manning Document

US—United States

USAF—United States Air Force

UXO—Unexploded Explosive Ordnance

VBIED—Vehicle-Borne Improvised Explosive Device

WaFERS—Water and Fuels Expedient Repair Systems

WFSM—Water and Fuels System Maintenance

WRM—War Reserve Materiel

Terms

Air Force Civil Engineer Center—An AF Installation Mission Support Center Primary Subordinate Unit (PSU) headquartered at Joint Base San Antonio-Lackland, Texas. The Readiness Directorate (AFCEC/CX) located at Tyndall Air Force Base Florida, provides readiness and emergency services support to the Air Force civil engineer community through technical information and standardized methodology, enabling civil engineers worldwide to execute their expeditionary combat support and emergency services missions safely, effectively and efficiently. Also called **AFCEC**.

Base Civil Engineer—The office of primary responsibility for all activities and measures the installation designs or takes to protect Air Force resources from the effects of attacks, natural disasters and major accidents; to restore primary mission assets after disasters; and to fulfill the humanitarian disaster relief responsibilities of commanders. Also called **BCE**.

Base Defense—The local military measures, both normal and emergency, required to nullify or reduce the effectiveness of enemy attacks on, or sabotage of, a base, to ensure that the maximum capacity of its facilities is available to US forces. (JP 1-02)

Base Denial—Removal of resources from a threatened area, rendering resources unusable by removal of parts, contamination (other than by nuclear, biological or chemical means), immobilization or partial or total destruction of military equipment, supplies or infrastructure.

CE Contingency Response Plan—The plan of action the BCE develops to prepare for and respond to all types of contingencies, emergencies and disasters. Also called **CRP**.

Command and Control—The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Also called **C2**. (JP 1-02)

Common Operational Picture—A single identical display of relevant information shared by more than one command that facilitates collaborative planning and assists all echelons to achieve situational awareness. Also called **COP**. (JP 1-02)

Continental United States—United States territory, including the adjacent territorial waters, located within North America between Canada and Mexico. Also called **CONUS**. (JP 1-02)

Contingency—A situation requiring military operations in response to natural disasters, terrorists, subversives, or as otherwise directed by appropriate authority to protect US interests. (JP 1-02)

Continuity of Operations—The degree or state of being continuous in the conduct of functions, tasks, or duties necessary to accomplish a military action or mission in carrying out the national military strategy. Also called **COOP**. (JP 1-02)

Convoy—A group of vehicles organized for the purpose of control and orderly movement with or without escort protection that moves over the same route at the same time and under one commander. (JP 1-02)

Crisis Action Team (CAT)—A staff formed by the commander to plan, direct, and coordinate forces in response to contingencies, crises, natural/manmade disasters, or wartime situations. The CAT develops courses of action and executes the commander's and HHQ's directives. The composition and function of the CAT is largely mission driven and therefore a MAJCOM or unit commander prerogative. However, membership for the CAT is most frequently a combination of the commander's senior staff and special staff, which includes a CP representative. The composition of a CAT varies according to the situation. (AFI 10-207)

Decontamination—The process of making any person, object, or area safe by absorbing, destroying, neutralizing, making harmless, or removing chemical or biological agents or by removing radioactive material clinging to or around it.

Defense Force Commander—The senior Air Force commander responsible for the air base normally delegates operational authority to conduct integrated defense to the defense force commander. The defense force commander exercises command and control through an established chain of command and directs the planning and execution of base defense operations.

Also called DFC. (AFDD 3—10)

Defensive Fighting Positions—Fortifications constructed at various locations around an installation to assist in base defense operations. These positions can vary from hastily built bunkers to elevated, hardened towers. Usually constructed to support security forces requirements, fighting positions can also be built for work party security purposes or specific point defense needs. Also called **DFP**.

Deployment—The rotation of forces into and out of an operational area.

Detection—In chemical, biological, radiological, and nuclear environments, the act of locating chemical, biological, radiological, and nuclear hazards by use of chemical, biological, radiological, and nuclear detectors or monitoring and/or survey teams. (JP 1-02)

Disaster Response Force—The Air Force structure that responds to disasters or accidents, establishing C2 and supporting disaster operations. Also called **DRF**. (AFI 10-2501)

Dispersal—Relocation of forces for the purpose of increasing survivability. (JP 1-02)

Emergency Airfield Lighting Set—A rapidly installed runway lighting system designed for contingency airfield and other locations that need temporary airfield lighting. Included are runway edge lighting, approach lighting, threshold/end lighting, taxiway lighting, Precision Approach Path Indicator (PAPI) lights, Distance-To-Go (DTG) marker lighting, and obstruction lighting. Also called **EALS**.

Emergency Management Support Team (EMST)—The EMST (formerly the Readiness Support Team [RST]), is a trained team that augments the R&EM Flight during emergency response or natural disaster operations.

Emergency Operations Center—A temporary or permanent facility where the coordination of information and resources to support domestic incident management activities normally takes place. Also called **EOC**. (JP 1-02)

Emergency Operations Center (EOC)—For the purposes of AFIMS, the EOC is the C2 support elements that directs, monitors, and supports the installation's actions before, during, and after an incident. The EOC is activated and recalled as necessary by the Installation Commander. The EOC updates the CAT with ongoing incident status and seeks support through the CAT when on-scene requirements surpass the installation's inherent capability and the installation's cumulative capabilities acquired through mutual aid agreements. According to the National Response Framework (NRF), the EOC is defined as "The physical location at which the coordination of information and resources to support attack response and incident management activities normally takes place. An EOC may be a temporary facility or may be located in a more central or permanently established facility, perhaps at a higher level of organization within a jurisdiction. EOCs may be organized by major functional disciplines such as fire, law enforcement, and medical services, by jurisdiction such as Federal, State, regional, county, city, tribal, or by some combination thereof." (AFI 10-2501)

Explosive Ordnance Disposal—The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. Also called **EOD**. (JP 1-02)

Explosive Ordnance Reconnaissance—Reconnaissance involving the investigation, detection, location, marking, initial identification, and reporting of suspected unexploded ordnance, by explosive ordnance reconnaissance agents, in order to determine further action. Also called **EOR**.

Facility—A real property entity consisting of one or more of the following: a building, a structure, a utility system, pavement, and underlying land. (JP 1-02)

Halon—An inert gas used as a fire fighting agent.

Hardening—The process of providing protection of personnel, equipment, and facilities against the effects of CBRNE weapons.

Host Nation—A nation that receives the forces and/or supplies of allied nations and/or NATO organizations and permits such forces and supplies to be located on, operate in, or transit through its territory. Also called **HN**. (JP 1-02)

Host Nation Support—Civil and/or military assistance rendered by a nation to foreign forces within its territory during peacetime, crises or emergencies, or war based on agreements mutually concluded between nations. (JP 1-02)

Incident— An occurrence, caused by either human action or natural phenomena, that requires action to prevent or minimize loss of life, or damage, loss of, or other risks to property, information, and/or natural resources. (JP 1-02)

Incident Commander (IC)—The command function is directed by the IC, who is the person in charge at the incident and who must be fully qualified to manage the response. Major responsibilities for the IC include: performing command activities, such as establishing command; protecting life and property; controlling personnel and equipment resources; maintaining accountability for responder and public safety, as well as for task accomplishment; establishing and maintaining an effective liaison with outside agencies and organizations, including the EOC, when it is activated.

Individual Protective Equipment—In chemical, biological, radiological, or nuclear operations, the personal clothing and equipment required to protect an individual from chemical, biological, and radiological hazards and some nuclear hazards. Also called **IPE**. (JP 1-02)

Installation Commander—The individual typically responsible for all operations performed by an installation, normally the host unit commander. (AFI 10-207)

Integrated Defense—The integration of multidisciplinary active and passive, offensive and defensive capabilities, employed to mitigate potential risks and defeat adversary threats to Air Force operations. Also called **ID**. (AFI 31-101)

Main Operating Base—A facility outside the United States and US territories with permanently stationed operating forces and robust infrastructure. Main operating bases are characterized by command and control structures, enduring family support facilities, and strengthened force protection measures. Also called **MOB**. (JP 1-02)

Minimum Operating Strip—A runway which meets the minimum requirements for operating assigned and/or allocated aircraft types on a particular airfield at maximum or combat gross weight. Also called **MOS**.

Mobile Aircraft Arresting System—An airliftable, towable aircraft arresting system capable of rapidly being installed on a minimum operating strip. Also called **MAAS**.

Navigational Aids—A collective term encompassing aids to navigation such as TACAN, RAPCON, Middle Markers, and mobile control tower. Also called **NAVAIDS**.

Petroleum, Oils, and Lubricants—A broad term which includes all petroleum and associated products used by the Armed Forces. Also called **POL**. (JP 1-02)

Personal Protective Equipment (PPE)—The protective clothing and equipment provided to shield or isolate a person from the chemical, physical, and thermal hazards that can be encountered at a hazardous materials incident. Also called **PPE.** (JP 1-02)

Potable Water—Water which is safe for consumption.

Prime BEEF (Base Engineer Emergency Force)—A Headquarters US Air Force, major command (MAJCOM), and base-level program that organizes civil engineer forces for worldwide direct and indirect combat support roles. It assigns civilian employees and military personnel to both peacetime real property maintenance and wartime engineering functions.

RED HORSE Squadron—Air Force squadron with a highly mobile, self-sufficient, rapidly deployable, civil engineering heavy repair and construction capability. Also called **RHS**.

SECRET Internet Protocol Router Network—The worldwide SECRET-level packet switch network that uses high-speed internet protocol routers and high-capacity Defense Information Systems Network circuitry. Also called **SIPRNET**. (JP 1-02)

Splinter-Protected—Protected using steel bin revetments, sandbags, earth berms, concrete revetments, or other expedient methods.

Staging—Assembling, holding, and organizing arriving personnel, equipment, and sustaining materiel in preparation for onward movement. (JP 1-02)

Standpipe and Hose System—An arrangement of piping, valves, hose connections and allied equipment installed in a facility so water can be discharged through a hose and nozzle for immediate fire fighting by trained firefighters or building occupants.

Tactical Control—The authority over forces that is limited to the detailed direction and control of movements or maneuvers within the operational area necessary to accomplish missions or tasks assigned. Also called **TACON**. (JP 1-02)

Technical Rescue—The application of special knowledge, skills, and equipment to safely resolve unique and/or complex rescue situations.

Unexploded Explosive Ordnance—Explosive ordnance which has been primed, fused, armed or otherwise prepared for action, and which has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material and remains unexploded either by malfunction or design or for any other cause. Also called **UXO**. (JP 1-02)

War Reserve Materiel—Materiel required in addition to primary operating stocks and deployment (mobility) equipment necessary to attain objectives in the scenarios approved for sustainability planning in the Strategic Planning Guidance. Also called **WRM**. (AFI 25-101)

Attachment 2

ENGINEER REACHBACK AND OTHER USEFUL LINKS

Table A2.1. Useful Organizational and Product Links

Useful Links
Air Force Civil Engineer Center (AFCEC): www.afcec.af.mil/
AF Publications and Forms: www.e-publishing.af.mil/
AF Design Guides (AFDG): www.wbdg.org/ccb/browse_cat.php?o=33&c=129
AF Engineering Technical Letters (ETL): www.wbdg.org/ccb/browse_cat.php?o=33&c=125
Whole Building Design Guide (WBDG): www.wbdg.org/
Unified Facilities Criteria (UFC): www.wbdg.org/ccb/browse_cat.php?o=29&c=4
Construction Criteria Base (CCB)/(WBDG): www.wbdg.org/ccb
USACE Protective Design Center (PDC): pdc.usace.army.mil/
Army Publications and Forms: www.apd.army.mil/ProductMap.asp
USACE Afghanistan Engineer District Design Library: www.aed.usace.army.mil/Design.asp
DOD Issuances: www.dtic.mil/whs/directives/
Joint Publications: www.dtic.mil/doctrine/new_pubs/jointpub.htm
Code of Federal Regulations (CFR): www.ecfr.gov/cgi-bin/ECFR?page=browse

Attachment 3

DAMAGE ASSESSMENT WORKSHEETS

Table A3.1. Preliminary Damage Assessment Summary (Example Only)

PRELIMINARY DAMAGE ASSESSMENT SUMMARY					REPORT NO:
INFRASTRUCTURE DESCRIPTION				FACILITY DAMAGE	
#	Type	Facility Designation	Location: (Road, grid, etc.)	Damage Description	Damage Code
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
DAMAGE CODES: 1: Affected (Mostly Cleaning Required) 2: Minor Damage 3: Major Damage 4: Destroyed	SAFETY HAZARDS PRESENT: (e.g. fire, structural, electrical, gas, biological, asbestos, lead, animal)				
Team Chief Rank/Name:			Team Chief Signature:		Date:

Table A3.2. Detailed Facility Damage Assessment Worksheet (Example Only)

DETAILED FACILITY DAMAGE ASSESSMENT WORKSHEET					REPORT NO:
FACILITY INFORMATION			FACILITY DAMAGE		
Facility Number/Designation	Location: (Road, grid, etc.)	Worksheet Number	General Description	Damage Code	Estimated Total Repair Cost
					$

Type Construction (circle all that apply)		LF or SF Affected	Quantity	Repair and Estimated Crew Size	Required Tools/Heavy Equipment	Estimated Repair Time	Estimated Repair Cost
Building:	Wood						$
	Wood-frame						$
	Brick						$
	CMU						$
	Concrete						$
	Metal						$
	Steel Joists						$
Roof:	Flat						$
	Slope						$
	Built-Up						$
	Metal						$
	Asphalt Shingles						$
	Wood Shingles						$
	Tile Shingles						$
Windows:	Wood-frame						$
	Metal-frame						$
	Wood Shutters						$

	Metal Shutters						$
Interior Walls:	Concrete Block						$
	Gypsum Board						$
	Wood						$
	Plaster						$
Floors:	Concrete						$
	Wood						$
	Carpeted						$
Ceiling:	Acoustic Tile						$
	Gypsum Board						$
	Wood						$
	Plaster						$
Fencing:	Wood						$
	Metal						$
	CMU						$
HVAC:	Window						$
	Split						$
	Central						$
Electrical Service:	Primary						$
	Secondary						$
	Paneled						$
	Transformer						$
	Emer. Generator						$
Plumbing:	Toilet						$
	Fixtures/Piping						$
DAMAGE CODES:			SAFETY HAZARDS PRESENT: (e.g. fire, structural, electrical, gas, biological, asbestos, lead, animal)				

1: Affected (Mostly Cleaning Required) 2: Minor Damage 3: Major Damage 4: Destroyed		
Team Chief Rank/Name:	Team Chief Signature:	Date:

Table A3.3. Water Systems Damage Assessment Worksheet (Example Only)

WATER SYSTEMS DAMAGE ASSESSMENT WORKSHEET					REPORT NO:		
System Component	Location	Damage Code	Damage/Repair Description	Required Tools/Heavy Equipment	Estimated Crew Size	Estimated Repair Time	Estimated Repair Cost
Distribution Pipes							$
							$
Pumps/Pump Station							$
							$
Valves							$
							$
Hydrants/Fill Stands							$
							$
Mains							$
							$
Production Unit							$
Storage Unit							$
Treatment Unit							$
							$
							$
							$
DAMAGE CODES: 1: Affected (Mostly Cleaning Required) 2: Minor Damage 3: Major Damage 4: Destroyed			SAFETY HAZARDS PRESENT: (e.g. fire, structural, electrical, gas, biological, asbestos, lead, animal)		Estimated Total Cost:	$	
Team Chief Rank/Name:			Team Chief Signature:			Date:	

Table A3.4. Sewage/Wastewater Systems Damage Assessment Worksheet (Example Only)

SEWAGE AND WASTEWATER SYSTEMS DAMAGE ASSESSMENT WORKSHEET					REPORT NO:		
System Component	Location	Damage Code	Damage/Repair Description	Required Tools/Heavy Equipment	Estimated Crew Size	Estimated Repair Time	Estimated Repair Cost
Sewer Pipes							$
							$
							$
Lift Stations							$
							$
Pumps/Pump Stations							$
							$
Leach Fields/ Septic Tanks							$
							$
Treatment Plants							$
							$
							$
							$
							$
							$
							$
							$

DAMAGE CODES: 1: Affected (Mostly Cleaning Required) 2: Minor Damage 3: Major Damage 4: Destroyed	SAFETY HAZARDS PRESENT: (e.g. fire, structural, electrical, gas, biological, asbestos, lead, animal)	Estimated Total Cost: $

Team Chief Rank/Name:	Team Chief Signature:	Date:

Table A3.5. Fuels Systems Damage Assessment Worksheet (Example Only)

FUELS SYSTEMS DAMAGE ASSESSMENT WORKSHEET					REPORT NO:		
System Component	Location	Damage Code	Damage/Repair Description	Required Tools/Heavy Equipment	Estimated Crew Size	Estimated Repair Time	Estimated Repair Cost
Distribution Pipes							$
							$
							$
Pumps							$
							$
							$
Valves							$
							$
							$
Tanks							$
							$
							$
Hydrants/Fill Stands							$
							$
							$
							$
							$
DAMAGE CODES: 1: Affected (Mostly Cleaning Required) 2: Minor Damage 3: Major Damage 4: Destroyed			SAFETY HAZARDS PRESENT: (e.g. fire, structural, electrical, gas, biological, asbestos, lead, animal)		Estimated Total Cost:	$	
Team Chief Rank/Name:			Team Chief Signature:		Date:		

Table A3.6. Power Production/Electrical Systems Damage Assessment Worksheet (Example Only)

POWER PRODUCTION AND ELECTRICAL SYSTEMS DAMAGE ASSESSMENT WORKSHEET					REPORT NO:		
System Component	Location	Damage Code	Damage/Repair Description	Required Tools/Heavy Equipment	Estimated Crew Size	Estimated Repair Time	Estimated Repair Cost
Station/Substation							$
Poles							$
Cross-arms							$
Insulators							$
Conductors							$
Generators							$
Switch Gear							$
Cables							$
Barriers							$
Approach Lighting							$
Threshold Lighting							$
VASI Lighting							$
Runway Lighting							$
Taxiway Lighting							$
TACAN							$
ILS							$
							$
DAMAGE CODES: 1: Affected (Mostly Cleaning Required) 2: Minor Damage 3: Major Damage		SAFETY HAZARDS PRESENT: (e.g. fire, structural, electrical, gas, biological, asbestos, lead, animal)			Estimated Total Cost:	$	

4: Destroyed		
Team Chief Rank/Name:	Team Chief Signature:	Date:

Table A3.7. Roads and Pavements Damage Assessment Worksheet (Example Only)

ROADS AND PAVEMENTS DAMAGE ASSESSMENT WORKSHEET					REPORT NO:		
Damage Area	Location/Designation	Damage Code	Damage/Repair Description	Required Tools/Heavy Equipment	Estimated Crew Size	Estimated Repair Time	Estimated Repair Cost
Roads							$
							$
							$
							$
							$
							$
							$
Parking Areas/Lots							$
							$
							$
							$
							$
Fencing							$
							$
							$
Other							$
							$
							$
DAMAGE CODES: 1: Affected (Mostly Cleaning Required) 2: Minor Damage 3: Major Damage 4: Destroyed			SAFETY HAZARDS PRESENT: (e.g. fire, structural, electrical, gas, biological, asbestos, lead, animal)		Estimated Total Cost:	$	

Team Chief Rank/Name:	Team Chief Signature:	Date:

Attachment 4

PORTABLE FIRE EXTINGUISHERS PROS AND CONS

Table A4.1. Portable Fire Extinguishers Pros and Cons

Dry Chemical:

- Interrupts chemical reactions
- Sodium bicarbonate (baking soda)
- Very effective on Class B and C fires
- Not considered toxic

Disadvantages:

- Leaves a residue
- Obscures vision
- Not good on deep-seated Class A fires
- Absorbs moisture and may "cake" within container
- May be irritating
- Nozzle pressure may cause burning liquids to splash

Carbon Dioxide (CO_2):

- Reduces oxygen to less than 15%
- Effective on Class B and C fires
- No residue
- Relatively inert

Disadvantages:

- Generally >35% concentration by volume required for total flooding system
- Toxic to humans at >4% by volume
- Not the best agent for smoldering deep-seated fires (maintain concentration for >20 minutes)

Air-Pressurized Water (APW):

- Removes heat
- Effective on Class A fires
- Inexpensive
- Plentiful
- Non-toxic

Disadvantages:

- Conducts electricity
- May spread Class B fires
- Freezes in cold climates
- May carry pollutants as run-off water

Multipurpose Dry Chemical:

- Interrupts chemical reactions
- Ammonium phosphate
- Effective on Class A, B, and C fires
- Non-conductive

Disadvantages:

- Obscures vision
- More irritating than ordinary dry chemical
- Nozzle pressure may cause burning liquids to splash

Dry Powder (MET-L-X):

- Smothers fire by blanketing fuel source
- Heat causes agent to cake and form a crust (barrier); cuts air and reduces heat
- Effective on Class D fires

Disadvantages:

- Crust must not be disturbed until residue has cooled below re-ignition temperature

• Dissipates rapidly - allows re-flash • Has a cooling/chilling effect on some electronic components • Vapor density = 1.5 (collects in pits and low areas)	• Crust may develop cracks allowing air to pass and fire to reignite
Sources: U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Office of Training and Education, Common Fire Extinguishing Agents, May 1996 and Incipient Stage Fire Extinguisher Education	

Attachment 5

CIVIL ENGINEER EQUIPMENT/TASK SAFETY CHECKLIST

A5.1. The following checklist highlights basic CE equipment and task safety procedures. It is NOT all inclusive and readers must review and adhere to mandatory safety procedures and requirements outlined in specific equipment and task publications and guidance.

Table A5.1. CE Equipment Operation/Task Safety Checklist

Heavy Equipment	✓
Backhoes:	
Are the front bucket (if so equipped) and outriggers in fully-down positions before digs are attempted?	
Is the entire area where the digging arm may swing cleared of people and equipment? Is clearance for fixed obstructions assured?	
Is operation under energized lines permitted only when absolutely necessary? Are these operations approved by the commander?	
During travel to and from worksites, is the backhoe folded, secured, and centered? Is the front bucket raised only high enough to provide adequate ground clearance?	
Mobile Cranes:	
Are mobile cranes operated only by authorized and qualified persons possessing a valid Operator's Identification Card or persons in training under direct supervision of a qualified operator?	
During operation, is a person appointed to provide signals to the operator?	
Before leaving the crane unattended, are all shutdown procedures performed?	
Is a pre-operational inspection performed and are discrepancies reported to the supervisor?	
Are load weights determined before lifting?	
Are outriggers set before lifting, telescoping the boom, or turning a load within the ratings?	
Are loads transported on cranes specifically designed for this purpose?	
Are personnel restricted from riding on loads or the hook?	
Are outriggers used, regardless of the load, when the ground is soft or otherwise unstable?	
When two or more cranes are used to lift one load, is one person designated as the responsible individual?	
Are required safety measures such as securing the empty hook, attaching warning flags (as necessary), etc., taken before the crane is moved to a new job site?	
Are all parts of the crane and load restricted within 10 feet of an energized power line? If this is not practical, is the line de-energized?	

Table A5.1. (Continued)

Are additional clearances assured for work near lines greater than 50 kV?	
Is a permanent sign posted within the crane cab warning of electrical power line dangers and restrictions?	
Are operators aware of necessary precautions in the event of contact with power lines?	
Is an approved fire extinguisher kept in the crane cab?	
Dump Trucks:	
Are dump trucks operated within the load capabilities established by the manufacturer and consideration given to the specified weights of the material being carried?	
Are personnel restricted from the bed while it is being raised?	
Graders, Loaders, and Bulldozers:	
Are operators familiar with manufacturer's operating instructions, including clearances and weight limitations, if applicable?	
Sweepers:	
Are sweepers operated on airfields equipped with headset radios in direct contact with control tower or escorted by a vehicle that is?	
Pavement Equipment	✓
Concrete Saw:	
Is a water supply maintained during operation?	
Pavement Breaker (Jackhammer):	
Are proper lifting techniques used during equipment operation and transport?	
Concrete Mixer:	
Are mixers supported in stable positions prior to operation?	
Joint Seal Kettle-Melter:	
Is an approved fire extinguisher available near the kettle?	
Is the safe heating temperature specified by the manufacturer maintained during heating?	
Is material eased into the kettle to prevent splashing?	
Are open flames or other sources of ignition not permitted near material heated to its flashpoint?	
Compressed Air, Pneumatic, and Portable Power Tools	✓
Compressed Air and Pneumatic Tools:	
Is compressed air never used to blow debris from personnel?	
Is the downstream pressure of compressed air used for cleaning purposes maintained below 30 psi and only used when effective chip guarding and eye protection are used?	

Are air supply lines marked or tagged to identify the maximum psi on the line?	
Portable Power Tools:	
Are electric power tools operated in dry conditions; never operated in the rain, sprinklers, or any kind of precipitation?	
Carpentry and Structural Maintenance	✓
General:	
Are all woodworking machines turned off when left unattended?	
Are workers restricted from clearing or repairing equipment while it is operating?	
Are machines shut down, locked out, and tagged during maintenance?	
Are all machine guards in place and, if not, is the machine locked out and tagged?	
Ventilation Systems:	
Are industrial ventilation systems installed as required, and are they operational?	
Do industrial ventilation systems exhaust to an enclosed collection container?	
Storage and Handling of Lumber:	
When lumber is stored in tiers, is it stored properly?	
Is smoking prohibited in lumber storage areas?	
When stock cannot be safely handled by hand, is suitable material handling equipment available and used?	
Powder-Actuated Fastening Tools:	
Are operators trained and issued a qualified operator's card? Do operators keep this card in their possession when using the tool?	
Do operators wear required PPE when using the powder-actuated tool?	
Does the operator use the tool correctly within the limitations of its prescribed use?	
Are tools cleaned, maintained, and checked prior to use according to manufacturer's instructions?	
Does the operator ensure no personnel are present on the opposite side of the wall, structure, or material prior to firing a fastener into it?	
Roofing Operations:	
Are scaffolds provided or fall protection equipment used as required?	
Is roofing material segregated and stored in stable conditions?	
Are tar kettles and pots located so they will not pose a fire hazard?	
Masonry:	
Are workers aware of potential hazards associated with the use of Portland Cement?	
Are personnel aware of the hazards and is required PPE used when cleaning and etching brick and concrete work?	
When using power mixers and trowels, are gears, pulleys, chains, or belts adequately guarded?	

When preparing footings, are locations of underground utilities identified prior to any excavations?	
Mobile Work Platforms:	
Do workers use and maintain mobile work platforms IAW manufacturer's operating manuals and 35-Series T.O.s?	
Are platforms inspected daily, prior to use IAW applicable T.O.s and manuals? Do inspections include brakes, jacks, wheel locks, securing cables, locking pins, hydraulic systems, anchor connections, railings and removable attachments and overall equipment condition?	
Are protective guardrails installed on all open sides if platform is elevated four (4) feet or higher above ground or floor?	
Are bolts, pins or other locking devices provided and used on removable railings and attachments?	
Are mobile work platforms marked with reflective materials to the maximum extent authorized by appropriate T.O.s, such as 35-1-3, *Corrosion Prevention and Control, Cleaning, Painting, and Marking of USAF Support Equipment (SE)*?	
When not being transported, are mobile work platforms secured to prevent collision with equipment or items?	
When personnel and equipment are still onboard, are self-propelled work platforms placed in the lowered position prior to moving?	
Are mobile work platforms equipped with authorized hitches when towed by vehicles?	
When mobile work platforms are being towed by vehicles, are safety pins used to secure vehicle pintle hooks and platform hitches?	
Protective Coating Maintenance	✓
General:	
Are flammable and combustible liquids used and stored according to instructions in AFOSHSTD 91-501?	
Are required control measures for exposures to pigments, extenders, and fillers instituted and enforced?	
Are required control measures for exposure to solvents instituted and enforced?	
Plumbing Maintenance	✓
Torches and Furnaces:	
Are operators trained and familiar with operating instructions of torches and furnaces before being permitted to use them?	
Are torches and furnaces restricted from use where flammable or explosive environments may be present?	
Is the use of gasoline torches and furnace prohibited in small, unventilated spaces?	
Are appropriate fire extinguishers available as required?	
Soldering and Brazing:	

Are electric soldering irons grounded unless double insulated?	
Are soldering irons placed in suitable non-combustible receptacles when not in use?	
Industrial Waste Drains/Open Storm Drains:	
Are industrial waste manholes treated as confined spaces and appropriate safety measures taken prior to entry?	
Are proper pry bar tools, special lifting tools, and additional help used when lifting storm drain manhole covers as necessary?	
Gas Systems:	
Where a gas leak is suspected, is the area properly vented and purged and do personnel entering the area utilize required PPE?	
Are tools used to repair leaks or perform maintenance on gas lines spark-free and is clothing static-free?	
Tunnels, Pits, and Sumps:	
Are atmospheric conditions tested prior to entry into tunnels, pits, and sumps?	
Are tunnels, pits, and sumps (which are known to be contaminated) tagged or identified for information of work crews?	
Is a second person available to provide emergency assistance for persons entering a subsurface?	
Compressed Air:	
Are lines completely drained of existing air prior to opening compressed air lines? Are new lines completely secured prior to air entry into the system?	
Is air used for cleaning restricted to 30 psi and below?	
Metal Fabrication and Welding	✓
Inert Gas Brazing and Welding:	
Are workers instructed on the hazards of inert gas asphyxiation in confined spaces?	
Are chambers completely ventilated and cooled prior to entry?	
Is adequate ventilation or, as necessary, air-supplied respiratory protection available?	
Electron Beam Welding:	
Are operating instructions for electron beam welding established and adhered to?	
Plasma Arc Cutting:	
Is required shielding in place and do walls, floors, ceilings, etc., have non-reflective surfaces?	
Are adequate controls (e.g., exhaust ventilation or approved respiratory protective devices) provided?	
Induction (Spot) Welding and Brazing:	
Do welders replace filter materials within induction coils and not attempt to adjust placement while the welding or brazing equipment is activated?	
Magnesium-Thorium Welding, Cutting, and Grinding:	

Prior to welding, cutting, or grinding operations on magnesium-thorium, is the Installation Radiation Safety Officer (IRSO) consulted? The IRSO in most instances is the base Bioenvironmental Engineer.	
Welding and Cutting Tanks, Cylinders, or Containers:	
Are all tanks, cylinders, or containers to be welded or cut, purged or made inert prior to the operation being conducted?	
Are pipelines to these containers disconnected prior to welding or cutting?	
Portable Gas Units:	
Are compressed gas cylinders equipped with pressure reducing regulators?	
Are cylinders stored in upright position with caps installed and secured with materials other than rope or other readily combustible material?	
Are gaseous systems and containers color-coded?	
Are pressure hoses secured to prevent whipping?	
Are oxygen cylinders and fittings free of grease and oil?	
Are cylinders kept separate from external sources of heat?	
Are approved devices provided for flashback protection?	
Portable Electric Units:	
Are units de-energized before they are tested, repaired, or transported?	
Are motor generators and other electrical equipment grounded prior to use?	
Arc Welding:	
Are necessary cable splices performed only by qualified electricians and are splices prohibited within 10 feet of the electrode holder?	
When welders are working close together on one structure, are machines connected to minimize shock hazards according to AFOSHSTD 91-10?	
Resistance Welding:	
Are thermal protection switches in use on ignition tubes?	
Are controls safeguarded from inadvertent activation?	
Are multi-gun welding machines guarded at the point of operation?	
Are all external weld-initiating control circuits operated on required voltage and are interlocks available to prevent access by unauthorized individuals?	
Welding in Confined Spaces:	
Are confined spaces where welding or cutting is performed adequately ventilated?	
Is an attendant positioned on the outside of a confined space entry point to ensure the safety of those in the confined space?	
Are gas cylinders and welding machines left outside confined spaces?	
Are confined spaces tested for oxygen content and combustible vapors prior to entry?	
Hazards Associated With Fluxes, Coverings, Filler Metals, and Base Metals:	

Are precautions identified and requirements met according to AFOSHSTD 91-10, when welding Fluorine compounds, Zinc, Lead, Beryllium, Cadmium, and Mercury materials?	
Refrigeration/Air Conditioning Maintenance	✓
General:	
Are all belts, pulleys, and rotating shafts adequately guarded?	
Storage and Handling:	
Are compressed gas cylinders adequately stored and handled?	
Interior and Exterior Electric Maintenance	✓
Do all personnel strictly adhere to AFI 32-1064, *Electrical Safe Practices*, any time lethal voltages are involved?	
Electric Motor Rewind Shops:	
Are capacitors disconnected for at least 5 minutes before circuit terminals are shorted by an approved method?	
Storage Batteries:	
Are open flames or spark-producing devices restricted in the vicinity of storage battery banks?	
Is a neutralizing solution available when work involves contact with electrolyte?	
When mixing acid and water, is the acid poured into the water and not vice-versa?	
Work on Energized Circuits:	
Is work on energized circuits performed only when absolutely necessary?	
Is approved protective equipment used when work on energized conductors or parts is performed?	
Work Near Energized Circuits:	
When air operated equipment is used around live parts, are the nozzles made of non-conducting material?	
Are appropriate warning tags used as a temporary means of warning employees of existing electrical hazards?	
Exterior Electric:	
Are leather gloves and safety-toed shoes worn when removing or replacing manhole covers?	
Are confined space entry precautions used when entering manholes and vaults?	
Electrical Power Production	✓
Do all personnel strictly adhere to AFI 32-1064, *Electrical Safe Practices*, any time lethal voltages are involved?	
Plant Operations:	

Are generators located in outside facilities housed in weatherproof protection and all moving parts and electrical connections adequately guarded or covered?	
Are all metal frames for electrical control panels, switches, meters, and other hazardous electrical devices grounded not to exceed 25 ohms?	
Are standard operating procedures developed and posted for normal and emergency operations for equipment controls?	
Are noise hazard and high voltage warning signs posted where appropriate?	
Plant Maintenance:	
Is jewelry removed prior to working on machinery?	
Are appropriate safety clearance tags and interlocks used to prevent accidental or unintentional startup of equipment that is being worked on?	
Does all test equipment have current calibration?	
Are proper jacking procedures used?	
Plant Switchgear and Substation:	
When work is performed on energized circuits, is it approved by the CE Commander or designated representative?	
When performing approved work on energized circuits, are at least two fully qualified workers and required PPE available?	
When working adjacent to energized circuits exceeding 600 volts, are rubber blankets or other guards provided?	
Batteries:	
Are nickel-cadmium and unsealed lead-acid batteries stored separately?	
If required, are emergency eyewashes and showers provided?	
Vaults and Manholes:	
Are vaults and manholes considered confined space hazards until proven otherwise and if so, are confined space requirements followed?	
Air Compressors:	
Are adequate safety relief valves installed on air tanks?	
Are valves prohibited between air tanks and safety valves?	
Water and Wastewater Treatment	✓
Nature of Hazards:	
Are chlorinator treatment rooms that are identified as potentially immediately dangerous to life and health (IDLH), equipped with a telephone or other means of emergency communication?	
Are chlorinator treatment rooms equipped with mechanical exhaust systems that are turned on prior to entry?	

Are written procedures developed for emergency conditions for chlorinator treatment rooms?	
Personal Sanitation:	
Are emergency eyewashes and showers provided when necessary?	
Treatment Plant:	
Are emergency OIs developed?	
At shredding and grinding stations, is power turned off, tagged, and locked out before servicing?	
Are guards and screens in place at shredding and grinding stations?	
Sedimentation Basin (Clarifier):	
Are approved life vests and lifelines located around the clarifier?	
Are guards provided around moving parts?	
Is the rotary distributor of the trickling filter anchored prior to inspection or servicing?	
Aeration Tanks:	
Are firm guardrails in place for work areas and walkways?	
Are approved life vests with lifelines located at appropriate points around aerator rails?	
Stabilization Ponds:	
Are life vests available and worn when working on a boat or raft?	
Laboratories:	
Are laboratories clean and designed safely and are chemicals stored properly?	
Is electrical equipment properly grounded in laboratories?	
Is pipetting of chemicals by mouth restricted?	
Aircraft Arresting Systems (AAS)	✓
General:	
Is good housekeeping maintained in all AAS operations and maintenance areas?	
Are flammable and combustible liquids stored, used, and handled according to instructions in AFOSHSTD 91-501?	
When using compressed air for cleaning is air pressure less than 30 psi and is required PPE used?	
Where necessary, are emergency eyewashes and showers provided?	
When working on active runways, is total communication maintained with the tower and operations?	
Runway Barriers:	
Are facilities housing the AAS evacuated to proper distances?	
After engagement and upon returning to the AAS housing facility is required PPE designated and used?	

Is the minimum number of operators, according to applicable T.O.s available?	