 

HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

APR 1 2001

FROM: HQ AFCESA/CES
139 Barnes Drive, Suite 1
Tyndall AFB, FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 01-2: Fire Protection Engineering Criteria - New Aircraft Facilities**

**1. Purpose.** This ETL provides fire protection criteria for protection of aircraft and facilities in the event of a fuel spill fire. Human intervention is required to minimize damage to incident aircraft.

**2. Summary of Revisions.** This ETL supersedes ETL 98-7, and includes the following changes: standard for design and construction packages (paragraph 6); tension fabric structures on metal frames (paragraph A1.1.1.1.1); internal fire-rated separations (paragraph A1.1.1.2.1); draft curtains (paragraph A1.1.1.5.1); floor and ramp drainage (paragraph A1.1.2.1); heating, ventilation, and air conditioning (HVAC) systems (paragraph A1.1.2.2); electrical systems (paragraph A1.1.2.3.1); fire hydrants (paragraph A1.1.2.4); foam-water retention systems (paragraph A1.1.2.5); facility sprinkler systems (paragraphs A1.3.1.1.2, A1.3.1.1.3, A1.3.1.6.2, A1.3.2); painting and labeling requirements for piping (paragraphs A1.3.1.8.5, A1.3.1.8.6); low-level high-expansion foam systems (paragraph A1.3.3); bladder system proportioners (paragraph A1.3.4.4.3); bladder tanks (paragraph A1.3.4.7.2); thermal fire detectors (paragraph A1.3.5.2.1); manual foam discharge stations (paragraphs A1.3.5.5.2 through A1.3.5.5.4); system water supply (paragraphs A1.4.2.2, A1.4.2.4); and water and foam pump systems (paragraphs A1.4.3, A1.4.3.3, A1.4.3.8, A1.4.3.9, A1.4.3.10). The following material was added: using fuel as a heat sink (paragraph A1.1.2.3.1); solar evaporation as a foam disposal method (paragraph A1.1.2.5.1); multi-spectrum optical detectors as a fire detector (paragraph A1.3.5.3.2.2); external visual water level gauge for storage tanks (paragraph A1.4.2.5); and Attachment 2, *Low-Level High-Expansion Foam System Views*.

**Note:** All references to aqueous film forming foam (AFFF), overhead closed head foam-water systems, and low-level low-expansion systems have been removed.

**Note:** Fire protection modifications for protective and hardened aircraft shelters will be addressed in ETL 01-4.

**3. Application:** All types of aircraft facilities, including, but not limited to, maintenance, servicing, and storage hangars; corrosion control hangars; fuel cell repair hangars;

depot overhaul facilities; research and development (R&D)/testing facilities housing aircraft; and all types of aircraft shelters (weather, alert, semi-hardened, hardened). Compliance with this ETL should be considered for projects in active design beyond project definition (PD). Applying these criteria will result in reduced original construction and life-cycle maintenance costs, and increased overall reliability of the fire protection system. Compliance with this ETL is mandatory for:

- Projects that have not completed the PD phase.
- Projects beyond the PD phase, but not in active design status.

**3.1.** New Construction. Criteria within this ETL applies to the design and construction of all new aircraft facilities on Air Force installations or housing Air Force aircraft.

**3.2.** Existing Facilities. Criteria within this ETL applies to the design and construction of fire protection features for all existing aircraft facilities without installed fire suppression systems. Renovation, modification, or alteration of existing aircraft facilities without installed fire suppression systems will comply with the criteria contained in this ETL.

**3.3.** Occupancy Changes. Use of this ETL is mandatory during a major occupancy change, such as converting a former hangar currently being used as a warehouse back to an aircraft hangar. Change of aircraft does not constitute a change of occupancy; however, beddown of a new mission is not recommended in an existing hangar without a fire suppression system.

**3.4.** Integrated Combat Turn (ICT) Facilities. Criteria within this ETL apply to facilities for ICTs; however, compliance with this ETL is not authorization to conduct ICTs. ICT locations must be specifically evaluated and approved through the System Safety Engineering Program (AFI 91-202, *The US Air Force Mishap Prevention Program*).

**3.5.** Other Facilities. Facilities used exclusively for small aircraft (T-3, T-41, TG-3, TG-4, TG-7, TG-9, S-10), aero club aircraft, and similar aircraft within the size limitations for Group III hangars in NFPA 409, *Standard on Aircraft Hangars*, will comply with either NFPA 409 requirements for Group III aircraft hangars and the suppression system requirements of this ETL, or the requirements of this ETL.

**3.6.** Excluded Facilities. The following facilities are not addressed in this ETL:

- Aircraft shelters with two or fewer sides (including partial walls). These shelters will be treated as open ramps.
- Existing aircraft facilities with fire suppression systems in aircraft servicing areas. Fire protection modification/upgrade requirements will be addressed in a separate ETL.
- Protective aircraft shelters (PAS), hardened aircraft shelters (HAS), and semi-hardened aircraft shelters (HAS). These facilities are designed to provide a

degree of survivability under combat conditions and or enemy attack. Refer to ETL 01-4.

**3.7.** Authority: AFI 32-1023, *Design and Construction Standards and Execution of Facility Construction Projects*.

**3.8.** Effective Date: Immediately.

**3.9.** Recipients: All major commands (MAJCOM) and Air Force activities.

**3.10.** Coordination: HQ USAF/ILEC, MAJCOM fire protection engineers, HQ NAVFAC, and USACE/CECP-TM.

**Note:** Criteria in this ETL assume fire department capabilities consistent with AFI 32-2001, *The Fire Protection Operations and Fire Prevention Program*, and a water supply and fire hydrant configuration at the hangar to support firefighting. Use of these criteria at other locations is not recommended without a complete risk analysis prepared by the base (or the project architect-engineer [A-E] for new construction) and accepted by the MAJCOM fire protection engineer (FPE) and the MAJCOM fire department operations (FDO) group.

**4. Referenced Publications.**

**4.1.** Air Force:

- AFI 32-1066, *Plumbing Systems*
- AFH(I) 32-1163, *Engineering Weather Data*
- AFI 32-2001, *The Fire Protection Operations and Fire Prevention Program*
- AFI 91-202, *The US Air Force Mishap Prevention Program*
- Technical Order 1-1-3, *Inspection and Repair of Aircraft Integral Tank and Fuel Cells*

**4.2.** U.S. Army Corps of Engineers (USACE):

- Engineer Technical Letter 1110-3-484, *Engineering and Design – Aircraft Hangar Fire Protection Systems*

**4.3.** Department of Defense (DoD):

- MIL-HDBK-1008C, *Fire Protection for Facilities Engineering, Design, and Construction*

**4.4.** National Fire Protection Association (NFPA).

**Note:** The latest edition of an NFPA standard applies.

- NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*
- NFPA 13, *Installation of Sprinkler Systems*

- NFPA 20, *Standard for the Installation of Stationary Fire Pumps for Fire Protection*
- NFPA 24, *Installation of Private Fire Service Mains and their Appurtenances*
- NFPA 30, *Flammable and Combustible Liquids Code*
- NFPA 31, *Standard for the Installation of Oil-Burning Equipment*
- NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*
- NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*
- NFPA 54, *National Fuel Gas Code*
- NFPA 70, *National Electrical Code®*
- NFPA 72, *National Fire Alarm Code®*
- NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*
- NFPA 101, *Life Safety® Code*
- NFPA 409, *Standard on Aircraft Hangars*

**4.5.** American Society for Testing and Materials (ASTM):
- ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*
- ASTM A795, *Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use*
- ASTM D2996, *Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe*

**4.6.** American National Standards Institute (ANSI):
- ASME/ANSI A13.1-1996, *Scheme for the Identification of Piping Systems*
- ASME/ANSI B31.3-1996, *Process Piping*

**4.7.** Underwriter's Laboratories (UL):
- UL 1449, *Standard for Safety Transient Voltage Surge Suppressors*, Second Edition
- UL 1283, *Electromagnetic Interference Filters*, latest edition

**4.8.** Private Industry:
- Factory Mutual (FM) Global Property Loss Prevention Data Sheet 1-22, *Criteria for Maximum Foreseeable Loss Fire Walls and Space Separation*
- FM Global Property Loss Prevention Data Sheet 1-23, *Protection of Openings*
- International Conference of Building Officials, *Uniform Building Code™ (UBC) 1997*

## 5. Acronyms and Terms:

AC - alternating current

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|---|---|
| A-E | - architect-engineer |
| AFFF | - aqueous film forming foam |
| DoD | - Department of Defense |
| ETL | - Engineering Technical Letter |
| FACP | - fire alarm control panel |
| FDO | - Fire Department Operations |
| FPE | - Fire Protection Engineer |
| FSCP | - foam system control panel |
| $ft^2$ | - square foot |
| $ft^3$ | - cubic foot |
| gpm | - gallons per minute |
| HAS | - hardened aircraft shelter |
| HVAC | - heating, ventilation, and air conditioning |
| ICT | - integrated combat turn |
| ILBP | - in-line balanced pressure |
| lpm | - liters per minute |
| $m^2$ | - square meter |
| $m^3$ | - cubic meter |
| MAJCOM | - major command |
| MILCON | - military construction |
| NAVFACENGCOM | - Naval Facilities Engineering Command |
| NCEE | - National Council of Examiners for Engineering and Surveys |
| NDI | - non-destructive inspection |
| NEC | - National Electrical Code |
| NFPA | - National Fire Protection Standard |
| OSHA | - Occupational Safety and Health Administration |
| PAS | - protective aircraft shelter |
| PD | - project definition |
| PE | - Professional Engineer |
| R&D | - research and development |
| HAS | - hardened or semi-hardened aircraft shelter |
| SIOH | - supervision, inspection, and overhead |
| T.O. | - Technical Order |
| TVSS | - transient voltage surge suppression |
| UBC | - Uniform Building Code |
| UL | - Underwriters Laboratories |
| USACE | - U.S. Army Corps of Engineers |
| UV/IR | - ultraviolet/infrared |
| V | - volt |
| Vac | - volts alternating current |

**6. Specific Requirements.** This ETL, in accordance with MIL-HDBK-1008C, *Fire Protection for Facilities Engineering, Design, and Construction*, paragraph 1.3.4., takes precedence over MIL-HDBK-1008C, section 4.16. This ETL is the Air Force alternative to NFPA Standard 409, and will be used except as noted. Attachment 1 provides criteria and technical guidance.

**Note:** Aircraft Hangar Standards. All design and construction packages will use the Air Force aircraft hangar standardized design details for system components (available Fall 2001).

**6.1.** U.S. Army Corps of Engineers (USACE) Center of Expertise for Aircraft Hangar Fire Protection.

**Note:** Services of the Center of Expertise are provided on a cost reimbursable basis between the USACE district designing and constructing the project and USACE. This service is expected to be covered in the standard design management fee, and supervision, inspection, and overhead (SIOH) paid on the project. This service should not result in additional costs or fees to the project.

**6.1.1.** For all hangar military construction (MILCON) projects on which USACE is the design agent, the USACE Center of Expertise will review all project designs to ensure compliance with this ETL. This review is mandatory at all design review stages, and all formal review comments issued by the Center of Expertise will be implemented to the satisfaction of the Air Force in accordance with USACE Engineer Technical Letter 1110-3-484, *Engineering and Design – Aircraft Hangar Fire Protection Systems.*

**6.1.2.** For all hangar MILCON projects on which USACE is the construction agent, the Center of Expertise will review all contractor shop submittals to ensure compliance with this ETL. All review comments issued by the Center of Expertise will be implemented by the USACE contracting officer to the satisfaction of the Air Force. An FPE at the Center of Expertise will perform the final acceptance testing of all hangar fire protection systems. The MILCON project will not be accepted by the USACE contracting officer until the Center of Expertise has accepted the fire protection systems.

**6.3.** Naval Facilities Engineering Command (NAVFACENGCOM) Division FPE.

**6.3.1.** For all hangar MILCON projects on which NAVFACENGCOM is the design agent, the division FPE will review all project designs to ensure compliance with this ETL. This review is mandatory at all design review stages, and all formal review comments issued will be implemented to the satisfaction of the Air Force.

**6.3.2.** For all hangar MILCON projects, the division FPE will review all contractor shop submittals to ensure compliance with this ETL. The contracting officer will implement all review comments to the satisfaction of the Air Force. An FPE will perform the final acceptance testing of all hangar fire protection systems.

**6. Point of Contact.** Fire protection criteria for aircraft facilities must evolve concurrently with technical developments in fire science, data generated in fire testing programs, and the availability of new fire protection equipment or methodologies. Recommendations for improvements to this ETL are encouraged and should be furnished to HQ AFCESA/CESM, 139 Barnes Drive, Suite 1, Tyndall AFB, FL

32408-5319, Attention: Mr. Fred Walker; DSN 523-6315, commercial (850) 283-6315, FAX DSN 523-6219, Internet: fred.walker@tyndall.af.mil.

//signed//

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Technical Director

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1. Technical Criteria
2. Low-Level High-Expansion Foam System Views
3. Distribution List

## TECHNICAL CRITERIA
## AIR FORCE AIRCRAFT HANGAR FIRE PROTECTION

**A1.1. Construction Requirements.**

**A1.1.1.** Structural Requirements. All new aircraft hangars will be exclusively noncombustible construction in accordance with the International Conference of Building Officials, *Uniform Building Code 1997™* (UBC) requirements for any category of Type I or Type II construction.

**Note:** Additional protection of structural members (columns, beams, trusses, joists) above that established in the UBC for Type I or Type II construction is not required in a facility protected by an approved fire suppression system in compliance with this ETL.

**A1.1.1.1.** Exceptions:

**A1.1.1.1.1.** Tension fabric structures on metal structural frames when sited in accordance with paragraph A1.1.1.4.3 and protected in accordance with paragraph A3.

**A1.1.1.1.2.** Facilities used exclusively for small aircraft (T-3, T-41, TG-3, TG-4, TG-7, TG-9, S-10), aero club aircraft, and similar aircraft meeting the space requirements of NFPA 409 for Group III structures. These facilities must comply with criteria in NFPA 409 for Group III hangars and paragraph A1.3.1.1.4.

**A1.1.1.2.** Internal Fire-Rated Separations. To allow the greatest operational flexibility in hangars covered by this ETL, fire-rated walls and partitions are not required between adjacent aircraft servicing areas when the nature of the occupancy is similar in both bays. Operations such as fuel cell maintenance, ICT, and indoor refueling must be separated from general maintenance by walls of masonry construction, having not less than a one-hour fire rating with 45-minute opening protection. Such walls will extend from the floor to the underside of the roof deck.

**A1.1.1.2.1.** All operations outside the aircraft servicing area must be isolated from the aircraft servicing area by a masonry wall having a fire resistance rating of at least one hour. This wall will extend from the concrete floor to the roof. All openings in this wall will be automatic closing or self-closing and will be rated for at least 45 minutes. These areas outside the aircraft servicing area must have full sprinkler coverage in accordance with this ETL.

**A1.1.1.2.2.** Air Force operational aircraft assets will be isolated from the non-Department of Defense (DoD) areas by four-hour rated firewalls when Air Force aircraft assets are co-located in a facility with non-DoD operations that are beyond the control of the DoD activity. Penetrations of such firewalls must be minimized. Any necessary door, window, and other penetration must be protected in accordance with Factory

Mutual Global Property Loss Prevention Data Sheets 1-22, *Criteria for Maximum Foreseeable Loss Fire Walls and Space Separation*, and 1-23, *Protection of Openings*.

**A1.1.1.3.** Allowable Floor Area.

**A1.1.1.3.1.** The allowable floor area of a facility is unlimited when all of the following conditions are met:

- 100 percent of the facility has full sprinkler coverage in accordance with this ETL.
- Water supply to the sprinkler systems is in compliance with the criteria in this ETL.
- Separations from adjacent structures complies with paragraphs A1.1.4. through A1.1.4.3.
- Internal separation walls comply with paragraph A1.1.1.2.

**A1.1.1.3.2.** Facilities not meeting the conditions in paragraph A1.1.1.3.1 will be limited to the floor areas contained in the latest edition of the UBC for occupancy type B-3, except facilities used for fuel cell maintenance, ICT, or indoor refueling/defueling, which will be occupancy type H-5.

**A1.1.1.4.** Siting/Separation. No separation is required between any combination of Type I or Type II construction hangars protected by approved fire suppression systems.

**A1.1.1.4.1.** Separation Between Type I and Type II Hangars and Hangars of Other Construction Types. The minimum separation distance between adjacent hangars is 12 meters (40 feet). This may be reduced to 7.6 meters (25 feet) if one of the hangars has a one-hour exposure wall and protected 45-minute openings (e.g., windows, doors), or if both hangars have approved fire suppression systems. This may be further reduced to 3 meters (10 feet) if both hangars have one-hour exposure walls and protected 45-minute openings.

**A1.1.1.4.2.** Separation Between Hangars and Other Buildings. Minimum separation between hangars and other buildings is 12 meters. Reductions in this distance must conform to the UBC.

**A1.1.1.4.3.** Separation Between Tension Fabric Hangars and All Other Structures. Minimum separation between tension fabric structures and other structures will be 30 meters (100 feet), with a clear zone of 15 meters (50 feet) immediately adjacent to the tension fabric structure. The clear zone cannot be used for storage and must be clear of vegetation (maintained lawn is permitted). The clear zone may be used as a street or driveway, but not for vehicle parking.

**A1.1.1.5.** Draft Curtains.

**A1.1.1.5.1.** Provide draft curtains surrounding each sprinkler system, or up to 1400 square meters (15,000 square feet), whichever is less, for all hangars. Extend draft curtains down from the roof (or ceiling) not less than one-eighth of the distance from the roof (or ceiling) to the floor. When roof structural supports extend below the roof or ceiling, suspend draft curtains to the lowest member of the structural supports, or one-eighth the distance from the roof or ceiling, whichever is greater.

**A1.1.1.5.2.** Install draft curtains to form rectangular roof pockets whenever possible. Install draft stops on exposed structural roof supports whenever possible.

**A1.1.2.** Utility Systems.

**A1.1.2.1.** Floor and Ramp Drainage.

**A1.1.2.1.1.** Outside the Hangar. Aprons and the approach into the hangar must be sloped away from the hangar with a grade of not less than one-half of one percent (0.3:60 meters [1:200 feet]) to preclude a ramp fuel spill from entering. If the required grade cannot be achieved, provide an appropriately sized trench drain across the entire apron side of the hangar with a discharge to a remote safe location.

**A1.1.2.1.2.** Inside the Hangar. Floor elevations within the hangar must be arranged to prevent a liquid spill within the aircraft servicing area from flowing into adjacent areas.

**A1.1.2.2.** HVAC Systems.

**A1.1.2.2.1.** Install heating equipment in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*; NFPA 31, *Standard for the Installation of Oil-Burning Equipment*; or NFPA 54, *National Fuel Gas Code* and this section.

**A1.1.2.2.2.** Heating devices with a flame or glowing element open to the atmosphere in the aircraft servicing area are not permitted.

**A1.1.2.2.3.** Where radiant heating is used, install only overhead radiant tube systems.

**A1.1.2.2.4.** Forced- or recirculated-air HVAC systems will not draw air from the aircraft servicing area below 0.4 meter (1.5 feet).

**A1.1.2.2.5.** Exhaust systems discharging to the exterior of the facility may draw air at any level.

**A1.1.2.3.** Electrical Systems.

**A1.1.2.3.1.** Install electrical equipment in general maintenance aircraft hangars in accordance with NFPA 70, *National Electrical Code®* (NEC), Article 513.

**Note:** Most operational aircraft use on-board fuel for a heat sink/dissipater. Many hangar maintenance activities, including avionics and hydraulic operations, will cause heating of the fuel on these aircraft. Fuel temperatures above 71 °C (160 °F) are operationally acceptable; therefore, NFPA 70, Article 513 requirements for combustible fuel above its flash point must be followed.

**A1.1.2.3.2.** Install electrical equipment in hangars for fuel system maintenance operations involving combustible fuels, including JP-8, in accordance with NFPA 70, Article 513, for flammable fuels or combustible fuels above their flash point.

**Note:** Technical Order (T.O.) 1-1-3, *Inspection and Repair of Aircraft Integral Tank and Fuel Cells*, additionally requires all outlets in the aircraft servicing area to be Class I Division 2 rated. This is an aircraft maintenance (user) safety requirement, not a fire safety issue. Questions should be directed to the command fuels system maintenance office or the T.O. manager at Warner Robins Air Logistics Center.

**A1.1.2.3.3.** Install electrical equipment in hangars with the following operations:

- Refueling or defueling, regardless of fuel type (other than that associated with fuel system maintenance).
- ICTs, regardless of fuel type.
- Fuel system maintenance operations with flammable fuels.

**A1.1.2.3.3.1.** Electrical equipment above the floor in the aircraft servicing area up to the height of the highest hangar door must satisfy NEC criteria for Class I Division 2 locations.

**A1.1.2.3.3.2.** Electrical equipment outside the classified area in the aircraft maintenance area, including lights, must conform to NFPA 70, Article 513.

**A1.1.2.3.4.** In hangars where the rate of spray paint application exceeds 0.9 liter (1 quart) per hour, or the cumulative application of more than 3.7 liters (1 gallon) over an eight-hour period, install electrical equipment in accordance with NFPA 33, *Spray Applications Using Flammable or Combustible Materials*, for an enclosed spray room or booth.

**A1.1.2.4.** Fire Hydrants.

**A1.1.2.4.1.** Hydrants protecting aircraft hangars will be located at 91-meter (300-foot) maximum intervals, and there will be at least one hydrant within 30 meters of each corner of the hangar. When the aircraft parking apron pavement comes within 11 meters (35 feet) or less of the hangar wall at the hydrant location, the hydrants protecting hangars will be located not more than 3 meters from the hangar wall. When the aircraft parking apron pavement is 11 meters or more away from the hangar wall at the hydrant location, the hydrants protecting hangars will be located not less than 7.6 meters from the pavement edge.

**A1.1.2.4.2.** Use low-profile conventional hydrants, not higher than 0.7 meter (2.5 feet) above the pavement height. Flush-mounted hydrants in the pavement are not permitted.

**A1.1.2.4.3.** Hose threads on hydrants must match those used by the base fire department.

**A1.1.2.4.4.** Fire hydrants will be supplied from the domestic (potable) water system around the hangar in accordance with MIL-HDBK-1008C, Section 5.7.3. Install water mains supplying hydrants in accordance with MIL-HDBK-1008C. Hydrants will not be supplied by the hangar fire protection water system.

**A1.1.2.5.** Foam-Water Retention Systems. Retention systems are not required for facilities or systems designed and constructed in accordance with this ETL. Foam-water retention is not required in any of the following cases:

- Testing discharges of any systems discussed in this ETL (test headers/connections are required on all new foam-water systems allowing controlled discharge into a tank or other portable collection device, so no fixed permanent retention capability is required). In geographic regions where there is little or no open water, streams, or wetlands, and no high-ground water table (solar evaporation is an appropriate disposal method).
- Low-level high-expansion foam systems, as the highly expanded foam contains little liquid and is impractical to control.
- Catastrophic events, such as actual fires. Foam discharge associated with a fire is not a "most probable worst case" event. A fire in a hangar is a catastrophic event. Designing a containment system for a catastrophic event is impractical due to the number of associated variables and the mass of fire debris generated.

**A1.1.2.5.1.** Unplanned Accidental Events. Current environmental guidance for management of unplanned accidental foam discharges:

- Formally documented response plan by the installation spill team and/or off-base contractors to contain, collect, and dispose of discharged foam.
- Direct release to a government-operated sanitary or industrial waste treatment facility, if the foam-water solution is less than 50 parts per million of the plant influent.
- In geographic regions where there is little or no open water, streams, or wetlands, and no high-ground water table, solar evaporation is an appropriate disposal method.

**A1.1.2.5.2.** Other Retention Issues. For additional guidance or information on foam retention and management, consult with HQ USAF/ILEV and or MAJCOM/CEV.

**A1.2. Accessibility for Firefighting:**

**A1.2.1.** Exterior Firefighting. Provide fire apparatus access on at least two complete sides of every hangar. Suitable access surfaces include ramps, aircraft parking aprons, automotive parking areas, and fire apparatus access roads.

**A1.2.1.1.** Automotive parking areas used for fire department access must include at least one aisle 5.4 meters (18 feet) wide, with adequate turning radius for fire department apparatus.

**A1.2.1.2.** Fire department access roads must be at least 5.4 meters wide, designed to support imposed loads of fire apparatus, and provide all-weather driving capabilities. Where mowed lawns cover fire department access roads, use bollards to mark the limits of the supporting surface. Fire department access roads over 45 meters (150 feet) long must allow fire apparatus to drive through or turn around. Fire department access roads must not be used for any other purpose, and should be secured with gates, bollards, or similar devices to restrict use.

**A1.2.2.** Interior Firefighting.

**A1.2.2.1.** Hangar doors must operate under emergency conditions. The electrical supply for power-operated doors must be independent of the building power supply to permit isolation of power to the facility during a fire without interrupting power to door motors.

**A1.2.2.1.1.** Configure hangar doors for manual operation without special tools or disassembly.

**A1.2.2.1.2.** Use door track heaters in areas subject to freezing to prevent accumulated snow and ice from impeding operation of hangar doors.

**A1.2.2.1.3.** Provide a key-operated or other access-controlled switch on the exterior of the facility for operation of the doors.

**A1.2.2.2.** Personnel doors satisfying requirements of the Life Safety Code, *Industrial Occupancies* chapter, *Special Provisions for Aircraft Servicing Hangars* section (NFPA 101, *Life Safety® Code*), will provide adequate access into the hangar for normal structural firefighting operations.

**A1.3. Fire Suppression Systems.**

**A1.3.1.** General Requirements.

**A1.3.1.1.** Applicable Design Standards and Criteria. Provide automatic sprinkler protection in all areas of aircraft facilities, including shop and administration. Sprinkler protection must be designed for the occupancy hazard present in accordance with this ETL, MIL-HDBK-1008C, NFPA 33, and the following NFPA standards (if there is a conflict between this ETL and any provisions of an NFPA standard or code, this ETL will take precedence):

- NFPA 13, *Installation of Sprinkler Systems*
- NFPA 30, *Flammable and Combustible Liquids Code*
- NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*

**A1.3.1.1.1.** Protect areas used exclusively for unfueled aircraft (in accordance with T.O. 1-1-3) with conventional wet-pipe sprinkler systems designed for Ordinary Hazard Group 2 occupancy (8.0 lpm/m$^2$ over 270 square meters [0.2 gpm/ft$^2$ over 3000 square feet]).

**A1.3.1.1.2.** Protect areas used for fueled aircraft with a conventional wet-pipe sprinkler system (8.0 lpm/m$^2$ over 465 square meters [0.2 gpm/ft$^2$ over 5000 square feet]) and a low-level high-expansion foam system.

**A1.3.1.1.3.** Protect dedicated single-aircraft facilities used exclusively for non-destructive inspection (NDI) (e.g., x-raying) of fueled or unfueled aircraft with no aircraft maintenance or servicing operations with conventional wet-pipe sprinkler systems designed for Extra Hazard Group 1 occupancy (12.0 lpm/m$^2$ over 270 square meters [0.3 gpm/ft$^2$ over 3000 square feet]).

**A1.3.1.1.4.** Protect NFPA Group III hangars used exclusively for small aircraft (T-3, T-41, TG-3, TG-4, TG-7, TG-9, S-10), aero club aircraft, and similar aircraft with conventional wet-pipe or dry-pipe sprinkler systems designed for Extra Hazard Group 1 occupancy (12 lpm/m$^2$ over 270 square meters [0.3 gpm/ft$^2$ over 3000 square feet]).

**A1.3.1.2.** Manual Foam-Water/Water Fire Hose Stations. Do not provide interior or exterior hose stations or fire hose connections.

**A1.3.1.3.** Fire Department Connections. Do not provide fire department connections on foam-water systems.

**A1.3.1.4.** Strainers. Provide basket-type strainers upstream of risers on all foam-water systems.

**A1.3.1.5.** Test Header. Provide a test header for all overhead and low-level nozzle foam-water systems. Locate the header inside the aircraft servicing area as near as practicable to an outside door. Configure the test header to permit each proportioner to be individually tested. Each test header must have at least four valved 2.5-inch (no equal metric standard) hose fittings.

**A1.3.1.6.** Underground Piping. Install underground piping systems, including piping in fire pump systems, in accordance with NFPA 24, *Installation of Private Fire Service Mains and their Appurtenances*, and the following:

**A1.3.1.6.1.** Provide ductile iron pipe or other pipe (high-density polyethylene or filament-wound fiberglass) listed by Underwriters Laboratories (UL) or approved by Factory Mutual for buried fire service application for all underground uses.

**A1.3.1.6.2.** Do not install any piping under hangar/facility floor slabs. If piping must be located below the floor line, use concrete trenching with open steel grating. Provide drains to sanitary sewer from any trenches. Do not install any piping, including the fire protection water service entrance into the building, that allows pressurization of the space below the floor slab. Minimize piping under paved operational surfaces (taxiways and aircraft parking).

**A1.3.1.6.3.** Size underground mains to ensure the maximum flow velocity does not exceed 3 meters per second.

**A1.3.1.6.4.** Use flanged or welded fittings (Figures A1 and A2) to transition the fire protection water service entrance from horizontal to vertical as it enters the building. Do not use gasketed compression fittings (including locking type), or flange fittings with setscrews.

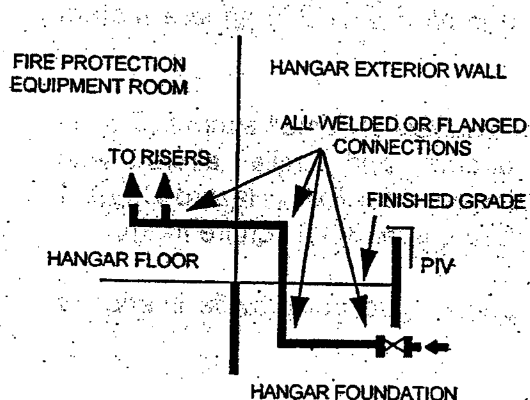


**Figure A1. Water Supply Pipe Entry**

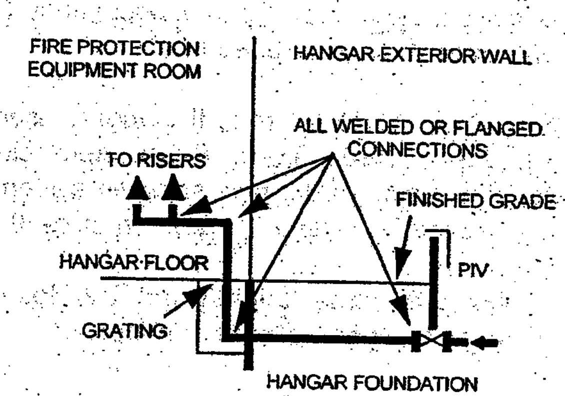


**Figure A2. Water Supply Pipe Entry**

**A1.3.1.6.5.** Provide corrosion protection on underground fire mains in the same manner as required for domestic water and other buried piping at the location.

**A1.3.1.6.6.** Do not install piping carrying foam concentrate or foam-water solution underground.

**A1.3.1.7.** Backflow Prevention. Install backflow prevention devices at connections to domestic water distribution systems. Backflow prevention is not required in dedicated non-potable water distribution systems. Valves that are part of a backflow prevention assembly will be the indicating type and will be supervised. Omit post indicator valves when backflow preventers are located outside. Locate backflow preventers inside the protected buildings when freeze protection is required. Do not use heat tapes or tracings to provide freeze protection; however, in locations where simple insulation will provide adequate freeze protection, the backflow preventer may be located outside (see AFI 32-1066, *Plumbing Systems).*

**A1.3.1.7.1.** Connections between potable water systems and systems containing chemical fire suppression agents or additives will use reduced-pressure backflow preventers.

**A1.3.1.7.2.** Connections between potable water systems and systems that do not contain chemicals (e.g., wet pipe systems) will use double-check valve assemblies unless otherwise required by local health and or water authorities.

**A1.3.1.7.3.** Install backflow prevention on the discharge side of pumps supplied directly from domestic water systems.

**A1.3.1.8.** Interior Piping Systems.

**A1.3.1.8.1.** Limit maximum flow velocity in interior facility piping to 6 meters per second (20 feet per second) or less.

**A1.3.1.8.2.** For water systems, use standard-weight pipe conforming to ASTM A795, *Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use,* or ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.*

**A1.3.1.8.3.** For foam-water systems, use one of the following:

- Standard-weight pipe conforming to ASTM A795 (exception: do not use galvanized pipe) or ASTM A53.
- Filament-wound fiberglass pipe conforming to ASTM D2996, *Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe,* designation code "RTRP-11 FF-3121."

**Note:** Filament-wound fiberglass pipe must be installed in accordance with ASME/ANSI B31.3-1996, *Process Piping.*

**A1.3.1.8.4.** Use threaded, flanged, or grooved fittings. Do not use fittings which couple plain-end pipe. Do not use welded sprinkler fittings or outlets for foam-water solution.

**A1.3.1.8.5.** Paint all exposed interior piping (color will be the same as the walls and or ceiling, or a complementing color). Do not paint exposed interior fire protection piping red. Exposed piping in the fire protection equipment room and mechanical rooms may be left unpainted. Stainless steel piping may be cleaned and left unpainted.

**A1.3.1.8.6.** Mark all exposed interior piping, at 8-meter (26-foot) intervals, with plastic wraparound-type pipe labels conforming to ASME/ANSI A13.1-1996, *Scheme for the Identification of Piping Systems*, indicating the type of fluid carried and direction of flow. Labels are not required on sprinkler system branch lines and pipes less than 51 millimeters (2 inches) in nominal size. The following legends are required:

- FIRE PROTECTION WATER - Used on dedicated potable and non-potable fire protection water supply lines.
- FOAM CONCENTRATE - Used on high-expansion foam concentrate lines.
- FIRE SPRINKLER or SPRINKLER FIRE - Used on standard water-only sprinkler systems.
- HIGH EXPANSION FOAM - Used on lines supplying low-level high-expansion foam generators.

**A1.3.2.** Automatic Sprinkler System.

**A1.3.2.1.** Use a wet-pipe automatic sprinkler system in all heated areas of the hangars other than the aircraft servicing area. Use a wet-pipe automatic sprinkler system in the aircraft servicing area in geographic locations having a 99.6% dry bulb temperature greater than -17.7 °C (0 °F) (per AFH[I] 32-1163, *Engineering Weather Data*). See paragraph A1.5.4, pertaining to building temperature supervision, when the 99.6% dry bulb temperature is less than 0.5 °C (33 °F) (per AFH[I] 32-1163).

**A1.3.2.2.** Risers will be provided with riser check valves and vane-type water flow switches rather than alarm check valves and associated trim.

**A1.3.2.3.** Provide a pressure relief trim device above the riser check valve. These devices typically are available in standard trim packages in the range of 1.2 to 1.3 MPa (175 to 185 psi). Discharge from these devices will be directed to sanitary waste collection.

**A1.3.2.4.** When multiple systems are required in an aircraft servicing area, all overhead systems will cover essentially equal floor areas.

**A1.3.2.5.** Provide upright quick-response sprinklers at the roof or ceiling level with temperature ratings of 79.4 °C (175 °F). In areas where extremely high temperatures normally occur, upright quick-response sprinklers at the roof or ceiling level with temperature ratings of 93.3 °C (200 °F) may be used.

**A1.3.2.6.** Provide a surge arrester (expansion tank) of not less than 38-liter (10-gallon) capacity for each separate wet pipe riser above the riser check valve.

Tanks must be listed/approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi).

**A1.3.2.7.** Connect all drains to an appropriately sized sanitary drain.

**A1.3.2.8.** Use a pre-action automatic sprinkler system activated by a roof- or ceiling-level thermal detection system, as described in paragraph A1.3.5.2, in the aircraft servicing area in geographic locations having a 99.6% dry bulb temperature less than -17.7 °C (0 °F) (per AFH[I] 32-1163).

**A1.3.2.8.1.** Provide externally resettable (without opening the valve assembly and without use of special tools) automatic water control (deluge) valves for pre-action systems. Maximum valve size is 150 millimeters (6 inches).

**A1.3.2.8.2.** Do not provide supervisory air on pre-action sprinkler systems in aircraft servicing areas.

**A1.3.2.8.3.** Provide a surge arrester (expansion tank) of not less than 38-liter capacity for each separate pre-action riser below the riser indicating valve. Provide a surge arrester (expansion tank) of not less than 95-liter (25-gallon) capacity for each set of multiple pre-action risers below the riser indicating valves on the header. Tanks must be listed/approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi).

**A1.3.3.** Low-Level High-Expansion Foam Systems. Low-level high-expansion foam systems are designed in accordance with NFPA 11A, *Standard for Medium and High Expansion Foam Systems.*

**A1.3.3.1.** Installation. Locate low-level high-expansion foam generators so that foam discharge falls close to, but not directly on, the aircraft fuselage or wings. Initial discharge of foam must protect the underaircraft and underwing area and then spread to the remaining hangar floor area. Low-level high-expansion foam generators may be designed to use either outside or inside air.

**A1.3.3.2.** Performance. Performance is greatly affected by the physical shape of the aircraft servicing area and the placement of the generators. Low-level high-expansion foam systems must cover 90 percent of the aircraft silhouette area projected on the floor in one minute or less. The area under engines extending beyond the wing edge and under rear elevators does not have to be considered in the aircraft's silhouette area. Low-level high-expansion foam systems must cover the aircraft servicing area and adjacent accessible areas to a depth of one meter (3.2 feet) in four minutes or less. These are performance requirements and failure to achieve these during acceptance testing will indicate a design failure.

Tanks must be listed/approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi).

**A1.3.2.7.** Connect all drains to an appropriately sized sanitary drain.

**A1.3.2.8.** Use a pre-action automatic sprinkler system activated by a roof- or ceiling-level thermal detection system, as described in paragraph A1.3.5.2, in the aircraft servicing area in geographic locations having a 99.6% dry bulb temperature less than -17.7 °C (0 °F) (per AFH[I] 32-1163).

**A1.3.2.8.1.** Provide externally resettable (without opening the valve assembly and without use of special tools) automatic water control (deluge) valves for pre-action systems. Maximum valve size is 150 millimeters (6 inches).

**A1.3.2.8.2.** Do not provide supervisory air on pre-action sprinkler systems in aircraft servicing areas.

**A1.3.2.8.3.** Provide a surge arrester (expansion tank) of not less than 38-liter capacity for each separate pre-action riser below the riser indicating valve. Provide a surge arrester (expansion tank) of not less than 95-liter (25-gallon) capacity for each set of multiple pre-action risers below the riser indicating valves on the header. Tanks must be listed/approved as a surge arrester with a rated working pressure of not less than 1895 kPa (275 psi).

**A1.3.3.** Low-Level High-Expansion Foam Systems. Low-level high-expansion foam systems are designed in accordance with NFPA 11A, *Standard for Medium and High Expansion Foam Systems.*

**A1.3.3.1.** Installation. Locate low-level high-expansion foam generators so that foam discharge falls close to, but not directly on, the aircraft fuselage or wings. Initial discharge of foam must protect the underaircraft and underwing area and then spread to the remaining hangar floor area. Low-level high-expansion foam generators may be designed to use either outside or inside air.

**A1.3.3.2.** Performance. Performance is greatly affected by the physical shape of the aircraft servicing area and the placement of the generators. Low-level high-expansion foam systems must cover 90 percent of the aircraft silhouette area projected on the floor in one minute or less. The area under engines extending beyond the wing edge and under rear elevators does not have to be considered in the aircraft's silhouette area. Low-level high-expansion foam systems must cover the aircraft servicing area and adjacent accessible areas to a depth of one meter (3.2 feet) in four minutes or less. These are performance requirements and failure to achieve these during acceptance testing will indicate a design failure.

**A1.3.3.3.** Rate of Discharge. The minimum rate of discharge or total generator capacity will be calculated in accordance with NFPA 11A; however, it will never be less than 0.8 $m^3 min/m^2$ (2.6 $ft^3 min/ft^2$). Application rates in the range of 0.8 to 1.2 $m^3 min/m^2$ (2.6 to 4 $ft^3 min/ft^2$) are required to meet the performance requirements

**A1.3.3.3.1.** The minimum rate of discharge or total generator capacity will be calculated from the following formula:

$$R = ([V/T] + R_S) \times C_N \times C_L$$

where:

R = Rate of discharge in $m^3$/min ($ft^3$/min)
V = Submergence volume in $m^3$ ($ft^3$) determined by the following formula:

$$V = A \times D$$

where:

A = Area of the aircraft servicing floor and adjacent floor areas not cut off from the aircraft servicing floor $m^2$ ($ft^2$)
D = Depth = 1 meter (3.28 feet) (see paragraph A1.3.3.2) which is greater than the 0.6-meter (2-foot) minimum foam depth over the hazard required in NFPA 11A

T = Submergence time in minutes = 4 (see paragraph A1.3.3.2)
$R_S$ = Rate of foam breakdown by sprinklers in $ft^3$/min ($m^3$/min) determined by the following formula:

$$R_S = S \times Q$$

where:

S = Foam breakdown from sprinkler discharge = 0.0748 cubic meters per minute • L/min (10 cubic feet per minute • gpm)
Q = Estimated total discharge from maximum number of sprinklers expected to operate in L/min (gpm).

$C_N$ = Compensation for normal foam shrinkage = 1.15. This is an empirical factor based on average reduction in foam quantity from solution drainage, fire, wetting of surfaces, and absorbency of stock.
$C_L$ = Compensation for loss of foam due to leakage around doors and windows and through unclosable openings determined by the design engineer after

proper evaluation of the structure. This factor for Air Force hangars cannot be less than 3.0.

**A1.3.3.4.** Concentrate and Water Supply. Concentrate and water supply will permit continuous operation of the system to generate four times the submergence volume, but for not less than 15 minutes. No additional foam is required for maintenance of the submergence volume beyond 15 minutes. Do not provide a connected reserve concentrate supply.

**A1.3.3.5.** Power Supply. Low-level high-expansion foam generators may be either hydraulically (water) or electrically powered. Electrically powered low-level high-expansion foam generators should be supplied ahead of the building disconnect and do not require a secondary power source when the power source meets the reliability requirements in paragraph A1.4.3.3.

**A1.3.3.6.** Activation. The following will activate the low-level high-expansion foam systems:

- Manual foam activation stations located at main exits from aircraft servicing area.
- Water flow signal in overhead sprinkler systems.
- Roof- or ceiling-level heat detection systems associated with pre-action systems (if installed).

**A1.3.4.** Foam Proportioning Systems.

**A1.3.4.1.** Listing. All components and assemblies used in this fire protection subsystem must be specifically listed/approved for their intended use by a nationally recognized testing organization whose listing/approval process includes follow-up factory inspections to ensure that products comply with the listing/approval conditions.

**A1.3.4.2.** High-Expansion Concentrate. Use only high-expansion foam (Hi-Ex®) concentrate listed/approved for use with the foam generators installed.

**A1.3.4.3.** Location. For high-expansion foam, provide independent concentrate storage and proportioning systems for each aircraft hangar facility. Locate foam concentrate storage, foam proportioning, foam injection, and system risers in a dedicated fire protection equipment room isolated from the aircraft servicing area by construction rated for at least one hour. These rooms must have direct exterior access.

**A1.3.4.3.1.** The foam equipment room will be large enough to accommodate all required equipment. All equipment will be fully accessible for inspection, testing, maintenance, and removal/replacement without the removal of any other equipment.

**A1.3.4.3.2.** If any equipment and or valves requiring access for maintenance, periodic testing, or re-servicing are located more than 2.4 meters (8 feet) above the floor, provide an open steel grate mezzanine, with a permanent ladder, at that equipment level. All platforms and ladders must be in compliance with Occupational Safety & Health Administration (OSHA) requirements.

**A1.3.4.4.** Proportioning.

**A1.3.4.4.1.** Proportioners will be limited to 152 millimeters (6 inches) or less.

**A1.3.4.4.2.** Use in-line balanced-pressure (ILBP) proportioners on all pumped concentrate systems. Do not use ILBP proportioners on bladder tank systems. ILBP proportioners must be factory assembled and tested by the manufacturer, and the entire ILBP proportioner assembly must be listed/approved by a recognized laboratory. Disassembly, reassembly, and or modification by the installing contractor will be prohibited.

**A1.3.4.4.3.** Use pressure proportioners for all bladder systems.

**A1.3.4.5.** Control Valve. Provide water-powered ball valves as foam concentrate control valves. The valve must be operated by connection to the alarm line of the automatic water control valve or alarm valve. Provide a retard chamber in the line to the water-powered ball valve on wet pipe foam water systems.

**A1.3.4.6.** Application Time.

**A1.3.4.6.1.** For foam-water sprinklers and foam-water nozzles, provide a connected foam concentrate supply sized for a single 10-minute application of foam, based on the actual system flow in the least hydraulically demanding area.

**A1.3.4.6.2.** For low-level high-expansion generators, provide a connected foam concentrate supply sized for a single 15-minute application (or four times the submergence volume, whichever is greater) of foam.

**A1.3.4.7.** Concentrate Storage. Atmospheric foam storage tanks must be either plastic or fiberglass construction and listed/approved for the storage of foam concentrate. Pressure tanks for bladder tank systems must be steel and listed/approved for the storage of foam concentrate.

**A1.3.4.7.1.** Do not provide back-up supply of foam concentrate in the facility, either as a connected reserve or bulk reserve.

**A1.3.4.7.2.** Provide clear space at one end of a horizontal bladder tank, at least equal to the length of the tank, to permit bladder replacement. Doors to the outside or adjacent open space at the end of the tank are an acceptable alternative. Provide clear space above vertical bladder tanks and permanent personnel access and work area, to permit re-servicing and bladder replacement.

**A1.3.4.8.** Foam Concentrate Pipe. Foam concentrate pipe must satisfy the following criteria:

- Grooved, welded, or flanged stainless steel.
- Filament-wound fiberglass conforming to ASTM D2996, designation code "RTRP-11 FF-3121," installed in accordance with ASME/ANSI B31.3-1996.

**A1.3.5.** Foam System Detection and Controls. Design all foam system detection and controls in accordance with NFPA 72, *National Fire Alarm Code®*, and the following criteria.

**A1.3.5.1.** Foam System Control Panel (FSCP).

**A1.3.5.1.1.** Locate all FSCPs in the fire protection equipment room, in a clean environment having temperature and humidity control, in accordance with the unit's listing/approval.

**A1.3.5.1.2.** Transient Voltage Surge Suppression (TVSS).

**A1.3.5.1.2.1.** All FSCPs must have TVSS on all fire alarm circuits entering and leaving the facility, including, but not limited to, the power supply circuits to the FSCP, circuits interfacing with fire pumping stations outside the facility, and circuits interfacing with the fire alarm receiving station (e.g., communication circuits, antenna systems).

**A1.3.5.1.2.2.** Alternating Current (ac) Power TVSS Devices. These devices will have been tested in accordance with UL 1449, *Standard for Safety Transient Voltage Surge Suppressors*, Second Edition, and UL 1283, *Electromagnetic Interference Filters*, latest edition, by a nationally recognized testing laboratory. The TVSS devices must provide normal sine wave tracking, with Category A1 ring wave suppression (2000 volts [V], 67 amperes, 180 degrees) of less than 50 V for nominal 120 V alternating current (Vac) legs. The TVSS will provide independent, distinct, and dedicated circuitry for each possible protection mode (i.e., line-to-line, line-to-neutral, line-to-ground, neutral-to-ground). TVSS device circuitry must be fully encapsulated for protection of the circuitry and to provide longer life expectancy.

**A1.3.5.1.2.3.** Data, Signal, and Control Wire TVSS Devices. The TVSS devices must be designed by the same manufacturer as the ac power TVSS devices to ensure overall compatibility and system reliability. The TVSS manufacturer will provide the TVSS devices based on evaluation of individual system parameters, including: conductor size and length, number of conductors, shield type, peak current and voltage, signal type, signal baud rate, frequency bandwidth, maximum attenuation, maximum standing-wave ratio, and maximum reflection coefficient. TVSS device circuitry must be fully encapsulated for protection of the circuitry and to provide longer life expectancy.

**A1.3.5.1.3.** Provide an FSCP for all suppression and detection functions in the aircraft area. The FSCP must be fully compatible with the base fire alarm receiving system without field modifications to any system hardware or software.

**A1.3.5.1.3.1.** The FSCP must transmit a separate and distinctive fire signal to the fire department upon activation of any portion of the foam-water system. Separate fire alarm transmitters/receivers will be permitted when they are fully compatible with the FSCP and the base fire alarm receiving system without field modifications to the FSCP.

**A1.3.5.1.3.2.** The specific number of alarm signals (e.g., fire, supervisory, tamper) to be transmitted must be defined in the system matrix (Figures A3 and A4).

| SYSTEM INPUTS | ANNUNCIATION AT LOCAL PANELS | | | | FIRE SUPPRESSION SYSTEM FUNCTIONS | | | | TRANSMIT SIGNALS TO FIRE DEPARTMENT | | | | | | AUXILIARY FUNCTIONS | | EVACUATION SIGNALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Audio-Visual Fire Alarm Indication by Zone | Audio-Visual Trouble Indication by Zone | Audio-Visual Common Trouble Indication | Audio-Visual Alarm Indication by Device | Transmit Pump Start Signal to Pumphouse | Open Pre-Action Sprinkler Valves | Open Low Level Spill Fire Suppression System Valve | Divert Drain Flow from Separators to Containment | Common Trouble Signal Per Building | Common Supervisory Signal Per Building | Common Fire Alarm Per General Area | Sprinkler Water Flow Per General Area | Low-Level Optical Detectors Per General Area | Foam-Water Discharge Per General Area | Shut Down All Supply & Recirculating Fans | Release magnetically Held Smoke Doors | Facility Fire Evacuation Audio-Visual Signal | Foam System Signal Blue Strobe/Beacon |
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
| **FIRE ALARMS** | | | | | | | | | | | | | | | | | | |
| 1 Manual Fire Alarm Stations | | | | | | | | | | | | | | | | | | |
| 2 Spot-Type Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 3 Fixed Temp & Rate-of-Rise Type Heat Detectors | | | | | | | | | | | | | | | | | | |
| 4 In-Duct Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 5 Rate-Compensated Type Heat Detectors on Hangar Ceiling | | | | | | | | | | | | | | | | | | |
| 6 Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems i Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 7 Water Flow Switches - Wet-Pipe Sprinkler Systems | X | | | | X | | X | X | | | | | | X | X | X | X | X |
| 8 Water Switches - Low Level System | X | | | | | | X | X | | | | | | X | X | X | X | X |
| 9 Manual Foam Discharge Station for Low-Level | X | | | | X | | X | X | | | | | | X | X | X | X | X |
| 10 Low Level Optical Fire Detector | | | | X | | | | | | | | | X | | | | X | |
| **SUPERVISORY SIGNALS** | | | | | | | | | | | | | | | | | | |
| 11 Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 12 Valve Supervisory Switches - Sprinklers | | X | | | | | | | | X | | | | | | | | |
| 13 Valve Supervisory Switches - Low-Level High-Expansion System | | X | | | | | | | | X | | | | | | | | |
| 14 Valve Supervisory Switches - Water Supply Entrance | | X | | | | | | | | X | | | | | | | | |
| 15 Hi-Lo Pressure Switches - Dry-Pipe Sprinklers | | | | | | | | | | | | | | | | | | |
| 16 Temperature Monitoring System | | | | X | | | | | | X | | | | | | | | |
| 17 Low-Level Optical Fire Detector Trouble | | X | | | | | | | | X | | | | | | | | |
| 18 Control Component Common Trouble Condition | | X | | | | | | | | X | | | | | | | | |
| 19 Low Level Auto Disable Switch | | X | | | | | | | | X | | | | | | | | |
| **TROUBLE CONDITIONS** | | | | | | | | | | | | | | | | | | |
| 20 Low Battery Voltage | | | X | | | | | | X | | | | | | | | | |
| 21 Circuit Fault | | X | X | | | | | | X | | | | | | | | | |
| 22 Supervised Component Failure | | | X | | | | | | X | | | | | | | | | |
| 23 AC Power Failure | | | X | | | | | | X | | | | | | | | | |

NOTES:

1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2. General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.
3. This sample matrix shows the basic requirements and is expected to be tailored to each individual project.

**Figure A3. Sample Wet-Pipe & Low-Level High-Expansion System Functional Matrix**

| SYSTEM INPUTS | ANNUNCIATION AT LOCAL PANELS | | | | FIRE SUPPRESSION SYSTEM FUNCTIONS | | | | TRANSMIT SIGNALS TO FIRE DEPARTMENT | | | | | | AUXILIARY FUNCTIONS | | EVACUATION SIGNALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Audio-Visual Fire Alarm Indication by Zone | Audio-Visual Trouble Indication by Zone/Middle | Audio-Visual Common Trouble Indication | Audio-Visual Alarm Indication by Device | Transmit Pump Start Signal to Pumphouse | Open Pre-Action Sprinkler Valves | Open Low Level Spill Fire Suppression System Valves | Divert Drain Flow from Separators to Containment | Common Trouble Signal Per Building | Common Supervisory Signal Per Building | Common Fire Alarm Per General Area | Sprinkler Water Flow Per General Area | Low-Level Optical Detectors Per General Area | Foam Discharge Per General Area | Shut Down All Supply & Recirculating Fans | Release magnetically Held Smoke Doors | Facility Fire Evacuation Audio-Visual Signal | Foam System Signal Blue Strobe/Beacon |
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
| **FIRE ALARMS** | | | | | | | | | | | | | | | | | | |
| 1 Manual Fire Alarm Stations | | | | | | | | | | | | | | | | | | |
| 2 Spot-Type Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 3 Fixed Temp & Rate-of-Rise Type Heat Detectors | | | | | | | | | | | | | | | | | | |
| 4 In-Duct Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 5 Rate-Compensated Type Heat Detectors on Hanger Ceiling | X | | | | X | X | X | X | | | | | | X | X | X | X | X |
| 6 Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems in Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 7 Water Flow Switches - Pre-Action Sprinkler Systems | X | | | | X | | X | X | | | | | | X | X | X | X | X |
| 8 Water Switches - Low Level System | X | | | | | | X | X | | | | | | X | X | X | X | X |
| 9 Manual Foam Discharge Station for Low-Level | X | | | | X | X | X | X | | | | | | X | X | X | X | X |
| 10 Low Level Optical Fire Detector | | | | X | | | | | | | | | X | | | | X | |
| **SUPERVISORY SIGNALS** | | | | | | | | | | | | | | | | | | |
| 11 Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 12 Valve Supervisory Switches - Sprinklers | | X | | | | | | | | X | | | | | | | | |
| 13 Valve Supervisory Switches - Low-level High Expansion | | X | | | | | | | | X | | | | | | | | |
| 14 Valve Supervisory Switches - Water Supply Entrance | | X | | | | | | | | X | | | | | | | | |
| 15 Hi-Lo Pressure Switches - Dry-Pipe Sprinklers | | | | | | | | | | | | | | | | | | |
| 16 Temperature Monitoring System | | | | | | | | | | | | | | | | | | |
| 17 Low-Level Optical Fire Detector Trouble | | X | | | | | | | | X | | | | | | | | |
| 18 Control Component Common Trouble Condition | | X | | | | | | | | X | | | | | | | | |
| 19 Low Level System Auto Disable Switch | | X | | | | | | | | X | | | | | | | | |
| **TROUBLE CONDITIONS** | | | | | | | | | | | | | | | | | | |
| 20 Low Battery Voltage | | | X | | | | | | X | | | | | | | | | |
| 21 Circuit Fault | | X | X | | | | | | X | | | | | | | | | |
| 22 Supervised Component Failure | | | X | | | | | | X | | | | | | | | | |
| 23 AC Power Failure | | | X | | | | | | X | | | | | | | | | |

NOTES:
1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2. General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.
3. This sample matrix shows the basic requirements and is expected to be tailored to each individual project.

**Figure A4. Sample Pre-Action & Low-Level High-Expansion System Functional Matrix**

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**A1.3.5.1.4.** Control panels activating deluge, pre-action, or nozzle systems must be listed/approved as releasing panels. All releasing panels must be specifically listed/approved for use with the automatic water control valves/solenoid release valves specified for the fire suppression system. Provide a switch within the lockable control panel to disable the releasing functions of the panel while leaving all detection and other functions of the panel operational. Activation of this switch will transmit a trouble signal to the fire alarm center.

**A1.3.5.2.** Thermal Fire Detectors.

**A1.3.5.2.1.** Provide one of the following automatic fire detection systems at the underside of the roof of the aircraft servicing area to activate pre-action suppression systems:

- Rate-compensated fire detector having a temperature rating between 71 °C (160 °F) and 76 °C (170 °F). Maximum spacing between detectors is 12 meters, or the detectors' listed spacing, whichever is less.
- Linear thermistor (line-type electrical conductivity) fire detector having a temperature setting of 76 °C (170 °F). Maximum spacing between detection lines is 9 meters (30 feet). The manufacturer must verify the detector response setting by an approved test method after installation. On steeply sloped or curved roofs, thermistor detectors must be installed perpendicular to the slope or arc (along the axis of the curve).

**A1.3.5.2.2.** The area covered by the fire detection system must correspond with its affiliated roof-level sprinkler system bound by draft curtains. The activation of any heat detection device in the sprinkler zone will immediately:

- Send a start signal to the fire pumping system (if any).
- Activate all low-level fuel spill fire suppression systems in the aircraft servicing area of fire origin.
- Actuate the appropriate suppression system valves (e.g., pre-action valves, foam concentrate valves) for the floor area covered by the detection system.
- Activate the facility fire evacuation alarm system and the foam system annunciation signal.
- Transmit a fire alarm signal to the base fire alarm communications center (fire department). The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment and planned upgrades.

**A1.3.5.3.** Optional Low-Level Optical Fire Detectors. The MAJCOM may establish an additional requirement for low-level optical detection.

**A1.3.5.3.1.** Connect low-level optical fire detectors to the FSCP. Arrange for alarm notification only; do not use optical detection systems to activate any fire suppression system.

**A1.3.5.3.2.** Use one of the following types of detectors:

**A1.3.5.3.2.1.** Combination or dual-spectrum ultraviolet/infrared (UV/IR) type optical detectors, listed/approved by a nationally recognized laboratory. Additionally, the manufacturer must provide a copy of the test report prepared by a nationally recognized laboratory certifying the listed/approved unit will detect a fully developed 3 meter by 3 meter JP-4, JP-8, or JET-A fuel fire at a minimum distance of 45 meters, within 5 seconds.

**A1.3.5.3.2.2.** Multi-spectrum optical detectors complying with the NAVFACENGCOM guide specification. The detectors must be listed/approved by a nationally recognized laboratory and the manufacturer must provide a copy of the test report prepared by a nationally recognized laboratory certifying the listed/approved unit fully meets the NAVFACENGCOM guide specification requirements.

**A1.3.5.3.3.** Install a sufficient number of optical detectors such that a fire at any position under an aircraft will be within the range and cone-of-vision of at least one optical detector.

**A1.3.5.3.4.** Mount optical detectors approximately 3 meters above the hangar floor level; however, specifics of each design must take into account facility construction, aircraft configuration and positioning, fixed and mobile equipment within the aircraft servicing area, and all other relevant factors. Do not mount optical detectors in inaccessible locations such as under roofs or on roof trusses.

**A1.3.5.3.5.** Optical detectors will be of a latching design. Fire detection by any optical detector will immediately:

- Activate the facility fire evacuation alarm system.
- Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

**A1.3.5.4.** Water Flow Detecting Devices. Provide water flow detecting devices on all fire protection risers with a built-in adjustable retard (not less than 0 to 90 seconds) on all sprinkler systems. Water flow will cause the FSCP to:

- Activate the low-level high-expansion fire suppression systems.
- Activate the facility fire evacuation alarm system and the foam system annunciation signal.
- Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

**A1.3.5.5.** Manual Foam Discharge Stations for Low-Level High-Expansion Fire Suppression Systems.

**A1.3.5.5.1.** Provide manual foam discharge stations inside the aircraft servicing area at exits to actuate the low-level high-expansion fire suppression systems.

**A1.3.5.5.2.** Manual foam discharge stations must be yellow and distinctively different from the manual fire alarm stations, and will have distinctive signage at each device stating "Start FOAM System" in red lettering not less than 76 millimeters (3 inches) high on a yellow or lime-yellow background.

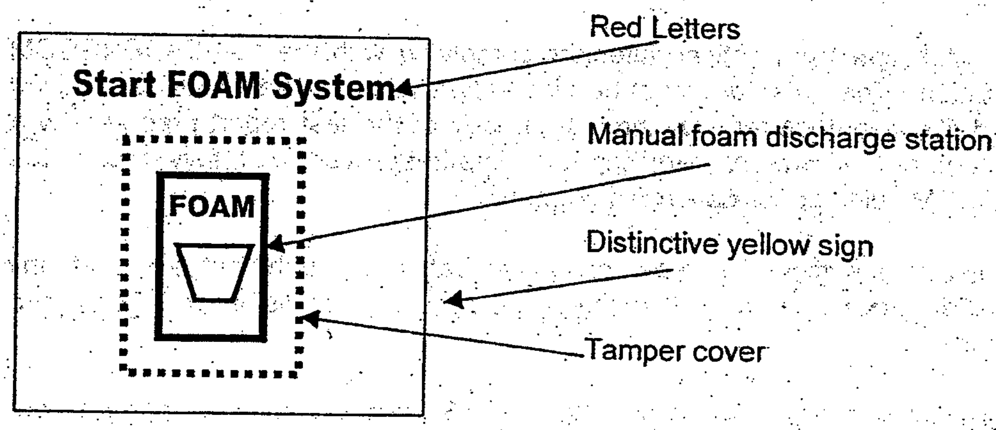


**Figure A5. Manual Foam Discharge Station, Tamper Cover, and Signage**

**A1.3.5.5.3.** Manual foam discharge stations must be housed within a clear plastic tamper cover that must be lifted prior to actuating the station. Any colored portions of the tamper covers must be yellow and any lettering on the cover must be "FOAM"; the words "fire" or "fire alarm" will not appear on the cover.

**A1.3.5.5.4.** Actuation of any manual foam discharge stations will cause the FSCP to:

- Activate foam discharge through the low level high-expansion generators.
- Activate the facility fire evacuation alarm and the foam system annunciation signal.
- Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

**A1.3.5.6.** Foam System Signals. Provide blue visual alarm signals (strobes or rotating beacons) within the aircraft servicing area to indicate foam system activation. When the base has adopted a standard audio-visual signal for foam system activation, the signals in the facility will comply fully with that base standard.

**A1.4. Fire Protection System Water Supply.**

**A1.4.1.** Requirement. Use the base domestic water system for hangar fire protection systems whenever adequate capacity (flow rate and pressure) is available. The A-E is responsible for testing and determining the capability of the existing systems and integrating those systems with the new systems being designed.

**A1.4.1.1.** Provide booster fire pumps in accordance with paragraph A1.4.3 when the water flow rate is adequate but pressure is inadequate to meet system pressure demands.

**A1.4.1.2.** Provide a separate dedicated fire protection system water supply when the available domestic flow rate is not sufficient to meet the system flow rate demands.

**A1.4.2.** Fire Protection Water Storage System.

**A1.4.2.1.** Provide water storage tanks in accordance with NFPA 24. Provide corrosion protection when steel water tanks and associated piping are used.

**A1.4.2.2.** Use a single water storage system, when practical, for multiple aircraft facilities. Limit water supply distribution mains from a fire pump station to less than 450 meters (1500 feet). As an exception, the MAJCOM FPE may approve a greater length when justified by specific physical situations. Such longer systems are subject to hydraulic surge (water hammer). Surge suppression must be provided at each end point of the system and at the pump station.

**A1.4.2.3.** Provide storage capacity equal to 120 percent of the maximum demand for 30 minutes. Divide the required storage capacity between two equal-sized water tanks, each storing one-half of the required volume. The piping configuration must allow water to be supplied by both reservoirs, and either of the reservoirs if the other is out of service.

**A1.4.2.4.** Provide each tank with a low-water-level alarm and a low-temperature alarm, each transmitting back to the fire department as separate supervisory signals. In areas with a 90% dry bulb temperature less than 0 °C (32 °F), provide appropriate freeze protection.

**A1.4.2.5.** Provide an external visual water-level gauge on each tank.

**A1.4.2.6.** Provide automatic refill from the base water distribution system.

**A1.4.3.** Fire Protection Water and Foam Pump Systems.

**A1.4.3.1** Design and install pumping installations in accordance with NFPA 20, *Standard for the Installation of Stationary Fire Pumps for Fire Protection.* Use a single water pumping station for multiple aircraft facilities, when practical.

**A1.4.3.2.** Provide one redundant pump for every water and foam pump system.

**A1.4.3.3.** Pumps must have electric motor drivers conforming to NFPA 20, supplied by a single reliable power source. Use dual power sources when a single reliable power source is not available. Use diesel engine drivers only when the installation electrical service fails to meet the reliable standard and dual power sources are not available. (For pump systems with one primary and one redundant pump, provide one electric and one diesel if the electrical service fails to meet the reliability standard and dual power sources are not available.) The A-E is responsible for determining and documenting the reliability of the existing power sources. A power source is considered reliable when the following are not exceeded:

- Forced downtime, excluding scheduled repairs, 8 consecutive hours for any one incident over the previous 3 years;
- 24 cumulative hours of downtime during the previous year.

**A1.4.3.4.** Use "soft start" or variable frequency pump controllers when electric-driven pumps are installed.

**A1.4.3.5.** Limit the maximum rated pump size to 9.463 $m^3$pm (9463 lpm) (2500 gpm) at 862 kPa (8.5 bar) (125 psi).

**A1.4.3.6.** Ensure the pumping system will have capacity to meet the maximum demand when the largest capacity pump is out of service.

**A1.4.3.7.** Provide pressure maintenance pumps ("jockey pumps") to maintain normal operating pressure on the system and to compensate for normal system leakage. See NFPA 20 for jockey pump flow requirements. The jockey pump's rated pressure must be sufficient for the startup and shutdown pressures specified in NFPA 20. Set jockey pump controllers to automatically start and stop in accordance with NFPA 20, paragraph A-11-2.6. Provide run timers to ensure that the jockey pump will operate for at least the minimum time recommended by the manufacturer of the jockey pump's motor.

**A1.4.3.8.** Arrange multiple-pump installations for sequential starting at 10-second intervals until the operating pumps maintain the required pressure. The starting sequence will begin automatically as follows:

- Pump start signal transmitted from the foam system control panel in the protected facility.
- Drop in system water pressure in accordance with NFPA 20.

Atch 1

**A1.4.3.9.** Provide connection through the installation fire reporting system to notify the fire department of pump running signals, pump system trouble, tamper and supervisory signals provided by the pump controllers. Pump running signals will be transmitted as a "fire" signal.

**A1.4.3.10.** Provide surge arresters to moderate the potentially destructive effects of pressure surges or water hammer due to pump starting and stopping and valve opening and closing. These hydropneumatic devices absorb pressure surges into a precalculated volume of captive gas and return the absorbed water volume to the system in a controlled fashion. Surge arresters are installed on the system side of the fire pump discharge check valve and as close to the valve as possible. At least one arrester will be provided for each pump and each must be listed/approved as a surge arrester for fire protection piping, with a volume of not less than 378.4 liters (100 gallons) and a rated working pressure not less than 1724 kPa (250 psi). Provide each arrester with an indicating valve to isolate it from the system. Supervision is not required. Because of the complex effects of system variables on satisfactory performance, the manufacturer should engineer each surge arrester installation.

**A1.5. Facility Fire Detection and Alarm System.** Design all facility fire detection and alarm systems in accordance with NFPA 72 and the following criteria.

**A1.5.1.** Fire Alarm Control Panel (FACP).

**A1.5.1.1.** Locate all FACPs in a clean environment with temperature and humidity control in accordance with the unit's listing/approval.

**A1.5.1.2.** FACPs will have TVSS on all fire alarm circuits entering and leaving the facility, including, but not limited to, the power supply circuits to the FACP, circuits interfacing with fire pumping stations outside the facility, and circuits interfacing with the fire alarm receiving station (e.g., communication circuits, antenna systems). TVSS devices must comply with the requirements of paragraph A1.3.5.1.2.

**A1.5.1.3.** Provide a single FACP for all detection alarm functions in the facility that are not part of the foam-water fire suppression system. The FACP must be fully compatible with the base fire alarm receiving system without field modifications to any system hardware or software.

**A1.5.1.4.** Separate fire alarm transmitters/receivers are permitted when they are fully compatible with the FACP and the base fire alarm receiving system without field modifications to the FACP.

**A1.5.1.5.** The specific number of alarm signals to be transmitted will be defined in the system matrix (Figure A5).

**A1.5.2.** Manual Fire Alarm Stations (Pull Stations).

**A1.5.2.1.** Provide pull stations throughout the facility at all exit doors. Provide additional pull stations when required by NFPA 101.

**A1.5.2.2.** Ensure all manual alarm activation stations are identical throughout the facility. If the base has established a formal base-wide standard for manual pull stations, the pull stations in facilities governed by this ETL will comply fully with that standard.

**A1.5.2.3.** Actuation of any manual alarm activation stations will immediately cause the FACP to:

- Activate the facility fire evacuation alarm signal throughout the facility.
- Transmit a fire alarm signal to the base fire department.

**A1.5.3.** Fire Alarm Notification. Provide audio-visual alarm notification devices. When the base has a standard for audible sound (e.g., slow whoop, bell) and visual signal (red, white), the devices in the facility will comply fully with the base standards. No other system (hangar doors, alert signal) will be permitted to use these signals. The fire alarm must be distinctive in high-noise areas.

**A1.5.4.** Temperature Monitoring System.

**A1.5.4.1.** Provide a system of temperature sensors for the aircraft servicing area in all geographic areas having a 99.6% dry bulb temperature less than -1 °C (30 °F) when wet-pipe sprinkler systems are present. The temperature sensors will be located at the same level as the sprinkler piping and spaced not more than 60 meters (200 feet) apart. Provide this temperature monitoring to ensure a warning when freezing temperatures endanger sprinkler piping.

**A1.5.4.2.** This facility temperature monitoring system will be tied into the FACP as a dedicated supervisory zone, and this supervisory signal will be transmitted to the fire department in the same manner as all fire-related supervisory signals in the facility.

## SYSTEM INPUTS

| # | System Inputs | ANNUNCIA… LOCAL PANEL | | | | FIRE SUPPRESSION SYSTEM FUNCTIONS | | | | TRANSMIT SIGNALS TO FIRE DEPARTMENT | | | | | | AUXILIARY FUNCTIONS | | …ION SIGNALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A Audio-Visual Fire Alarm Indication by Zone | B Audio-Visual Trouble Indication by Zone/Middle | C Audio-Visual Common Trouble Indication | D Audio-Visual Alarm Indication by Device | E Transmit Pump Start Signal to Pumphouse | F Open Pre-Action Sprinkler Valves | G Open All Low-Level High-Expansion | H Divert Drain Flow from Separators to Containment | I Common Trouble Signal Per Building | J Common Supervisory Signal Per Building | K Common Fire Alarm Per General Area | L Sprinkler Water Flow Per General Area | M Low-Level Optical Detectors Per General Area | N Foam-Water Discharge Per General Area | O Shut Down All Supply & Recirculating Fans | P Release magnetically Held Smoke Doors | Q Facility Fire Evacuation Audio-Visual Signal | R Foam System Signal Blue Strobe/Beacon |
| | **FIRE ALARMS** | | | | | | | | | | | | | | | | | | |
| 1 | Manual Fire Alarm Stations | X | | | | | | | | | | X | | | | | X | X | |
| 2 | Spot-Type Smoke Detectors | X | | | | | | | | | | X | | | | X | X | X | |
| 3 | Fixed Temp & Rate-of-Rise Type Heat Detectors | X | | | | | | | | | | X | | | | | X | X | |
| 4 | In-Duct Smoke Detectors | X | | | | | | | | | | X | | | | X | X | X | |
| 5 | Rate-Compensated Type Heat Detectors on Hangar Ceiling | | | | | | | | | | | | | | | | | X | |
| 6 | Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems in Adjacent Areas | X | | | | | | | | | | | X | | | X | X | X | |
| 7 | Water Flow Switches - Pre-Action Sprinkler Systems | | | | | | | | | | | | | | | | | X | |
| 8 | Water Switches - Low-level High-expansion System | | | | | | | | | | | | | | | | | X | |
| 9 | Manual Foam Discharge Station for Low-Level | | | | | | | | | | | | | | | | | X | |
| 10 | Low Level Optical Fire Detector | | | | | | | | | | | | | | | | | X | |
| | **SUPERVISORY SIGNALS** | | | | | | | | | | | | | | | | | | |
| 11 | Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas | | X | | | | | | | | X | | | | | | | | |
| 12 | Valve Supervisory Switches - Sprinklers | | | | | | | | | | | | | | | | | | |
| 13 | ~~Valve Supervisory Switches - Low-Level High-Expansion~~ System | | | | | | | | | | | | | | | | | | |
| 14 | Valve Supervisory Switches - Water Supply Entrance | | | | | | | | | | | | | | | | | | |
| 15 | Hi-Lo Pressure Switches - Dry-Pipe Sprinklers | | X | | | | | | | | X | | | | | | | | |
| 16 | Temperature Monitoring System | | | | X | | | | | | X | | | | | | | | |
| 17 | Low-Level Optical Fire Detector Trouble | | | | | | | | | | | | | | | | | | |
| 18 | Control Component Common Trouble Condition | | X | | | | | | | | X | | | | | | | | |
| 19 | Under-Aircraft Foam-Water System Auto Disable Switch | | | | | | | | | | | | | | | | | | |
| | **TROUBLE CONDITIONS** | | | | | | | | | | | | | | | | | | |
| 20 | Low Battery Voltage | | | X | | | | | | X | | | | | | | | | |
| 21 | Circuit Fault | | X | X | | | | | | X | | | | | | | | | |
| 22 | Supervised Component Failure | | | X | | | | | | X | | | | | | | | | |
| 23 | AC Power Failure | | | X | | | | | | X | | | | | | | | | |

NOTES:

1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2. General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.
3. This sample matrix shows the basic requirements and is expected to be tailored to each individual project.

**Figure A5. Sample Facility Fire Detection and Alarm System Functional Matrix**

**A1.6. Design and Construction Management.**

**A1.6.1.** A-E Qualifications.

**A1.6.1.1.** It is mandatory that design organizations (whether the design is accomplished by an in-house design agent or an outside A-E firm) use a qualified FPE, experienced in the design of aircraft hangars, for the design of the fire protection systems in all Air Force projects covered by this ETL.

**A1.6.1.1.1.** "Qualified FPE" does not have a universal definition and is defined differently among various government agencies. For this ETL, one of the following credentials is required to meet the criteria for "qualified FPE":

- Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university, plus a minimum of 5 years' work experience in fire protection engineering.
- Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEE) fire protection engineering written examination.
- Qualification as a GS/GM 804-series FPE.
- PE registration in a related discipline with a minimum of 5 years' work experience in fire protection engineering.

**A1.6.1.1.2.** For Air Force aircraft hangars, the design agent will confirm that:

- Designer complies with the definition of "qualified FPE."
- FPE has substantial experience in the design and construction of aircraft hangar fire protection systems of similar complexity.

**A1.6.1.2.** The Commerce Business Daily announcement for the project design will specifically include the requirement for a qualified FPE on the A-E design team.

**A1.6.2.** System Testing and Acceptance:

**A1.6.2.1.** Preliminary Testing.

**A1.6.2.1.1.** Testing of the fire protection system is critical. The entire fire protection system must be tested in accordance with the specification to ensure that all equipment, components, and subsystems function as intended. In addition to establishing written confirmation of all test results, all preliminary tests will be videotaped to record the methods and equipment employed to conduct the tests.

**A1.6.2.1.2.** A copy of the videotape must be submitted with a copy of the proposed test plan to the USACE Center of Expertise or NAVFACENGCOM FPE before the request for a final acceptance test is made. All preliminary tests must be completed prior to scheduling the final acceptance test.

**A1.6.2.2.** Final Acceptance Test. The final test will be a repeat of all preliminary tests, except that flushing and hydrostatic tests will not be repeated. Tests must be witnessed by the USACE Center of Expertise or NAVFACENGCOM FPE. All system failures or other deficiencies identified during the testing must be corrected and retested in the presence of the USACE Center of Expertise or NAVFACENGCOM FPE.

## LOW-LEVEL HIGH-EXPANSION FOAM SYSTEM VIEWS

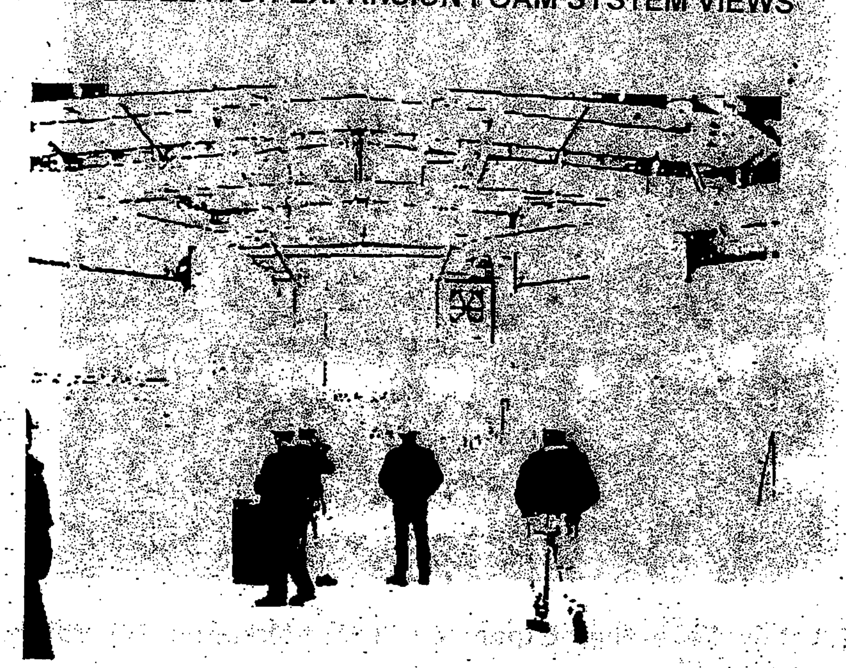

**Figure A2.1. Low-Level High-Expansion Foam Wall-Mounted (Adjacent Leading Wing Edge) Generators' Initial Discharge**

**Figure A2.2. Low-Level High-Expansion Foam After Three-Minute Discharge**

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Figure A2.3. Low-Level High-Expansion Ceiling-Mounted Generators' Foam Discharge

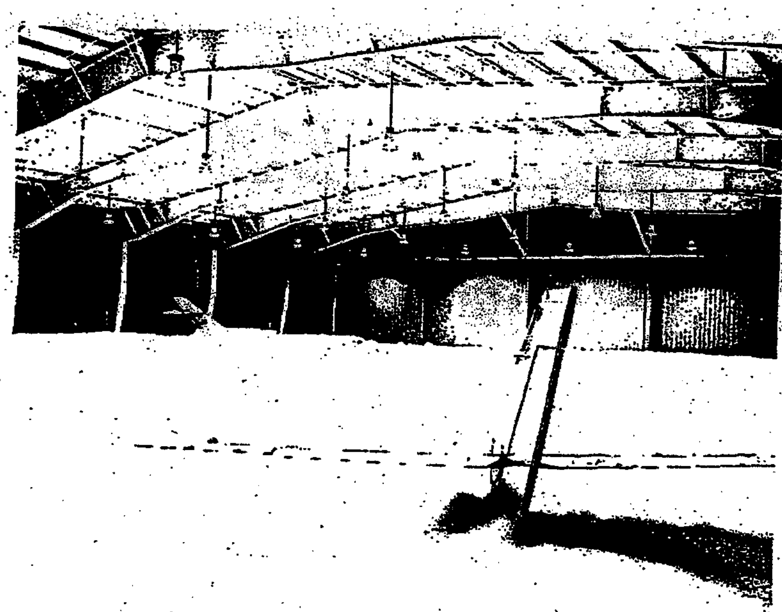

Figure A2.4. Low-Level High-Expansion Foam After 15-Minute Discharge

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## DISTRIBUTION LIST

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National Institute of Bldg Sciences
1201 L Street NW, Suite 400
Washington DC 20005

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**A1.3.4.3.2.** If any equipment and or valves requiring access for maintenance, periodic testing, or re-servicing are located more than 2.4 meters (8 feet) above the floor, provide an open steel grate mezzanine, with a permanent ladder, at that equipment level. All platforms and ladders must be in compliance with Occupational Safety & Health Administration (OSHA) requirements.

**A1.3.4.4.** Proportioning.

**A1.3.4.4.1.** Proportioners will be limited to 152 millimeters (6 inches) or less.

**A1.3.4.4.2.** Use in-line balanced-pressure (ILBP) proportioners on all pumped concentrate systems. Do not use ILBP proportioners on bladder tank systems. ILBP proportioners must be factory assembled and tested by the manufacturer, and the entire ILBP proportioner assembly must be listed/approved by a recognized laboratory. Disassembly, reassembly, and or modification by the installing contractor will be prohibited.

**A1.3.4.4.3.** Use pressure proportioners for all bladder systems.

**A1.3.4.5.** Control Valve. Provide water-powered ball valves as foam concentrate control valves. The valve must be operated by connection to the alarm line of the automatic water control valve or alarm valve. Provide a retard chamber in the line to the water-powered ball valve on wet pipe foam water systems.

**A1.3.4.6.** Application Time.

**A1.3.4.6.1.** For foam-water sprinklers and foam-water nozzles, provide a connected foam concentrate supply sized for a single 10-minute application of foam, based on the actual system flow in the least hydraulically demanding area.

**A1.3.4.6.2.** For low-level high-expansion generators, provide a connected foam concentrate supply sized for a single 15-minute application (or four times the submergence volume, whichever is greater) of foam.

**A1.3.4.7.** Concentrate Storage. Atmospheric foam storage tanks must be either plastic or fiberglass construction and listed/approved for the storage of foam concentrate. Pressure tanks for bladder tank systems must be steel and listed/approved for the storage of foam concentrate.

**A1.3.4.7.1.** Do not provide back-up supply of foam concentrate in the facility, either as a connected reserve or bulk reserve.

**A1.3.4.7.2.** Provide clear space at one end of a horizontal bladder tank, at least equal to the length of the tank, to permit bladder replacement. Doors to the outside or adjacent open space at the end of the tank are an acceptable alternative. Provide clear space above vertical bladder tanks and permanent personnel access and work area, to permit re-servicing and bladder replacement.

**A1.3.4.8.** Foam Concentrate Pipe. Foam concentrate pipe must satisfy the following criteria:

- Grooved, welded, or flanged stainless steel.
- Filament-wound fiberglass conforming to ASTM D2996, designation code "RTRP-11 FF-3121," installed in accordance with ASME/ANSI B31.3-1996.

**A1.3.5.** Foam System Detection and Controls. Design all foam system detection and controls in accordance with NFPA 72, *National Fire Alarm Code®*, and the following criteria.

**A1.3.5.1.** Foam System Control Panel (FSCP).

**A1.3.5.1.1.** Locate all FSCPs in the fire protection equipment room, in a clean environment having temperature and humidity control, in accordance with the unit's listing/approval.

**A1.3.5.1.2.** Transient Voltage Surge Suppression (TVSS).

**A1.3.5.1.2.1.** All FSCPs must have TVSS on all fire alarm circuits entering and leaving the facility, including, but not limited to, the power supply circuits to the FSCP, circuits interfacing with fire pumping stations outside the facility, and circuits interfacing with the fire alarm receiving station (e.g., communication circuits, antenna systems).

**A1.3.5.1.2.2.** Alternating Current (ac) Power TVSS Devices. These devices will have been tested in accordance with UL 1449, *Standard for Safety Transient Voltage Surge Suppressors*, Second Edition, and UL 1283, *Electromagnetic Interference Filters*, latest edition, by a nationally recognized testing laboratory. The TVSS devices must provide normal sine wave tracking, with Category A1 ring wave suppression (2000 volts [V], 67 amperes, 180 degrees) of less than 50 V for nominal 120 V alternating current (Vac) legs. The TVSS will provide independent, distinct, and dedicated circuitry for each possible protection mode (i.e., line-to-line, line-to-neutral, line-to-ground, neutral-to-ground). TVSS device circuitry must be fully encapsulated for protection of the circuitry and to provide longer life expectancy.

**A1.3.5.1.2.3.** Data, Signal, and Control Wire TVSS Devices. The TVSS devices must be designed by the same manufacturer as the ac power TVSS devices to ensure overall compatibility and system reliability. The TVSS manufacturer will provide the TVSS devices based on evaluation of individual system parameters, including: conductor size and length, number of conductors, shield type, peak current and voltage, signal type, signal baud rate, frequency bandwidth, maximum attenuation, maximum standing-wave ratio, and maximum reflection coefficient. TVSS device circuitry must be fully encapsulated for protection of the circuitry and to provide longer life expectancy.

**A1.3.5.1.3.** Provide an FSCP for all suppression and detection functions in the aircraft area. The FSCP must be fully compatible with the base fire alarm receiving system without field modifications to any system hardware or software.

**A1.3.5.1.3.1.** The FSCP must transmit a separate and distinctive fire signal to the fire department upon activation of any portion of the foam-water system. Separate fire alarm transmitters/receivers will be permitted when they are fully compatible with the FSCP and the base fire alarm receiving system without field modifications to the FSCP.

**A1.3.5.1.3.2.** The specific number of alarm signals (e.g., fire, supervisory, tamper) to be transmitted must be defined in the system matrix (Figures A3 and A4).

| SYSTEM INPUTS | ANNUNCIATION AT LOCAL PANELS | | | | [...]RESSION SYST[...]UNCTIONS | | | | TRANSMIT SIGNALS TO FIRE DEPARTMENT | | | | | | AUXILIARY FUNCTIONS | | EVACUATION SIGNALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Audio-Visual Fire Alarm Indication by Zone | Audio-Visual Trouble Indication by Zone | Audio-Visual Common Trouble Indication | Audio-Visual Alarm Indication by Device | Transmit Pump Start Signal to Pumphouse | Open Pre-Action Sprinkler Valves | Open Low Level Spill Fire Suppression System Valve | Divert Drain Flow from Separators to Containment | Common Trouble Signal Per Building | Common Supervisory Signal Per Building | Common Fire Alarm Per General Area | Sprinkler Water Flow Per General Area | Low-Level Optical Detectors Per General Area | Foam-Water Discharge Per General Area | Shut Down All Supply & Recirculating Fans | Release magnetically Held Smoke Doors | Facility Fire Evacuation Audio-Visual Signal | Foam System Signal Blue Strobe/Beacon |
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
| FIRE ALARMS | | | | | | | | | | | | | | | | | | |
| 1 Manual Fire Alarm Stations | | | | | | | | | | | | | | | | | | |
| 2 Spot-Type Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 3 Fixed Temp & Rate-of-Rise Type Heat Detectors | | | | | | | | | | | | | | | | | | |
| 4 In-Duct Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 5 Rate-Compensated Type Heat Detectors on Hangar Ceiling | | | | | | | | | | | | | | | | | | |
| 6 Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems I Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 7 Water Flow Switches - Wet-Pipe Sprinkler Systems | X | | | | X | | X | X | | | | | | X | X | X | X | X |
| 8 Water Switches - Low Level System | X | | | | | | X | X | | | | | | X | X | X | X | X |
| 9 Manual Foam Discharge Station for Low-Level | X | | | | X | | X | X | | | | | | X | X | X | X | X |
| 10 Low Level Optical Fire Detector | | | | X | | | | | | | | | X | | | | X | |
| SUPERVISORY SIGNALS | | | | | | | | | | | | | | | | | | |
| 11 Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 12 Valve Supervisory Switches - Sprinklers | | X | | | | | | | | X | | | | | | | | |
| 13 Valve Supervisory Switches - Low-Level High-Expansion System | | X | | | | | | | | X | | | | | | | | |
| 14 Valve Supervisory Switches - Water Supply Entrance | | X | | | | | | | | X | | | | | | | | |
| 15 Hi-Lo Pressure Switches - Dry-Pipe Sprinklers | | | | | | | | | | | | | | | | | | |
| 16 Temperature Monitoring System | | | | X | | | | | | X | | | | | | | | |
| 17 Low-Level Optical Fire Detector Trouble | | X | | | | | | | | X | | | | | | | | |
| 18 Control Component Common Trouble Condition | | X | | | | | | | | X | | | | | | | | |
| 19 Low Level Auto Disable Switch | | X | | | | | | | | X | | | | | | | | |
| TROUBLE CONDITIONS | | | | | | | | | | | | | | | | | | |
| 20 Low Battery Voltage | | | X | | | | | | X | | | | | | | | | |
| 21 Circuit Fault | | X | X | | | | | | X | | | | | | | | | |
| 22 Supervised Component Failure | | | X | | | | | | X | | | | | | | | | |
| 23 AC Power Failure | | | X | | | | | | X | | | | | | | | | |

NOTES:
1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2 General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.
3, This sample matrix shows the basic requirements and is expected to be tailored to each individual project.

**Figure A3. Sample Wet-Pipe & Low-Level High-Expansion System Functional Matrix**

| SYSTEM INPUTS | ANNUNCIATION AT LOCAL PANELS | | | | FIRE SUPPRESSION SYSTEM FUNCTIONS | | | | TRANSMIT SIGNALS TO FIRE DEPARTMENT | | | | | | AUXILIARY FUNCTIONS | | EVACUATION SIGNALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Audio-Visual Fire Alarm Indication by Zone | Audio-Visual Trouble Indication by Zone/Module | Audio-Visual Common Trouble Indication | Audio-Visual Alarm Indication by Device | Transmit Pump Start Signal to Pumphouse | Open Pre-Action Sprinkler Valves | Open Low Level Spill Fire Suppression System Valves | Divert Drain Flow from Separators to Containment | Common Trouble Signal Per Building | Common Supervisory Signal Per Building | Common Fire Alarm Per General Area | Sprinkler Water Flow Per General Area | Low-Level Optical Detectors Per General Area | Foam Discharge Per General Area | Shut Down All Supply & Recirculating Fans | Release magnetically Held Smoke Doors | Facility Fire Evacuation Audio-Visual Signal | Foam System Signal Blue Strobe/Beacon |
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
| **FIRE ALARMS** | | | | | | | | | | | | | | | | | | |
| 1 Manual Fire Alarm Stations | | | | | | | | | | | | | | | | | | |
| 2 Spot-Type Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 3 Fixed Temp & Rate-of-Rise Type Heat Detectors | | | | | | | | | | | | | | | | | | |
| 4 In-Duct Smoke Detectors | | | | | | | | | | | | | | | | | | |
| 5 Rate-Compensated-Type Heat Detectors on Hangar Ceiling | X | | | | X | X | X | X | | | | | | X | X | X | X | X |
| 6 Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems in Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 7 Water Flow Switches - Pre-Action Sprinkler Systems | X | | | | X | | X | X | | | | | | X | X | X | X | X |
| 8 Water Switches - Low Level System | X | | | | | | X | X | | | | | | X | X | X | X | X |
| 9 Manual Foam Discharge Station for Low-Level | X | | | | X | X | X | X | | | | | | X | X | X | X | X |
| 10 Low Level Optical Fire Detector | | | | X | | | | | | | | | X | | | | X | |
| **SUPERVISORY SIGNALS** | | | | | | | | | | | | | | | | | | |
| 11 Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas | | | | | | | | | | | | | | | | | | |
| 12 Valve Supervisory Switches - Sprinklers | | X | | | | | | | | X | | | | | | | | |
| 13 Valve Supervisory Switches - Low-level High Expansion | | X | | | | | | | | X | | | | | | | | |
| 14 Valve Supervisory Switches - Water Supply Entrance | | X | | | | | | | | X | | | | | | | | |
| 15 Hi-Lo Pressure Switches - Dry-Pipe Sprinklers | | | | | | | | | | | | | | | | | | |
| 16 Temperature Monitoring System | | | | | | | | | | | | | | | | | | |
| 17 Low-Level Optical Fire Detector Trouble | | X | | | | | | | | X | | | | | | | | |
| 18 Control Component Common Trouble Condition | | X | | | | | | | | X | | | | | | | | |
| 19 Low Level System Auto Disable Switch | | X | | | | | | | | X | | | | | | | | |
| **TROUBLE CONDITIONS** | | | | | | | | | | | | | | | | | | |
| 20 Low Battery Voltage | | | X | | | | | | X | | | | | | | | | |
| 21 Circuit Fault | | X | X | | | | | | X | | | | | | | | | |
| 22 Supervised Component Failure | | | X | | | | | | X | | | | | | | | | |
| 23 AC Power Failure | | | X | | | | | | X | | | | | | | | | |

NOTES:

1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2. General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.
3. This sample matrix shows the basic requirements and is expected to be tailored to each individual project.

**Figure A4. Sample Pre-Action & Low-Level High-Expansion System Functional Matrix**

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**A1.3.5.1.4.** Control panels activating deluge, pre-action, or nozzle systems must be listed/approved as releasing panels. All releasing panels must be specifically listed/approved for use with the automatic water control valves/solenoid release valves specified for the fire suppression system. Provide a switch within the lockable control panel to disable the releasing functions of the panel while leaving all detection and other functions of the panel operational. Activation of this switch will transmit a trouble signal to the fire alarm center.

**A1.3.5.2.** Thermal Fire Detectors.

**A1.3.5.2.1.** Provide one of the following automatic fire detection systems at the underside of the roof of the aircraft servicing area to activate pre-action suppression systems:

- Rate-compensated fire detector having a temperature rating between 71 °C (160 °F) and 76 °C (170 °F). Maximum spacing between detectors is 12 meters, or the detectors' listed spacing, whichever is less.
- Linear thermistor (line-type electrical conductivity) fire detector having a temperature setting of 76 °C (170 °F). Maximum spacing between detection lines is 9 meters (30 feet). The manufacturer must verify the detector response setting by an approved test method after installation. On steeply sloped or curved roofs, thermistor detectors must be installed perpendicular to the slope or arc (along the axis of the curve).

**A1.3.5.2.2.** The area covered by the fire detection system must correspond with its affiliated roof-level sprinkler system bound by draft curtains. The activation of any heat detection device in the sprinkler zone will immediately:

- Send a start signal to the fire pumping system (if any).
- Activate all low-level fuel spill fire suppression systems in the aircraft servicing area of fire origin.
- Actuate the appropriate suppression system valves (e.g., pre-action valves, foam concentrate valves) for the floor area covered by the detection system.
- Activate the facility fire evacuation alarm system and the foam system annunciation signal.
- Transmit a fire alarm signal to the base fire alarm communications center (fire department). The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment and planned upgrades.

**A1.3.5.3.** Optional Low-Level Optical Fire Detectors. The MAJCOM may establish an additional requirement for low-level optical detection.

**A1.3.5.3.1.** Connect low-level optical fire detectors to the FSCP. Arrange for alarm notification only; do not use optical detection systems to activate any fire suppression system.

**A1.3.5.3.2.** Use one of the following types of detectors:

**A1.3.5.3.2.1.** Combination or dual-spectrum ultraviolet/infrared (UV/IR) type optical detectors, listed/approved by a nationally recognized laboratory. Additionally, the manufacturer must provide a copy of the test report prepared by a nationally recognized laboratory certifying the listed/approved unit will detect a fully developed 3 meter by 3 meter JP-4, JP-8, or JET-A fuel fire at a minimum distance of 45 meters, within 5 seconds.

**A1.3.5.3.2.2.** Multi-spectrum optical detectors complying with the NAVFACENGCOM guide specification. The detectors must be listed/approved by a nationally recognized laboratory and the manufacturer must provide a copy of the test report prepared by a nationally recognized laboratory certifying the listed/approved unit fully meets the NAVFACENGCOM guide specification requirements.

**A1.3.5.3.3.** Install a sufficient number of optical detectors such that a fire at any position under an aircraft will be within the range and cone-of-vision of at least one optical detector.

**A1.3.5.3.4.** Mount optical detectors approximately 3 meters above the hangar floor level; however, specifics of each design must take into account facility construction, aircraft configuration and positioning, fixed and mobile equipment within the aircraft servicing area, and all other relevant factors. Do not mount optical detectors in inaccessible locations such as under roofs or on roof trusses.

**A1.3.5.3.5.** Optical detectors will be of a latching design. Fire detection by any optical detector will immediately:

- Activate the facility fire evacuation alarm system.
- Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

**A1.3.5.4.** Water Flow Detecting Devices. Provide water flow detecting devices on all fire protection risers with a built-in adjustable retard (not less than 0 to 90 seconds) on all sprinkler systems. Water flow will cause the FSCP to:

- Activate the low-level high-expansion fire suppression systems.
- Activate the facility fire evacuation alarm system and the foam system annunciation signal.
- Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

**A1.3.5.5.** Manual Foam Discharge Stations for Low-Level High-Expansion Fire Suppression Systems.

**A1.3.5.5.1.** Provide manual foam discharge stations inside the aircraft servicing area at exits to actuate the low-level high-expansion fire suppression systems.

**A1.3.5.5.2.** Manual foam discharge stations must be yellow and distinctively different from the manual fire alarm stations, and will have distinctive signage at each device stating "Start FOAM System" in red lettering not less than 76 millimeters (3 inches) high on a yellow or lime-yellow background.

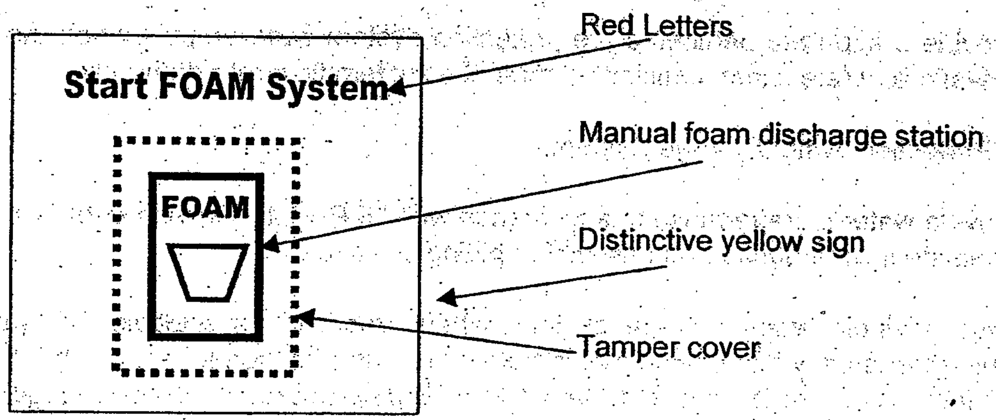


**Figure A5. Manual Foam Discharge Station, Tamper Cover, and Signage**

**A1.3.5.5.3.** Manual foam discharge stations must be housed within a clear plastic tamper cover that must be lifted prior to actuating the station. Any colored portions of the tamper covers must be yellow and any lettering on the cover must be "FOAM"; the words "fire" or "fire alarm" will not appear on the cover.

**A1.3.5.5.4.** Actuation of any manual foam discharge stations will cause the FSCP to:

- Activate foam discharge through the low level high-expansion generators.
- Activate the facility fire evacuation alarm and the foam system annunciation signal.
- Transmit a fire alarm signal to the fire department. The number and type of signals transmitted to the fire department will be locally determined based on the current fire alarm receiving equipment.

**A1.3.5.6.** Foam System Signals. Provide blue visual alarm signals (strobes or rotating beacons) within the aircraft servicing area to indicate foam system activation. When the base has adopted a standard audio-visual signal for foam system activation, the signals in the facility will comply fully with that base standard.

**A1.4. Fire Protection System Water Supply.**

**A1.4.1.** Requirement. Use the base domestic water system for hangar fire protection systems whenever adequate capacity (flow rate and pressure) is available. The A-E is responsible for testing and determining the capability of the existing systems and integrating those systems with the new systems being designed.

**A1.4.1.1.** Provide booster fire pumps in accordance with paragraph A1.4.3 when the water flow rate is adequate but pressure is inadequate to meet system pressure demands.

**A1.4.1.2.** Provide a separate dedicated fire protection system water supply when the available domestic flow rate is not sufficient to meet the system flow rate demands.

**A1.4.2.** Fire Protection Water Storage System.

**A1.4.2.1.** Provide water storage tanks in accordance with NFPA 24. Provide corrosion protection when steel water tanks and associated piping are used.

**A1.4.2.2.** Use a single water storage system, when practical, for multiple aircraft facilities. Limit water supply distribution mains from a fire pump station to less than 450 meters (1500 feet). As an exception, the MAJCOM FPE may approve a greater length when justified by specific physical situations. Such longer systems are subject to hydraulic surge (water hammer). Surge suppression must be provided at each end point of the system and at the pump station.

**A1.4.2.3.** Provide storage capacity equal to 120 percent of the maximum demand for 30 minutes. Divide the required storage capacity between two equal-sized water tanks, each storing one-half of the required volume. The piping configuration must allow water to be supplied by both reservoirs, and either of the reservoirs if the other is out of service.

**A1.4.2.4.** Provide each tank with a low-water-level alarm and a low-temperature alarm, each transmitting back to the fire department as separate supervisory signals. In areas with a 90% dry bulb temperature less than 0 °C (32 °F), provide appropriate freeze protection.

**A1.4.2.5.** Provide an external visual water-level gauge on each tank.

**A1.4.2.6.** Provide automatic refill from the base water distribution system.

**A1.4.3.** Fire Protection Water and Foam Pump Systems.

**A1.4.3.1** Design and install pumping installations in accordance with NFPA 20, *Standard for the Installation of Stationary Fire Pumps for Fire Protection*. Use a single water pumping station for multiple aircraft facilities, when practical.

**A1.4.3.2.** Provide one redundant pump for every water and foam pump system.

**A1.4.3.3.** Pumps must have electric motor drivers conforming to NFPA 20, supplied by a single reliable power source. Use dual power sources when a single reliable power source is not available. Use diesel engine drivers only when the installation electrical service fails to meet the reliable standard and dual power sources are not available. (For pump systems with one primary and one redundant pump, provide one electric and one diesel if the electrical service fails to meet the reliability standard and dual power sources are not available.) The A-E is responsible for determining and documenting the reliability of the existing power sources. A power source is considered reliable when the following are not exceeded:

- Forced downtime, excluding scheduled repairs, 8 consecutive hours for any one incident over the previous 3 years;
- 24 cumulative hours of downtime during the previous year.

**A1.4.3.4.** Use "soft start" or variable frequency pump controllers when electric-driven pumps are installed.

**A1.4.3.5.** Limit the maximum rated pump size to 9.463 $m^3$pm (9463 lpm) (2500 gpm) at 862 kPa (8.5 bar) (125 psi).

**A1.4.3.6.** Ensure the pumping system will have capacity to meet the maximum demand when the largest capacity pump is out of service.

**A1.4.3.7.** Provide pressure maintenance pumps ("jockey pumps") to maintain normal operating pressure on the system and to compensate for normal system leakage. See NFPA 20 for jockey pump flow requirements. The jockey pump's rated pressure must be sufficient for the startup and shutdown pressures specified in NFPA 20. Set jockey pump controllers to automatically start and stop in accordance with NFPA 20, paragraph A-11-2.6. Provide run timers to ensure that the jockey pump will operate for at least the minimum time recommended by the manufacturer of the jockey pump's motor.

**A1.4.3.8.** Arrange multiple-pump installations for sequential starting at 10-second intervals until the operating pumps maintain the required pressure. The starting sequence will begin automatically as follows:

- Pump start signal transmitted from the foam system control panel in the protected facility.
- Drop in system water pressure in accordance with NFPA 20.

**A1.4.3.9.** Provide connection through the installation fire reporting system to notify the fire department of pump running signals, pump system trouble, tamper and supervisory signals provided by the pump controllers. Pump running signals will be transmitted as a "fire" signal.

**A1.4.3.10.** Provide surge arresters to moderate the potentially destructive effects of pressure surges or water hammer due to pump starting and stopping and valve opening and closing. These hydropneumatic devices absorb pressure surges into a precalculated volume of captive gas and return the absorbed water volume to the system in a controlled fashion. Surge arresters are installed on the system side of the fire pump discharge check valve and as close to the valve as possible. At least one arrester will be provided for each pump and each must be listed/approved as a surge arrester for fire protection piping, with a volume of not less than 378.4 liters (100 gallons) and a rated working pressure not less than 1724 kPa (250 psi). Provide each arrester with an indicating valve to isolate it from the system. Supervision is not required. Because of the complex effects of system variables on satisfactory performance, the manufacturer should engineer each surge arrester installation.

**A1.5. Facility Fire Detection and Alarm System.** Design all facility fire detection and alarm systems in accordance with NFPA 72 and the following criteria.

**A1.5.1.** Fire Alarm Control Panel (FACP).

**A1.5.1.1.** Locate all FACPs in a clean environment with temperature and humidity control in accordance with the unit's listing/approval.

**A1.5.1.2.** FACPs will have TVSS on all fire alarm circuits entering and leaving the facility, including, but not limited to, the power supply circuits to the FACP, circuits interfacing with fire pumping stations outside the facility, and circuits interfacing with the fire alarm receiving station (e.g., communication circuits, antenna systems). TVSS devices must comply with the requirements of paragraph A1.3.5.1.2.

**A1.5.1.3.** Provide a single FACP for all detection alarm functions in the facility that are not part of the foam-water fire suppression system. The FACP must be fully compatible with the base fire alarm receiving system without field modifications to any system hardware or software.

**A1.5.1.4.** Separate fire alarm transmitters/receivers are permitted when they are fully compatible with the FACP and the base fire alarm receiving system without field modifications to the FACP.

**A1.5.1.5.** The specific number of alarm signals to be transmitted will be defined in the system matrix (Figure A5).

**A1.5.2.** Manual Fire Alarm Stations (Pull Stations).

**A1.5.2.1.** Provide pull stations throughout the facility at all exit doors. Provide additional pull stations when required by NFPA 101.

**A1.5.2.2.** Ensure all manual alarm activation stations are identical throughout the facility. If the base has established a formal base-wide standard for manual pull stations, the pull stations in facilities governed by this ETL will comply fully with that standard.

**A1.5.2.3.** Actuation of any manual alarm activation stations will immediately cause the FACP to:

- Activate the facility fire evacuation alarm signal throughout the facility.
- Transmit a fire alarm signal to the base fire department.

**A1.5.3.** Fire Alarm Notification. Provide audio-visual alarm notification devices. When the base has a standard for audible sound (e.g., slow whoop, bell) and visual signal (red, white), the devices in the facility will comply fully with the base standards. No other system (hangar doors, alert signal) will be permitted to use these signals. The fire alarm must be distinctive in high-noise areas.

**A1.5.4.** Temperature Monitoring System.

**A1.5.4.1.** Provide a system of temperature sensors for the aircraft servicing area in all geographic areas having a 99.6% dry bulb temperature less than -1 °C (30 °F) when wet-pipe sprinkler systems are present. The temperature sensors will be located at the same level as the sprinkler piping and spaced not more than 60 meters (200 feet) apart. Provide this temperature monitoring to ensure a warning when freezing temperatures endanger sprinkler piping.

**A1.5.4.2.** This facility temperature monitoring system will be tied into the FACP as a dedicated supervisory zone, and this supervisory signal will be transmitted to the fire department in the same manner as all fire-related supervisory signals in the facility.

| | SYSTEM INPUTS | ANNUNCIATION AT LOCAL PANELS | | | | FIRE SUPPRESSION SYSTEM FUNCTIONS | | | | TRANSMIT SIGNALS TO FIRE DEPARTMENT | | | | | | AUXILIARY FUNCTIONS | | EVACUATION SIGNALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Audio-Visual Fire Alarm Indication by Zone | Audio-Visual Trouble Indication by Zone/Middle | Audio-Visual Common Trouble Indication | Audio-Visual Alarm Indication by Device | Transmit Pump Start Signal to Pumphouse | Open Pre-Action Sprinkler Valves | Open All Low-Level High-Expansion | Divert Drain Flow from Separators to Containment | Common Trouble Signal Per Building | Common Supervisory Signal Per Building | Common Fire Alarm Per General Area | Sprinkler Water Flow Per General Area | Low-Level Optical Detectors Per General Area | Foam-Water Discharge Per General Area | Shut Down All Supply & Recirculating Fans | Release magnetically Held Smoke Doors | Facility Fire Evacuation Audio-Visual Signal | Foam System Signal Blue Strobe/Beacon |
| | | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R |
| | FIRE ALARMS | | | | | | | | | | | | | | | | | | |
| 1 | Manual Fire Alarm Stations | X | | | | | | | | | | X | | | | | X | X | |
| 2 | Spot-Type Smoke Detectors | X | | | | | | | | | | X | | | | X | X | X | |
| 3 | Fixed Temp & Rate-of-Rise Type Heat Detectors | X | | | | | | | | | | X | | | | | X | X | |
| 4 | In-Duct Smoke Detectors | X | | | | | | | | | | X | | | | X | X | X | |
| 5 | Rate-Compensated Type Heat Detectors on Hangar Ceiling | | | | | | | | | | | | | | | | | X | |
| 6 | Water Flow Switches - Wet or Dry-Pipe Sprinkler Systems in Adjacent Areas | X | | | | | | | | | | | X | | | X | X | X | |
| 7 | Water Flow Switches - Pre-Action Sprinkler Systems | | | | | | | | | | | | | | | | | X | |
| 8 | Water Switches - Low-level High-expansion System | | | | | | | | | | | | | | | | | X | |
| 9 | Manual Foam Discharge Station for Low-Level | | | | | | | | | | | | | | | | | X | |
| 10 | Low Level Optical Fire Detector | | | | | | | | | | | | | | | | | X | |
| | SUPERVISORY SIGNALS | | | | | | | | | | | | | | | | | | |
| 11 | Valve Supervisory Switch - Wet or Dry-Pipe Sprinklers in Adjacent Areas | | X | | | | | | | | X | | | | | | | | |
| 12 | Valve Supervisory Switches - Sprinklers | | | | | | | | | | | | | | | | | | |
| 13 | ~~Valve Supervisory Switches - Low-Level High-Expansion~~ System | | | | | | | | | | | | | | | | | | |
| 14 | Valve Supervisory Switches - Water Supply Entrance | | | | | | | | | | | | | | | | | | |
| 15 | Hi-Lo Pressure Switches - Dry-Pipe Sprinklers | | X | | | | | | | | X | | | | | | | | |
| 16 | Temperature Monitoring System | | | | X | | | | | | X | | | | | | | | |
| 17 | Low-Level Optical Fire Detector Trouble | | | | | | | | | | | | | | | | | | |
| 18 | Control Component Common Trouble Condition | | X | | | | | | | | X | | | | | | | | |
| 19 | Under-Aircraft Foam-Water System Auto Disable Switch | | | | | | | | | | | | | | | | | | |
| | TROUBLE CONDITIONS | | | | | | | | | | | | | | | | | | |
| 20 | Low Battery Voltage | | | X | | | | | | X | | | | | | | | | |
| 21 | Circuit Fault | | X | X | | | | | | X | | | | | | | | | |
| 22 | Supervised Component Failure | | | X | | | | | | X | | | | | | | | | |
| 23 | AC Power Failure | | | X | | | | | | X | | | | | | | | | |

NOTES:

1. Fire alarm signals and supervisory alarm signals shall be clearly differentiated at the fire alarm control panel(s).
2. General area means the specific bay, dock, mezzanine, office area, or mechanical area. System zoning shall be sufficient to direct responding firefighters directly to the fire area.
3. This sample matrix shows the basic requirements and is expected to be tailored to each individual project.

**Figure A5. Sample Facility Fire Detection and Alarm System Functional Matrix**

**A1.6. Design and Construction Management.**

**A1.6.1.** A-E Qualifications.

**A1.6.1.1.** It is mandatory that design organizations (whether the design is accomplished by an in-house design agent or an outside A-E firm) use a qualified FPE, experienced in the design of aircraft hangars, for the design of the fire protection systems in all Air Force projects covered by this ETL.

**A1.6.1.1.1.** "Qualified FPE" does not have a universal definition and is defined differently among various government agencies. For this ETL, one of the following credentials is required to meet the criteria for "qualified FPE":

- Bachelor of Science or Master of Science degree in fire protection engineering from an accredited university, plus a minimum of 5 years' work experience in fire protection engineering.
- Professional Engineer (PE) registration by examination, National Council of Examiners for Engineering and Surveys (NCEE) fire protection engineering written examination.
- Qualification as a GS/GM 804-series FPE.
- PE registration in a related discipline with a minimum of 5 years' work experience in fire protection engineering.

**A1.6.1.1.2.** For Air Force aircraft hangars, the design agent will confirm that:

- Designer complies with the definition of "qualified FPE."
- FPE has substantial experience in the design and construction of aircraft hangar fire protection systems of similar complexity.

**A1.6.1.2.** The Commerce Business Daily announcement for the project design will specifically include the requirement for a qualified FPE on the A-E design team.

**A1.6.2.** System Testing and Acceptance:

**A1.6.2.1.** Preliminary Testing.

**A1.6.2.1.1.** Testing of the fire protection system is critical. The entire fire protection system must be tested in accordance with the specification to ensure that all equipment, components, and subsystems function as intended. In addition to establishing written confirmation of all test results, all preliminary tests will be videotaped to record the methods and equipment employed to conduct the tests.

**A1.6.2.1.2.** A copy of the videotape must be submitted with a copy of the proposed test plan to the USACE Center of Expertise or NAVFACENGCOM FPE before the request for a final acceptance test is made. All preliminary tests must be completed prior to scheduling the final acceptance test.

**A1.6.2.2.** Final Acceptance Test. The final test will be a repeat of all preliminary tests, except that flushing and hydrostatic tests will not be repeated. Tests must be witnessed by the USACE Center of Expertise or NAVFACENGCOM FPE. All system failures or other deficiencies identified during the testing must be corrected and retested in the presence of the USACE Center of Expertise or NAVFACENGCOM FPE.

Atch 1
(27 of 27)

## LOW-LEVEL HIGH-EXPANSION FOAM SYSTEM VIEWS

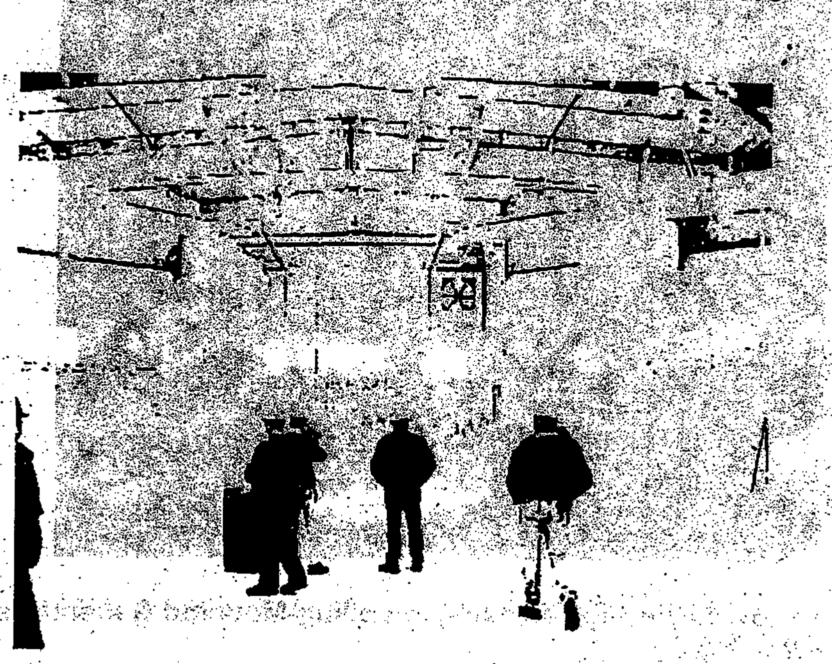

**Figure A2.1. Low-Level High-Expansion Foam Wall-Mounted (Adjacent Leading Wing Edge) Generators' Initial Discharge**

**Figure A2.2. Low-Level High-Expansion Foam After Three-Minute Discharge**

**Figure A2.3. Low-Level High-Expansion Ceiling-Mounted Generators' Foam Discharge**

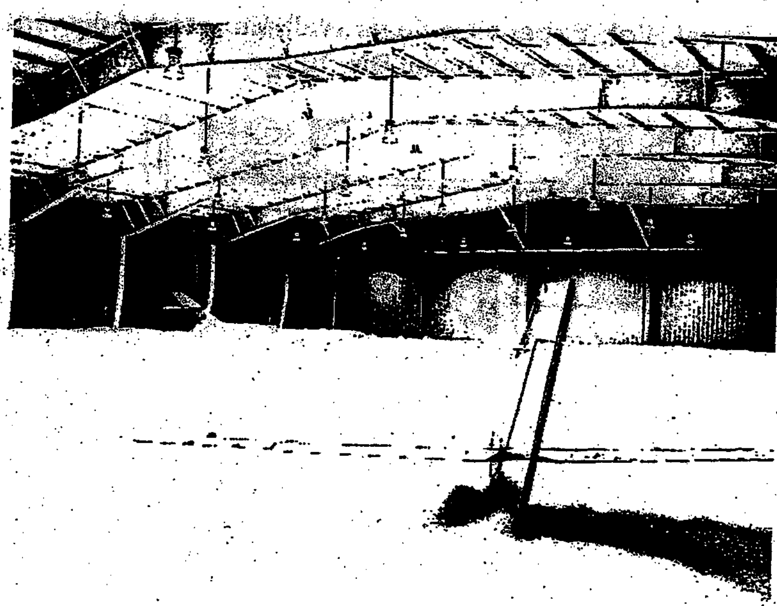

**Figure A2.4. Low-Level High-Expansion Foam After 15-Minute Discharge**

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1990 M Street NW, Suite 400
Washington DC 20036

Construction Criteria Database (1)
National Institute of Bldg Sciences
1201 L Street NW, Suite 400
Washington DC 20005

Atch 3



--END OF APPENDIX 12--

CEPOA-EN-ES-M (200-1-c) 16 September 2002

MEMORANDUM FOR CEPOA-PM-M (Wallace)

SUBJECT: New Fuel Systems Maintenance Dock, Site #3 Investigation Chemical Data Report

1. Reference e-mail from Jerome Raychel to James Pekar and Doug Deters, dated 16 August 2002, Subject: RE: Hgr 10 3rd site ELM179.

2. The chemical report in enclosed.

3. Questions should be addressed to Julie Sharp-Dahl (x 5689) or Doug Deters (x 2612).

encl

JEROME RAYCHEL
Chief, Geotechnical Services

**United States Army**
**Corps of Engineers**

Alaska District
PO Box 898
Anchorage, AK
99506-0898

# Final Chemical Data Report

## New Fuel Systems Maintenance Dock, Site #3
## Elmendorf Air Force Base, Alaska
## August 2002

Prepared by
Engineering Services Branch
Materials Section

September 2002

## Executive Summary

Soil samples collected from the third site considered for construction of a new fuel systems maintenance dock and a connected taxiway at Elmendorf Airforce Base, Alaska, were analyzed for the fuel related contaminants benzene, toluene, ethylbenzene, and xylenes (BTEX), gasoline range organic compounds (GRO), diesel range organic compounds (DRO), residual range organic compounds (RRO) and lead. Analytical results for soil samples collected from boreholes drilled within the proposed hangar site indicate that the area under consideration for construction was generally free of fuel contamination. Soils collected from one location near the railroad (AP-4269) contained benzene above ADEC cleanup criteria at both the one-foot and five-foot depths. Since the proposed taxiway passes directly over AP-4269, the contractor will need to be made aware of potential fuel contamination in the area. Excavated soil may require field screening and analysis if disposed of offsite. Additionally, results from AP-4279 and AP-4282, just outside of the proposed building footprint, indicate a possible plume of fuel contamination at depths below ten feet. Further characterization may be required near these borings if the building footprint is altered from the present location.

## Table of Contents

## 1. Introduction

This chemical data report was prepared by the U.S. Army Corps of Engineers Alaska District Engineering Services Branch, Materials Section (CEPOA-EN-ES-M), at the request of the Alaska District Project Management Division Military Branch (CEPOA-PM-M).

The present report summarizes the results from the chemical/geotechnical investigation at the third site proposed for a new fuel systems maintenance dock, located at the southeastern end of the runway in the vicinity of the Riding Stables near Truemper Loop, Elmendorf Air Force Base (AFB) Alaska. Borings were drilled to evaluate the physical and engineering properties of the subsurface soils, and soil samples were collected in order to estimate the extent of soil contamination within the latest proposed construction site.

## 2. Project Location

The proposed project is on Elmendorf AFB, Alaska (Figure 1). Elmendorf AFB is within the Municipality of Anchorage, Alaska. The base is comprised of approximately 13,000 acres, of which more than half are essentially undeveloped. It is bound on the west and north by the Knik Arm of Cook Inlet and on the east by the Fort Richardson U.S. Army Installation. Immediately to the south of Elmendorf AFB lies urban development within the Municipality of Anchorage. Ship Creek adjoins and passes through a portion of the base on the south. The Glenn Highway borders the installation on the southeast.

The project site is located north of Arctic Warrior Drive and east of Truemper Loop at Building 8675, near the Riding Stables. The site location is shown on the enclosed Project Location and Vicinity Map (Figure 1).

## 3. Field Activities

U.S. Army Corps of Engineers personnel performed the chemical and geotechnical site investigation for latest proposed location for hangar facility during 31 July 2002 to 7 August 2002. Douglas Deters (chemist) and Damian Walter (chemist/industrial hygienist) from CEPOA-EN-ES-M, and Rob Weakland (geotechnical engineer), Jim Robson (geotechnical engineer) and Robert (Joey) Wagner (geotechnical engineer) from CEPOA-ES-EN-SG were all involved in the investigation. Drilling was performed by Denali Drilling personnel Jason Love (driller) and Rian Ruth (drillers helper) under contract to Alaska District Soils and Geology Section. Samples for chemical analysis were collected to estimate the nature and extent of contamination that would be encountered during construction, while samples for mechanical analysis were collected to aid in the design and construction of the new facilities.

Fifteen primary soil samples were collected from eight of the twenty-four boreholes drilled. Five surface samples were collected from the proposed taxiway leading from the runway to the proposed location of the fuel system maintenance dock, and one surface sample was collected from soils at Building 8675. The other samples for chemical analysis were collected from a variety of depths. All samples were analyzed for GRO/BTEX using AK101 and SW846 Method

8021B, DRO/RRO using AK102/AK103, and lead using SW846 Method 6010B. A trip blank was submitted with the volatile samples to assess potential contamination during sample handling and transport. All samples except 02HNGR002SL and -013SL were additionally analyzed for organochlorine pesticides via Method 8081A. The results for soil samples collected for the determination of physical and engineering properties are presented in a separate geotechnical findings report.

Sample collection follows standard Corps sampling procedures as detailed in EM 200-1-3. Soil borings were drilled in pre-selected locations, determined by U.S. Army Corps of Engineers, using a CME 850 drill rig. Subsurface soil samples were collected with a steel split-spoon sampler driven ahead of the advancing borehole. Upon retrieval from the boring, the split spoon was opened and the soil samples rapidly collected with a stainless steel spoon. Soils were screened at five-foot intervals using heated headspace PID. Field screening results can be found in the Chemist's field notes provided in Appendix A.

Samples were collected for GRO/BTEX, DRO, RRO and lead from various depths within the expected limit of excavation. The fraction for volatiles analysis (GRO/BTEX) was collected first, followed by collection of the less volatile fractions. Soil samples for GRO/BTEX were field preserved with methanol after collecting between 45 g and 75 g (wet weight) soil into a tared jar. Each container was labeled with the project name and number, a unique sample identification number, the test to be performed, the date and time of collection, and the sampler's name. Quality assurance/quality control duplicates were not collected for this project.

## 4 Analytical Results

Data summary tables are provided in Appendix B. Complete data packages are on file at the Alaska District U.S. Army Corps of Engineers.

### 4.1 Applicable Regulatory Levels

The analytical methods used for this project were selected based upon the nature of the contaminants known to exist in the area and on the expected regulatory requirements. Sample results are compared to 18 AAC 75 Method Two, Soil Cleanup Levels (Migration to Groundwater in the Under 40 Inch Zone). Table 1 summarizes the applicable site cleanup levels for contaminants detected at these two sites.

| Table 4.1. APPLICABLE CLEANUP LEVELS | |
|---|---|
| **Contaminants Detected** | **Regulatory Level** |
| Benzene | 0.02 mg/kg |
| β-BHC | 0.009 mg/kg |
| Dieldren | 0.015 mg/kg |
| 4,4'-DDD | 35 mg/kg |
| 4,4'-DDE | 24 mg/kg |
| 4,4'-DDT | 24 mg/kg |
| DRO | 250 mg/kg |
| Endosulfan | 7 mg/kg |
| Ethylbenzene | 5.5 mg/kg |
| GRO | 300 mg/kg |
| Heptachlor | 0.8 mg/kg |
| Lead | 400 mg/kg |
| RRO | 11000 mg/kg |
| Toluene | 5.4 mg/kg |
| Total xylenes | 78 mg/kg |

## 4.2 Data Quality Evaluation

Data quality was evaluated in-house by a CEPOA-EN-ES-M chemist. The review included evaluation of sample collection, holding times, field blanks (to assess cross-contamination during transport) method blanks (to assess contamination during preparation and analysis), laboratory control samples (to assess accuracy), matrix spike/matrix spike duplicate recoveries (to assess precision and matrix effect) and surrogate recoveries (to assess matrix effect). Sample results have been flagged using flagging criteria from the National Functional Guideline for Organic Data Review. A summary of the appropriate chemical data quality evaluation is included below with the chemical results.

## 4.3 Soil Sampling Results

Data from the chemical analyses are reported in Tables 1-3 of Appendix B. The practical quantitation limits (PQLs) for each analyte were below State of Alaska 18 AAC 75 Method Two Soil Cleanup Levels and were adequate for the comparison of analytical results to State cleanup levels.

The following sections identify chemical results that may impact proposed project activities. Results exceeding regulatory levels, and factors affecting chemical data quality, are identified. The usability of the chemical data for project purposes is described.

### 4.3.1 GRO/BTEX

GRO were detected in nine of the fifteen soil samples analyzed (Table 1, App. B), but were not above the ADEC cleanup criteria of 300 mg/kg. The highest concentration of GRO measured was 5.77 mg/kg in sample 02HNGR005SL collected at one-foot below ground surface (bgs) from AP-4269 located near the railroad tracks.

BTEX were detected in six of the fifteen soil samples analyzed (Table 1, App. B). Samples 02HNGR005SL, -06SL, and -14SL had confirmed concentrations of benzene above the ADEC cleanup criteria of 0.020 mg/kg. The highest concentrations of BTEX were detected in sample -05SL collected at one-foot below ground surface (bgs) from AP-4269 located near the railroad tracks. Benzene in this sample was measured at 0.0338 mg/kg, toluene at 0.269 mg/kg, ethylbenzene at 0.081 mg/kg and xylenes at 0.586 mg/kg. Sample -06SL, collected from the same boring but at five-foot bgs, contained 0.0203 mg/kg benzene as well as measurable toluene, ethylbenzene, and xylenes.

The quality of the GRO/BTEX data is acceptable with the following qualification: low level (0.023 mg/kg) toluene was estimated in the method blank, resulting in some of the samples to be qualified as blank contaminated. Toluene results less than 5x the blank concentration are B flagged in Table 1. All other data is usable as reported.

### 4.3.2 DRO/RRO

DRO were detected in eleven of fifteen soil samples analyzed (Table 1, App. B). Sample 02HNGR011SL, collected from AP-4279 auger debris (generated from 10-15 feet bgs), was the only sample to contained DRO above the ADEC cleanup criteria of 250 mg/kg. This rather ambiguous sample measured 484 mg/kg DRO, field notes indicate that soils at the ten-foot bgs did not show any signs of contamination (heated PID response was 0.0 ppm) and soil sample 02HNGR012SL collected from 15 feet bgs contained an estimated 10 mg/kg DRO. The analytical laboratory noted that the chromatogram for -11SL suggests aged or degraded diesel. It is possible that the boring passed through a portion of a fuel plume; a 500 gallon UST used to store heating oil for the boy Scout Hut at Building 8675 was removed in 1996 with a removal action performed in 2001 (USAF 2002).

RRO were detected in eight of the fifteen soil samples analyzed (Table 1, App. B), but were not above the ADEC cleanup criteria of 11000 mg/kg. Sample 02HNGR009SL, collected at one-foot bgs from AP-4275 located near the runway, contained the highest amount of RRO at 566 mg/kg.

The quality of the DRO/RRO data is acceptable, and all data is usable as reported. DRO in sample 02HNGR005SL was measured at 237 mg/kg, which is slightly below the ADEC cleanup criteria of 250 mg/kg. The recovery of surrogate o-terphenyl was 113%, which implies good extraction efficiency for DRO, and substantiates the result is below the ADEC regulatory limit.

### 4.3.3 Lead

Lead was detected in all soil samples collected (Table 2, App. B). Lead was not measured above State of Alaska 18 AAC 75 Method Two Soil Cleanup Level of 400 mg/kg (for residential sites) in any of the soil samples analyzed. The highest soil concentration of lead measured was 47.3

mg/kg in sample 02HNGR009SL, collected at a depth of one-foot bgs from AP-4275 located near the runway.

The quality of the lead data is acceptable. The RPD for duplicate analyses for sample 02HNGR001SL was 29%, which is outside of the 20% RPD acceptance criteria required in EM 200-1-3 (Table I-2) but since all results are well below the ADEC cleanup levels for residential as well as industrial sites (1000 mg/kg), the variability between these results does not have a significant impact on the usability of this data for project purposes.

### 4.3.4 Pesticides

Low levels of pesticides, primarily 4,4'-DDT and its breakdown products 4,4'-DDE and 4,4'-DDD, were detected in all surface samples (Table 3, App. B). Soil samples collected at five-foot below ground surface (bgs) also contained confirmed concentrations of pesticides, whereas samples collected from depths greater than five-foot bgs did not. All pesticide results were below ADEC Method Two cleanup levels. The highest soil concentrations of 4,4'-DDT, 4,4'-DDE and 4,4'-DDD were 0.252 mg/kg, 0.043 mg/kg, and 0.0127 mg/kg measured in sample 02HNGR005SL, collected from one-foot bgs at AP-4269 located near the railroad.

The pesticide data quality is acceptable. The recovery of 4,4'-DDT from the MS/MSD was marginally outside of advisory control limits due to the high concentration of the analyte in the original sample (02HNGR003SL), however all other data quality indicators were satisfactory. All data is usable as reported.

## 5 Conclusion

Field screening and analytical data indicate that very little contamination exists in surface and subsurface soils of the site under consideration for construction of a new fuel system maintenance dock and taxiway. The soil samples analyzed from near the railway (AP-4269) show the presence of benzene above ADEC cleanup criteria at both the one-foot and the five-foot depth and since the proposed taxiway footprint overlies the contaminated soils, the contractor will need to be made aware of potential fuel contamination in the area. Excavated soil may require field screening and analysis if disposed of offsite. Additionally, soils below ten-foot depth at AP-4279 and AP-4282 should be considered potentially contaminated based on the DRO results from the auger, and the presence of benzene in soils collected from the groundwater interface at AP-4282.

## 6. References

Alaska Department of Environmental Conservation, 18 AAC 75, Oil and Other Hazardous Substances Pollution Control, as amended through July 11, 2002.

Alaska Department of Environmental Conservation, Technical Memorandum 01-007, Calculated Cleanup Levels for Compounds without Tabular Values in Site Cleanup Rules, 18 December 2001.

DD Form 1391, Add/Alter Degraded Fuel Systems Maintenance Dock, Elmendorf Air Force Base, Alaska.

USAF, ST534 Removal Action Report, Elmendorf Airforce Base, Alaska, January 2002.

USACE, Final Chemical Data Report, Hangar 10 Upgrade, Elmendorf Air Force Base, Alaska. Prepared by CEPOA-EN-ES-M August 2001.

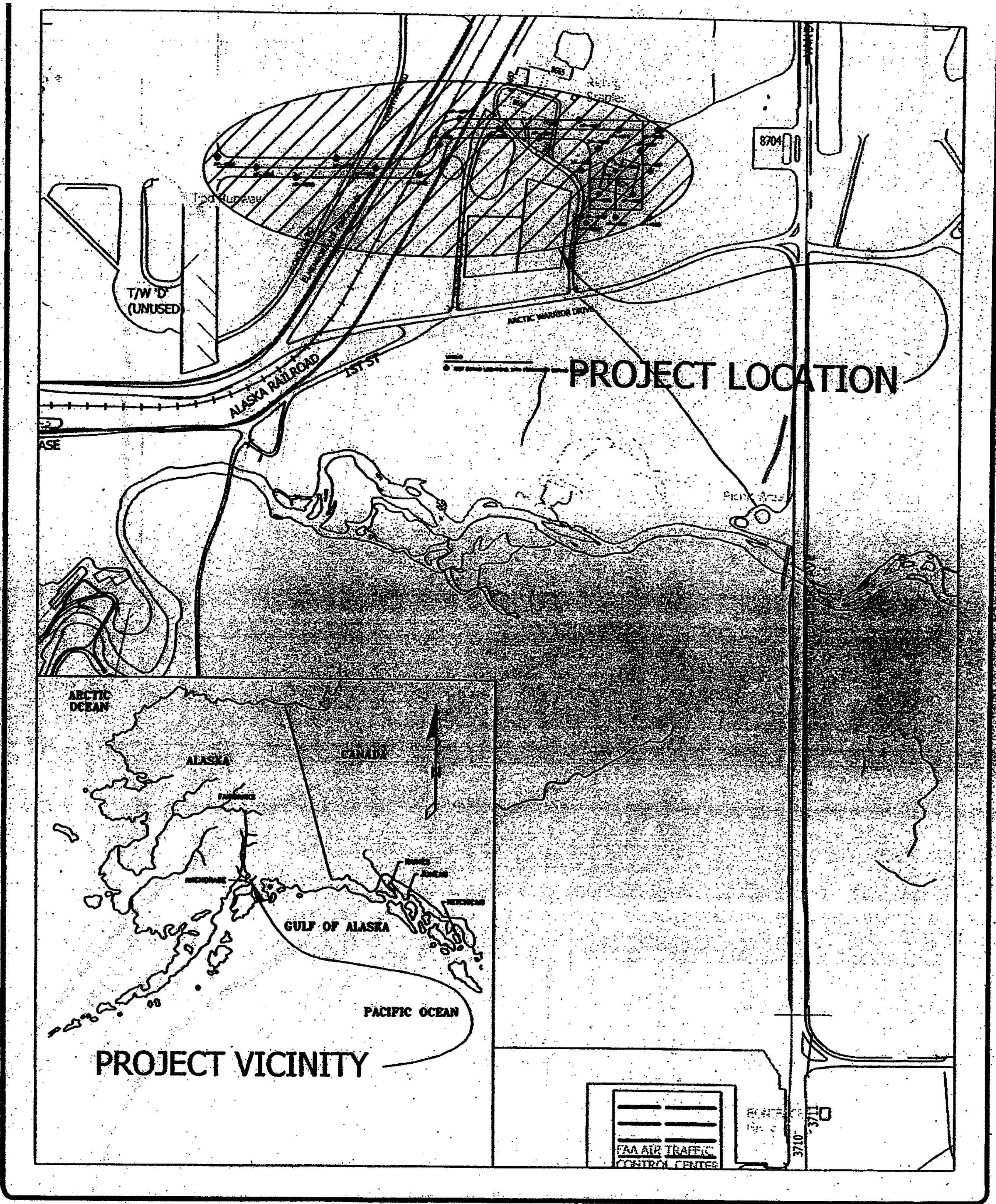
USACE, Final Chemical Data Report, Hangar 10 Resite, Elmendorf Air Force Base, Alaska. Prepared by CEPOA-EN-ES-M February 2002.

USACE, EM 200-1-3 Requirements for the Preparation of Sampling and Analysis Plans, February 2001.

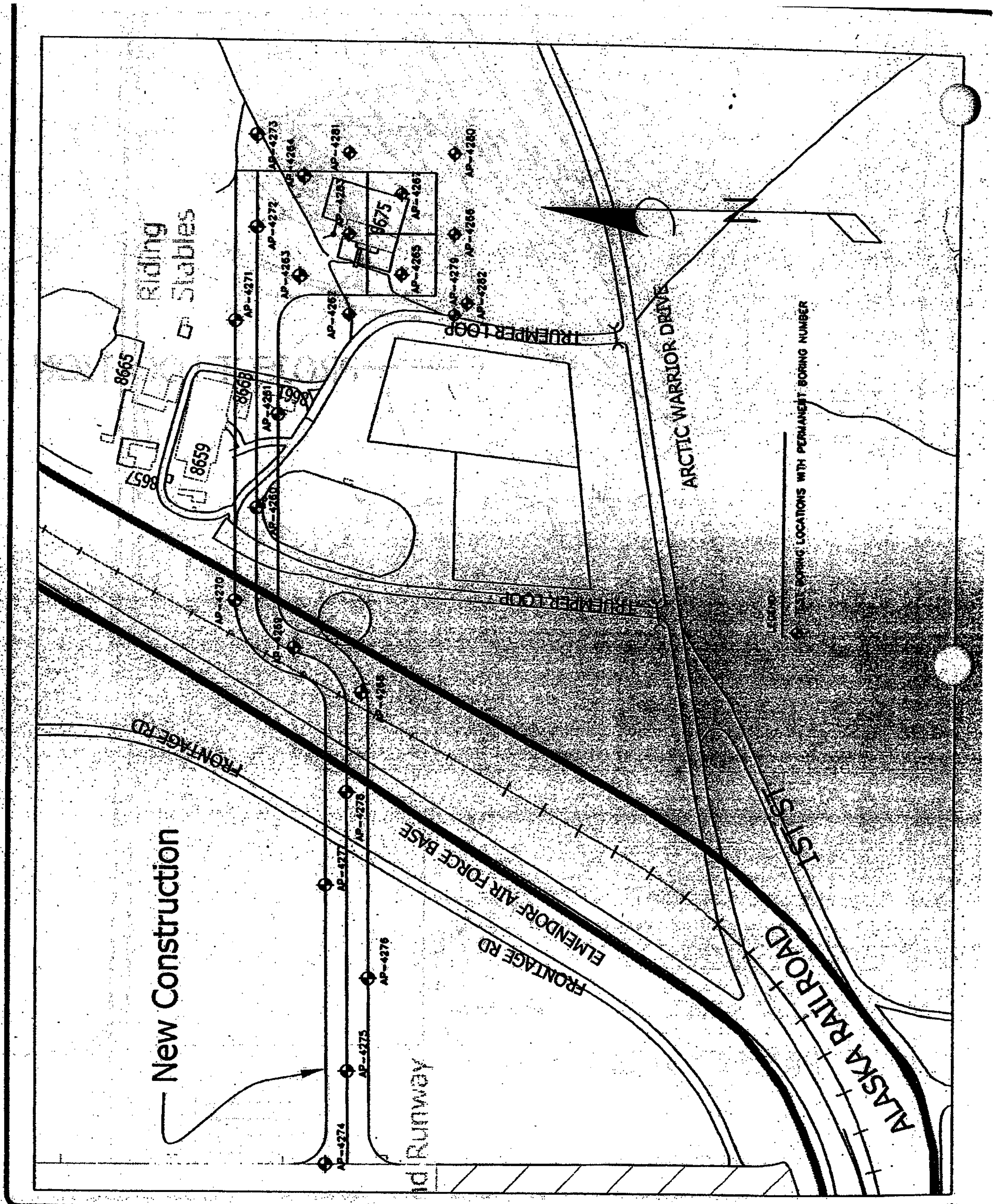
USACE, EM 200-1-6, Environmental Quality - Chemical Quality Assurance for Hazardous, Toxic and Radioactive Waste (HTRW) Projects, October 1997.

USEPA, "National Functional Guidelines for Organic Data Review", October 1999.

USEPA, 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IIIA, May 1997.




| | | |
|---|---|---|
| ALASKA DISTRICT<br>CORPS OF ENGINEERS<br>SOILS AND GEOLOGY | LOCATION AND VICINITY MAP<br>NEW FUEL SYSTEMS MAINTENANCE DOCK,<br>SITE 3 (ELM179)<br>ELMENDORF AFB, ALASKA | SCALE: NTS<br>DATE: 16 SEPT 2002<br>DRAWN/RVW: MDP/CRW<br>FIGURE 1 |



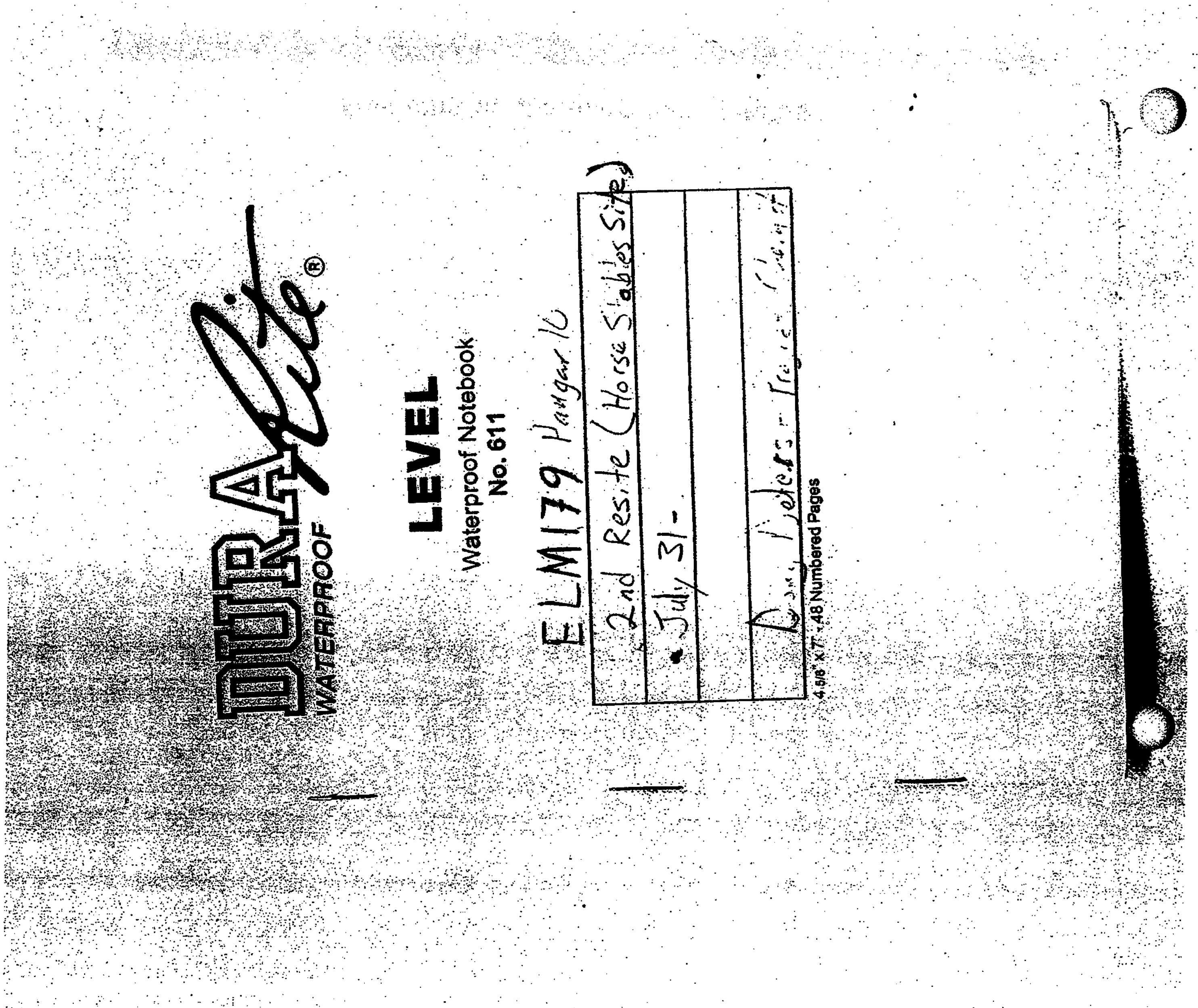

ALASKA DISTRICT
CORPS OF ENGINEERS
SOILS & GEOLOGY SECTION

TEST BORING LOCATION MAP
NEW FUEL SYSTEMS MAINTENANCE DOCK,
SITE 3 (ELM179)
ELMENDORF AFB, ALASKA

SCALE: 1 IN. = 250 F
DATE: SEPT. 2002
DRAWN/RVW: RW/CRW
FIGURE 2

Appendix A

# Chemist Field Observation Summary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CONTENTS

REFERENCE | DATE

Doug Deters - Chemist
Joey Wagner - Geotech Engineer
Rob Weakland "
Jim Robsen " "
Damian Walter Chemist/IH
Drill Crew: Rian Roth - Drillers Asst.
Jason Love - Driller

2107 - flight line ops.

INCHES 1 2 3 4 5 6

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31 July 2002

1000 Onsite. 70° Sunny
Drillers not onsite yet. Met with flightline Services Escort (Derrick) and discussed our drilling plan - we will start next to flightline and work our way East.

1023 Drillers still not onsite - Derrick needs to leave site. Said to call when we're ready.

1027 Joey Called - Gate security is not letting drill rig on base due to registration issues. Return to office

1028 Offsite

~~AP4260~~ AP1 (15')

01 Aug 02

0830 Onsite 65° Sunny
Waiting for Jim Robson and Drill Crew.

0930 Drillers & Engineer Arrive

0933 Calibrate PID - Background: 0.0
Using older model (HW-101)

1005 Depth: 1'
PID - ~~Spoon~~ hole: 0.8
cold: 0.4
warm: 1.0 Earthy Smell
No signs of contamination - DNS

1015 Depth: 5'
PID - Spoon: 0.4
cold: 0.5
warm: 1.9
No signs of contamination - DNS

1030 Depth: 10' PID - spoon: 0.6
cold: 0.5
Warm: Moisture interference 500 ppm
NSOC - DNS

1040 Depth: 15' PID - spoon: 0.6
cold: 0.7
warm:

PID is very sensitive to moisture.

see Next page

AP2 (15') AP4261
01 Aug 2002
Breathed into probe and got a reading of >500ppm. Will rely more on initial readings than heated readings
1050 Onsite, 70° Sunny, Background PID 0.0
1102 Depth: 1' PID- hole: 0.0
cold: 0.1
warm: 0.2
No signs of contamination - DNS
1108 Depth: 5' PID- spoon: 0.4
cold: 0.4
warm: 0.3
No signs of contamination - DNS
1115 Depth: 10' PID- spoon: 0.5
cold: 0.4
warm: 0.3
No signs of contamination - DNS
1121 Depth: 15' PID- spoon: 0.8
cold: 0.4
warm: 0.3
No signs of contamination - DNS
Offsite

AP4262 (30') AP3
01 Aug 2002
1220 Onsite 70° Sunny, Background PID: 0.0
1225 Depth: 1' PID- hole: 0.0
cold: 0.0
warm: 0.2
No signs of contamination
DNS
1236 Depth: 5' PID- spoon: 0.2
cold: 0.4
warm: 0.2
No signs of contamination
DNS
1244 Depth: 10' PID- spoon: 0.3
cold: 0.2
warm: 0.1
No signs of contamination
Did Not Sample
1250 Depth: 15' PID- spoon: 0.2
cold: 0.4
warm: 0.1
No signs of Contamination - DNS...
1257 Depth: 20' PID- spoon: 0.2
cold: 0.2
warm: 0.3
NSOC - DNS

Next PAGE →

AP3 (30') Continued 01 Aug 2002

1315 Depth: 25'
PID - spoon: 0.2
cold: 0.6
warm: 0.2
No signs of contamination
DNS

1323 Depth: 30'
PID - spoon: 0.0
cold: 0.2
warm: 0.1
No signs of contamination
Did Not Sample

1340 Offsite

01 August 02 AP4263 AP4 (15')

1345 Onsite, 75° Sunny, Background PID: 0.3
Drilled in wooded area

1424 Depth: 1' PID - hole: 0.6
cold: 0.4
warm: Moisture Interference
Earthy smell - No signs of contamination
Did not sample

1426 Depth: 2' PID - spoon: 0.2
cold: 0.2
warm: Moisture Interference
No signs of contamination
DNS

Depth: 5'
PID - spoon: 0.3

1447 Depth: 10' PID - spoon: 0.1
cold: 0.3
warm: Moisture Interference
ASOC - DNS

1455 Depth 15' PID - spoon: 0.5
cold: 0.4
warm: Moisture Interference
No signs of contamination - DNS

AP 5 (15') AP 4264

01 Aug 2002

1520 Onsite 75° Sunny, Background PID: 0.4

1530 Depth: 1' PID - hole: [illegible] 2.9
cold: 0.6
warm: Moisture Interference
No signs of contam. DNS
sample smelled slightly like Ane Tar

1537 Depth: 5' PID - spoon: 0.3
cold: 0.4
warm: Moisture Interference
No signs of contamination
Did not sample

1544 Depth: 10' PID - spoon: 0.6
cold: 0.3
warm:
No signs of contamination
Did Not Sample

1551 Depth: 15' PID - spoon: 0.4
cold: 0.3
warm:
No signs of contamination
Did Not Sample

AP-4265

02 Aug 2002 AP 6 (30')

0815 Onsite 65° Sunny
Tried to calibrate HW-101 (SN 801171) Zeroed, but span could not be set @ 58 ppm. Would not go below 150 ppm while setting span. PID will be more sensitive than normal. Background: 0.0
Hole (1'): 0.0
Depth: 25' PID - hole:
cold: Not
warm: Collected
Said he was taking a drive @ 25' bgs but didn't. No signs of contamination in any cutting thus far.

0857 Depth: 5' PID - spoon: 0.8
cold: 0.8
warm: 0.0
No signs of contamination - DNS
Did not sample

0901 Depth: 10' PID - spoon: 0.1
cold: 0.0
warm: 0.0
No signs of contamination - DNS

0907 Depth: 15' PID - spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination DNS cont.

AP6 continued (30') 02 Aug 2002

0914 Depth: 20' PID - spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

0922 Depth: 25' PID - spoon: 0.1
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

0928 Depth: 30' PID - spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination in any of the drill cuttings. DNS
Left site to go back to ~~office~~

1000 Offsite

---

AP4266

02 Aug 2002 AP7(30')

~~Onsite~~
Onsite 68° Sunny, clear sky
Same problem w/ HNU as on AP6
background PID = 0.0

Time:

1006 Depth: 1' Pd hole: 0.0
Cold: 0.0
Warm: 0.0
No signs of contamination
Didn't Sample

1012 Depth: 5' PID Spoon: 0.0
Cold: 0.0
Warm: 0.0
No sign of contamination
Didn't Sample

no sign of contamination
Didn't sample

Due to clay, Jim took another sample at 7.5'
spoon PID 0.0

1050 Depth: 10' PID Spoon: 0.0
Cold: 0.0
Warm: 0.0
No sign of contamination
Didn't sample

AP7 (cont) 02 Aug 2002

10:57 Depth 15' PID spoon: 0.0
Cold: 0.0
Warm: 0.0
No sign of contamination
Didn't sample

11:07 Depth 20' PID spoon: 0.0
cold: 0.0
warm: 0.0
No sign of contamination
Did not sample

1115 Depth 25' PID spoon: 0.0
Cold: 0.0
Warm: 0.0
No sign of contamination
Did not sample

1123 Depth 30' PID spoon: 0.0
cold: 0.0
Warm: 0.0
No sign of contamination
Did not sample

02 Aug 2002 AP8 (30') AP4267

Onsite:
Sonny clear sky 70°
background PID: 0.0

Time Depth ' Pid hole: 0.0
cold: 0.0
warm: 0.1

02HUGR001SL GRO, DRO, RRO, BTEX, Pesticides, Lead
Some Organics in samples

Depth 5' PID spoon: 0.0
cold: 0.0
warm: 0.0
No sign of contamination
Didn't Sample

1304 Depth 10' PID spoon: 0.0
cold: 0.1
warm: 0.0
No signs of contamination
Did not sample

1313 Depth 15' PID spoon: 0.0
cold 0.0
warm: 0.0
No signs of contamination
Did not sample

Continued

AP8 continued (30') 02 Aug 2002

1320 Depth 20' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did Not Sample

1330 Depth 25' Pid spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

1337 Depth 30' PID spoon: 0.0
cold: 0.0
warm: 0.0
Collect Sample 02HNGR02SL
Tested for GRO/BTEX, DRO/RRO, Pb
No signs of contamination.
Backfilled borehole, Drillers
to spend remainder of afternoon
cutting brush for hole access.

1346 Offsite

AP-4268 15

05 August 2002 AP9 (15')

0900 Onsite ≈62° Cloudy/overcast
Tried to calibrate HW-101
(S/N 801171) zeroed, but span could
not set @ 58 ppm would not go
below 140 ppm while setting span
PID will be more sensitive.
background: 0.0 started at 1000 hrs

Time
1015 Depth 1' Pid hole: 0.0
cold: 0.0
warm: 0.0
Collected Sample 03HNGR03SL, Tested for
Part, GRO/BTEX, DRO, RRO, Pb. No sign of contamination, roots & high organic matter

1023 Depth 6' PID Spoon: 0.0
cold: 0.0
warm: 0.0
Collected Sample
03HNGR04SL Tested for GRO/BTEX, DRO, RRO, Pb
Extremely Rockie, No sign of contamination, roots on top 2" root rocky

1030 Depth 10', PID Spoon: 0.0
Cold: 0.0
Warm: 0.0
No signs of contamination
Did not sample

over →

AP9 (Continued)
1036 Depth 15' PID Spoon: 0.0
Cold: 0.0
Warm: 0.0
No signs of contamination
Did not sample

No 4269 17

05 August 2002 AP10 (15')
1105 Onsite: 65° Cloudy & warm
background: 0.0
Time 1110 Depth 1' PID Hub: 0.2
cold: 0.0
warm: 0.1
Collected sample 05AUGR05SL Tested for GRO/BTEX, DRO, RRO, Pb, Pest. No signs of contamination smell of
Some organics, roots & leaves in samples, pine
1116 Depth 5' PID Spoon: 0.0
cold: 0.0
Warm: 0.1
Collected Sample 05AUGR06SL Tested for GRO/BTEX, DRO, RRO, Pb, Pest. No signs of contamination. Some organics in sample roots.
1122 Depth 10' PID Spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample
1131 Depth 15' PID Spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample
Broke for lunch 1152

18 AR-4270

AP11 05 August 2002
1305 Onsite: 74° Sunny - 30% clouds white
Background: 0.0

Time
1317 Depth 1' PID hole: 0.0
cold: 0.0
warm: 0.0
No signs of Contamination
Did not sample

1323 Depth 5' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

1331 Depth 10' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

1339 Depth 15' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

801171 pump stopped working
replaced w/ SN 106003, Recalibrate
to 58ppm earlier problem w/pump may have

AR-4271 19

AP12 (15') 05 August 2002
Onsite: 74° Cloudy/Sunny
Background: 0.0

Time Depth 1' PID ~~hole: 0.2~~
not present at time of extraction
cold: 0.2
warm: 0.0
No signs of contamination
Did not sample

1412 Depth 5' PID spoon 0.0
cold: 0.0
warm 0.0
No signs of contamination
Did not sample

1422 Depth 10' PID spoon 0.0
cold 0.0
warm 0.0
No signs of contamination
Did not sample

1429 Depth 15' PID Spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

20 AP-4272

AP13 (15') 05 August 2002

1445 Onsite: 74° cloudy & Sunny
Background: 0.0

Time

1450 Depth 1' PID hole: 0.0
cold: 0.0
warm: 0.2

No signs of contamination
Did not sample - Jim took one at 2.5'

1505 Depth 5' PID spoon 0.0 (Did not sample)
cold 0.0
warm 0.0

No signs of contamination
Did not sample

1513 Depth 10' PID spoon: 0.0
cold: 0.0
warm 0.0

No signs of contamination
Did not Sample

1521 Depth 15' PID Spoon: 0.0
cold: 0.0
warm: 0.0

No signs of contamination
Did not sample

---

AP-4273 21

AP14 (15') 05 August 2002

1545 Onsite: 72° Cloudy
background: 0.0

Hit Gas line

Time Depth 1' PID hole:
cold
warm:

Depth 5' PID spoon:
cold
warm

Depth 10' PID spoon
cold
warm

Depth 15' PID spoon
cold
warm

22

~1600hrs - hit gas 1" line & evacuation
called 911, will come back and
drill later, Area clear 16:35
Offsite 1703 and, did
not finish hole
-will redrill after area gets
remarked etc. Contacted Chuck
Wilson during the incident

0715 06 August 2002
at Hangar 4 parking
Calibrated HNU to 58ppm
Meeting Jim & Drillers
Jim & Drillers arrived 0736
called contact, waiting for
arrival.

AP4274 23

AP15(15') 06 August 2002
0800 Onsite: 64° Cloudy
background 0.0

Time Depth 1' PID hole: 0.0
0808 cold: 0.0
warm: 0.0
Collected Sample 02HNGR07SL Tested
for GRO/BTEX, DRO, TRO, Pb, Pest
No signs of contamination, organic matter in sample
0815 Depth 5' PID spoon: 0.0
cold: 0.0
warm: 0.0
Collected Sample 02HNGR08SL
Tested for GRO/BTEX, DRO, TRO, Pb, Pest
No signs of contamination.
08:21 Depth 10' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample
828 Depth 15' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

24 AP-4275

AP16 (15') 06 August 2002
0848 Onsite: 62° Cloudy
background: 0.0

Time 0858 Depth 1' PID hole: 0.0
cold: 0.0
warm: 0.0

Collected Sample 02HUGROSSL Tested for GRO/BTEX, DRO, RRO, Pb, Pest. No signs of contamination, organic matter in sample

0908 Depth 5' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

0915 Depth 10' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

0920 Depth 15' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

AP-4276 25

AP17 (15') 06 August 2002
0930 Onsite: 62° Cloudy
background: 0.0

Time 0937 Depth 1' PID hole: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

0945 Depth 5' PID spoon: 0.0
cold 0.0
warm: 0.0
No signs of contamination Did not sample
Jim took another spoon @ 7.5 - did not sample

0955 Depth 10' PID Spoon 0.0
cold 0.0
warm 0.0
No signs of contamination
Did not sample

1001 Depth 15' PID spoon: 0.0
cold 0.0
warm 0.0
No signs of contamination
Did not sample

26

APIS (15') 06 August 2002
1020 Onsite - 64° Cloudy
Background: 0.0

| Time | | | |
|---|---|---|---|
| 1025 | Depth 1' | PID hole | 0.0 |
| | | cold: | 0.0 |
| | | warm: | 0.0 |

No signs of contamination
Did not sample

| | | | |
|---|---|---|---|
| 1032 | Depth 5' | PID spoon: | 0.0 |
| | | cold: | 0.0 |
| | | warm: | 0.0 |

No signs of contamination
Did not sample

| | | | |
|---|---|---|---|
| 1037 | Depth 10' | PID spoon: | 0.0 |
| | | cold: | 0.0 |
| | | warm: | 0.0 |

No signs of contamination
Did not sample

| | | | |
|---|---|---|---|
| 1045 | Depth 15' | PID spoon: | 0.0 |
| | | cold: | 0.0 |
| | | warm: | 0.0 |

No signs of contamination
Did not sample

27

AP19 (15') 06 August 2002
11:35 Onsite 67° Cloudy
background: 0.0

| Time | | | |
|---|---|---|---|
| 1141 | Depth 1' | PID hole | 0.0 |
| | | cold | 0.0 |
| | | warm | 0.0 |

No signs of contamination
Did not sample

| | | | |
|---|---|---|---|
| 1147 | Depth 5' | PID spoon | 0.0 |
| | | cold: | 0.0 |
| | | warm: | 0.0 |

No signs of contamination
Did not sample

| | | | |
|---|---|---|---|
| 1153 | Depth 10' | PID spoon | 0.0 |
| | | cold | 0.0 |
| | | warm | 0.0 |

No signs of contamination
Did not sample

| | | | |
|---|---|---|---|
| 1159 | Depth 15' | PID spoon | 0.0 |
| | | cold | 0.0 |
| | | warm | 0.0 |

No signs of contamination
Did not sample

AP4279 50' new

AP20 (30') 06 August 2002

1235 Onsite 70° / Cloudy

background: 0.0

Time

Depth 1' PID hole: 0.0

1243 cold: 0.0

warm: 0.0

No signs of contamination

Did not sample

1250 Depth 5' PID spoon: 0.0

cold 0.0

warm 0.0

No signs of contamination

Did not sample

1300 Depth 10' PID spoon: 0.0

cold: 0.0

warm: 0.0

No signs of contamination

Did not sample

Depth 15' PID spoon: 0.0

Hit contaminate soil cold: 0.4

Reading: 5ppm at ground warm: 0.4

Collected Sample 02HJGR10SL Tested for GRO/BTEX, DRO, RRO, Pb, Pest. Smells like fuel

(Continued →)

Took sample 02HNGR11SL Tested for GRO/BTEX, DRO, RRO, Pb, Pest of debri soil around auger



AP20 (Continued)

Time

Depth 20' Pid spoon: cold: warm:

Depth 25' PID spoon: cold: warm:

Depth 30' PID spoon: cold: warm:

Depth 35' PID spoon: cold: warm:

Stopped Drilling The Hole, PM, Mark Wallace

→ Assumed to be soil between 10'-16' - AP23 is replacement hole. (over →)

JFW 9-16-02

See p. 37 JSD 9/16/02

AP20 Continued

Time Depth 40' PID spoon:
cold:
warm:

Depth 45' PID spoon:
cold:
warm:

Depth 50' PID spoon:
cold:
warm:

Write up for contaminated soil layer at ≈ 1330 ±15' soil came up around auger had a fuel smell, took PID of soil got a reading of 5 ppm. stopped rig & sampled at 15' & sampled soil around auger. Contacted Jim Peler, Ms Paige & John Mahaffey - Paige was check on water table, John stated



to continue and don't have to containerize soil just separate and contact if hit more and if it exceeds 20 ppm on the PID
- Extracted sample at 15' & from auger debri

Auger debris cold: 3ppm
warm: 2.8ppm

Clearing debri for next hole
≈ 1429 hrs

AP4280
AP21 (30') 06 August 2002
1432 Onsite 70° cloudy
background 0.0

Time
1452 Depth 1' PID hole 0.0
cold 0.0
warm 0.0

No signs of contamination
Did not sample

Depth 5' PID spoon 0.0
cold 0.0
warm 0.0

1501 No signs of contamination
Did not sample

1511 Depth 10' PID spoon 0.0
cold 0.0
warm 0.2

No signs of contamination
Did not sample

Old back of a truck ~ 30 yards
~~~~ east of hole



1520 Depth 15' PID spoon 0.0
cold 0.0
warm 0.0

No signs of contamination
Did not sample

1529 Depth 20' PID spoon 0.0
cold 0.0
warm 0.0

No signs of contamination
Did not sample

1540 Depth 25' PID spoon 0.0
cold 0.0
warm 0.0

No signs of contamination
Did not sample

1552 Depth 30' PID spoon 0.0
cold 0.0
warm 0.0

No signs of contamination
Did not sample
Ending Day
Offsite
~~~~

AP4281
07 August 2002
0825 Calibrate PID ~~~ was unable to get it w/ span to below 64 ppm

Onsite: 62° Cloudy and overcast

AP22 (30') 07 August 2002
background: 0.0

Time
0855 Depth 1' PID hole: 0.0
cold: 0.0
warm: 0.0
No signs of Contamination
Did not Sample

0901 Depth 5' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of Contamination
Did not sample

0909 Depth 10' PID spoon 0.0
cold 0.0
warm: 0.0
* No signs of Contamination
Did not Sample
Over →

AP22 (Continued) 07 August 2002

Time
0917 Depth 15' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of Contamination
Did not Sample

0925 Depth 20' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of Contamination
Did not sample

0940 Depth 25' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

0951 Depth 30' PID spoon 0.0
cold: 0.0
warm: 0.0
No signs of Contamination
Did not Sample

1004 Depth 35' PID spoon 0.0
Water at 33.5'
cold: 0.0
warm: 0.0
No signs of Contamination, Did not Sample
Cover)

AI 4282

APZZ (Continued) 07 August 2002

Time

Depth 40' PID spoon: 0.0
10:15 In water table cold: 0.0
warm: 0.0

No signs of Contamination
Did not Sample

1035 Depth 45' PID Spoon: 0.0
cold: 0.0
warm: 0.0

No signs of Contamination
Did not Sample

10:54 Depth 50' PID Spoon: 0.0
cold: 0.0
warm: 0.0

No signs of Contamination
Did not sample

AP23 (50') 07 August 2002
Onsite 68° Cloudy
background: 0.0
using This hole to replace info from 15' - 50' from APZ0

Time Depth 13' PID spoon: 13'
cold:
warm:

Monitoring as go, had a spike to 20 ppm on PID, but most of time only 1.5-2.5 ppm 15-20 ft range

1251 Depth 20' PID spoon: 0.0
cold: 0.2
Smells like fuel warm: 0.0

Signs of Contamination as digging Sample collected
02HNGR12SL For GRO/BTEX, DRG, RRO, Pb, Pest

1301 Depth 25' PID spoon: 0.0
Go reading of 3 ppm on cold: 0.0
while coming up from 20'-25' warm: 0.0

No signs of Contamination Sample Collected 02HNGR13SL For GRO/BTEX, DRO, RRO, Pb, Pest No smell of fuel

Over →

39

AP23 (Continued) 07 August 2002

1315 Depth 30' PID spoon: 0.0
Still got between 0-5ppm, typically cold: 0.0
1ppm as digging warm: 0.0
No signs of contamination
Did not sample

~~Depth 35' PID spoon~~
~~cold:~~
~~warm~~

Did Not due
Since did one
at 33'

1400 Depth 40' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

1415 Depth 45' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination
Did not sample

1427 Depth 50' PID spoon: 0.0
cold: 0.0
warm: 0.0
No signs of contamination, Did not sample

AP23 — 07 August 2002

Taking a Sample at water interface. 33'

1338 Sample collected 07AUGUST 145L
for GRO/BTEX, DRO, RRO, Pb, Pest.
No signs of contamination, no
Sean or smell of film.

spoon: 0.0
cold: 0.0
warm: 0.0

AP4283

AP24 (30') 07 August 2002

15:35 Onsite: 68° Cloudy
background: 0.0

1540 Depth 1' PID hole: 0.0
cold: 0.0
warm 0.0

Collected Sample 02HNGR0155L
for GRO/BTEX, DRO, RRO, Pb, Pest
No signs of contamination

1548 Depth 5' PID spoon: 0.0
cold: 0.0
warm: 0.0

No signs of contamination
Did not sample

1555 Depth 10' PID spoon: 0.0
cold: 0.0
warm: 0.0

No signs of contamination
Did not sample

Over →

AP24 (Continued) 07 August 2002

Time
1603 Depth 15' PID spoon: 0.0
cold: 0.0
warm 0.0

No signs of contamination
Did not sample

1610 Depth 20' PID spoon: 0.0
cold: 0.0
warm 0.0

No signs of contamination
Did not sample

1621 Depth 25' PID Spoon: 0.0
cold: 0.0
warm: 0.0

No signs of contamination
Did not sample

1628 Depth 30' PID Spoon: 0.0
cold: 0.0
warm: 0.0

No signs of contamination
Did not sample

Offsite 17:01 hrs

AP26 - Trip blank for BTEX/GRO

# Appendix B Analytical Data Tables

**Hangar 10 Site #3 (Horse Stable Site)**
**Method AK101, Gasoline Range Organics**
**Method AK102, Diesel Range Organics**
**Method AK103, Residual Range Organics**
**Method 8021B, BTEX**
**August, 2002**

| LOCATION OF SAMPLE: | AP-4267 | AP-4267 | AP-4268 | AP-4268 | AP-4269 |
|---|---|---|---|---|---|
| DATE OF SAMPLE: | 8/2/2002 | 8/2/2002 | 8/5/2002 | 8/5/2002 | 8/5/2002 |
| TYPE OF SAMPLE: | Soil | Soil | Soil | Soil | Soil |
| DEPTH OF SAMPLE (FEET): | 1 | 30 | 1 | 5 | 1 |
| FIELD SAMPLE ID: 02HNGR0- | 01SL | 02SL | 03SL | 04SL | 05SL |
| TESTING LABORATORY: | STL8 | STL8 | STL8 | STL8 | STL8 |
| LABORATORY SAMPLE ID: | 107844-01 | 107844-02 | 107844-03 | 107844-04 | 107844-05 |
| DATE RECEIVED: | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| DATE ANALYZED: | 8/13 - 14/02 | 8/13 - 14/02 | 8/13 - 14/02 | 8/13 - 14/02 | 8/13 - 14/02 |
| CONCENTRATION UNITS: | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg |
| Gasoline Range Organics | ND (0.716) | ND (0.782) | 3.21 | 1.13 | 5.77 |
| Diesel Range Organics | 17.1 | ND (16.6) | 132 | 70.2 | 237 |
| Residual Range Organics | 35.5 | ND (33.2) | 317 | 194 | 145 |
| Benzene | ND (0.0071) | ND (0.0078) | 0.0165 | ND (0.0086) | 0.0338 |
| Toluene | ND (0.0143) | ND (0.0156) | 0.132 | 0.0319 B | 0.269 |
| Ethylbenzene | ND (0.0143) | ND (0.0156) | 0.0375 | 0.0093 J | 0.081 |
| o-Xylene | ND (0.0143) | ND (0.0156) | 0.119 | 0.0372 | 0.216 |
| Xylene, Isomers m & p | ND (0.0143) | ND (0.0156) | 0.207 | 0.0717 | 0.38 |

STL8: Severn Trent Laboratories, Inc., Tacoma, WA.
B: Method Blank Contamination
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

**Hangar 10 Site #3 (Horse Stable Site)**
**Method AK101, Gasoline Range Organics**
**Method AK102, Diesel Range Organics**
**Method AK103, Residual Range Organics**
**Method 8021B, BTEX**
**August, 2002**

| | | | | | |
|---|---|---|---|---|---|
| **LOCATION OF SAMPLE:** | AP-4269 | AP-4274 | AP-4274 | AP-4275 | AP-4279 |
| **DATE OF SAMPLE:** | 8/5/2002 | 8/6/2002 | 8/6/2002 | 8/6/2002 | 8/6/2002 |
| **TYPE OF SAMPLE:** | Soil | Soil | Soil | Soil | Soil |
| **DEPTH OF SAMPLE (FEET):** | 5 | 1 | 5 | 1 | 15 |
| **FIELD SAMPLE ID: 02HNGR0-** | 06SL | 07SL | 08SL | 09SL | 10SL |
| **TESTING LABORATORY:** | STL8 | STL8 | STL8 | STL8 | STL8 |
| **LABORATORY SAMPLE ID:** | 107844-06 | 107844-07 | 107844-08 | 107844-09 | 107844-10 |
| **DATE RECEIVED:** | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| **DATE ANALYZED:** | 8/13 - 14/02 | 8/13 - 14/02 | 8/13 - 14/02 | 8/13 - 14/02 | 8/13 - 14/02 |
| **CONCENTRATION UNITS:** | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg |
| Gasoline Range Organics | 4.55 | ND (0.874) | 0.472 J | ND (1.05) | 0.872 J |
| Diesel Range Organics | 43.4 | 94.7 | 31.9 | 119 | 9.98 J |
| Residual Range Organics | 106 | 502 | 155 | 566 | ND (32.1) |
| Benzene | 0.0203 | ND (0.0087) | ND (0.0093) | ND (0.0105) | ND (0.0105) |
| Toluene | 0.179 | 0.0101 B | 0.0101 B | ND (0.021) | ND (0.021) |
| Ethylbenzene | 0.0471 | ND (0.0175) | ND (0.0187) | ND (0.021) | ND (0.021) |
| o-Xylene | 0.162 | ND (0.0175) | ND (0.0187) | ND (0.021) | ND (0.021) |
| Xylene, Isomers m & p | 0.275 | ND (0.0175) | 0.0224 | ND (0.021) | ND (0.021) |

STL8: Severn Trent Laboratories, Inc., Tacoma, WA.
B: Method Blank Contamination
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

**Hangar 10 Site #3 (Horse Stable Site)**
**Method AK101, Gasoline Range Organics**
**Method AK102, Diesel Range Organics**
**Method AK103, Residual Range Organics**
**Method 8021B, BTEX**
**August, 2002**



| | | | | | |
|---|---|---|---|---|---|
| LOCATION OF SAMPLE: | AP-4279 | AP-4282 | AP-4282 | AP-4282 | AP-4283 |
| DATE OF SAMPLE: | 8/6/2002 | 8/7/2002 | 8/7/2002 | 8/7/2002 | 8/7/2002 |
| TYPE OF SAMPLE: | Soil | Soil | Soil | Soil | Soil |
| DEPTH OF SAMPLE (FEET): | Auger debris | 20 | 25 | 33 (water interface) | 1 |
| FIELD SAMPLE ID: 02HNGR0- | 11SL | 12SL | 13SL | 14SL | 15SL |
| TESTING LABORATORY: | STL8 | STL8 | STL8 | STL8 | STL8 |
| LABORATORY SAMPLE ID: | 107844-11 | 107844-12 | 107844-13 | 107844-14 | 107844-15 |
| DATE RECEIVED: | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| DATE ANALYZED: | 8/14 - 15/02 | 8/13 - 15/02 | 8/13 - 15/02 | 8/13 - 15/02 | 8/13 - 15/02 |
| CONCENTRATION UNITS: | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg |
| Gasoline Range Organics | 3.68 | 0.582 J | ND (1.09) | 0.856 J | ND (1.33) |
| Diesel Range Organics | 484 | ND (16.7) | ND (16.2) | ND (17.5) | 11.1 J |
| Residual Range Organics | ND (36.3) | ND (33.4) | ND (32.4) | ND (34.9) | ND (38.2) |
| Benzene | ND (0.0078) | ND (0.0088) | ND (0.0109) | 0.0273 | ND (0.0133) |
| Toluene | ND (0.0156) | ND (0.0178) | ND (0.0217) | 0.0089 B | ND (0.0267) |
| Ethylbenzene | ND (0.0156) | ND (0.0178) | ND (0.0217) | ND (0.0193) | ND (0.0267) |
| o-Xylene | ND (0.0156) | ND (0.0178) | ND (0.0217) | 0.0211 | ND (0.0267) |
| Xylene, Isomers m & p | ND (0.0156) | ND (0.0178) | ND (0.0217) | ND (0.0193) | ND (0.0267) |

STL8: Severn Trent Laboratories, Inc., Tacoma, WA.
B: Method Blank Contamination
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

**Hangar 10 Site #3 (Horse Stable Site)**
**Method AK101, Gasoline Range Organics**
**Method AK102, Diesel Range Organics**
**Method AK103, Residual Range Organics**
**Method 8021B, BTEX**
**August, 2002**

| | |
|---|---|
| LOCATION OF SAMPLE: | AP-26 |
| DATE OF SAMPLE: | 8/7/2002 |
| TYPE OF SAMPLE: | Soil |
| DEPTH OF SAMPLE (FEET): | 26 |
| FIELD SAMPLE ID: 02HNGR0- | 16SL |
| TESTING LABORATORY: | STL8 |
| LABORATORY SAMPLE ID: | 107844-16 |
| DATE RECEIVED: | 8/9/2002 |
| DATE ANALYZED: | 8/15/2002 |
| CONCENTRATION UNITS: | mg/Kg |

| | |
|---|---|
| Gasoline Range Organics | ND (2) |
| Diesel Range Organics | - |
| Residual Range Organics | - |
| Benzene | ND (0.02) |
| Toluene | ND (0.04) |
| Ethylbenzene | ND (0.04) |
| o-Xylene | ND (0.04) |
| Xylene, Isomers m & p | ND (0.04) |

STL8: Severn Trent Laboratories, Inc., Tacoma, WA.
B: Method Blank Contamination
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

 

**Hanger 10 Resite (Horse Stable Site)**
**Method AK101, Gasoline Range Organics**
**Method AK102, Diesel Range Organics**
**Method AK103, Residual Range Organics**
**Method 8021B, BTEX**
**August, 2002**

| | |
|---|---|
| LOCATION OF SAMPLE: | Tripblank |
| DATE OF SAMPLE: | 8/7/2002 |
| TYPE OF SAMPLE: | Soil |
| DEPTH OF SAMPLE (FEET): | Tripblank |
| FIELD SAMPLE ID: 02HNGR- | TBSL |
| TESTING LABORATORY: | STL8 |
| LABORATORY SAMPLE ID: | 107844-17 |
| DATE RECEIVED: | 8/9/2002 |
| DATE ANALYZED: | 8/15/2002 |
| CONCENTRATION UNITS: | mg/Kg |
| Gasoline Range Organics | ND (2) |
| Diesel Range Organics | - |
| Residual Range Organics | - |
| Benzene | ND (0.02) |
| Toluene | ND (0.04) |
| Ethylbenzene | ND (0.04) |
| o-Xylene | ND (0.04) |
| Xylene, Isomers m & p | ND (0.04) |

**Hangar 10 Site #3 (Horse Stable Site)**
**Method 6010A - Lead**
**August, 2002**

| | | | | | |
|---|---|---|---|---|---|
| **LOCATION OF SAMPLE:** | AP-4267 | AP-4267 | AP-4268 | AP-4268 | AP-4269 |
| **DATE OF SAMPLE:** | 8/2/2002 | 8/2/2002 | 8/5/2002 | 8/5/2002 | 8/5/2002 |
| **TYPE OF SAMPLE:** | Soil | Soil | Soil | Soil | Soil |
| **DEPTH OF SAMPLE: (FEET)** | 1 | 30 | 1 | 5 | 1 |
| **FIELD SAMPLE ID: 02HNGR0** | 01SL | 02SL | 03SL | 04SL | 05SL |
| **TESTING LABORATORY:** | STL8 | STL8 | STL8 | STL8 | STL8 |
| **LABORATORY SAMPLE ID:** | 107844-01 | 107844-02 | 107844-03 | 107844-04 | 107844-05 |
| **DATE RECEIVED:** | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| **DATE ANALYZED:** | 8/13/2002 | 8/13/2002 | 8/13/2002 | 8/13/2002 | 8/13/2002 |
| **CONCENTRATION UNITS:** | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg |
| **Lead** | 11.6 | 14.4 | 36 | 11.9 | 34.6 |

**STL8:** Severn Trent Laboraotories, Inc., Tacoma, WA
**J:** Estimated Value.
**ND:** Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

**Hangar 10 Site #3 (Horse Stable Site)**
**Method 6010A - Lead**
**August, 2002**



| | | | | | |
|---|---|---|---|---|---|
| LOCATION OF SAMPLE: | AP-4269 | AP-4274 | AP-4274 | AP-4275 | AP-4279 |
| DATE OF SAMPLE: | 8/5/2002 | 8/6/2002 | 8/6/2002 | 8/6/2002 | 8/6/2002 |
| TYPE OF SAMPLE: | Soil | Soil | Soil | Soil | Soil |
| DEPTH OF SAMPLE: (FEET) | 5 | 1 | 5 | 1 | 15 |
| FIELD SAMPLE ID: 02HNGR0 | 06SL | 07SL | 08SL | 09SL | 10SL |
| TESTING LABORATORY: | STL8 | STL8 | STL8 | STL8 | STL8 |
| LABORATORY SAMPLE ID: | 107844-06 | 107844-07 | 107844-08 | 107844-09 | 107844-10 |
| DATE RECEIVED: | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| DATE ANALYZED: | 8/13/2002 | 8/13/2002 | 8/13/2002 | 8/13/2002 | 8/13/2002 |
| CONCENTRATION UNITS: | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg |
| Lead | 12.1 | 38.1 | 31.0 | 47.3 | 12.3 |

STL8: Severn Trent Laboraotories, Inc., Tacoma, WA
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

Hangar 10 Site #3 (Horse Stable Site)
Method 6010A - Lead
August, 2002



| | | | | | |
|---|---|---|---|---|---|
| LOCATION OF SAMPLE: | AP-4279 | AP-4282 | AP-4282 | AP-4282 | AP-4283 |
| DATE OF SAMPLE: | 8/6/2002 | 8/7/2002 | 8/7/2002 | 8/7/2002 | 8/7/2002 |
| TYPE OF SAMPLE: | Soil | Soil | Soil | Soil | Soil |
| DEPTH OF SAMPLE: (FEET) | Auger debris | 20 | 25 | 33 (Water interface) | 1 |
| FIELD SAMPLE ID: 02HNGR0 | 11SL | 12SL | 13SL | 14SL | 15SL |
| TESTING LABORATORY: | STL8 | STL8 | STL8 | STL8 | STL8 |
| LABORATORY SAMPLE ID: | 107844-11 | 107844-12 | 107844-13 | 107844-14 | 107844-15 |
| DATE RECEIVED: | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| DATE ANALYZED: | 8/13/2002 | 8/13/2002 | 8/13/2002 | 8/13/2002 | 8/13/2002 |
| CONCENTRATION UNITS: | mg/Kg | mg/Kg | mg/Kg | mg/Kg | mg/Kg |
| Lead | 15.9 | 9.82 | 9.27 | 10.7 | 13.7 |

STL8: Severn Trent Laboraotories, Inc., Tacoma, WA
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

**Hangar 10 Site #3 (Horse Stable Site)**
**Method 8081A**
**Organochlorine Pesticides**
**August, 2002**



| LOCATION OF SAMPLE: | AP-4267 | AP-4268 | AP-4268 | AP-4269 | AP-4269 |
|---|---|---|---|---|---|
| DATE OF SAMPLE: | 8/2/2002 | 8/5/2002 | 8/5/2002 | 8/5/2002 | 8/5/2002 |
| TYPE OF SAMPLE: | Soil | Soil | Soil | Soil | Soil |
| DEPTH OF SAMPLE: (FEET) | 1 | 1 | 5 | 1 | 5 |
| FIELD SAMPLE ID: 02HNGR0 | 01SL | 03SL | 04SL | 05SL | 06SL |
| TESTING LABORATORY: | STL8 | STL8 | STL8 | STL8 | STL8 |
| LABORATORY SAMPLE ID: | 107844-01 | 107844-03 | 107844-04 | 107844-05 | 107844-06 |
| DATE RECEIVED: | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| DATE ANALYZED: | 8/13/2002 | 8/13/2002 | 8/14/2002 | 8/14/2002 | 8/14/2002 |
| CONCENTRATION UNITS: | µg/Kg | µg/Kg | µg/Kg | µg/Kg | µg/Kg |
| 4,4'-DDD | 2.01 | 10.5 | 4.71 | 12.7 | 3.26 |
| 4,4'-DDE | 1.56 J | 26.5 | 6.82 | 43 | 6.23 |
| 4,4'-DDT | 12.1 | 151 | 48.9 | 252 | 46 |
| Aldrin | ND (1) | ND (0.946) | ND (0.909) | ND (1) | ND (0.789) |
| Chlordane | ND (10) | ND (9.46) | ND (9.09) | ND (10) | ND (7.89) |
| Dieldrin | 0.348 J | ND (1.89) | ND (1.82) | ND (2) | 0.791 J |
| Endosulfan I | ND (1) | 1.09 | ND (0.909) | ND (1) | ND (0.789) |
| Endosulfan II | ND (2) | 2.15 | ND (1.82) | ND (2) | ND (1.58) |
| Endosulfan sulfate | ND (2) | ND (1.89) | 1.84 | ND (2) | ND (1.58) |
| Endrin | ND (2) | ND (1.89) | ND (1.82) | ND (2) | ND (1.58) |
| Endrin aldehyde | 0.598 J | ND (1.89) | ND (1.82) | 2.88 | ND (1.58) |
| Endrin ketone | ND (2) | ND (1.89) | ND (1.82) | ND (2) | ND (1.58) |
| Heptachlor | 0.856 J | ND (0.946) | ND (0.909) | ND (1) | ND (0.789) |
| Heptachlor epoxide | ND (1) | ND (0.946) | ND (0.909) | ND (1) | ND (0.789) |
| Methoxychlor | ND (10) | ND (9.46) | ND (9.09) | ND (10) | ND (7.89) |
| Toxaphene | ND (100) | ND (94.6) | ND (90.9) | ND (100) | ND (78.9) |
| alpha-BHC | ND (1) | ND (0.946) | ND (0.909) | ND (1) | ND (0.789) |
| beta-BHC | ND (1) | 2.23 | ND (0.909) | 2.35 | ND (0.789) |
| delta-BHC | ND (1) | ND (0.946) | ND (0.909) | ND (1) | ND (0.789) |
| gamma-BHC (Lindane) | ND (1) | ND (0.946) | ND (0.909) | ND (1) | ND (0.789) |

STL8: Severn Trent Laboratories, Inc., Tacoma, WA.
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

**Hangar 10 Site #3 (Horse Stable Site)**
**Method 8081A**
**Organochlorine Pesticides**
**August, 2002**

| LOCATION OF SAMPLE: | AP-4274 | AP-4274 | AP-4275 | AP-4279 | AP-4279 |
|---|---|---|---|---|---|
| DATE OF SAMPLE: | 8/6/2002 | 8/6/2002 | 8/6/2002 | 8/6/2002 | 8/6/2002 |
| TYPE OF SAMPLE: | Soil | Soil | Soil | Soil | Soil |
| DEPTH OF SAMPLE: (FEET) | 1 | 5 | 1 | 15 | Auger debris |
| FIELD SAMPLE ID: 02HNGR0 | 07SL | 08SL | 09SL | 10SL | 11SL |
| TESTING LABORATORY: | STL8 | STL8 | STL8 | STL8 | STL8 |
| LABORATORY SAMPLE ID: | 107844-07 | 107844-08 | 107844-09 | 107844-10 | 107844-11 |
| DATE RECEIVED: | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| DATE ANALYZED: | 8/14/2002 | 8/14/2002 | 8/14/2002 | 8/14/2002 | 8/14/2002 |
| CONCENTRATION UNITS: | µg/Kg | µg/Kg | µg/Kg | µg/Kg | µg/Kg |
| 4,4'-DDD | 9.83 | 2.32 J | 18.6 | ND (1.52) | ND (2.13) |
| 4,4'-DDE | 24.1 | 6.29 | 5.87 | ND (1.52) | ND (2.13) |
| 4,4'-DDT | 155 | 36.9 | 156 | 0.943 J | ND (2.13) |
| Aldrin | ND (1.82) | ND (1.79) | ND (1.49) | ND (0.76) | ND (1.07) |
| Chlordane | ND (18.2) | ND (17.9) | ND (14.9) | ND (7.6) | ND (10.7) |
| Dieldrin | ND (3.65) | ND (3.58) | ND (2.97) | ND (1.52) | ND (2.13) |
| Endosulfan I | ND (1.82) | ND (1.79) | 34.8 | ND (0.76) | ND (1.07) |
| Endosulfan II | 2.27 J | ND (3.58) | ND (2.97) | ND (1.52) | ND (2.13) |
| Endosulfan sulfate | ND (3.65) | ND (3.58) | ND (2.97) | ND (1.52) | ND (2.13) |
| Endrin | ND (3.65) | ND (3.58) | ND (2.97) | ND (1.52) | ND (2.13) |
| Endrin aldehyde | ND (3.65) | ND (3.58) | ND (2.97) | ND (1.52) | ND (2.13) |
| Endrin ketone | ND (3.65) | ND (3.58) | ND (2.97) | ND (1.52) | ND (2.13) |
| Heptachlor | ND (1.82) | ND (1.79) | ND (1.49) | ND (0.76) | ND (1.07) |
| Heptachlor epoxide | ND (1.82) | ND (1.79) | ND (1.49) | ND (0.76) | ND (1.07) |
| Methoxychlor | ND (18.2) | ND (17.9) | ND (14.9) | ND (7.6) | ND (10.7) |
| Toxaphene | ND (182) | ND (179) | ND (149) | ND (76) | ND (107) |
| alpha-BHC | ND (1.82) | ND (1.79) | ND (1.49) | ND (0.76) | ND (1.07) |
| beta-BHC | ND (1.82) | ND (1.79) | ND (1.49) | ND (0.76) | ND (1.07) |
| delta-BHC | ND (1.82) | ND (1.79) | ND (1.49) | ND (0.76) | ND (1.07) |
| gamma-BHC (Lindane) | ND (1.82) | ND (1.79) | ND (1.49) | ND (0.76) | ND (1.07) |

STL8: Severn Trent Laboratories, Inc., Tacoma, WA.
J: Estimated Value.
ND: Not Detected. (The number in parentheses is the Practical Quantitation Limit (PQL)).

**Hangar 10 Site #3 (Horse Stable Site)**
**Method 8081A**
**Organochlorine Pesticides**
**August, 2002**

| | | | |
|---|---|---|---|
| LOCATION OF SAMPLE: | AP-4282 | AP-4282 | AP-4283 |
| DATE OF SAMPLE: | 8/7/2002 | 8/7/2002 | 8/7/2002 |
| TYPE OF SAMPLE: | Soil | Soil | Soil |
| DEPTH OF SAMPLE: (FEET) | 20 | 25 | 1 |
| FIELD SAMPLE ID: 02HNGR0 | 12SL | 14SL | 15SL |
| TESTING LABORATORY: | STL8 | STL8 | STL8 |
| LABORATORY SAMPLE ID: | 107844-12 | 107844-14 | 107844-15 |
| DATE RECEIVED: | 8/9/2002 | 8/9/2002 | 8/9/2002 |
| DATE ANALYZED: | 8/14/2002 | 8/14/2002 | 8/14/2002 |
| CONCENTRATION UNITS: | µg/Kg | µg/Kg | µg/Kg |
| 4,4'-DDD | ND (1.89) | ND (1.96) | 2.16 J |
| 4,4'-DDE | ND (1.89) | ND (1.96) | 1.67 J |
| 4,4'-DDT | 0.712 J | ND (1.96) | 8.6 |
| Aldrin | ND (0.943) | ND (0.981) | ND (1.15) |
| Chlordane | ND (9.43) | ND (9.81) | ND (11.5) |
| Dieldrin | ND (1.89) | ND (1.96) | ND (2.31) |
| Endosulfan I | ND (0.943) | ND (0.981) | ND (1.15) |
| Endosulfan II | ND (1.89) | ND (1.96) | ND (2.31) |
| Endosulfan sulfate | ND (1.89) | ND (1.96) | ND (2.31) |
| Endrin | ND (1.89) | ND (1.96) | ND (2.31) |
| Endrin aldehyde | ND (1.89) | ND (1.96) | ND (2.31) |
| Endrin ketone | ND (1.89) | ND (1.96) | ND (2.31) |
| Heptachlor | ND (0.943) | ND (0.981) | ND (1.15) |
| Heptachlor epoxide | ND (0.943) | ND (0.981) | ND (1.15) |
| Methoxychlor | ND (9.43) | ND (9.81) | ND (11.5) |
| Toxaphene | ND (94.3) | ND (98.1) | ND (115) |
| alpha-BHC | ND (0.943) | ND (0.981) | ND (1.15) |
| beta-BHC | ND (0.943) | ND (0.981) | ND (1.15) |
| delta-BHC | ND (0.943) | ND (0.981) | ND (1.15) |
| gamma-BHC (Lindane) | ND (0.943) | ND (0.981) | ND (1.15) |

STL8: Severn Trent Laboratories, Inc., Tacoma, WA.
J: Estimated Value.
ND: Not Detected. (The numbe itation Limit (PQL)).



--END OF APPENDIX 13--

# TAB 21 - Appendix 14

## COE - INSERT
## STANDARD OPERATING PROCEDURES (SOP)



--END OF APPENDIX 14--

**UFC 4-010-01**
**31 July 2002**

# UNIFIED FACILITIES CRITERIA (UFC)

# DoD MINIMUM ANTITERRORISM STANDARDS FOR BUILDINGS

**DISTRIBUTION STATEMENT A: Approved for Public Release; Distribution is unlimited.**

**UFC 4-010-01**
**31 July 2002**

# UNIFIED FACILITIES CRITERIA (UFC)

## DoD MINIMUM ANTITERRORISM STANDARDS FOR BUILDINGS



UNDER SECRETARY OF DEFENSE (ACQUISITION, TECHNOLOGY, AND LOGISTICS) (Preparing Activity)

J3, DEPUTY DIRECTORATE FOR ANTITERRORISM AND FORCE PROTECTION, JOINT CHIEFS OF STAFF

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

| Change No. | Date | Location |
|---|---|---|
| | | |
| | | |

**This UFC supersedes Interim Department of Defense Antiterrorism / Force Protection Construction Standards of 16 December 1999, except that the Interim Standard will remain in effect for fiscal year 2002 and 2003 Military Construction Programs.**

## FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following sources:

- Unified Facilities Criteria (UFC) Index http://65.204.17.188//report/doc_ufc.html.
- USACE TECHINFO Internet site http://www.hnd.usace.army.mil/techinfo.
- NAVFAC Engineering Innovation and Criteria Office Internet site http://criteria.navfac.navy.mil.
- Construction Criteria Base (CCB) system maintained by the National Institute of Building Sciences at Internet site http://www.ccb.org.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

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Department of Defense

## FOREWORD (continued)

This specific document is also issued under the authority of DoD Instruction Number 2000.16, *DoD Antiterrorism Standards* which requires DoD Components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats.

This document applies to the Office of the Secretary of Defense (OSD); the Military Departments (including their National Guard and Reserve Components); the Chairman, Joint Chiefs of Staff and Joint Staff; the Combatant Commands; the Office of the Inspector General of the Department of Defense; the Defense Agencies; the Department of Defense Field Activities; and all other organizational entities within the Department of Defense hereafter referred to collectively as "the DoD Components."

The standards established by this document are minimums set for DoD. Each DoD Component may set more stringent antiterrorism building standards to meet the specific threats in its area of responsibility.

Any changes, updates, or amendments to this particular UFC must have the approval of the DoD Engineering Senior Executive Panel (ESEP).

This document is effective immediately and is mandatory for use by all the DoD Components.

# CONTENTS

## FIGURES



## TABLES

# CHAPTER 1

# INTRODUCTION

1-1 **GENERAL.** This document represents a significant commitment by DoD to seek effective ways to minimize the likelihood of mass casualties from terrorist attacks against DoD personnel in the buildings in which they work and live.

1-1.1 **Dynamic Threat Environment.** Terrorism is real, evolving, and continues to increase in frequency and lethality throughout the world. The unyielding, tenacious, and patient nature of the terrorists targeting DoD interests forces us to closely examine existing policies and practices for deterring, disrupting, and mitigating potential attacks. Today, terrorist attacks can impact anyone, at any time, at any location, and can take many forms. Deterrence against terrorist attacks begins with properly trained and equipped DoD personnel employing effective procedures. While terrorists have many tactics available to them, they frequently use explosive devices when they target large numbers of DoD personnel. Most existing DoD buildings offer little protection from terrorist attacks. By applying the Minimum Antiterrorism Standards for Buildings described in this document, we become a lesser target of opportunity for terrorists.

1-1.2 **Responsibility.** Protecting people on a DoD installation or site must start with an understanding of the risk of a terrorist attack. Application of the standards herein should be consistent with the perceived or identified risk. Everyone in DoD is responsible for protecting our people and other resources.

1-1.2.1 **Individuals.** Each DoD employee, contractor, or vendor is responsible for minimizing opportunities for terrorists to threaten or target themselves, their co-workers, and their families on DoD installations or sites.

1-1.2.2 **Installation Commanders.** The installation commander must protect the people on his/her installation, or site, by managing and mitigating the risk to those people in the event of a terrorist attack. The installation commander is responsible for applying the standards herein, consistent with the identified or perceived risk of DoD people being hurt or killed.

1-1.2.3 **Service Secretaries and Agency Heads.** The heads of DoD Components shall ensure compliance and issue guidance to implement these standards. That guidance will include direction to require the installation commander to notify or seek approval from a major command or claimant or higher headquarters level if a new construction or renovation project, or a leased facility, will not meet any one or more of the standards. Heads of DoD Components will establish plans and procedures to mitigate risks in such situations.

1-1.3 **Planning and Integration.** When the best procedures, proper training, and appropriate equipment fail to deter terrorist attacks, adherence to these standards goes far in mitigating the possibility of mass casualties from terrorist attacks against DoD personnel in the buildings in which they work and live. Although predicting the specific threat to everyone is not possible, proper planning and integration of those plans provides a solid foundation for preventing, and if necessary reacting, when terrorist incidents or other emergencies unfold. An effective planning process facilitates the necessary decision making, clarifies roles and responsibilities, and ensures support actions generally go as planned. A team consisting of the chain of command and key personnel from all appropriate functional areas who have an interest in the building and its operation executes this planning process. The team should include, as a minimum, antiterrorism/force protection, intelligence, security, and facility engineering personnel. This team is responsible for identifying requirements for the project, facilitating the development of supporting operational procedures, obtaining adequate resources, and properly supporting all other efforts needed to prudently enhance protection of the occupants of every inhabited DoD building. For further information on planning and integration, refer to the *DoD Security Engineering Manual.*

1-2 **REFERENCES.**

- Interim Department of Defense Antiterrorism / Force Protection Construction Standards, December 16, 1999 (hereby cancelled)
- DoD Instruction 2000.16, DoD Antiterrorism Standards, June 14, 2001.
- DoD Handbook 2000.12-H, Protection of DoD Personnel and Activities Against Acts of Terrorism and Political Turbulence, February 1993
- American Society of Civil Engineers Standard (ANSI/ASCE) 7-98, Minimum Design Loads for Buildings and Other Structures, January 2000
- Unified Facilities Criteria (UFC) 4-010-02, *DoD Security Engineering Manual*, (Draft)
- Unified Facilities Criteria (UFC) 4-010-10, *DoD Minimum Antiterrorism Standoff Distances for Buildings; (For Official Use Only (FOUO))*
- Sections 2805(a)(1) and 2805(c)(1) of Title 10, US Code
- Security Engineering Working Group web site (http://sewg.nwo.usace.army.mil)
- DoD 6055.9-STD, DoD Ammunition and Explosive Safety Standards, July 1999

1-3 **STANDARDS AND RECOMMENDATIONS.** Mandatory DoD minimum antiterrorism standards for new and existing inhabited buildings are contained in Appendix B. Additional recommended measures for new and existing inhabited buildings are included in Appendix C. Mandatory DoD minimum antiterrorism standards for expeditionary and temporary structures are contained in Appendix D.

1-4 **INTENT.** The intent of these standards is to minimize the possibility of mass casualties in buildings or portions of buildings owned, leased, privatized, or otherwise occupied, managed, or controlled by or for DoD. These standards provide appropriate, implementable, and enforceable measures to establish a level of protection against terrorist attacks for all inhabited DoD buildings where no known threat of terrorist activity currently exists. While complete protection against all potential threats for every inhabited building is cost prohibitive, the intent of these standards can be achieved through prudent master planning, real estate acquisition, and design and construction practices. Where the minimum standoff distances detailed in these standards are met, most conventional construction techniques can be used with only marginal impact on the total construction or renovation cost. The financial impact of these standards will be significantly less than the economic and intangible costs of a mass casualty event.

1-5 **LEVELS OF PROTECTION.** The levels of protection provided by these standards meet the intent described above and establish a foundation for the rapid application of additional protective measures in a higher threat environment. These standards may be supplemented where specific terrorist threats are identified, where more stringent local standards apply, or where local commanders dictate additional measures. Detailed descriptions of the levels of protection are provided in Chapter 2 and the *DoD Security Engineering Manual*.

1-5.1 **DoD Component Standards.** Where DoD Component standards such as geographic Combatant Commander standards address unique requirements, those standards will be incorporated in accordance with their implementing directives, but not to the exclusion of these standards.

1-5.2 **Threat-Specific Requirements.** Where a design basis threat is identified whose mitigation requires protective measures beyond those required by these standards or DoD Component standards, those measures will be developed in accordance with the provisions of the *DoD Security Engineering Manual*. The provisions of the *DoD Security Engineering Manual* include the design criteria that will be the basis for the development of the protective measures, estimates of the costs of those measures, and detailed guidance for developing the measures required to mitigate the identified threat. The design criteria include the assets to be protected, the threat to those assets, and the desired level of protection. Use of the *DoD Security Engineering Manual* will ensure uniform application, development, and cost estimation of protective measures throughout DoD.

1-5.3 **Critical Facilities.** Buildings that must remain mission operational during periods of national crisis and/or if subjected to terrorist attack should be designed to significantly higher levels of protection than those provided by these standards.

1-5.4 **Explosive Safety Standards.** These antiterrorism standards establish criteria to minimize the potential for mass casualties and progressive collapse from a terrorist attack. DoD 6055.9-STD, *DoD Ammunition and Explosive Safety Standards* as implemented by Service component explosive safety standards, establish acceptable levels of protection for accidental explosions of DoD-titled munitions. The explosive safety and antiterrorism standards address hazards associated with unique events; therefore, they specify different levels of protection. Compliance with both standards is required. Where conflicts arise, the more stringent criteria will govern.

1-6 **APPLICABILITY.** These standards apply to all DoD Components, to all DoD inhabited buildings, and to all DoD expeditionary and temporary structures in accordance with the following:

1-6.1 **New Construction.** Implementation of these standards is mandatory for all new construction regardless of funding source in accordance with the following:

1-6.1.1 **Military Construction (MILCON).** These standards apply to MILCON projects starting with the Fiscal Year 2004 Program. Projects programmed or designed under the Interim DoD Antiterrorism / Force Protection Construction Standards do not have to be reprogrammed or redesigned to meet the requirements of these standards. The provisions of the Interim Standards will apply to those projects. Due to minor changes between these standards and the Interim Standards, projects prior to the Fiscal Year 2004 Program should comply with these standards where possible.

1-6.1.2 **Host-Nation And Other Foreign Government Funding.** These standards apply to new construction funded under host-nation agreements or from other funding sources starting in Fiscal Year 2004 or as soon as negotiations with the foreign governments can be completed.

1-6.1.3 **Other Funding Sources.** These standards apply to all new construction projects funded by sources other than MILCON (such as Non-Appropriated Funds, Operations and Maintenance, and Working Capital Funds) starting with Fiscal Year 2004. Projects funded prior to that fiscal year should comply with these standards where possible.

1-6.2 **Existing Buildings.** These standards will apply to existing facilities starting with the Fiscal Year 2004 program when triggered as specified below, regardless of funding source. Projects funded prior to that fiscal year should comply with these standards where possible. For existing leased buildings see paragraph 1-6.4.

1-6.2.1 **Major Investments.** Implementation of these standards to bring an entire building into compliance is mandatory for all DoD building renovations, modifications, repairs, and restorations where those costs exceed 50% of the replacement cost of the building except as otherwise stated in these standards. The 50% cost is exclusive of the costs identified to meet these standards. Where the 50% threshold is not met, compliance with these standards is recommended.

1-6.2.2 **Conversion of Use.** Implementation of these standards is mandatory when any portion of a building is modified from its current use to that of an inhabited building, billeting, or a primary gathering building for one year or more. Examples would include a warehouse (uninhabited) being converted to administrative (inhabited) use and an inhabited administrative building being converted to a primary gathering building or billeting.

1-6.2.3 **Glazing Replacement.** Because of the significance of glazing hazards in a blast environment, implementation of the glazing provisions of these standards is mandatory for existing inhabited buildings within any planned window or door glazing replacement project. Such replacements may require window frame modification or replacement.

1-6.3 **Building Additions.** Additions to existing inhabited buildings shall comply with the minimum standards for new buildings. If the addition is 50% or more of the gross area of the existing building, the existing building shall comply with the minimum standards for existing buildings.

1-6.4 **Leased Buildings.** DoD personnel occupying leased buildings deserve the same level of protection as those in DoD-owned buildings. Implementation of these standards is therefore mandatory for all facilities leased for DoD use and for those buildings in which DoD receives a space assignment from another government agency except as established below. This requirement is intended to cover all situations, including General Services Administration space, privatized buildings, and host-nation and other foreign government buildings. This requirement is applicable for all new leases executed on or after 1 October 2005 and to renewal or extension of any existing lease on or after 1 October 2009. Leases executed prior to the above fiscal years will comply with these standards where possible.

1-6.4.1 **Partial Occupancy.** These standards only apply where DoD personnel occupy leased or assigned space constituting at least 25% of the net interior useable area or the area as defined in the lease, and they only apply to that portion of the building that is occupied by DoD personnel.

1-6.4.2 **New Buildings.** Buildings that are built to lease to DoD as of the effective date established above shall comply with the standards for new construction.

1-6.4.3 **Existing Buildings.** New leases or renewals of leases of existing buildings will trigger the minimum standards for existing buildings in accordance with the effective dates established above.

1-6.5 **Expeditionary and Temporary Structures.** Implementation of these standards is mandatory for all expeditionary and temporary structures that meet the occupancy criteria for inhabited or primary gathering buildings or billeting. See Appendix D for structure types that meet the expeditionary and temporary structures criteria.

1-6.5.1 **New Structures.** These standards apply to all new expeditionary sites effective immediately.

1-6.5.2 **Existing Structures.** These standards will apply to all existing expeditionary activities beginning in Fiscal Year 2004. Prior to that fiscal year, existing expeditionary structures should comply with these standards where possible.

1-6.6 **National Guard Buildings.** Any National Guard building that uses Federal funding for new construction, renovations, modifications, repairs, restorations, or leasing and that meets the applicability provisions above, will comply with these standards.

1-6.7 **Exemptions.** Unless DoD Components dictate otherwise, the following buildings are exempt from requirements of these standards as specified below. However, compliance with these standards for those buildings is recommended where possible. In addition, there are some exemptions to elements of individual standards that are included in the text of those standards in appendix B. The rationale for all exemptions is detailed in chapter 2.

1-6.7.1 **Family Housing With 12 Units Or Fewer Per Building.** These buildings are exempt from all provisions of these standards.

1-6.7.2 **Stand-Alone Franchised Food Operations.** These buildings are exempt from standoff distances to parking and roadways. All other standards apply.

1-6.7.3 **Stand Alone Shoppettes, Mini Marts And Similarly Sized Commissaries.** These buildings are exempt from standoff distances to parking and roadways. All other standards apply.

1-6.7.4 **Gas Stations And Car Care Centers.** These facilities are exempt from all provisions of these standards.

1-6.7.5 **Medical Transitional Structures And Spaces.** These structures are exempt from standoff distances to parking and roadways. All other standards apply.

1-6.7.6 **Other Transitional Structures And Spaces.** Transitional structures and spaces that will be occupied for less than one year and that are not billeting, primary gathering buildings, or medical transitional structures, are exempt from standoff distances to parking and roadways. All other standards apply.

1-6.7.7 **Recruiting Stations In Leased Spaces.** Recruiting stations located in leased spaces are exempt from all provisions of these standards.

## 1-7 PROGRAMMING.

1-7.1 **Documentation.** The inclusion of these standards into DoD construction or the inclusion of protective measures above the requirements of these standards will be incorporated into the appropriate construction programming documents (such as the DD Form 1391) in accordance with DoD Component guidance. Refer to the *DoD Security Engineering Manual* for guidance on the costs for implementing these standards and for providing protective measures beyond these standards.

1-7.2 **Funding Thresholds.** For existing buildings, these standards are intended solely to correct design deficiencies to appropriately address emergent life-threatening terrorist risks. As a result, funding thresholds for Unspecified Minor Military Construction and Operations and Maintenance funding may be increased in accordance with 10 USC Sections 2805(a)(1) and 2805 (c)(1).

1-8 **INFORMATION SENSITIVITY.** Some information in these standards is exempt from mandatory disclosure under the Freedom of Information Act. The sensitive information that is exempt is the explosive weights upon which the minimum standoff distances are based, which is included in UFC 4-010-10. Allowing potential aggressors to know the minimum explosive weights that all DoD inhabited buildings are designed to resist could constitute a vulnerability. To minimize the possibility of that information being used against DoD personnel, the following provisions apply:

1-8.1 **Distribution.** Follow governing DoD and Component guidance for specific requirements for handling and distribution of For Official Use Only information. In general, distribution of this document is unlimited. Distribution of the tables (Tables 1 and 2) in UFC 4-010-10 is authorized only to U.S. Government agencies and their contractors. In addition, where it is within Status of Forces Agreements (SOFA) or other similar information exchange agreements, the information in these standards may be distributed to host-nation elements for the purposes of their administration and design of host-nation funded or designed construction.

1-8.2 **Posting To The Internet.** This document may be posted freely to the Internet; however, because the tables (Tables 1 and 2) in UFC 4-010-10 are For Official Use Only they cannot be posted to any web site that is accessible to the general public. In addition, other documents that include information from these standards that are identified as For Official Use Only cannot be posted to web sites accessible to the general public. For Official Use Only information may be posted to protected, non-publicly accessible web sites that comply with standards established by DoD for administration of web sites.

1-8.3 **Plans and Specifications.** Construction plans and specifications should include only that information from this document that is necessary for a contractor to develop a bid on a project. The explosive weights used in these standards shall not be entered into the plans and specifications unless the plans and specifications are properly safeguarded. Plans and specifications may be posted to the Internet in accordance with existing DoD Component guidance, but such documents will not include For Official Use Only information. All plans and specifications for inhabited buildings shall include an annotation that cites the version of these standards that was used for design.

1-8.4 **Design – Build Contracts.** Where design – build contracts are employed, prospective contractors will be responsible for developing a design proposal for that project that may be impacted by provisions of these standards. Where that is the case, consider alternate means to provide sufficient information to support their proposals. Consider for example, either specifying specific design loads or specifying the required standoff distance and providing candidate structural systems that would allow for mitigation of the applicable explosive if that standoff was less than the minimum. Once the design – build contract is awarded the contractor will be eligible to receive this complete document for use in the development of the final design package, but that contractor will be responsible for protecting the integrity of the information throughout the contract and through any subcontracts into which that contractor might enter.

1-9 **Interim Design Guidance.** The *DoD Security Engineering Manual* is currently unpublished. In lieu of referring to the *DoD Security Engineering Manual*, please see the guidance provided on the Security Engineering Working Group website.

# CHAPTER 2

## PHILOSOPHY, DESIGN STRATEGIES, AND ASSUMPTIONS

2-1 **GENERAL.** The purpose of this chapter is to clarify the philosophy on which these standards are based, the design strategies that are their foundation, and the assumptions inherent in their provisions. Effective implementation of these standards depends on a reasonable understanding of the rationale for them. With this understanding, engineers and security and antiterrorism personnel can maximize the efficiency of their solutions for complying with these standards while considering site-specific issues and constraints that might dictate measures beyond these minimums.

2-2 **PHILOSOPHY.** The overarching philosophy upon which this document is based is that comprehensive protection against the range of possible threats may be cost prohibitive, but that an appropriate level of protection can be provided for all DoD personnel at a reasonable cost. That level of protection is intended to lessen the risk of mass casualties resulting from terrorist attacks. Full implementation of these standards will provide some protection against all threats and will significantly reduce injuries and fatalities for the threats upon which these standards are based. The costs associated with those levels of protection are assumed to be less than the physical and intangible costs associated with incurring mass casualties. Furthermore, given what we know about terrorism, all DoD decision makers must commit to making smarter investments with our scarce resources and stop investing money in inadequate buildings that DoD personnel will have to occupy for decades, regardless of the threat environment. There are three key elements of this philosophy that influence the implementation of these standards.

2-2.1 **Time.** Protective measures needed to provide the appropriate level of protection must be in place prior to the initiation of a terrorist attack. Incorporating those measures into DoD buildings is least expensive at the time those buildings are either being constructed or are undergoing major renovation, repair, restoration, or modification.

2-2.2 **Master Planning.** Many of these standards significantly impact master planning. The most significant such impact will be in standoff distances. If standoff distances are not "reserved" they will be encroached upon and will not be available should they become necessary in a higher threat environment. The master planning implications of these standards are not intended to be resolved overnight. They should be considered to be a blueprint for facilities and installations that will be implemented over decades as those facilities and installations evolve.

2-2.3 **Design Practices.** The philosophy of these standards is to build greater resistance to terrorist attack into all inhabited buildings. That philosophy affects the general practice of designing inhabited buildings. While these standards are not based on a known threat, they are intended to provide the easiest and most economical methods to minimize injuries and fatalities in the event of a terrorist attack. The primary methods to achieve this outcome are to maximize standoff distance, to construct superstructures to avoid progressive collapse, and to reduce flying debris hazards.

These and related design issues are intended to be incorporated into standard design practice in the future.

2-3 **DESIGN STRATEGIES.** There are several major design strategies that are applied throughout these standards. They do not account for all of the measures considered in these standards, but they are the most effective and economical in protecting DoD personnel from terrorist attacks. These strategies are summarized below.

2-3.1 **Maximize Standoff Distance.** The primary design strategy is to keep terrorists as far away from inhabited DoD buildings as possible. The easiest and least costly opportunity for achieving the appropriate levels of protection against terrorist threats is to incorporate sufficient standoff distance into project designs. While sufficient standoff distance is not always available to provide the minimum standoff distances required for conventional construction, maximizing the available standoff distance always results in the most cost-effective solution. Maximizing standoff distance also ensures that there is opportunity in the future to upgrade buildings to meet increased threats or to accommodate higher levels of protection.

2-3.2 **Prevent Building Collapse.** Provisions relating to preventing building collapse and building component failure are essential to effectively protecting building occupants, especially from fatalities. Designing those provisions into buildings during new construction or retrofitting during major renovations, repairs, restorations, or modifications of existing buildings is the most cost effective time to do that. In addition, structural systems that provide greater continuity and redundancy among structural components will help limit collapse in the event of severe structural damage from unpredictable terrorist acts.

2-3.3 **Minimize Hazardous Flying Debris.** In past explosive events where there was no building collapse, a high number of injuries resulted from flying glass fragments and debris from walls, ceilings, and fixtures (non-structural features). Flying debris can be minimized through building design and avoidance of certain building materials and construction techniques. The glass used in most windows breaks at very low blast pressures, resulting in hazardous, dagger-like shards. Minimizing those hazards through reduction in window numbers and sizes and through enhanced window construction has a major effect on limiting mass casualties. Window and door designs must treat glazing, frames, connections, and the structural components to which they are attached as an integrated system. Hazardous fragments may also include secondary debris such as those from barriers and site furnishings.

2-3.4 **Provide Effective Building Layout.** Effective design of building layout and orientation can significantly reduce opportunities for terrorists to target building occupants or injure large numbers of people.

2-3.5 **Limit Airborne Contamination.** Effective design of heating, ventilation, and air conditioning (HVAC) systems can significantly reduce the potential for chemical, biological, and radiological agents being distributed throughout buildings.

2-3.6 **Provide Mass Notification.** Providing a timely means to notify building occupants of threats and what should be done in response to those threats reduces the risk of mass casualties.

2-3.7 **Facilitate Future Upgrades.** Many of the provisions of these standards facilitate opportunities to upgrade building protective measures in the future if the threat environment changes.

2-4 **ASSUMPTIONS.** Several assumptions form the foundation for these standards.

2-4.1 **Baseline Threat.** The location, size, and nature of terrorist threats are unpredictable. These standards are based on a specific range of assumed threats that provides a reasonable baseline for the design of all inhabited DoD buildings. Designing to resist baseline threats will provide general protection today and will establish a foundation upon which to build additional measures where justified by higher threats or where the threat environment increases in the future. While those baseline threats are less than some of the terrorist attacks that have been directed against U.S. personnel in the past, they represent more severe threats than a significant majority of historical attacks. It would be cost prohibitive to provide protection against the worst-case scenario in every building. The terrorist threats addressed in these standards are further assumed to be directed against DoD personnel. Threats to other assets and critical infrastructure are beyond the scope of these standards, but they are addressed in the *DoD Security Engineering Manual*. The following are the terrorist tactics upon which these standards are based:

2-4.1.1 **Explosives.** The baseline explosive weights are identified in Tables B-1 and D-1 as explosive weights I, II, and III. Their means of delivery are discussed below.

2-4.1.1.1 **Vehicle Bombs.** For the purposes of these standards, the vehicle bomb is assumed to be a stationary vehicle bomb. The sizes of the explosives in the vehicle bombs associated with explosive weight I (in equivalent weight of TNT) are likely to be detected in a vehicle during a search. Therefore, explosive weight I is the basis for the standoff distances associated with the controlled perimeter. The quantity of explosives associated with explosive weight II is assumed to be able to enter the controlled perimeter undetected; therefore, explosive weight II is the basis for the standoff distances for roadways and parking. Explosive weight II was selected because it represents a tradeoff between likelihood of detection and the risk of injury or damage.

2-4.1.1.2 **Waterborne Vessel Bombs.** For the purposes of these standards, waterborne vessels will also be assumed to contain quantities of explosives associated with explosive weight I. That weight was selected because areas beyond the shoreline are assumed not to be controlled perimeters.

2-4.1.1.3 **Placed Bombs.** Hand-carried explosives placed near buildings can cause significant localized damage, potentially resulting in injuries or fatalities. It is assumed that aggressors will not attempt to place explosive devices in areas near buildings where those devices could be visually detected by building occupants casually observing the area around the building. It is also assumed that there will be sufficient controls to preclude bombs being brought into buildings. Explosive weight II is assumed to be placed by hand either in trash containers or in the immediate vicinity of buildings. That quantity of explosives is further assumed to be built into a bomb 150 millimeters (6 inches) or greater in height.

2-4.1.1.4 **Mail Bombs.** Explosives in packages delivered through the mail can cause significant localized damage, injuries, and fatalities if they detonate inside a building. No assumption as to the size of such explosives is made in these standards. Provisions for mail bombs are limited to locations of mailrooms so that they can be more readily hardened if a specific threat of a mail bomb is identified in the future.

2-4.1.2 **Indirect Fire Weapons.** For the purpose of these standards, indirect fire weapons are assumed to be military mortars with fragmentation rounds containing explosives equivalent to explosive weight III in Tables B-1 and D-1. Protection against the effects of such rounds on an individual building is not considered practical as a minimum standard; therefore, these standards are intended to limit collateral damage to adjacent buildings from these weapons.

2-4.1.3 **Direct Fire Weapons.** For the purpose of these standards, direct fire weapons include small arms weapons and shoulder fired rockets that require a direct line of sight. Some standards in this document are predicated on a direct fire weapon threat. Provisions of those standards are based on the assumption that those weapons will be fired from vantage points outside the control of an installation or facility. Obscuration or screening that minimizes targeting opportunities is assumed to be the primary means of protecting DoD personnel from these weapons in these standards.

2-4.1.4 **Fire.** Recent incidents indicate that causing fires can be considered a terrorist tactic. Fire may be used as a direct terrorist tactic or it may be a secondary effect of some other tactic. Examples of how fire might be used as a direct tactic would include arson and driving a fuel truck or other fuel-laden vehicle into a building.

2-4.1.5 **Chemical, Biological, and Radiological Weapons.** For the purposes of these standards, these weapons are assumed to be improvised weapons containing airborne agents employed by terrorists. These standards do not assume comprehensive protection against this threat. They provide means to reduce the potential for widespread dissemination of such agents throughout a building in the event of an attack.

2-4.2 **Controlled Perimeter.** These standards assume that procedures are implemented to search for and detect explosives to limit the likelihood that a vehicle carrying quantities of explosives equivalent to explosive weight I in Tables B-1 and D-1 could penetrate a controlled perimeter undetected. It is further assumed that access control will include provisions to reject vehicles without penetrating the controlled perimeter.

2-4.3 **Levels of Protection.** The potential levels of protection are described in Tables 2-1, 2-2, and 2-3. These standards provide a **Low** level of protection for billeting and primary gathering buildings and a **Very Low** level of protection for other inhabited buildings. Greater protection is provided for primary gathering buildings and billeting because of the higher concentration of personnel and the more attractive nature of the target. If the minimum standoff distances are provided, or if mitigating measures are provided to achieve an equivalent level of protection, and if the threats are no greater than those indicated in Tables B-1 and D-1, the risk of injuries and fatalities will be reduced. Threats higher than those envisioned in Tables B-1 and D-1 will increase the likelihood of injuries and fatalities regardless of the level of protection. Refer to the *DoD Security Engineering Manual* for detailed guidance on levels of protection and how to achieve them for a wide range of threats.

2-4.4 **Minimum Standoff Distances.** The minimum standoff distances identified in Tables B-1 and D-1 were developed to provide survivable structures for a wide range of conventionally constructed buildings and expeditionary/temporary structures. These buildings range from tents and wood framed buildings to reinforced concrete buildings. For a more detailed discussion of this issue, refer to the *DoD Security Engineering Manual*.

2-4.4.1 **Conventional Construction Standoff Distance.** The standoff distances in the "Conventional Construction Standoff Distance" column in Table B-1 are based on explosive safety considerations that have been developed based on years of experience and observation. Those standoff distances may be conservative for heavy construction such as reinforced concrete or reinforced masonry; however, they may be just adequate for lighter-weight construction.

2-4.4.2 **Effective Standoff Distance.** Because standoff distances from the "Conventional Construction Standoff Distance" column of Table B-1 may be overly conservative for some construction types, these standards allow for the adjustment of standoff distances based on the results of a structural analysis considering the applicable explosive weights in Table B-1. For new buildings, even if such an analysis suggests a standoff distance of less than those shown in the "Effective Standoff Distance" column of Table B-1, standoff distances of less than those in that column are not allowed to ensure there is a minimal standoff distance "reserved" to accommodate future upgrades that could be necessitated by emerging threats. In addition, the 10 meter (33 feet) minimum is established to ensure there is no encroachment on the unobstructed space. For existing buildings, the standoff distances in the "Effective Standoff Distance" column of Table B-1 will be provided except where doing so is not possible. In those cases, lesser standoff distances may be allowed where the required level of protection can be shown to be achieved through analysis or can be achieved through building hardening or other mitigating construction or retrofit.

2-4.4.3 **Temporary and Expeditionary Construction.** The standoff distances in Table D-1 are based on blast testing conducted against TEMPER Tents, SEA Huts, General Purpose Shelters, and Small Shelter Systems. With adequate analysis those distances may be able to be reduced without requiring mitigating measures.

2-4.5 **Exempted Building Types.** For the reasons below some building types are exempted from some or all of these standards. The minimum standards should be applied to the exempted building types where possible.

**Table 2-1 Levels of Protection – New Buildings**

| Level of Protection | Potential Structural Damage | Potential Door and Glazing Hazards | Potential Injury |
|---|---|---|---|
| Below AT standards | Severely damaged. Frame collapse/massive destruction. Little left standing. | Doors and windows fail and result in lethal hazards | Majority of personnel suffer fatalities. |
| Very Low | Heavily damaged - onset of structural collapse: Major deformation of primary and secondary structural members, but progressive collapse is unlikely. Collapse of non-structural elements. | Glazing will break and is likely to be propelled into the building, resulting in serious glazing fragment injuries, but fragments will be reduced. Doors may be propelled into rooms, presenting serious hazards. | Majority of personnel suffer serious injuries. There are likely to be a limited number (10% to 25%) of fatalities. |
| Low | Damaged – unrepairable. Major deformation of non-structural elements and secondary structural members and minor deformation of primary structural members, but progressive collapse is unlikely. | Glazing will break, but fall within 1 meter of the wall or otherwise not present a significant fragment hazard. Doors may fail, but they will rebound out of their frames, presenting minimal hazards. | Majority of personnel suffer significant injuries. There may be a few (<10%) fatalities. |
| Medium | Damaged – repairable. Minor deformations of non-structural elements and secondary structural members and no permanent deformation in primary structural members. | Glazing will break, but will remain in the window frame. Doors will stay in frames, but will not be reusable. | Some minor injuries, but fatalities are unlikely. |
| High | Superficially damaged. No permanent deformation of primary and secondary structural members or non-structural elements. | Glazing will not break. Doors will be reusable. | Only superficial injuries are likely. |

**Table 2-2 Levels of Protection – Existing Buildings**

| Level of Protection | Potential Structural Damage | Potential Door and Glazing Hazards | Potential Injury |
|---|---|---|---|
| **Below AT standards** | Severely damaged. Frame collapse/massive destruction. Little left standing. | Doors and windows fail and result in lethal hazards | Majority of personnel suffer fatalities. |
| **Very Low** | Heavily damaged - onset of structural collapse: Major deformation of primary structural members, but progressive collapse is unlikely. Collapse of secondary structural members and non-structural elements. | Glazing will break and is likely to be propelled into the building, resulting in serious glazing fragment injuries, but fragments will be reduced. Doors may be propelled into rooms, presenting serious hazards. | Majority of personnel suffer serious injuries. There are likely to be a limited number (10% to 25%) of fatalities. |
| **Low** | Damaged – unrepairable. Major deformation of secondary structural members and minor deformation of primary structural members, but progressive collapse is unlikely. Collapse of non-structural elements. | Glazing will break and is likely to be propelled into the building, but should result in survivable glazing fragment injuries. Doors may fail, but they will rebound out of their frames, presenting minimal hazards. | Majority of personnel suffer significant injuries. There may be a few (<10%) fatalities. |
| **Medium** | Damaged – repairable. Minor deformations of secondary structural members and no permanent deformation in primary structural members. Major deformation of non-structural elements. | Glazing will break, but will remain in the window frame. Doors will stay in frames, but will not be reusable. | Some minor injuries, but fatalities are unlikely. |
| **High** | Superficially damaged. No permanent deformation of primary and secondary structural members or non-structural elements. | Glazing will not break. Doors will be reusable. | Only superficial injuries are likely. |

| Table 2-3 Levels of Protection – Expeditionary and Temporary Structures | | |
|---|---|---|
| **Level of Protection** | **Potential Structural Damage** | **Potential Injury** |
| **Below AT Standards** | Severely damaged. Frame collapse/massive destruction. Little left standing. | Majority of personnel suffer fatalities. |
| **Very Low** | Heavily damaged. Major portions of the structure will collapse (over 50%). A significant percentage of secondary structural members will collapse (over 50%). | Majority of personnel suffer serious injuries. There are likely to be a limited number (10% to 25%) of fatalities. |
| **Low** | Damaged – unrepairable. Some sections of the structure may collapse or lose structural capacity (10 to 20% of structure). | Majority of personnel suffer significant injuries. There may be a few (<10%) fatalities. |
| **Medium** | Damaged – repairable. Minor to major deformations of both structural members and non-structural elements. Some secondary debris will be likely, but the structure remains intact with collapse unlikely. | Some minor injuries, but no fatalities are likely. |
| **High** | Superficially damaged. No permanent deformation of primary and secondary structural members or non-structural elements. | Only superficial injuries are likely. |

2-4.5.1 **Family Housing.** The exemption of family housing with 12 units or fewer in a single building acknowledges that the density of such units is generally low, reducing the likelihood of mass casualties. It also acknowledges the fact that low-density housing has rarely been directly targeted by terrorists. A further assumption for existing family housing with 13 or more units per building is that by designating parking spaces for specific residents or residences, the risk of parking vehicle bombs in those parking areas is reduced due to increased awareness of the vehicles that are authorized to park there.

2-4.5.2 **Shoppettes, Mini Marts, Similarly Sized Commissaries and Stand-Alone Franchised Food Operations.** These facilities by the nature of their smaller size and their operation require parking in close proximity; therefore, they are exempted from the minimum standoff distances for parking and roadways. Applying other upgrades required by these standards is feasible, however, and will lessen the risk of mass casualties.

2-4.5.3 **Gas Stations and Car Care Centers.** These facilities are exempted from these standards because, by the nature of their operation, cars must be allowed to be in close proximity to them. Other measures included in these standards would be ineffective in the absence of any control on vehicles.

2-4.5.4 **Medical Transitional Structures and Spaces.** These structures and spaces may be required for limited durations to maintain mission-critical operations during construction that require close proximity or physical connection to the existing building undergoing construction. This may make compliance with some of the standoff distance provisions of these standards impractical during the limited construction duration.

2-4.5.5 **Other Transitional Structures and Spaces.** These structures and spaces are exempted from some of the standoff distance provisions of these standards because it would be impractical to apply them considering the limited less-than-1-year duration of occupancy.

2-4.5.6 **Recruiting Stations In Leased Spaces.** These facilities are exempted because their visibility and accessibility necessitate their being located in public spaces, which makes requiring them to comply with these standards impractical. In addition, the majority of these facilities do not have a sufficient population and population density to meet the inhabited building standard.

2-4.6 **Policies and Procedures.** Policies and procedures are a critical adjunct to building standards. It is assumed that there are means to control access to controlled perimeters, underground parking, and other locations where vehicle access needs to be limited. It is further assumed that unusual packages or containers or improperly parked vehicles will be recognized as potential terrorist threats and appropriate reactive measures will be implemented to reduce the potential for casualties. Finally, it is assumed that policies and procedures will be developed to support these and other related issues and that those policies and procedures will be incorporated into antiterrorism plans, training, and exercises.

2-4.7 **Design Criteria.** It is assumed that the provisions of these standards will be coordinated with all other applicable DoD building and design criteria and policies. Nothing in these standards should be interpreted to supersede the provisions of any other applicable building or design criteria. Where other criteria mandate more stringent requirements, it is assumed that the provisions of those criteria will be followed.

2-4.8 **Enhanced Fire Safety.** Historic fire scenarios and fuel loadings for various common buildings types that are the basis for requirements in building and life safety codes are likely to be much less severe than those experienced in terrorist attacks. Therefore, in the event of a terrorist attack, fire safety may be critical to the survival of building occupants and limiting the extent of building damage. Fire safety may be enhanced by designing buildings to limit the extent or severity of a fire and providing more effective egress routes. Changes to fire safety requirements, while they may be justifiable from an antiterrorism standpoint, are beyond the scope of these standards.

2-4.9 **Training.** It is assumed that key security and facility personnel will receive training in security engineering, antiterrorism, and related areas. Refer to the Security Engineering Working Group web site for available training and to DoD 2000.12-H for additional information on training issues. It is further assumed that all DoD personnel have been trained in basic antiterrorism awareness in accordance with DoDI 2000.16, that they are able to recognize potential threats, and that they know the proper courses of action should they detect a potential threat.

2-4.10 **Expeditionary and Temporary Structures.** Expeditionary and temporary structures are commonly built of either combinations of metal frames and fabric or wood frames and rigid walls. It is assumed that most expeditionary and temporary structures cannot be retrofitted or hardened sufficiently for higher threats; therefore, unless adequate planning is done to obtain the needed space to achieve appropriate standoff, DoD personnel will be highly vulnerable to terrorist attack.

2-4.11 **Leased Buildings.** DoD personnel occupying leased buildings deserve the same level of protection as those in DoD-owned buildings; therefore, they should meet the requirements of these standards wherever possible. They must meet the requirements when the DoD occupancy meets the criteria in these standards. The thresholds in those criteria reflect the significance of higher populations of DoD personnel as targets versus the inherent risk reduction associated with dispersing DoD personnel.

# APPENDIX A

## DEFINITIONS

**Access control.** For the purposes of these standards, any combination of barriers, gates, electronic security equipment, and/or guards that can deny entry to unauthorized personnel or vehicles.

**Access road.** Any roadway such as a maintenance, delivery, service, emergency, or other special limited use road that is necessary for the operation of a building or structure.

**Billeting.** Any building or portion of a building in which 11 or more unaccompanied DoD personnel are routinely housed, including Temporary Lodging Facilities and military family housing permanently converted to unaccompanied housing. Billeting also applies to expeditionary and temporary structures with similar population densities and functions.

**Building hardening.** Enhanced conventional construction that mitigates threat hazards where standoff distance is limited. Building hardening may also be considered to include the prohibition of certain building materials and construction techniques.

**Building separation.** The distance between closest points on the exterior walls of adjacent buildings or structures.

**Collateral damage.** Injury to personnel or damage to buildings that are not the primary target of an attack.

**Container structures.** Structures built using shipping containers that are designed to withstand structural loadings associated with shipping, including Container Express (CONEX) and International Organization for Standardization (ISO) containers. Testing has shown that these structures behave similarly to buildings for the purposes of these standards.

**Controlled perimeter.** For the purposes of these standards, a physical boundary at which vehicle access is controlled at the perimeter of an installation, an area within an installation, or another area with restricted access. A physical boundary will be considered as a sufficient means to channel vehicles to the access control points. At a minimum, access control at a controlled perimeter requires the demonstrated capability to search for and detect explosives. Where the controlled perimeter includes a shoreline and there is no defined perimeter beyond the shoreline, the boundary will be at the mean high water mark.

**Conventional construction.** Building construction that is not specifically designed to resist weapons or explosives effects. Conventional construction is designed only to resist common loadings and environmental effects such as wind, seismic, and snow loads.

**Conventional Construction Standoff Distance.** The standoff distance at which conventional construction may be used for buildings without a specific analysis of blast effects, except as otherwise required in these standards.

**Design Basis Threat.** The threat (aggressors, tactics, and associated weapons, tools, or explosives) against which assets within a building must be protected and upon which the security engineering design of the building is based.

**DoD building.** Any building or portion of a building (permanent, temporary, or expeditionary) owned, leased, privatized, or otherwise occupied, managed, or controlled by or for DoD. DoD buildings are categorized within these standards as uninhabited, inhabited, primary gathering and billeting.

**DoD Components.** The Office of the Secretary of Defense (OSD); the Military Departments (including their National Guard and Reserve Components); the Chairman, Joint Chiefs of Staff and Joint Staff; the Combatant Commands; the Office of the Inspector General of the Department of Defense; the Defense Agencies; the DoD Field Activities; and all other organizational entities within DoD.

**DoD personnel.** Any U.S. military, DoD civilian, or family member thereof, host-nation employees working for DoD, or contractors occupying DoD buildings.

**Effective Standoff Distance.** A standoff distance less than the Conventional Construction Standoff Distance at which the required level of protection can be shown to be achieved through analysis or can be achieved through building hardening or other mitigating construction or retrofit.

**Expeditionary structures.** Those structures intended to be inhabited for no more than 1 year after they are erected. This group of structures typically include tents, Small and Medium Shelter Systems, Expandable Shelter Containers (ESC), ISO and CONEX containers, and General Purpose (GP) Medium tents and GP Large tents, etc.

**Fabric covered/metal frame construction.** A construction type that can be identified by a metal, load-bearing frame (usually aluminum) with some type of fabric (such as canvas) stretched or pulled over the frame. Examples of the types of structures that should be considered under this classification of structures include Frame-Supported Tensioned Fabric Structures (FSTFS); Tent, Extendable, Modular, Personnel (TEMPER Tents); and Small and Medium Shelter Systems (SSS and MSS); and air supported fabric structures. Testing has shown that for these fabric structures, the frame is what causes hazards.

**Family housing.** DoD buildings used as quarters for DoD personnel and their dependents. For the purposes of these standards, family housing will be considered to include Morale, Welfare, and Recreation housing (cottages) of similar occupancies.

**Glazing.** The part of a window or door assembly that normally transmits light, but not air.

**Inhabited building.** Buildings or portions of buildings routinely occupied by 11 or more DoD personnel and with a population density of greater than one person per 40 gross square meters (430 gross square feet). This density generally excludes industrial, maintenance, and storage facilities, except for more densely populated portions of those buildings such as administrative areas. The inhabited building designation also applies to expeditionary and temporary structures with similar population densities. In a building that meets the criterion of having 11 or more personnel, with portions that do not have sufficient population densities to qualify as inhabited buildings, those portions that have sufficient population densities will be considered inhabited buildings while the remainder of the building may be considered uninhabited, subject to provisions of these standards. An example would be a hangar with an administrative area within it. The administrative area would be treated as an inhabited building while the remainder of the hangar could be treated as uninhabited. (Note: This definition differs significantly from the definition for inhabited building used by DoD 6055.9-STD and is not construed to be authorization to deviate from criteria of DoD 6055.9-STD.)

**Laminated glass.** Multiple sheets of glass bonded together by a bonding interlayer.

**Level of protection.** The degree to which an asset (person, equipment, object, etc.) is protected against injury or damage from an attack.

**Mass notification.** Capability to provide real-time information to all building occupants or personnel in the immediate vicinity of a building during emergency situations.

**Medical transitional structures and spaces.** Structures that are erected or leased for temporary occupancy to maintain mission-critical medical care during construction, renovation, modification, repair or restoration of an existing medical structure. Examples include urgent, ambulatory, and acute care operations.

**Parking.** Designated areas where vehicles may be left unattended.

**Primary gathering building.** Inhabited buildings routinely occupied by 50 or more DoD personnel and family housing with 13 or more family units per building. This designation applies to the entire portion of a building that meets the population density requirements for an inhabited building. For example, an inhabited portion of the building that has an area within it with 50 or more personnel is a primary gathering building for the entire inhabited portion of the building. The primary gathering building designation also applies to expeditionary and temporary structures with similar population densities.

**Progressive collapse.** A chain reaction failure of building members to an extent disproportionate to the original localized damage. Such damage may result in upper floors of a building collapsing onto lower floors.

**Roadways.** Any surface intended for motorized vehicle traffic.

**Routinely occupied.** For the purposes of these standards, an established or predictable pattern of activity within a building that terrorists could recognize and exploit.

**Security engineering.** The process of identifying practical, risk managed short and long-term solutions to reduce and/or mitigate dynamic manmade hazards by integrating multiple factors, including construction, equipment, manpower, and procedures.

**Specific threat.** Known or postulated aggressor activity focused on targeting a particular asset.

**Standoff distance.** A distance maintained between a building or portion thereof and the potential location for an explosive detonation.

**Structure group.** A cluster of expeditionary or temporary structures consisting of multiple rows of individual structures with 200 or fewer DoD personnel.

**Structural glazed window systems.** Window systems in which glazing is bonded to both sides of the window frame using an adhesive such as a high-strength, high-performance silicone sealant.

**Superstructure.** The supporting elements of a building above the foundation.

**Temporary structures.** Those structures that are erected with an expected occupancy of 3 years or less. This group of structures typically includes wood frame and rigid wall construction, and such things as Southeast Asia (SEA) Huts, hardback tents, ISO and CONEX containers, pre-engineered buildings, trailers, stress tensioned shelters, Expandable Shelter Containers (ESC), and Aircraft Hangars (ACH).

**TNT equivalent weight.** The weight of TNT (trinitrotoluene) that has an equivalent energetic output to that of a different weight of another explosive compound.

**Transitional structures and spaces.** Structures or spaces within buildings that are used to temporarily (less than 1 year) relocate occupants of another building while that building undergoes renovations, modifications, repairs, or restorations.

**Unobstructed space.** Space within 10 meters (33 feet) of an inhabited building that does not allow for concealment from observation of explosive devices 150 mm (6 inches) or greater in height.

# APPENDIX B

## DoD MINIMUM ANTITERRORISM STANDARDS FOR NEW AND EXISTING BUILDINGS

B-1 **SITE PLANNING.** Operational, logistic, and security requirements must be integrated into the overall design of buildings, equipment, landscaping, parking, roads, and other features. The most cost-effective solution for mitigating explosive effects on buildings is to keep explosives as far as possible from them. Standoff distance must be coupled with appropriate building hardening to provide the necessary level of protection to DoD personnel. The following standards detail minimum standoff distances that when achieved will allow for buildings to be built with minimal additional construction costs. Where these standoff distances cannot be achieved because land is unavailable, these standards allow for building hardening to mitigate the blast effects. Costs and requirements for building hardening are addressed in the *DoD Security Engineering Manual*.

B-1.1 **Standard 1. Minimum Standoff Distances.** The minimum standoff distances apply to all new and existing (when triggered) DoD buildings covered by these standards. The minimum standoff distances are presented in Table B-1 and illustrated in Figures B-1 and B-2. Where the standoff distances in the "Conventional Construction Standoff Distance" column of Table B-1 can be met, conventional construction may be used for the buildings without a specific analysis of blast effects, except as otherwise required in these standards. Where those distances are not available, an engineer experienced in blast-resistant design should analyze the building and apply building hardening as necessary to mitigate the effects of the explosives indicated in Table B-1 at the achievable standoff distance to the appropriate level of protection. The appropriate levels of protection for each building category are shown in Table B-1, and are described in Tables 2-1 and 2-2 and in the *DoD Security Engineering Manual*. For new buildings, standoff distances of less than those shown in the "Effective Standoff Distance" column in Table B-1 are not allowed. For existing buildings, the standoff distances in the "Effective Standoff Distance" column of Table B-1 will be provided except where doing so is not possible. In those cases, lesser standoff distances may be allowed where the required level of protection can be shown to be achieved through analysis or can be achieved through building hardening or other mitigating construction or retrofit.

B-1.1.1 **Controlled Perimeter.** Measure the standoff distance from the controlled perimeter to the closest point on the building exterior or inhabited portion of the building.

B-1.1.2 **Parking and Roadways.** Standoff distances for parking and roadways are based on the assumption that there is a controlled perimeter at which larger vehicle bombs will be detected and kept from entering the controlled perimeter. Where there is a controlled perimeter, the standoff distances and explosive weight associated with parking and roadways in Table B-1 apply. If there is no controlled perimeter, assume that the larger explosive weights upon which the controlled perimeter standoff distances are based (explosive weight I from Table B-1) can access parking and roadways near

**Table B-1 Minimum Standoff Distances and Separation for New and Existing Buildings**

| Location | Building Category | Standoff Distance or Separation Requirements | | | |
|---|---|---|---|---|---|
| | | Applicable Level of Protection | Conventional Construction Standoff Distance | Effective Standoff Distance[1] | Applicable Explosive Weight [2] |
| Controlled Perimeter or Parking and Roadways without a Controlled Perimeter | Billeting | Low | 45 m [4] (148 ft.) | 25 m [4] (82 ft.) | I |
| | Primary Gathering Building | Low | 45 m [4] [5] (148 ft.) | 25 m [4] [5] (82 ft.) | I |
| | Inhabited Building | Very Low | 25 m [4] (82 ft.) | 10 m [4] (33 ft.) | I |
| Parking and Roadways within a Controlled Perimeter | Billeting | Low | 25 m [4] (82 ft.) | 10 m [4] (33 ft.) | II |
| | Primary Gathering Building | Low | 25 m [4] [5] (82 ft.) | 10 m [4] [5] (33 ft.) | II |
| | Inhabited Building | Very Low | 10 m [4] (33 ft.) | 10 m [4] (33 ft.) | II |
| Trash Containers | Billeting | Low | 25 m (82 ft.) | 10 m (33 ft.) | II |
| | Primary Gathering Building | Low | 25 m (82 ft.) | 10 m (33 ft.) | II |
| | Inhabited Building | Very Low | 10 m (33 ft.) | 10 m (33 ft.) | II |
| Building Separation (for new buildings only) | Billeting | Low | 10 m (33 ft.) | No antiterrorism minimum | III [3] |
| | Primary Gathering Building | Low | 10 m (33 ft.) | No antiterrorism minimum | III [3] |
| | Inhabited Building | Very Low | No antiterrorism minimum | No antiterrorism minimum | Not applicable |

(1) Even with analysis, standoff distances less than those in this column are not allowed for new buildings, but are allowed for existing buildings if constructed/retrofitted to provide the required level of protection at the reduced standoff distance.
(2) See UFC 4-010-10, for the specific explosive weights (kg/pounds of TNT) associated with designations – I, II, III. UFC 4-010-10 is For Official Use Only (FOUO).
(3) Explosive for building separation is an indirect fire (mortar) round.
(4) For existing buildings, see paragraph B-1.1.2.2.
(5) For existing family housing, see paragraph B-1.1.2.2.3.

**Figure B-1 Standoff Distances and Building Separation – Controlled Perimeter**

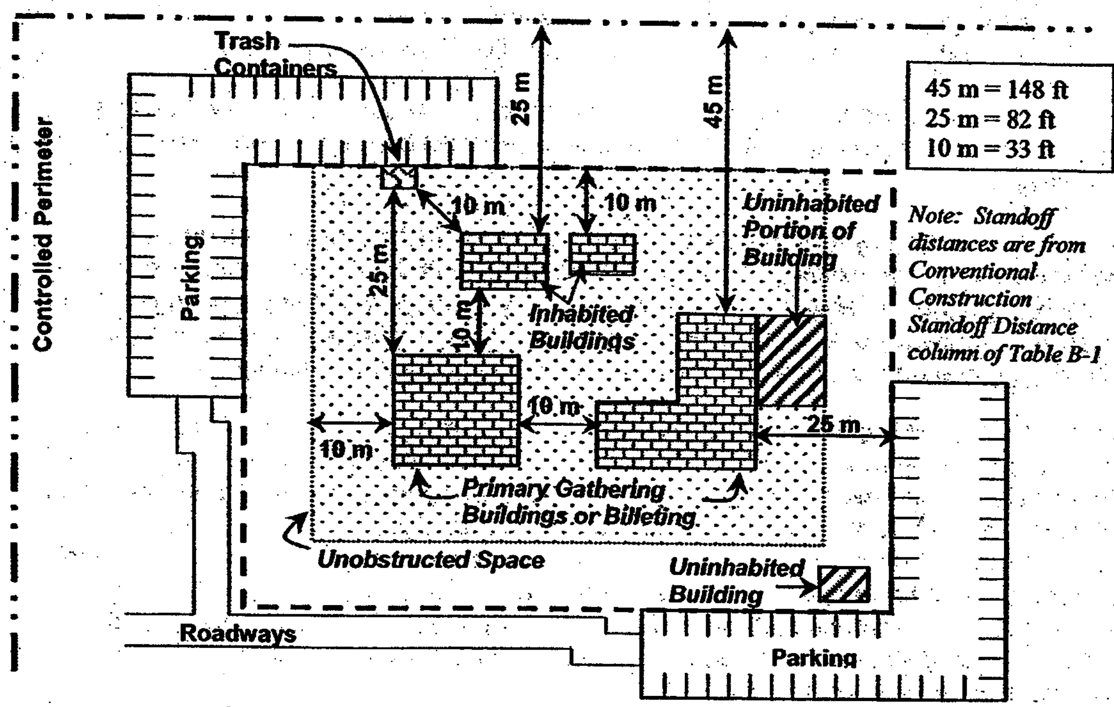
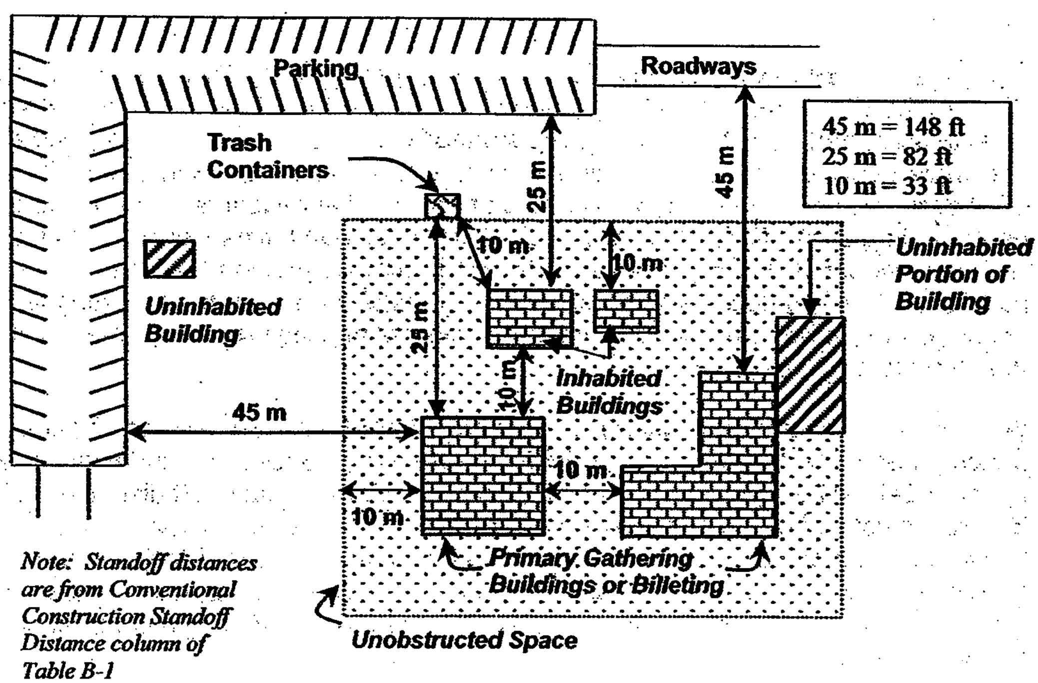



**Figure B-2 Standoff Distances and Building Separation – No Controlled Perimeter**



buildings. Therefore, where there is no controlled perimeter, use standoff distances from parking and roadways according to the distances and the explosive weight associated with controlled perimeters in Table B-1. Measure the standoff distance from the closest edge of parking areas and roadways to the closest point on the building exterior or inhabited portion of the building. In addition, the following apply:

B-1.1.2.1 **New Inhabited Buildings.** The minimum standoff for all new buildings regardless of hardening or analysis is 10 meters (33 feet) for both parking areas and roadways.

B-1.1.2.2 **Existing Inhabited Buildings.** Where possible, move parking and roadways away from existing buildings in accordance with the standoff distances and explosive weights in Table B-1. It is recognized, however, that moving existing parking areas and roadways or applying structural retrofits may be impractical; therefore, the following operational options are provided for existing inhabited buildings:

B-1.1.2.2.1 **Parking Areas.** Establish access control to portions of parking areas that are closer than the required standoff distance to ensure unauthorized vehicles are not allowed closer than the required standoff distance. For primary gathering buildings and billeting, if access control is provided to prevent unauthorized parking within the required standoff distance, controlled parking may be permitted as close as 10 meters (33 feet) without hardening or analysis. Controlled parking may be allowed closer if it can be shown by analysis that the required level of protection can be provided at the lesser standoff distance or if it can be provided through building hardening or other mitigating construction or retrofit.

B-1.1.2.2.2 **Parking on Roadways.** Eliminate parking on roadways within the required standoff distances along roads adjacent to existing buildings covered by these standards.

B-1.1.2.2.3 **Parking for Family Housing.** For existing family housing with 13 or more units per building within a controlled perimeter or where there is access control to the parking area, parking within the required standoff distances may be allowed where designated parking spaces are assigned for specific residents or residences. Do not label assigned parking spaces with names or ranks of the residents. Do not encroach upon existing standoff distances where the existing standoff distances are less than the required standoff distances. For example, where the required standoff distance is 10 meters, but existing designated parking is only 8 meters (27 feet) from existing family housing, that parking may be retained, but additional parking will not be allowed closer than 8 meters (27 feet.)

B-1.1.3 **Parking and Roadway Projects.** Where practical, all roadway and parking area projects should comply with the standoff distances from inhabited buildings in Table B-1. Where parking or roadways that are within the standoff distances in Table B-1 from existing buildings are being constructed, expanded, or relocated, do not allow those parking areas and roadways to encroach on the existing standoff distances of any existing inhabited building. That applies even where such projects are not associated with a building renovation, modification, repair, or restoration requiring compliance with these standards.

B-1.1.4 **Trash Containers.** Measure the standoff distance from the nearest point of the trash container or trash container enclosure to the closest point on the building exterior or inhabited portion of the building. Where the standoff distance is not available, harden trash enclosures to mitigate the direct blast effects and secondary fragment effects of the explosive on the building if the applicable level of protection can be proven by analysis. If trash enclosures are secured to preclude introduction of objects into the enclosures by unauthorized personnel, they may be located closer to the building as long as they do not violate the unobstructed space provisions of Standard 3. Openings in screening materials and gaps between the ground and screens or walls making up an enclosure must not be greater than 150 mm (6 inches).

B-1.2 **Standard 2. Building Separation.** Building separation requirements apply to new buildings and are established to minimize the possibility that an attack on one building causes injuries or fatalities in adjacent buildings. The separation distance is predicated on the potential use of indirect fire weapons.

B-1.2.1 **Billeting and Primary Gathering Buildings.** For all new billeting and primary gathering buildings, ensure that adjacent inhabited buildings are separated by at least the distances in Table B-1. Where it is necessary to encroach on those building separations, analyze the structure and provide hardened building components as necessary to mitigate the effects of the explosive indicated in Table B-1 to the appropriate level of protection shown in Table B-1. Levels of protection are described in Table 2-1 and in the *DoD Security Engineering Manual*.

B-1.2.2 **Other Inhabited Buildings.** There are no minimum separation distances required for antiterrorism purposes for inhabited buildings other than billeting and primary gathering buildings.

B-1.3 **Standard 3. Unobstructed Space.** It is assumed that aggressors will not attempt to place explosive devices in areas near buildings where these explosive devices could be visually detected by building occupants observing the area around the building. Therefore, ensure that obstructions within 10 meters (33 feet) of inhabited buildings or portions thereof do not allow for concealment from observation of explosive devices 150 mm (6 inches) or greater in height. This does not preclude the placement of site furnishings or plantings around buildings. It only requires conditions such that any explosive devices placed in that space would be observable by building occupants. For existing buildings where the standoff distances for parking and roadways have been established at less than 10 meters (33 feet) in accordance with paragraph B-1.1.2.2, the unobstructed space may be reduced to be equivalent to that distance.

B-1.3.1 **Electrical and Mechanical Equipment.** The preferred location of electrical and mechanical equipment such as transformers, air-cooled condensers, and packaged chillers is outside the unobstructed space or on the roof. However this standard does not preclude placement within the unobstructed space as long the equipment provides no opportunity for concealment of explosive devices.

B-1.3.2 **Equipment Enclosures.** If walls or other screening devices with more than two sides are placed around electrical or mechanical equipment within the unobstructed space, enclose the equipment on all four sides and the top. Openings in screening materials and gaps between the ground and screens or walls making up an enclosure will not be greater than 150 mm (6 inches). Secure any surfaces of the enclosures that can be opened so that unauthorized personnel cannot gain access through them.

B-1.4 **Standard 4. Drive-Up/Drop-Off Areas.** Some facilities require access to areas within the required standoff distance for dropping off or picking up people or loading or unloading packages and other objects. Examples that may require drive-up/drop-off include, but are not limited to, medical facilities, exchanges and commissaries, child care centers, and schools.

B-1.4.1 **Marking.** Where operational or safety considerations require drive-up or drop-off areas or drive-through lanes near buildings, ensure those areas or lanes are clearly defined and marked and that their intended use is clear to prevent parking of vehicles in those areas.

B-1.4.2 **Unattended Vehicles.** Do not allow unattended vehicles in drive-up or drop-off areas or drive-through lanes.

B-1.4.3 **Location.** Do not allow drive-through lanes or drive-up/drop-off to be located under any inhabited portion of a building.

B-1.5 **Standard 5. Access Roads.** Where access roads are necessary for the operation of a building (including those required for fire department access), ensure that access control measures are implemented to prohibit unauthorized vehicles from using access roads within the applicable standoff distances in Table B-1.

B-1.6 **Standard 6. Parking Beneath Buildings or on Rooftops.** Eliminate parking beneath inhabited buildings or on rooftops of inhabited buildings. Where very limited real estate makes such parking unavoidable, the following measures must be incorporated into the design for new buildings or mitigating measures must be incorporated into existing buildings to achieve an equivalent level of protection.

B-1.6.1 **Access Control.** Ensure that access control measures are implemented to prohibit unauthorized personnel and vehicles from entering parking areas.

B-1.6.2 **Structural Elements.** Ensure that the floors beneath or roofs above inhabited areas and all other adjacent supporting structural elements will not fail from the detonation in the parking area of an explosive equivalent to explosive weight II in Table B-1.

B-1.6.3 **Progressive Collapse.** All structural elements within and adjacent to the parking area will be subject to all progressive collapse provisions of Standard 7 except that the exterior member removal provision will also apply to interior vertical or horizontal load carrying elements. Apply those provisions based on an explosive equivalent to explosive weight II in Table B-1.

B-2 **STRUCTURAL DESIGN.** If the minimum standoff distances are achieved, conventional construction should minimize the risk of mass casualties from a terrorist attack. Even if those standoff distances can be achieved, however, incorporate the following additional structural issues that must be incorporated into building designs to ensure that buildings do not experience progressive collapse.

B-2.1 **Standard 7. Progressive Collapse Avoidance.** Progressive collapse is considered to be significant risk for buildings of three or more stories. Basements will be considered stories if they have one or more exposed walls. For all new and existing inhabited buildings of three stories or more, design the superstructure to sustain local damage with the structural system as a whole remaining stable and not being damaged to an extent disproportionate to the original local damage. Achieve this through an arrangement of the structural elements that provides stability to the entire structural system by transferring loads from any locally damaged region to adjacent regions capable of resisting those loads without collapse. Accomplish this by providing sufficient continuity, redundancy, or energy dissipating capacity (ductility, damping, hardness, etc.), or a combination thereof, in the members and connections of the structure. For further guidance, refer to American Society of Civil Engineers Standard 7-98 and to detailed guidance in the *DoD Security Engineering Manual*. In addition, the measures below apply to all buildings of three or more stories.

B-2.1.1 **Columns and Walls.** Design all exterior vertical load-carrying columns and walls to sustain a loss of lateral support at any of the floor levels by adding one story height to the nominal unsupported length. While this standard is based on the assumption of an external threat, where parking beneath buildings is unavoidable, this provision also applies to internal vertical load carrying columns and walls.

B-2.1.2 **Exterior Member Removal.** Analyze the structure to ensure it can withstand removal of one primary exterior vertical or horizontal load-carrying element (i.e., a column or a beam) without progressive collapse.

B-2.1.3 **Floors.** Design all floors with improved capacity to withstand load reversals due to explosive effects by designing them to withstand a net uplift equal to the dead load plus one-half the live load.

B-2.2 **Standard 8. Structural Isolation.**

B-2.2.1 **Building Additions.** Design all additions to existing buildings to be structurally independent from the adjacent existing building. This will minimize the possibility that collapse of one part of the building will affect the stability of the remainder of the building. Alternatively, verify through analysis that collapse of either the addition or the existing building will not result in collapse of the remainder of the building.

B-2.2.2 **Portions of Buildings.** Where there are areas of buildings that do not meet the criteria for inhabited buildings, design the superstructures of those areas to be structurally independent from the inhabited area. This will minimize the possibility that collapse of the uninhabited areas of the building will affect the stability of the superstructure of the inhabited portion of the building. Alternatively, verify through analysis that collapse of uninhabited portions of the building will not result in collapse of any portion of the building covered by this standard. This standard is not mandatory for existing structures, but it should be implemented where possible

B-2.3 **Standard 9. Building Overhangs.** Avoid building overhangs with inhabited spaces above them where people could gain access to the area underneath the overhang. Where such overhangs must be used, incorporate the following measures into the design for new buildings. Incorporate mitigating measures into existing buildings to achieve an equivalent level of protection.

B-2.3.1 **Parking and Roadway Restrictions.** Ensure that there are no roadways or parking areas under overhangs.

B-2.3.2 **Floors.** Ensure that the floors beneath inhabited areas will not fail from the detonation underneath the overhang of an explosive equivalent to explosive weight II where there is a controlled perimeter and explosive weight I for an uncontrolled perimeter. Explosive weights I and II are identified in Table B-1.

B-2.3.3 **Superstructure.** The progressive collapse provisions of Standard 7, including the provision for loss of lateral support for vertical load carrying elements, will include all structural elements within and adjacent to the overhang.

B-2.4 **Standard 10. Exterior Masonry Walls.** Unreinforced masonry walls are prohibited for the exterior walls of new buildings. A minimum of 0.05 percent vertical reinforcement with a maximum spacing of 1200 mm (48 in) will be provided. For existing buildings, implement mitigating measures to provide an equivalent level of protection.

B-3 **ARCHITECTURAL DESIGN.** Even where the minimum standoff distances are achieved, many aspects of building layout and other architectural design issues must be incorporated to improve overall protection of personnel inside buildings.

B-3.1 **Standard 11. Windows and Glazed Doors.** To minimize hazards from flying glass fragments, apply the provisions for glazing and window frames below for all new and existing inhabited buildings covered by these standards. Windows and frames must work as a system to ensure that their hazard mitigation is effective. These provisions apply even if the minimum standoff distances are met.

B-3.1.1 **Glazing.** Use a minimum of 6-mm (1/4-in) nominal laminated glass for all exterior windows and glazed doors. The 6-mm (1/4-in) laminated glass consists of two nominal 3-mm (1/8-in) glass panes bonded together with a minimum of a 0.75-mm (0.030-inch) polyvinyl-butyral (PVB) interlayer. For insulated glass units, use 6 mm (1/4 inch) laminated glass inner pane as a minimum. For alternatives to the 6-mm (1/4-in) laminated glass that provide equivalent levels of protection, refer to the *DoD Security Engineering Manual.*

B-3.1.2 **Window Frames.** Provide frames and mullions of aluminum or steel. To ensure that the full strength of the PVB inner layer is engaged, design frames, mullions, and window hardware to resist a static load of 7 kilopascals (1 lb per square in) applied to the surface of the glazing. Frame and mullion deformations shall not exceed 1/160 of the unsupported member lengths. The glazing shall have a minimum frame bite of 9.5-

mm (3/8-in) for structural glazed window systems and 25-mm (1-in) for window systems that are not structurally glazed. Design frame connections to surrounding walls to resist a combined ultimate loading consisting of a tension force of 35-kN/m (200-lbs/in) and a shear force of 13-kN/m (75 lbs/in). Design supporting elements and their connections based on their ultimate capacities. In addition, because the resulting dynamic loads are likely to be dissipated through multiple mechanisms, it is not necessary to account for reactions from the supporting elements in the design of the remainder of the structure. Alternatively, use frames that provide an equivalent level of performance. For existing buildings, this may require replacement or significant modification of window frames, anchorage, and supporting elements.

B-3.1.3 **Mitigation.** Where the minimum standoff distances cannot be met, provide glazing and frames that will provide an equivalent level of protection to that provided by the glazing above as described in Tables 2-1 and 2-2 for the applicable explosive weight in Table B-1.

B-3.1.4 **Window Replacement Projects.** Whenever window or door glazing is being replaced in existing inhabited buildings as part of a planned window or glazing replacement project, whether or not the building meets the triggers in paragraph 1-6.2, install glazing that meets all of the requirements above.

B-3.2 **Standard 12. Building Entrance Layout.** The areas outside of installations are commonly not under the direct control of the installations. Where the main entrances to buildings face installation perimeters, people entering and exiting the buildings are vulnerable to being fired upon from vantage points outside the installations. To mitigate those vulnerabilities apply the following measures:

B-3.2.1 **New Buildings.** For new inhabited buildings, ensure that the main entrance to the building does not face an installation perimeter or other uncontrolled vantage points with direct lines of sight to the entrance.

B-3.2.2 **Existing Buildings.** For existing inhabited buildings where the main entrance faces an installation perimeter, either use a different entrance as the main entrance or screen that entrance to limit the ability of potential aggressors to target people entering and leaving the building.

B-3.3 **Standard 13. Exterior Doors.** For all new and existing buildings covered by these standards, ensure that all exterior doors into inhabited areas open outwards. By doing so, the doors will seat into the door frames in response to an explosive blast, increasing the likelihood that the doors will not enter the buildings as hazardous debris.

B-3.4 **Standard 14. Mailrooms.** The following measures address the location of rooms to which mail is delivered or in which mail is handled in new and existing inhabited buildings. The measures involve limiting collateral damage and injuries and facilitating future upgrades to enhance protection should they become necessary.

B-3.4.1 **Location.** Where a new or existing building covered by these standards must have a mailroom, locate that mailroom on the perimeter of the building. By locating the mailroom on the building perimeter there is an opportunity to modify it in the future if a mail bomb threat is identified. Where mailrooms are located in the interior of buildings, few retrofit options are available for mitigating the mail bomb threat.

B-3.4.2 **Proximity.** Locate mailrooms as far from heavily populated areas of the building and critical infrastructure as possible. This measure will minimize injuries and damage if a mail bomb detonates in the mailroom. Further, it will reduce the potential for wider dissemination of hazardous agents. These apply where the mailroom is not specifically designed to resist those threats.

B-3.4.3 **Sealing.** To limit migration into buildings of airborne chemical, biological, and radiological agents introduced into mailrooms, ensure that mailrooms are well sealed between their envelopes and other portions of the buildings in which they are located. Ensure the mailroom walls are of full height construction that fully extends and is sealed to the undersides of the roofs, to the undersides of any floors above them, or to hard ceilings (i.e. gypsum wallboard ceiling.) Sealing should include visible cracks, the interface joints between walls and ceilings/roofs, and all wall and ceiling/roof penetrations. Doors will have weather stripping on all four edges. Refer to the *DoD Security Engineering Manual* for additional guidance.

B-3.5 **Standard 15. Roof Access.** For all new and existing inhabited buildings covered by these standards, control access to roofs to minimize the possibility of aggressors placing explosives or chemical, biological, or radiological agents there or otherwise threatening building occupants or critical infrastructure.

B-3.5.1 **New Buildings.** For new buildings eliminate all external roof access by providing access from internal stairways or ladders, such as in mechanical rooms.

B-3.5.2 **Existing Buildings.** For existing buildings, eliminate external access where possible or secure external ladders or stairways with locked cages or similar mechanisms.

B-3.6 **Standard 16. Overhead Mounted Architectural Features.** For all new and existing buildings covered by these standards, ensure that overhead mounted features weighing 14 kilograms (31 pounds) or more are mounted to minimize the likelihood that they will fall and injure building occupants. Mount all such systems so that they resist forces of 0.5 times the component weight in any direction and 1.5 times the component weight in the downward direction. This standard does not preclude the need to design architectural feature mountings for forces required by other criteria such as seismic standards.

B-4 **ELECTRICAL AND MECHANICAL DESIGN.** Electrical and mechanical design standards address limiting damage to critical infrastructure; protecting building occupants against chemical, biological, and radiological threats, and notifying building occupants of threats or hazards.

B-4.1 **Standard 17. Air Intakes.** Air intakes to heating, ventilation, and air conditioning (HVAC) systems that are designed to move air throughout a building that are at ground level provide an opportunity for aggressors to easily place contaminants that could be drawn into the building.

B-4.1.1 **New Buildings.** For all new inhabited buildings covered by this document locate all air intakes at least 3 meters (10 feet) above the ground.

B-4.1.2 **Existing Buildings.** The above requirement is recommended, but not mandatory, for existing inhabited buildings covered by these standards.

B-4.2 **Standard 18. Mailroom Ventilation.** To ensure airborne chemical, biological, and radiological agents introduced into mailrooms do not migrate into other areas of buildings in which the mailrooms are located, provide separate, dedicated air ventilation systems for mailrooms. Refer to the *DoD Security Engineering Manual* for additional guidance.

B-4.2.1 **Other Heating and Cooling Systems.** Building heating and cooling systems such as steam, hot water, chilled water, and refrigerant may serve mailrooms as long as the airflow systems for the mailrooms and other areas of the buildings in which they are located remain separate.

B-4.2.2 **Dedicated Exhaust Systems.** Provide dedicated exhaust systems within mailrooms to maintain slight negative air pressures with respect to the remainder of the buildings in which the mailrooms are located so that the flow of air is into and contained in the mailrooms. Though the airflow into the mailrooms will not eliminate the potential spread of contamination by personnel leaving the mailroom, it will limit the migration of airborne contaminants through openings and open doorways.

B-4.2.3 **Outside Intakes and Exhausts.** Provide mailroom ventilation system outside air intakes and exhausts with low leakage isolation dampers that can be closed to isolate the mailrooms.

B-4.2.4 **Isolation Controls.** Provide separate switches or methods of control to isolate mailrooms in the event of a suspected or actual chemical, biological, or radiological release.

B-4.3 **Standard 19. Emergency Air Distribution Shutoff.** For all new and existing inhabited buildings, provide an emergency shutoff switch in the HVAC control system that can immediately shut down air distribution throughout the building except where interior pressure and airflow control would more efficiently prevent the spread of airborne contaminants and/or ensure the safety of egress pathways. Locate the switch (or switches) to be easily accessible by building occupants. Providing such a capability will allow the facility manager or building security manager to limit the distribution of airborne contaminants that may be introduced into the building.

B-4.4 **Standard 20. Utility Distribution and Installation.** Utility systems can suffer significant damage when subjected to the shock of an explosion. Some of these utilities may be critical for safely evacuating personnel from the building or their destruction could cause damage that is disproportionate to other building damage resulting from an explosion. To minimize the possibility of the above hazards, apply the following measures:

B-4.4.1 **Utility Routing.** For all new inhabited buildings, route critical or fragile utilities so that they are not on exterior walls or on walls shared with mailrooms. This requirement is recommended, but not mandatory, for existing buildings.

B-4.4.2 **Redundant Utilities.** Where redundant utilities are required in accordance with other requirements or criteria, ensure that the redundant utilities are not collocated or do not run in the same chases. This minimizes the possibility that both sets of utilities will be adversely affected by a single event.

B-4.4.3 **Emergency Backup Systems.** Where emergency backup systems are required in accordance with requirements or criteria, ensure that they are located away from the system components for which they provide backup.

B-4.5 **Standard 21. Equipment Bracing.** Mount all overhead utilities and other fixtures weighing 14 kilograms (31 pounds) or more to minimize the likelihood that they will fall and injure building occupants. Design all equipment mountings to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction. This standard does not preclude the need to design equipment mountings for forces required by other criteria such as seismic standards.

B-4.6 **Standard 22. Under Building Access.** To limit opportunities for aggressors placing explosives underneath buildings, ensure that access to crawl spaces, utility tunnels, and other means of under building access is controlled.

B-4.7 **Standard 23. Mass Notification.** All inhabited buildings must have a timely means to notify occupants of threats and instruct them what to do in response to those threats.

B-4.7.1 **New Buildings.** All new inhabited buildings must have a capability to provide real-time information to building occupants or personnel in the immediate vicinity of the building during emergency situations. The information relayed must be specific enough to determine the appropriate response actions. Any system, procedure, or combination thereof that provides this capability will be acceptable under this standard.

B-4.7.2 **Existing Buildings.** For existing buildings, the above requirement is mandatory for primary gathering buildings and billeting, but recommended for all inhabited buildings.

# APPENDIX C

## RECOMMENDED ADDITIONAL ANTITERRORISM MEASURES FOR NEW AND EXISTING BUILDINGS

C-1 **SITE PLANNING.** The following additional measures, if implemented, will significantly enhance site security with little increase in cost and should be considered for all new and existing inhabited buildings.

C-1.1 **Recommendation 1. Vehicle Access Points.** The first line of defense in limiting opportunities for aggressors to get vehicles close to DoD buildings is at vehicle access points at the controlled perimeter, in parking areas, and at drive-up/drop-offs points. Keep the number of access points to the minimum necessary for operational or life safety purposes. This will limit the number of points at which access may have to be controlled with barriers and/or personnel in increased threat environments or if the threat increases in the future.

C-1.2 **Recommendation 2. High-Speed Vehicle Approaches.** The energy of a moving vehicle increases with the square of its velocity; therefore, minimizing a vehicle's speed allows vehicle barriers to be lighter and less expensive should vehicle barriers ever become necessary. To facilitate reductions in vehicle speeds in the future, ensure there are no unobstructed vehicle approaches perpendicular to inhabited buildings at the required parking and roadway standoff distances.

C-1.3 **Recommendation 3. Vantage Points.** Vantage points are natural or man-made positions from which potential aggressors can observe and target people or other assets in and around a building. Identify vantage points outside the control of personnel in the targeted building and either eliminate them or provide means to avoid exposure to them. Means to avoid exposure may include actions such as reorienting the building or shielding people or assets in and around the building using such measures as reflective glazing, walls, privacy fencing, or vegetation.

C-1.4 **Recommendation 4. Drive-Up/Drop Off.** Locate these points away from large glazed areas of the building to minimize the potential for hazardous flying glass fragments in the event of an explosion. For example, locate the lane at an outside corner of the building or otherwise away from the main entrance. Coordinate the drive-up/drop-off point with the building geometry to minimize the possibility that explosive blast forces could be increased due to being trapped or otherwise concentrated. For further discussion of this issue, refer to the *DoD Security Engineering Manual*.

C-1.5 **Recommendation 5. Building Location.** Activities with large visitor populations provide opportunities for potential aggressors to get near buildings with minimal controls, and therefore, limit opportunities for early detection. Maximize separation distance between inhabited buildings and areas with large visitor populations.

C-1.6 **Recommendation 6. Railroad Location.** Avoid sites for inhabited buildings that are close to railroads. Where railroads are in the vicinity of existing buildings, provide standoff distances between the railroad and any inhabited buildings based on the standoff distances and explosive weight associated with controlled perimeters in Table B-1. Where those standoff distances are not available, and since moving existing railroads may be difficult and prohibitively expensive, ensure that there are procedures in place to prohibit trains from stopping in the vicinity of inhabited structures.

C-1.7 **Recommendation 7. Access Control for Family Housing.** For new family housing areas, provide space for controlling access at the perimeter of the housing area so that a controlled perimeter can be established there if the need arises in the future.

C-1.8 **Recommendation 8. Standoff for Family Housing.** For new family housing construction, maintain a minimum standoff distance of 25 meters (82 feet) from installation perimeters and roads, streets, or highways external to housing areas.

C-1.9 **Recommendation 9. Minimize Secondary Debris.** To reduce the hazard of flying debris in the event of an explosion, eliminate unrevetted barriers and site furnishings in the vicinity of inhabited structures that are accessible to vehicle traffic. Revet exposed barriers and site furnishings near inhabited buildings with a minimum of 1 meter (3 feet) of soil or equivalent alternative techniques to prevent fragmentation hazards in the event of an explosion.

C-2 **STRUCTURAL AND ARCHITECTURAL DESIGN.** The following additional measures, if implemented, will significantly enhance building occupants' safety and security with little increase in cost. Consider these measures for all new and existing inhabited buildings.

C-2.1 **Recommendation 10. Structural Redundancy.** Unexpected terrorist acts can result in local collapse of building structural components. To limit the extent of collapse of adjacent components, utilize highly redundant structural systems such as moment resisting frames, detail connections to provide continuity across joints equal to the full structural capacity of connected members, and detail members to accommodate large displacements without complete loss of strength. This recommendation is consistent with paragraph B-2.1 (Standard 7) for preventing progressive collapse, but recommends selection of certain structural systems and greater attention to structural details.

C-2.2 **Recommendation 11. Internal Circulation.** Design circulation within buildings to provide visual detection and monitoring of unauthorized personnel approaching controlled areas or occupied spaces.

C-2.3 **Recommendation 12. Visitor Control.** Controlling visitor access maximizes the possibility of detecting potential threatening activities. Keep locations in buildings where visitor access is controlled away from sensitive or critical areas, areas where high-risk or mission-critical personnel are located, or other areas with large population densities of DoD personnel.

C-2.4 **Recommendation 13. Asset Location.** To minimize exposure to direct blast effects and potential impacts from hazardous glass fragments and other potential

**debris, locate critical assets and mission-critical or high-risk personnel away from the building exterior.**

**C-2.5 Recommendation 14. Room Layout.** **In rooms adjacent to the exterior of the building, position personnel and critical equipment to minimize exposure to direct blast effects and potential impacts from hazardous glass fragments and other potential debris.**

**C-2.6 Recommendation 15. External Hallways.** **Since doors can become hazardous debris during explosive blast events, doors designed to resist blast effects are expensive, and external hallways have large numbers of doors leading into inhabited areas, avoid exterior hallway configurations for inhabited structures.**

**C-2.7 Recommendation 16. Windows.** **To minimize the potential for glazing hazards, minimize the size and number of windows for new construction.**

# APPENDIX D

## DOD MINIMUM ANTITERRORISM STANDARDS FOR EXPEDITIONARY AND TEMPORARY STRUCTURES

D-1 **SITE PLANNING STANDARDS.** All the standards that are unique to expeditionary and temporary structures pertain to site planning. Integrate operational, logistic, and security requirements into the overall configuration of structures, equipment, landscaping, parking, roads, and other features. The most cost-effective solution for mitigating explosive effects on expeditionary and temporary structures is to keep explosives as far away as possible. This is especially critical for these types of structures because hardening may or may not be possible. Dispersed layouts reduce risks from a variety of threats by taking full advantage of terrain and site conditions; therefore, nothing in these standards is intended to discourage dispersal. Costs and requirements for expeditionary and temporary structure hardening are addressed in the *DoD Security Engineering Manual*.

D-1.1 **Standard 1. Minimum Standoff Distances.** The minimum standoff distances apply to all new and existing DoD expeditionary and temporary structures covered by these standards except as otherwise stated below. The minimum standoff distances are presented in Table D-1and illustrated in Figure D-1. Except as otherwise required in these standards, where the standoff distances in Table D-1 can be provided, use conventional expeditionary and temporary structures without a specific analysis of blast effects. Where those distances are not available, analysis of the structure by an engineer experienced in blast-resistant design is required and hardening will be applied as necessary (in those cases which permit structure hardening) to mitigate the effects of the explosives indicated in Table D-1 at the achievable standoff distance to the appropriate level of protection. The appropriate levels of protection for each structure category are shown in Table D-1, and are described in Table 2-3 and in the *DoD Security Engineering Manual*. The two structure types in Table D-1 respond in fundamentally different ways to explosive effects. Standoff distances in Table D-1 reflect those differences.

D-1.1.1 **Controlled Perimeter.** Measure the standoff distance from the closest point on the structure exterior to the controlled perimeter.

D-1.1.1.1 **Container Structures and Pre-engineered Buildings.** For these structures, apply the guidance in Appendix B.

D-1.1.1.2 **Fabric Covered/Metal Frame Construction and other Expeditionary or Temporary Structures.** Provide the standoff distance from Table D-1 for the applicable structure category.

D-1.1.2 **Parking and Roadways.** Standoff distances for parking and roadways are based on the assumption that there is a controlled perimeter at which larger vehicle bombs will be detected and kept from entering the controlled perimeter. Where there is a controlled perimeter, the standoff distances and explosive weight associated with parking and roadways in Table D-1 apply unless otherwise stated below. If there is no controlled perimeter, assume that the larger explosive weights upon which the controlled perimeter standoff distances are based (explosive weight I from Table D-1) can access parking and roadways near buildings. Therefore, where there is no controlled perimeter, use standoff distances from parking and roadways according to the distances and the explosive weight associated with controlled perimeters in Table D-1.

D-1.1.2.1 **Container Structures and Pre-engineered Buildings.** For these structures, apply the guidance in Appendix B.

D-1.1.2.2 **Fabric Covered/Metal Frame Construction and other Expeditionary or Temporary Structures.** Measure the standoff distance from the closest point on the structure exterior to the closest edge of parking areas and roadways. The minimum standoff for all structures regardless of hardening or analysis is 10 meters (33 feet).

D-1.1.2.3 **Existing Fabric Covered/Metal Frame Construction and other Expeditionary or Temporary Structures.** Moving existing parking areas and roadways may be difficult to achieve and structural retrofits to existing structures may be prohibitively expensive or technically impossible; therefore, the following operational options are provided for existing inhabited structures where the standoff distances in Table D-1 are impractical to achieve.

D-1.1.2.3.1 **Parking Areas.** Establish access control to portions of parking areas to ensure unauthorized vehicles are not allowed closer than the required standoff distance. For primary gathering structures and billeting, if access control is provided to prevent unauthorized parking within the required standoff distance, permit controlled parking as close as 10 meters (33 feet) without hardening or analysis.

D-1.1.2.3.2 **Roadways.** Eliminate parking within the required standoff distances along roads adjacent to existing structures covered by these standards.

D-1.1.3 **Trash Containers.** Measure the standoff distance from the nearest point of the trash container or trash container enclosure to the closest point on the structure exterior. Where the standoff distance is not available, hardening of trash enclosures to mitigate the direct blast effects and secondary fragment effects of the explosive on the structure is acceptable, if the applicable level of protection can be proven by analysis. If trash enclosures are secured to preclude introduction of objects into the enclosures by unauthorized personnel, locate them closer to the structure as long as they do not violate the unobstructed space provisions of Standard 3 below. Openings in screening materials and gaps between the ground and screens or walls making up an enclosure will not be greater than 150 mm (6 inches).

D-1.1.3.1 **Container Structures and Pre-engineered Buildings.** For these structures, apply the guidance in Appendix B.

D-1.1.3.2 **Fabric Covered/Metal Frame Construction and other Expeditionary or Temporary Structures.** Provide the standoff distance from Table D-1 for the applicable structure category.

D-1.2 **Standard 2. Structure Separation.** Structure separation requirements are established to minimize the possibility that an attack on one structure causes injuries or fatalities in adjacent structures. The separation distance is predicated on the potential use of indirect fire weapons.

D-1.2.1 **Billeting and Primary Gathering Structures.**

D-1.2.1.1 **Container Structures and Pre-engineered Buildings.** For these structures, apply the guidance in Appendix B.

D-1.2.1.2 **Fabric Covered/Metal Frame Construction and other Expeditionary or Temporary Structures.** For all new billeting and primary gathering structures, ensure that adjacent structures are separated by at least the distances in Table D-1. Where it is necessary to encroach on those structure separations, analyze the structure and provide hardened structure components as necessary to mitigate the effects of the explosive indicated in Table D-1 to the appropriate level of protection as shown in Table D-1. Levels of protection are described in Table 2-3 and in the *DoD Security Engineering Manual.*

D-1.2.2 **Other Inhabited Structures.** There are no minimum separation distances required for antiterrorism for inhabited buildings other than billeting and primary gathering structures.

D-1.3 **Standard 3. Unobstructed Space.** Keep areas within 10 meters (33 feet) of all expeditionary and temporary structures free of items other than those that are part of the utilities and other supporting infrastructure.

D-2 **ADDITIONAL STANDARDS.** In addition to the specific standards detailed in this appendix, apply the standards from Appendix B to expeditionary and temporary structures as follows:

D-2.1 **Fabric Covered/Metal Frame Construction and other Expeditionary or Temporary Structures.** Apply the following standards from Appendix B to these structures:

D-2.1.1 **Standard 4. Drive-Up/Drop Off Areas.**

D-2.1.2 **Standard 5. Access Roads.**

D-2.1.3 **Standard 11. Windows and Glazed Doors.**

D-2.1.4 **Standard 12. Building Entrance Layout.**

D-2.1.5 **Standard 20. Equipment Bracing.**

D-2.1.6 **Standard 22. Mass Notification.**

D-2.2 **Container Structures and Pre-engineered Buildings.** For these structures, all standards in Appendix B apply.

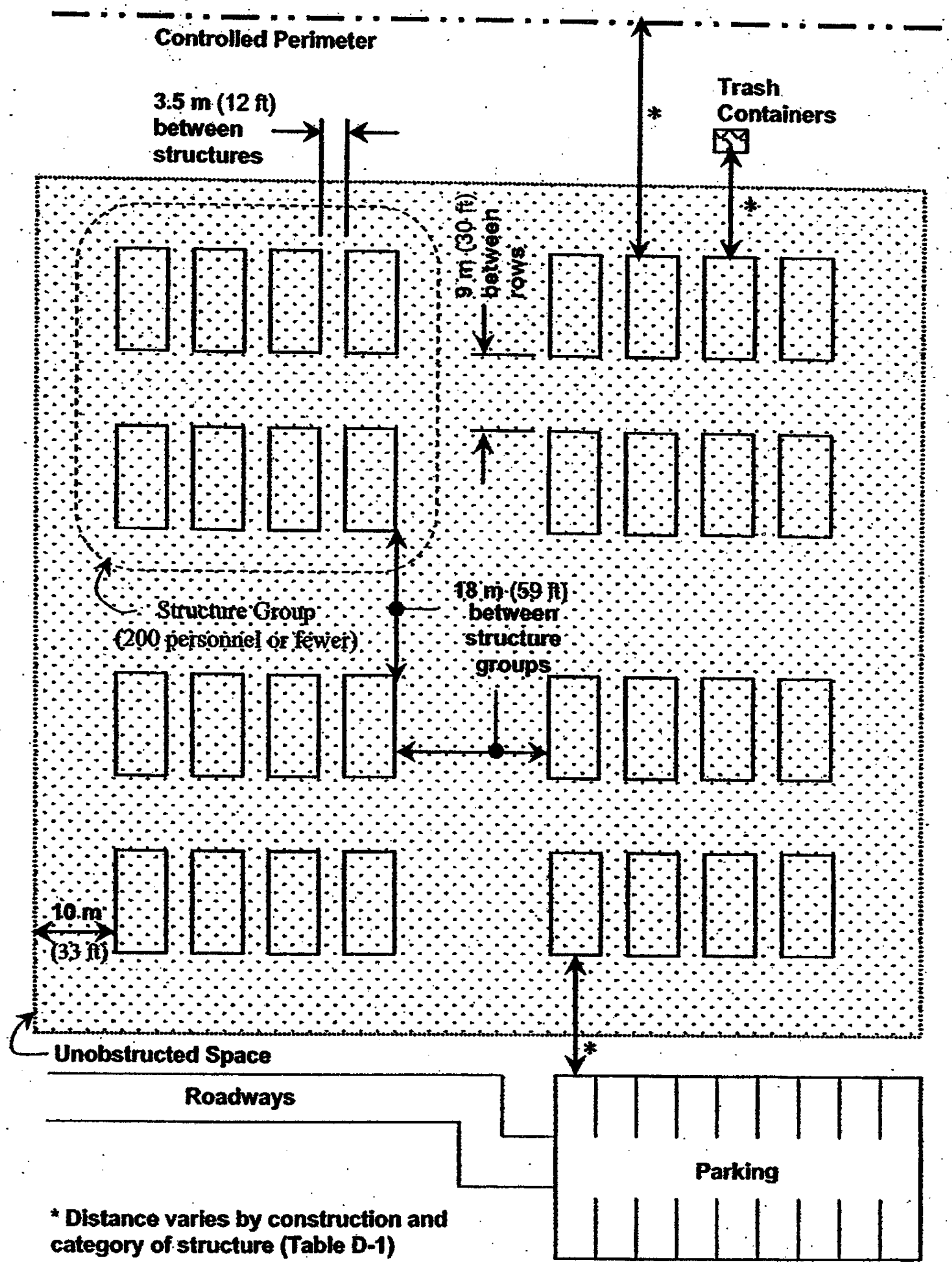
**D-3 ANTITERRORISM RECOMMENDATIONS.** Apply all recommendations except for Recommendation 7 (Access control for family housing) and Recommendation 8 (Standoff for family housing) from Appendix C to all expeditionary and temporary structures.

**Table D-1 Minimum Standoff Distances and Separation for Expeditionary and Temporary Structures**

| Location | Structure Category | Standoff Distance or Separation Requirements | | | |
|---|---|---|---|---|---|
| | | Applicable Level of Protection | Fabric Covered/Metal Frame Structures(1) | Other Expeditionary and Temporary Structures(1)(2) | Applicable Explosive Weight (TNT) (3) |
| Controlled Perimeter or Parking and Roadways without a Controlled Perimeter | Billeting | Low | 31 m (102 ft.) | 71 m (233 ft.) | I |
| | Primary Gathering Structure | Low | 31 m (102 ft.) | 71 m (233 ft.) | I |
| | Inhabited Structure | Very Low | 24 m (79 ft.) | 47 m (154 ft.) | I |
| Parking and Roadways within a Controlled Perimeter | Billeting | Low | 14 m (46 ft.) | 32 m (105 ft.) | II |
| | Primary Gathering Structure | Low | 14 m (46 ft.) | 32 m (105 ft.) | II |
| | Inhabited Structure | Very Low | 10 m (33 ft.) | 23 m (75 ft.) | II |
| Trash Containers | Billeting | Low | 14 m (46 ft.) | 32 m (105 ft.) | II |
| | Primary Gathering Structure | Low | 14 m (46 ft.) | 32 m (105 ft.) | II |
| | Inhabited Structure | Very Low | 10 m (33 ft.) | 23 m (75 ft.) | II |
| Structure Separation(4) | Separation between Structure Groups | Low | 18 m (59 ft.) | 18 m (59 ft.) | III(5) |
| | Separation between Structure Rows | Low | 9 m (30 ft.) | 9 m (30 ft.) | III (5) |
| | Separation between Structures in a Row | Very Low | 3.5 m (12 ft.) | 3.5 m (12 ft.) | III(5) |

(1) See Definitions for a complete description of these structure types.
(2) For container structures, Appendix B applies.
(3) See UFC 4-010-10, for the specific explosive weights (kg/pounds of TNT) associated with designations – I, II, III. UFC 4-010-10 is For Official Use Only (FOUO)
(4) Applies to Billeting and Primary Gathering Structures only. No minimum separation distances for other inhabited structures.
(5) Explosive for building separation is an indirect fire (mortar) round.

**Figure D-1 Standoff Distances and Separation for Expeditionary and Temporary Structures**





--END OF APPENDIX 15--

# Standard Telecommunications Infrastructure Requirements

for

New or Renovated Facilities

(26 December 2001)

3RD COMMUNICATIONS SQUADRON PLANNING SECTION (3 CS/SCX)
10471 20TH ST
ELMENDORF AFB AK 99506-2200

Phone: 907-552-5044/907-552-7133
FAX: 907-552-5021

3 CS/SCX shall provide specific information needed to connect new facilities to the existing communications plant. This information shall include type of connection (fiber optic or copper), required capacity, and connection point.

1 Exterior Duct

1.1 Number and Type of Ducts

A minimum of three 103-mm HDPE ducts shall be installed to each facility CER; however, the number of ducts installed shall always include two ducts left unused and available for future growth. All ducts shall be filled with inner duct (merely installing one inner duct in each duct is unacceptable). Type of inner duct installed will depend on whether or not the duct is connected to a manhole.

1.2 Duct Connected to Manhole

Duct connected to manholes shall be filled with tonable, 1-inch, direct-bury rated, HDPE smooth-wall inner duct run continuously from the manhole to the CER. Each inner duct shall have a labeled pull-rope installed.

1.3 Duct Entered by Direct-Bury Cable

Duct entered by direct-bury cable shall be filled with tonable, 1½-inch, direct-bury rated, HDPE smooth-wall inner duct. Inner duct splices shall be spliced in such a fashion to preserve pressurization and allow blowing in of fiber optic cable. The duct stub out shall be marked in such a way as to allow location by metal detector.

2 Communications Equipment Room (CER) and Riser Closets

The CER serves as entrance facility for all communications services to the facility. Riser closets serve to distribute those services throughout the facility. A CER may also serve as a riser closet.
CER and Riser Closet Applicability
All new facilities, regardless of size or intended use (with the exception of guardhouses, utility control facilities, and storage bunkers), shall have a CER. Facilities with multiple floors or facilities in which communications outlets lay more than 90 meters in horizontal cable length (not physical separation) from the closest CER shall have riser closets to keep total length of horizontal cable under 90 meters.

2.1 CER and Riser Closet Location

The CER may be located in the basement or on the first floor in a location to provide best service to the facility and riser closets. The CERs and riser closets must be located in the most central location available to keep total average length of horizontal cabling under 90 meters. Riser closets on successive floors must be vertically stacked. Three rigid 4-inch steel conduits shall be installed between stacked riser closets on successive floors. Floor space supporting communications can be reduced if the CER is centrally located with riser closets stacked above it on successive floors. If the CER location is centrally located, entrance cable must be enclosed in metallic conduit throughout its path through the facility. The CER function can never be co-located with electrical, mechanical, or HVAC facilities which could introduce electrical interference, moisture, gases, or dust. The CER and riser closets shall be free of piping, mechanical equipment or power cabling

2.2 CER and Riser Closet Size

The CER shall be approximately 1.1% of the total usable square footage of the facility. Riser closet size shall be approximately 1.1% of the floor space it serves. However, in no case shall the size of a CER or a riser closet be less than 10 feet by 10 feet. This is necessary to ensure adequate area for equipment and maintenance activities in the closet.

2.3 CER and Riser Closet Security

The CER shall have 36-inch by 80-inch double leaf (no center support) outward hinging doors. Riser closets shall have a 36-inch by 80-inch single-leaf outward hinging door. Doors shall be fitted with the standard lock for all CERs and telecommunications closets. Access to the CER and riser closets shall be from the inside of the building only.

2.4 CER and Riser Closet Climate Control

The CER and riser closets shall be provided climate control to maintain a temperature range between 68 and 78 degrees Fahrenheit. Positive pressure shall be maintained to reduce dust entrance.

2.5 CER and Riser Closet Lighting and Wall Finish

The CER and riser closet lighting shall be minimum 8.5 feet high, providing 50-foot candles @ 3 feet above floor. Walls and backboards shall be painted white to maximize illumination.

2.6 CER and Riser Closet Electrical Support

The CER and riser closets shall have 2 dedicated 20-amp quad outlets located on wall behind equipment racks. Standard duplex convenience outlets shall be placed on other walls.

2.7 CER and Riser Closet Grounding

Provide a single-point ground for all equipment in the CER. Provide a copper ground plate (bus bar with minimum 6 inches high by 24 inches long) installed 7 feet above the floor on a wall within the CER. The ground riser from the ground plate to the single main electrical service entrance ground shall be a No. 1 AWG or larger copper conductor directly connected to the ground plate with no taps. The resistance of the ground riser shall be 5 ohms or less measure from the main building ground point. All connection of wire-to-wire and/or wire-to-ground rod shall be thermo-welded. Extend No. 6 AWG or larger copper ground wires from the CER ground plate to each riser closet.

2.8 CER and Riser Closet Backboards

A minimum of two 8-foot by 4-foot by ¾-inch plywood sheets shall be installed in the CER and each riser closet. Additional backboards shall be installed at a ratio of one square foot of backboard for each 200 square feet of floor space. Backboards shall be finished with white, fire-retardant paint.

2.9 Terminal Blocks and Surge Arrestors

In most cases, cable termination and distribution shall occur on Cat 6 patch panels; however, when the entrance cable is copper, 110 blocks shall be installed on backboards to serve as a cable head, and separate carbon module surge arrestor units shall be installed.

## 3 Equipment Racks

A minimum of two 19-inch x 84-inch equipment racks shall be installed in the CER and each riser closet. Configuration of equipment racks for the CER and riser closets is essentially the same. Equipment racks shall be placed side-by-side, perpendicular to and against one of the CER's (or riser closet's) side walls, equidistant from both the front and rear walls. Rack fronts shall face the CER (or riser closet) door. In a 10-foot by 10-foot CER or riser closet, the distance between rear wall to back of the racks and front wall to the front of the racks shall be a minimum of 3 feet. Distance from the opposite side wall to the side of the rack shall be approximately 6 feet. The racks shall be anchored in accordance with seismic anchoring requirements. Equipment rack configuration depends on the type of cable (fiber optic or copper) servicing the facility.

### 3.1 Equipment Rack Configuration When Facility is Serviced by Fiber Optic

#### 3.1.1 Fiber Optic Patch Panel

Fiber optic patch panels will appear in the CER and all riser closets. They'll serve to (1) terminate entrance fiber optic cable in the CER, (2) originate riser cable in the CER, (3) terminate riser cable in riser closets, and (4) service channel bank and network equipment. The fiber optic patch panel shall be equivalent to Siecor FDC style fiber optic patch panel, shall be 19-inch rack-mountable and facilitate termination of ST type single mode fiber optic connectors. Fiber optic patch panels for riser closets shall have no less than 12 ports. Compute the number of fiber optic ports required on patch panels in the CER or riser closet by summing the number of fiber optic strands to be originated/terminated in the CER or riser closet.

In a CER: (number of entrance cable strands)+(number of riser closets x 12)
In a riser closet: 12 (each riser cable will be 12 strand)

No single fiber optic patch panels shall exceed 48 ports total. Each shall be fully populated with termination inserts. Fiber optic patch panels shall be installed at the top of the right equipment rack.

#### 3.1.2 Fiber Optic Channel Banks

The fiber optic channel bank equipment allows fiber optic networks to service phones, alarms and similar devices normally connected via copper to the DCO. Channel bank equipment shall 19 inch rack mountable, compatible with Advanced Fibre Comm channel bank equipment, and accept ST type fiber optic connectors. Channel bank equipment battery backup shall support operation for a minimum of 12 hours during loss of electrical power. Channel bank equipment must feature one POTS card for every 6 telephones serviced by the respective CER or riser closet. NOTE: FOR EACH CHANNEL BANK CARD INSTALLED IN THE FACILITY, A CORRESPONDING CHANNEL BANK CARD MUST BE INSTALLED AT THE DCO. If necessary, additional channel bank chassis must also be installed at the DCO if currently installed chassis lack expansion room for corresponding POTS cards. Fiber optic channel bank equipment shall be installed at the bottom of the right equipment rack.

#### 3.1.3 Phone Service Cat 6 Patch Panels

This set of Cat 6 patch panels shall provide a termination and connection point for phone and like services provided by the fiber optic channel bank equipment. Cat 6 UTP patch panels shall allow connection of Cat 6 RJ-45 connectors in the front and termination of UTP on 110-style punchdowns in the rear and be "high density" type having no more than 48 ports each. Cat 6 patch panels connecting to fiber optic channel banks shall be installed at the top of the left equipment rack.

3.1.4 Horizontal Cable Cat 6 Patch Panel

This set of Cat 6 patch panels shall provide origination of horizontal cable. Cat 6 UTP patch panels shall allow connection of Cat 6 RJ-45 connectors in the front and termination of UTP on 110-style punchdowns in the rear and be "high density" type having no more than 48 ports each. Cat 6 patch panels terminating horizontal cable shall be installed at the bottom of the left equipment rack. Each RJ-45 port on the front of the patch panel shall be labeled consecutively from 1 to end.

3.1.5 Connection of Channel Bank Equipment to Cat 6 Patch Panel

Channel bank equipment shall be connected to the Cat 6 UTP patch panel installed at the top of the left equipment rack. Specialized connectors for channel bank equipment cards provide UTP for punchdown. Punch down only 1 pair at each port on the 110-style punchdowns on the rear of the phone service Cat 6 patch panels.

3.2 Equipment Rack Configuration When Facility is Serviced by Copper

3.2.1 "Demarc" Cat 6 Patch Panels

"Demarcation" Cat 6 UTP patch panels shall serve as cross connect to horizontal cable Cat 6 patch panels. Cat 6 UTP patch panels shall allow connection of Cat 6 RJ-45 connectors in the front and termination of UTP on 110-style punchdowns in the rear and be "high density" type having no more than 48 ports each. These Cat 6 patch panels shall be installed on the top of the left equipment rack.

3.2.2 Horizontal Cable Cat 6 Patch Panel

This set of Cat 6 patch panels shall provide termination for horizontal cable. Cat 6 UTP patch panels shall allow connection of Cat 6 RJ-45 connectors in the front and termination of UTP on 110-style punchdowns in the rear and be "high density" type having no more than 48 ports each.. Cat 6 patch panels terminating horizontal cable shall be installed at the bottom of the left equipment rack.

4 Entrance Cable

The location and use of facility shall dictate whether the facility is connected via the copper plant or the fiber optic network. 3 CS/SCX shall specify what type of cable to use in connecting to the base communications plant.

4.1 Fiber Optic Entrance Cable

4.1.1 Fiber Optic Entrance Cable Type

Entrance fiber optic cable shall be unarmored, loose-tube, direct-bury rated, water-blocked, single mode, fiber optic cable. It shall have the same refraction index properties as Corning ALTOS fiber optic cable.

4.1.2 Fiber Optic Entrance Cable Capacity

A minimum of 12 strand fiber optic shall be used; however, the specific application may require more. 3 CS/SCX can provide this information.

#### 4.1.3 Fiber Optic Entrance Cable Termination

Entrance fiber optic cables shall connect the fiber optic patch panel in the CER to a fiber optic patch panel in the nearest information transport node (ITN) (not to the base communications center). 3 CS/SCX shall provide further information on the location of the most suitable ITN. Terminations at both ends (on the fiber optic patch panel in the CER and the ITN shall be with adhesive ST type connectors installed after a 50 foot service loop. Splices shall be fusion splice (hot melt or epoxy), no mechanical splices shall be used.

### 4.2 Copper Entrance Cable

#### 4.2.1 Copper Entrance Cable Type

Entrance copper cable shall be gel filled. When installed, the cable shall have no greater than 1200 ohm loop resistance from the DCO.

#### 4.2.2 Copper Entrance Cable Capacity

3 CS/SCX shall specify capacity required.

#### 4.2.3 Copper Entrance Cable Termination

All pairs shall terminate on type 110 terminal block cable head in the facility CER to the nearest point in the existing copper plant. 3 CS/SCX shall provide information on the main cable, pairs, and splice point. Splices into the existing copper plant shall be compatible with gel-filled copper cable.

## 5 Riser Cable

Type of riser cable and routing of the riser cable depends on the type of entrance cable servicing the facility.

### 5.1 Fiber Optic Riser Cable

Riser fiber optic cable shall connect the fiber optic patch panel in the CER with fiber optic patch panels in riser closets. Fiber optic riser cable shall be 12 strand, single mode, riser rated, tight buffered, compatible with Corning MIC type fiber optic, and shall originate and terminate on fiber optic patch panels with adhesive ST type connectors. Splices shall be fusion splice (hot melt or epoxy); no mechanical splices shall be used. One 12-strand fiber optic cable shall be run from the CER fiber optic patch panel to each riser closet fiber optic patch panel. Cable shall not be "daisy chained" from one riser closet to the next.

### 5.2 Copper Riser Cable

Riser copper cable shall originate at carbon module surge arrestor units at the cable head in the CER and shall be subdivided to form separate runs to Cat 6 patch panels in the CER and riser closets. Copper riser cable shall be 24 AWG. Each riser cable capacity shall be no less than 50 percent of the capacity of the cable servicing the facility. Cable shall not be "daisy chained" from one riser closet to the next. Terminate each riser cable with only 1 pair at each port on the 110-style punchdowns on the rear of the Cat 6 patch panels.

6 Horizontal Cable

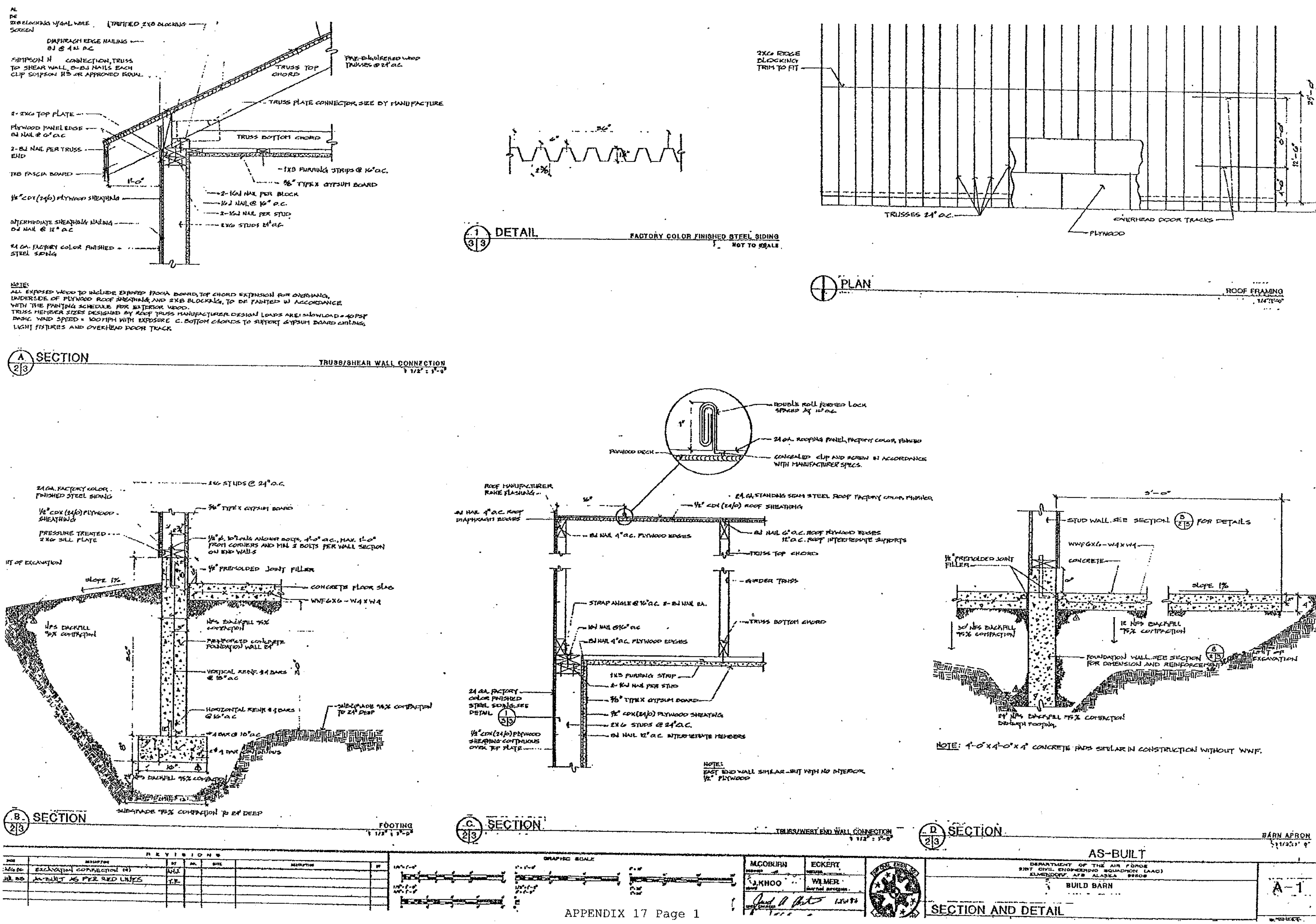
Horizontal cabling provides service to user area from CER or riser closets. Horizontal cabling shall be Cat 6 compliant UTP, plenum rated (blue jacket only), and 4+0 or "balanced" construction. Horizontal cabling originates on 110 style ports on the rear of Cat 6 patch panels installed in the lower portion of the left equipment rack in the CER or riser closets and terminates at wall outlets. No segment of horizontal cabling shall exceed 90 meters total from origination to termination. Careful riser closet (or CER) location is critical to ensuring compliance.

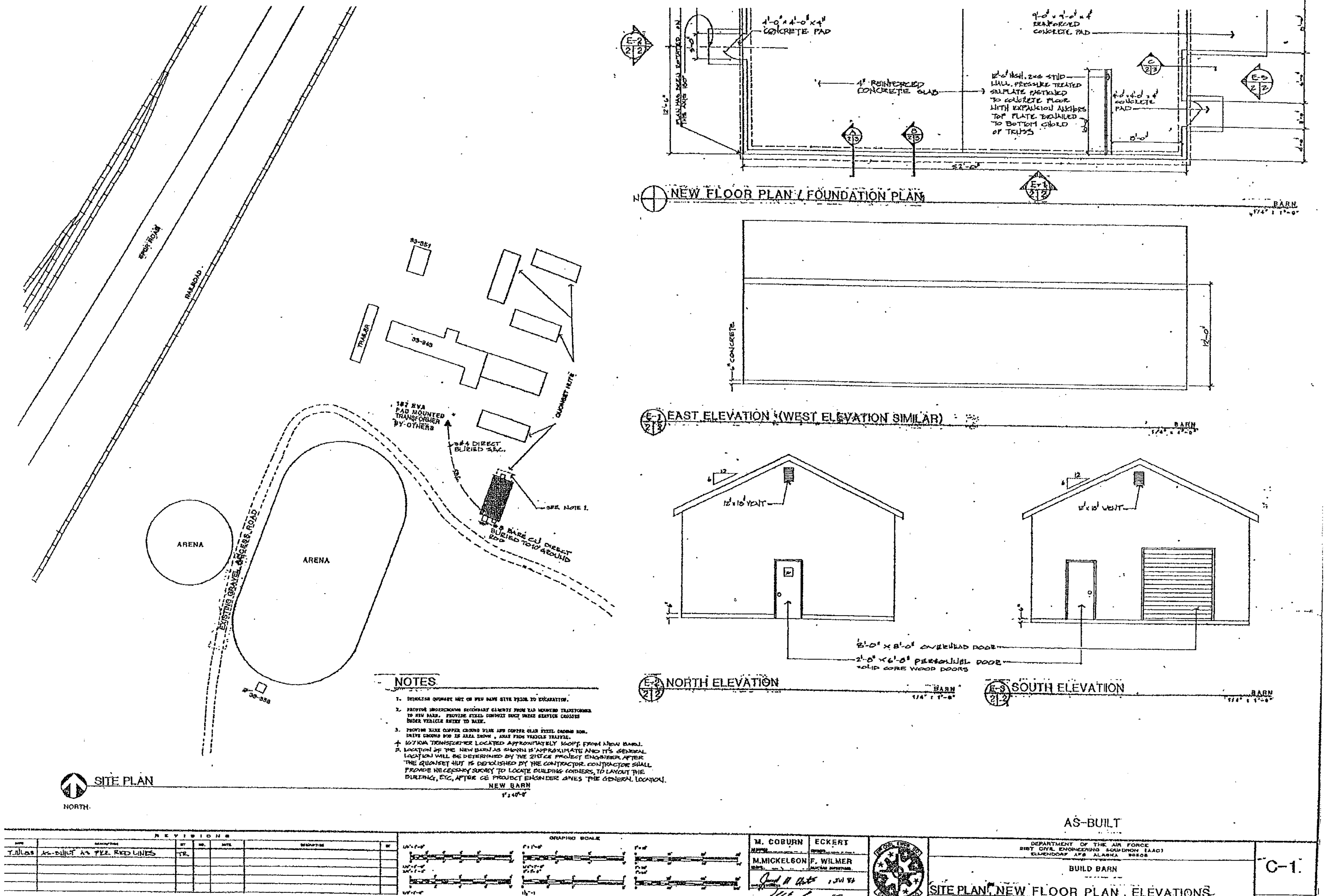
7 Outlets

Each outlet provides two double couplers allowing connection of four devices (typically, two telephones and two computers). All couplers shall be Cat 6 compliant, RJ-45 style, 568A wired, with indicators (pictographs or text) to indicate either "voice" or "data." Each coupler shall be numbered by the corresponding port# indicated on the horizontal cable patch panel in the connecting riser closet or CER. One outlet shall be installed for each 48 square feet of floor space unless a greater density is specified. Outlets shall be equivalent to the following components

Siemon Surface Mount Box for single gang faceplates CT4-BOX-02
Siemon Outlet Faceplate Wall (single gang) CT4-FP-02
Siemon Cat 6 double coupler (angled face, 568A wiring), part# CT-5-T4-T4-02

--END OF APPENDIX--

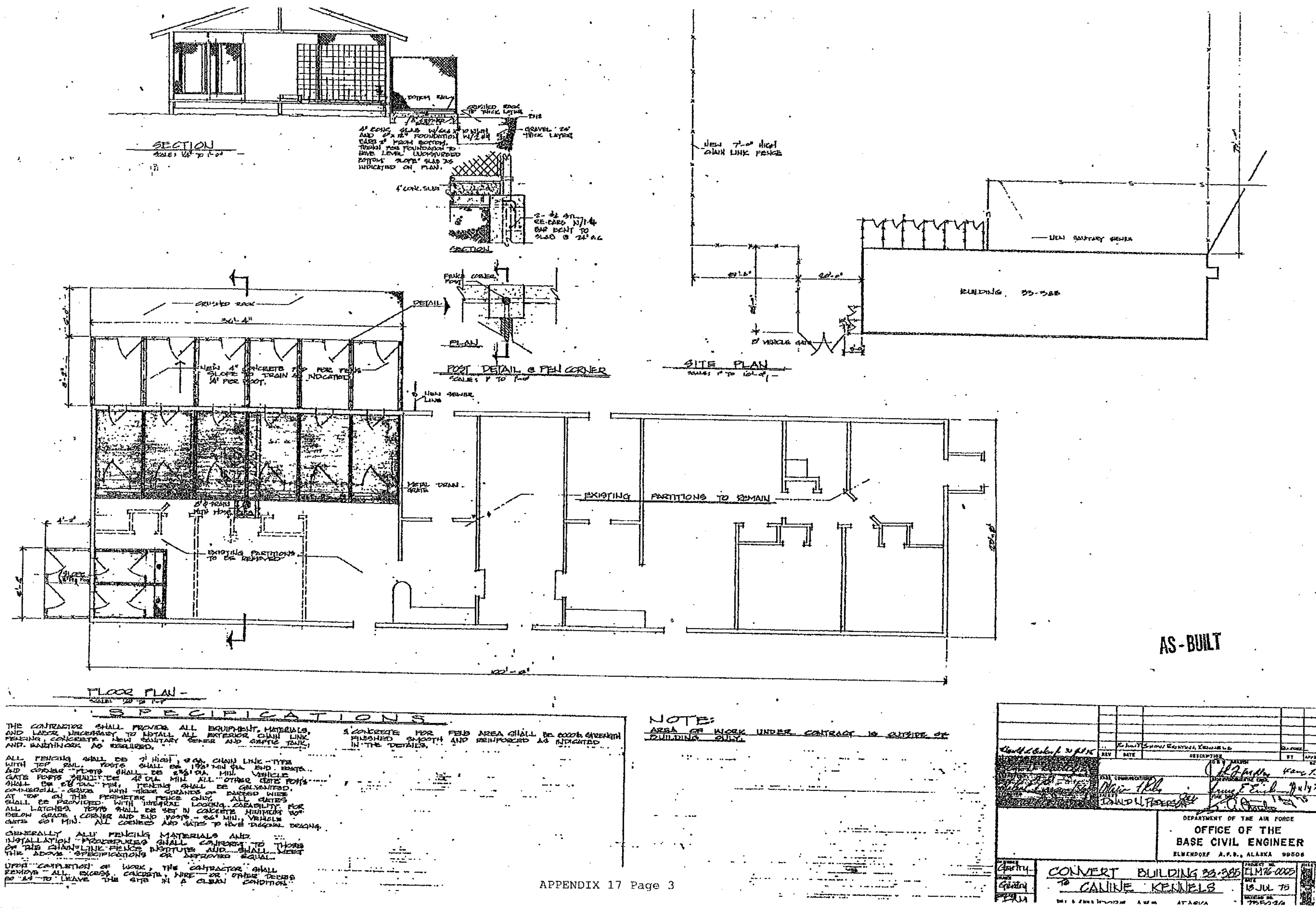

A 2/3 SECTION
TRUSS/SHEAR WALL CONNECTION
1 DETAIL 3/3
FACTORY COLOR FINISHED STEEL SIDING
NOT TO SCALE
PLAN
ROOF FRAMING
TRUSSES 24" O.C.
OVERHEAD DOOR TRACKS
PLYWOOD
2X6 RIDGE BLOCKING TRIM TO FIT
B 2/3 SECTION
FOOTING
C 2/3 SECTION
TRUSS/WEST END WALL CONNECTION
D 2/3 SECTION
BARN APRON
NOTE: 4'-0"x4'-0"x4" CONCRETE PADS SIMILAR IN CONSTRUCTION WITHOUT WWF.
REVISIONS
EXCAVATION CONNECTION
AS-BUILT AS PER RED LINES
GRAPHIC SCALE
M.COBURN
ECKERT
J.KHOO
WILMER
AS-BUILT
DEPARTMENT OF THE AIR FORCE
BUILD BARN
SECTION AND DETAIL
A-1

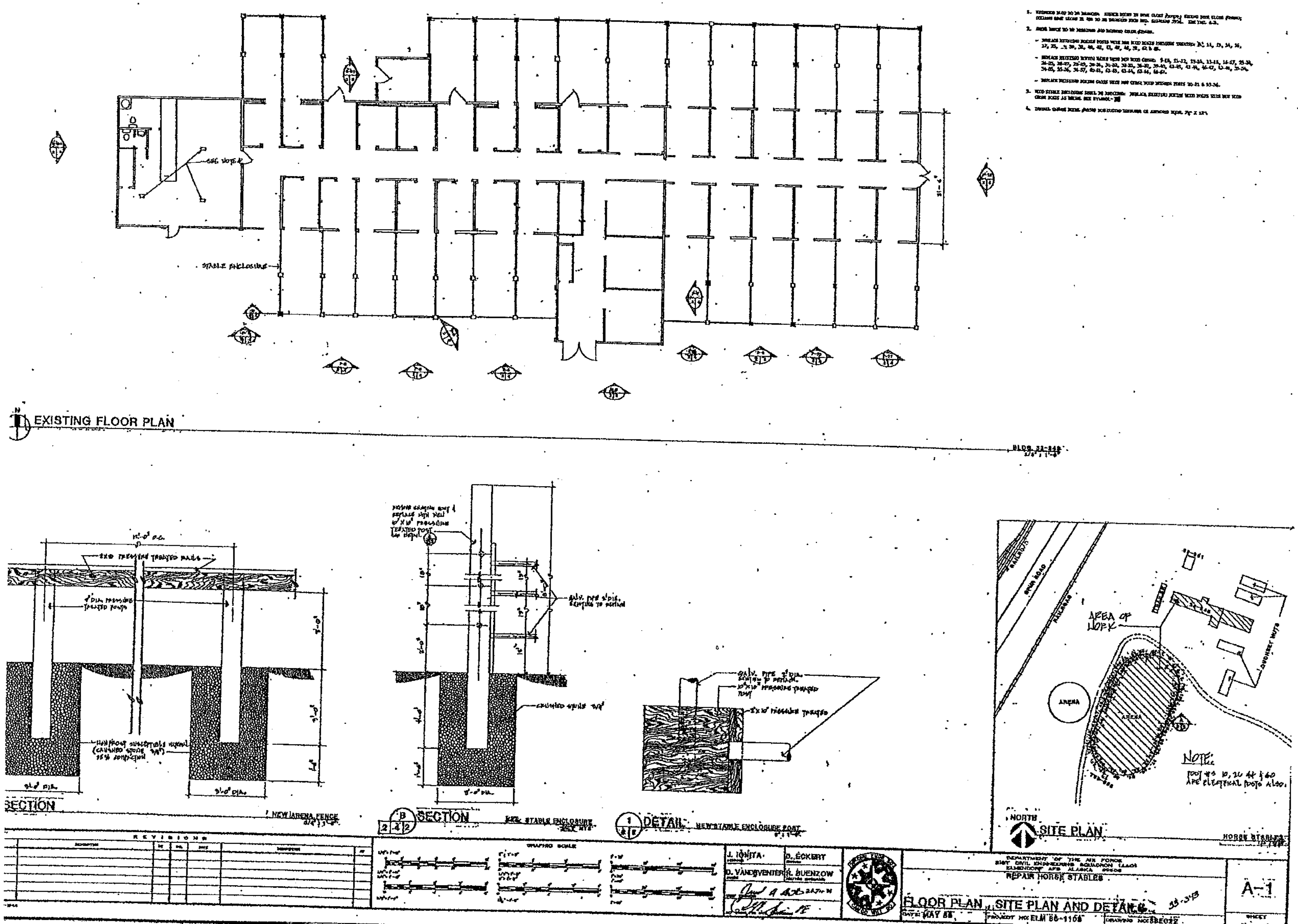



## NOTES

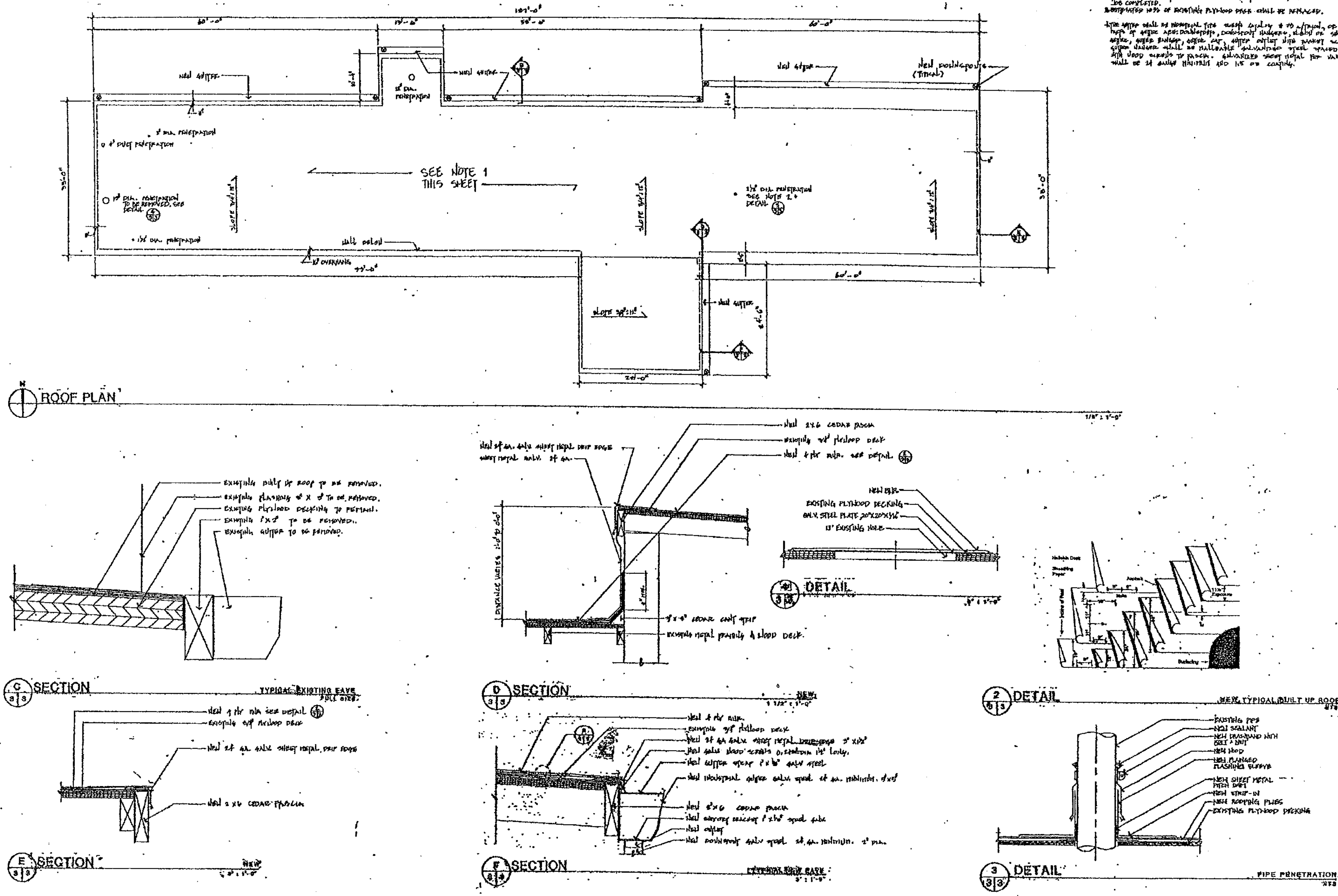
1. DEMOLISH QUONSET HUT ON NEW BARN SITE PRIOR TO EXCAVATION.
2. PROVIDE UNDERGROUND SECONDARY CIRCUIT FROM PAD MOUNTED TRANSFORMER TO NEW BARN. PROVIDE STEEL CONDUIT DUCT WHERE SERVICE CROSSES UNDER VEHICLE ENTRY TO BARN.
3. PROVIDE BARE COPPER GROUND WIRE AND COPPER CLAD STEEL GROUND ROD. DRIVE GROUND ROD IN AREA SHOWN, AWAY FROM VEHICLE TRAFFIC.
4. 167 KVA TRANSFORMER LOCATED APPROXIMATELY 160 FT. FROM NEW BARN.
5. LOCATION OF THE NEW BARN AS SHOWN IS APPROXIMATE AND IT'S GENERAL LOCATION WILL BE DETERMINED BY THE 21ST CE PROJECT ENGINEER AFTER THE QUONSET HUT IS DEMOLISHED BY THE CONTRACTOR. CONTRACTOR SHALL PROVIDE NECESSARY SURVEY TO LOCATE BUILDING CORNERS, TO LAYOUT THE BUILDING, ETC, AFTER CE PROJECT ENGINEER GIVES THE GENERAL LOCATION.

NEW BARN
1" = 40'-0"


SECTION
SCALE: 1/4" TO 1'-0"
SITE PLAN
SCALE: 1" TO 10'-0"
NEW 7'-0" HIGH CHAIN LINK FENCE
NEW SANITARY SEWER
BUILDING 33-385
8' VEHICLE GATE
POST DETAIL @ PEN CORNER
SCALE: 1" TO 1'-0"
PLAN
SECTION
DETAIL
CRUSHED ROCK
NEW 4" CONCRETE TOP FOR PENS SLOPE TO DRAIN AS INDICATED 1/4" PER FOOT.
NEW SEWER LINE
METAL DRAIN GRATE
EXISTING PARTITIONS TO REMAIN
EXISTING PARTITIONS TO BE REMOVED
100'-0"
FLOOR PLAN
SPECIFICATIONS
THE CONTRACTOR SHALL PROVIDE ALL EQUIPMENT, MATERIALS, AND LABOR NECESSARY TO INSTALL ALL EXTERIOR CHAIN LINK FENCING, CONCRETE, NEW SANITARY SEWER AND SEPTIC TANK, AND EARTHWORK AS REQUIRED.
ALL FENCING SHALL BE 7' HIGH, 9 GA. CHAIN LINK-TYPE WITH TOP RAIL. POSTS SHALL BE 1 5/8" MIN DIA. END POSTS AND CORNER POSTS SHALL BE 2 3/8" DIA. MIN. VEHICLE GATE POSTS SHALL BE 4" DIA. MIN. ALL OTHER GATE POSTS SHALL BE 2 7/8" DIA. MIN. FENCING SHALL BE GALVANIZED, COMMERCIAL-GRADE WITH THREE STRANDS OF BARBED WIRE AT TOP ON THE PERIMETER FENCE ONLY. ALL GATES SHALL BE PROVIDED WITH INTEGRAL LOCKING CAPABILITY FOR ALL LATCHES. POSTS SHALL BE SET IN CONCRETE MINIMUM 30" BELOW GRADE, CORNER AND END POSTS - 36" MIN., VEHICLE GATE 60" MIN. ALL CORNERS AND GATES TO HAVE DIAGONAL BRACING.
GENERALLY ALL FENCING MATERIALS AND INSTALLATION PROCEDURES SHALL CONFORM TO THOSE OF THE CHAIN-LINK FENCE INSTITUTE AND SHALL MEET THE ABOVE SPECIFICATIONS OR APPROVED EQUAL.
UPON COMPLETION OF WORK, THE CONTRACTOR SHALL REMOVE ALL EXCESS CONCRETE, WIRE OR OTHER DEBRIS SO AS TO LEAVE THE SITE IN A CLEAN CONDITION.
CONCRETE FOR PENS AREA SHALL BE 3000 lb STRENGTH FINISHED SMOOTH AND REINFORCED AS INDICATED IN THE DETAILS.
NOTE:
AREA OF WORK UNDER CONTRACT IS OUTSIDE OF BUILDING ONLY.
AS-BUILT
DEPARTMENT OF THE AIR FORCE
OFFICE OF THE
BASE CIVIL ENGINEER
ELMENDORF A.F.B., ALASKA 99506
CONVERT BUILDING 33-385
TO CANINE KENNELS
13 JUL 75


EXISTING FLOOR PLAN
STABLE ENCLOSURE
SECTION
NEW ARENA FENCE
SECTION
STABLE ENCLOSURE
DETAIL
NEW STABLE ENCLOSURE POST
SITE PLAN
NORTH
AREA OF WORK
ARENA
NOTE:
REVISIONS
GRAPHIC SCALE
J. IONITA
D. ECKERT
D. VANDEVENTER
R. BUENZOW
REPAIR HORSE STABLES
FLOOR PLAN, SITE PLAN AND DETAILS
A-1
HORSE STABLES

NOTES:




REVISIONS

GRAPHIC SCALE

J. IONITA | D. ECKERT
D. VANDEVENTER | R. BUENZOW

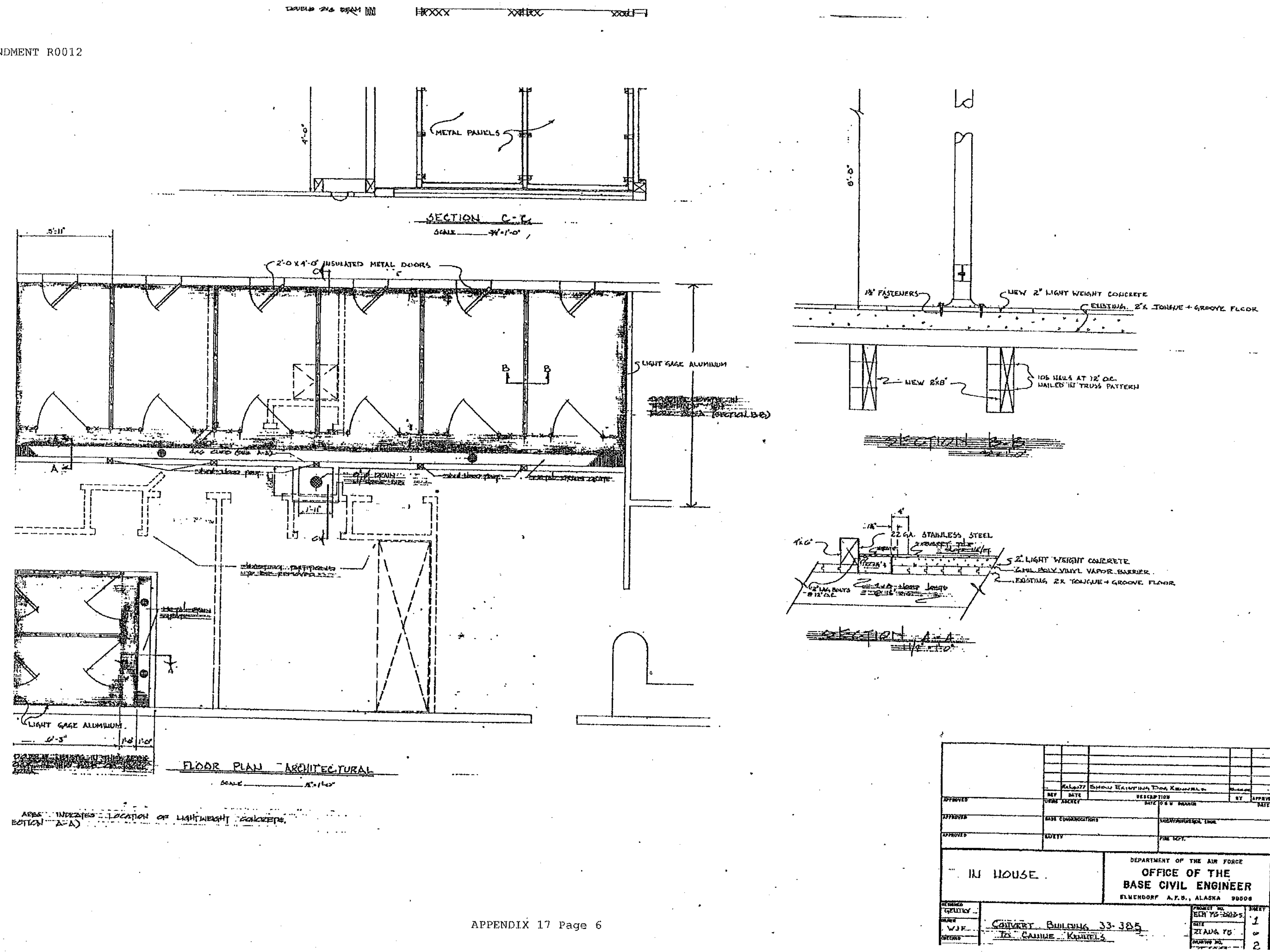
DEPARTMENT OF THE AIR FORCE
21ST CIVIL ENGINEERING SQUADRON (AAC)
ELMENDORF AFB ALASKA

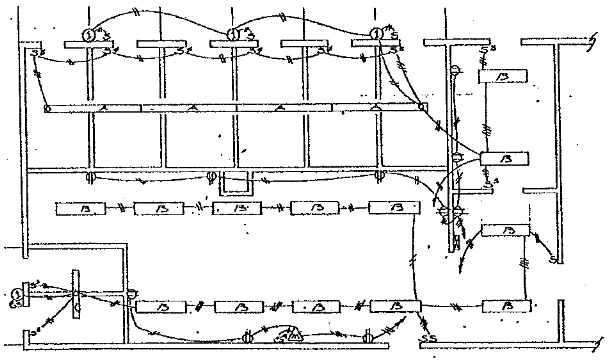
REPAIR HORSE STABLES

ROOF PLAN, SECTIONS AND DETAILS

DATE: MAY 86 | PROJECT NO. ELM 88-1109 | DRAWING NO. 88E022

A-2


METAL PANELS
SECTION C-C
2'-0 x 4'-0 INSULATED METAL DOORS
LIGHT GAGE ALUMINUM
LIGHT GAGE ALUMINUM
FLOOR PLAN - ARCHITECTURAL
AREA INDICATES LOCATION OF LIGHTWEIGHT CONCRETE, SECTION A-A
1/2" FASTENERS
NEW 2" LIGHT WEIGHT CONCRETE
EXISTING 2x TONGUE + GROOVE FLOOR
NEW 2x8"
10d NAILS AT 12" OC. NAILED IN TRUSS PATTERN
SECTION B-B
22 GA. STAINLESS STEEL
2" LIGHT WEIGHT CONCRETE
6 MIL POLY VINYL VAPOR BARRIER
EXISTING 2x TONGUE + GROOVE FLOOR
SECTION A-A
IN HOUSE
DEPARTMENT OF THE AIR FORCE
OFFICE OF THE
BASE CIVIL ENGINEER
ELMENDORF A.F.B., ALASKA 99506
CONVERT BUILDING 33-385 TO CANINE KENNELS

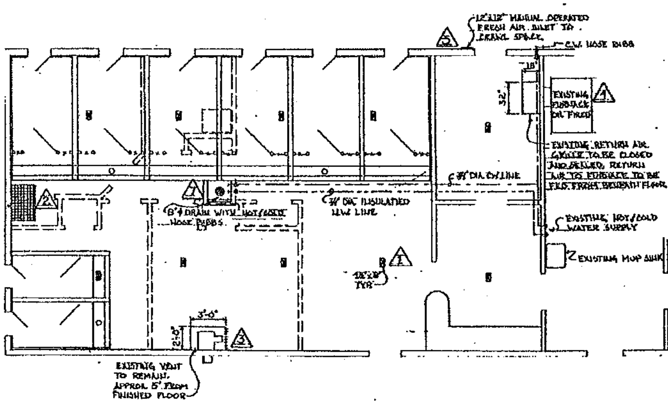



FLOOR PLAN - ELECTRICAL
SCALE 1/4"=1'

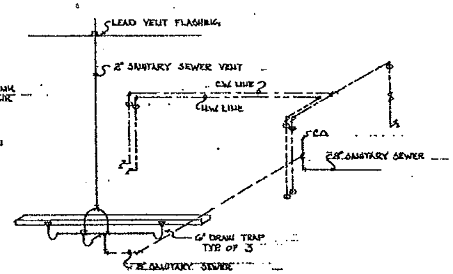
| Symbol | Description |
|---|---|
| B | [illegible] |
| [breaker panel symbol] | Existing breaker panel |
| (1) | 200 W. outdoor wall mount fixture |
| (M) | Existing exhaust fan motor. |
| S^M | Fractional HP motor control switch |
| S^3 | 3 way switch |
| S | Single pole switch |

ELECTRICAL NOTES

1. All circuits are 20 amp. Breakers are existing.
2. Wiring shall be surface mount in E.M.T.
3. All existing conduit and wiring in area shown shall be removed with the exception of the existing panel feeder. Circuits shall be maintained in remainder of bldg.




FLOOR PLAN - MECHANICAL
SCALE 1/4"=1'-0"




PLUMBING SCHEMATIC
N.T.S.

MECHANICAL NOTES

1. Leave 10 existing hot air outlets as is. Replace existing ceiling diffuser/volume controls after new ceiling is installed and rebalanced.
2. Install approximately 5 sq. ft. (2' x 3') of floor grills at north end of building to use crawl space as return air chamber. Insulate skirting to .07 BTU sq. ft. C4" fiberglas or 2" stynofoam or urethane.
3. Remove existing exhaust hood at coal table but leave exhaust blower in place. Enclose exhaust blower in removable wood or sheet metal housing with 3 sq. ft. (18" x 24") opening grill or wire screen opening to south.
4. Block off existing return air chamber & relocate the existing 18" x 32" wire grill so it draws return air from floor.
5. Install 12" x 12" manual operated damper in skirting to provide fresh air make up to heating system.
6. Extend existing hot and cold water lines from mechanical room near mop sink up thru attic and drop to hose bibs. Insulate the hot water line.
7. Extend (3) 6" trapped sanitary floor (1 through) drains from locations shown out under building to intersect sanitary drain installed by Contract.

| | | | |
|---|---|---|---|
| | Show Existing Dog Kennels | | |
| REV | DATE | DESCRIPTION | BY / APPRVD / DATE |
| APPROVED | USING AGENCY | DATE / O&M BRANCH | |
| APPROVED | BASE COMMUNICATIONS | ENVIRONMENTAL ENGR. | |
| APPROVED | SAFETY | FIRE DEPT. | |

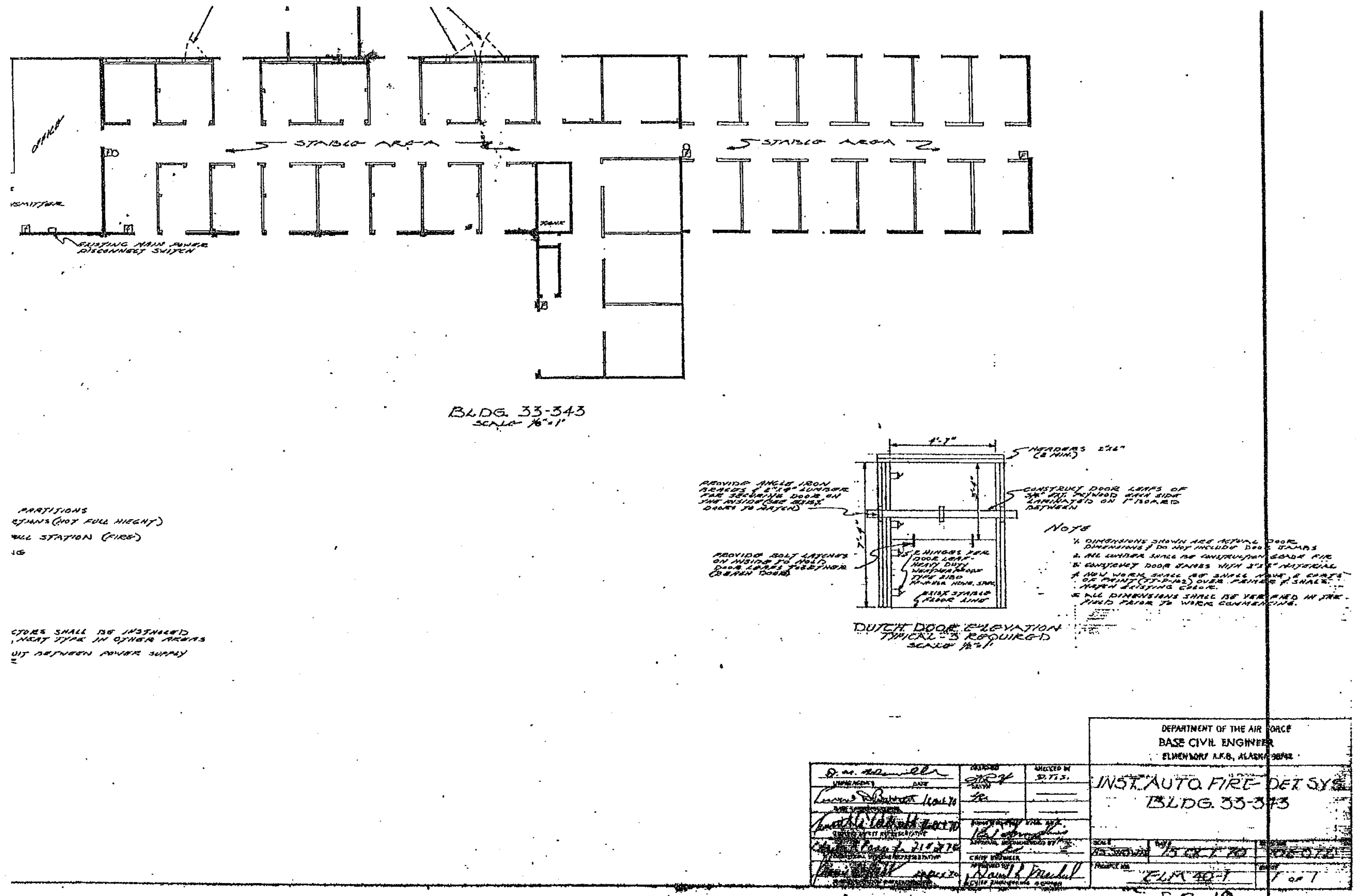
IN HOUSE

DEPARTMENT OF THE AIR FORCE
OFFICE OF THE BASE CIVIL ENGINEER
ELMENDORF A.F.B., ALASKA 99506

DESIGNED: | DRAWN: WJF | CHECKED:

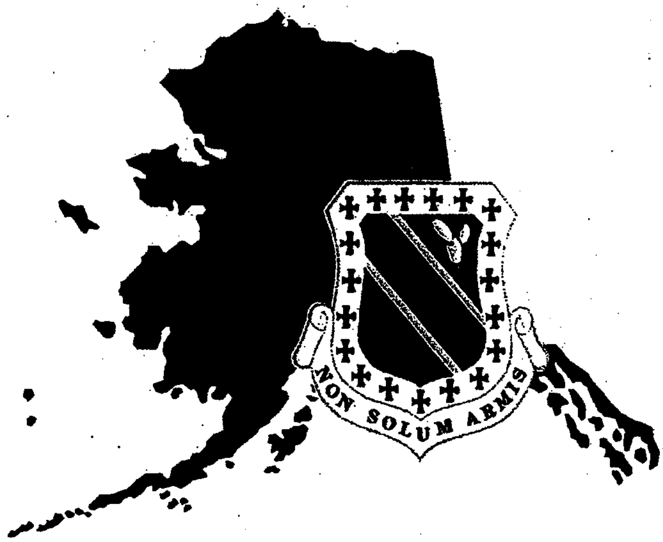
CONVERT BUILDING 33385 TO CANINE KENNELS

PROJECT NO. ELM 700065 | DATE 21 AUG 75 | DRAWING NO. 75ED44 | SHEET 2 of 2





--END OF APPENDIX 17--




# UNITED STATES AIR FORCE
# ELMENDORF AIR FORCE BASE, ALASKA

## ENVIRONMENTAL RESTORATION PROGRAM

# ST534 REMOVAL ACTION REPORT

## JANUARY 2002

**SECTION** **PAGE**



**TABLES**



**FIGURES**



**APPENDICES**

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## ABBREVIATIONS

| | |
|---|---|
| AAC | Alaska Administrative Code |
| ADEC | Alaska Department of Environmental Conservation |
| AFB | Air Force Base |
| ASR | Alaska Soil Recycling |
| bgs | below ground surface |
| BTEX | benzene, toluene, ethylbenzene, xylenes |
| DRO | diesel-range organics |
| GRO | gasoline-range organics |
| mg/kg | milligram per kilogram |
| PAHs | polynuclear aromatic hydrocarbons |
| PID | photoionization detector |
| POL | petroleum, oil, and lubricants |
| ppm | parts per million |
| PVC | polyvinyl chloride |
| SERA | State-Elmendorf Environmental Restoration Agreement |
| TERC | Total Environmental Restoration Contract |
| USAED | U.S. Army Engineer District, Alaska |
| USAF | U.S. Air Force |
| USCS | Unified Soil Classification System |
| UST | underground storage tank |

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# 1.0 INTRODUCTION

This report summarizes the removal of petroleum, oil, and lubricants (POL) impacted soil and collection of soil confirmation samples at Site ST534 on Elmendorf Air Force Base (AFB), Alaska, during the summer of 2001. The work was performed in support of the U.S. Air Force (USAF) 3rd Civil Engineering Squadron under the U.S. Army Engineer District, Alaska, (USAED) Total Environmental Restoration Contract (TERC), Contract No. DACA 85-95-D-0018, Task Order No. 12.

## 1.1 PROJECT BACKGROUND

Site ST534 is included in the State-Elmendorf Environmental Restoration Agreement (SERA) program. This cooperative agreement between the USAF and Alaska Department of Environmental Conservation (ADEC) addresses Elmendorf AFB's solid waste, underground storage tank (UST), and POL spill program areas. The SERA requires that Elmendorf AFB perform necessary assessments, monitoring, remediation, and closure of these applicable sites, as well as new sites identified subsequent to the issuance of the SERA.

Elmendorf AFB sites were investigated in phases under the SERA program. Each phase defines a group of sites that were addressed during a specific time or phase of the ongoing program and does not refer to the different types of investigations or steps in a specific process. In some cases, the succeeding SERA investigations were performed to fill data gaps identified in previous SERA investigations. Site ST534 was investigated under SERA Phase V in 1997. A summary of the SERA investigation results is provided in Section 1.2 and complete results are in the Summary Report for Site Evaluations and Bioventing Studies at SERA Phase V Sites (USAF 1999).

The SERA investigation report and site history were reviewed in spring 2001 to evaluate site conditions and develop corrective actions for the site if required. Site ST534 was recommended for excavation of shallow contamination. Shallow contamination is defined as contamination between 0 to 15 feet below ground surface (bgs). Deep contamination was not detected during the SERA investigation. Additional information on the evaluation and

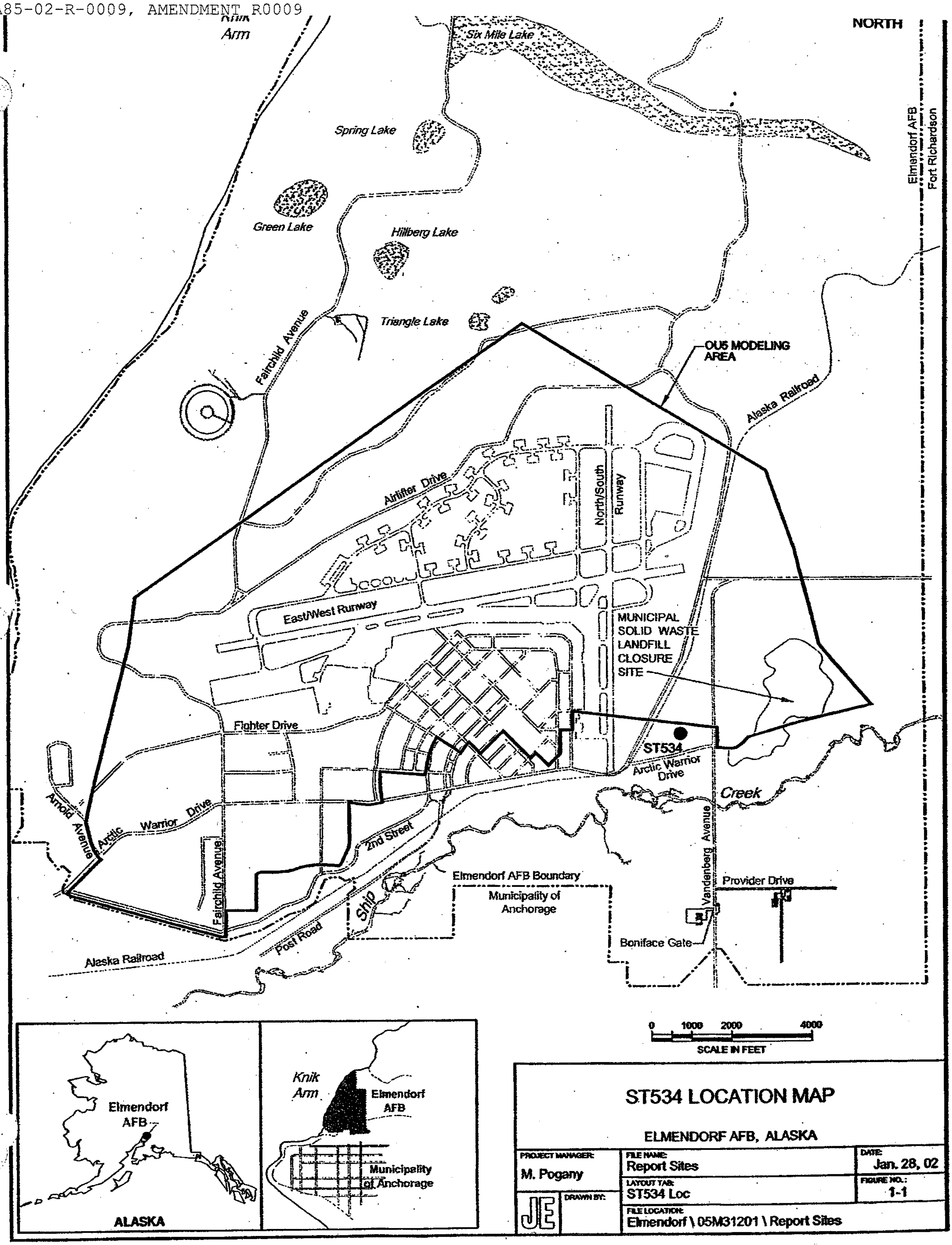
recommendation can be found in the Corrective Action Plan, SERA IV, V, VII, and VIII Sites (USAF 2001).

## 1.2 SITE BACKGROUND

Site ST534 is the location of a former 500-gallon steel UST that was used to store heating oil for the Boy Scout Hut, Building 8675 (former Building #33-385). See Figure 1-1 for site location. This UST (STMP 300) was removed in 1996 and confirmation samples were collected from the excavation. Soil encountered during the UST excavation at ST534 was described as a sandy, silty gravel with intervals of sandy clay, according to the Unified Soil Classification System (USCS). The depth to the water table (i.e., top of the shallow aquifer) is approximately 32.5 feet bgs in the vicinity of ST534, and the groundwater flows west-southwest towards Ship Creek (USAF 1996).

The SERA investigation was conducted in August 1997, during which four soil borings were advanced to the water table at ST534 to investigate potential soil contamination associated with the former UST. Two samples were collected and analyzed from each soil boring. Analytical samples were taken from the intervals with the highest field screening concentrations, or from an interval that could have been contaminated based on field observations.

Maximum contaminant concentrations were detected in SERA soil boring SB-534-01, sample 534-01-01, at 7.5 feet bgs. This sample location had a maximum diesel-range organics (DRO) concentration of 8,570 milligram per kilogram (mg/kg) at 7.5 feet bgs that decreased to 4.21 mg/kg at 15 feet bgs. The maximum level of gasoline-range organics (GRO) was 162 mg/kg. Benzene and toluene were non-detect, and the maximum levels for ethylbenzene and total xylenes were 0.316 mg/kg and 2.321 mg/kg, respectively. Polynuclear aromatic hydrocarbons (PAHs) were not detected in the soil sample with maximum concentrations listed above (Sample 534-01-01) (USAF 1999). Summary data from the SERA investigation is provided in Appendix A for reference.


Knik Arm
NORTH
Six Mile Lake
Spring Lake
Green Lake
Hillberg Lake
Triangle Lake
Elmendorf AFB
Fort Richardson
Fairchild Avenue
OU5 MODELING AREA
Alaska Railroad
Airlifter Drive
North/South Runway
East/West Runway
MUNICIPAL SOLID WASTE LANDFILL CLOSURE SITE
Fighter Drive
ST534
Arctic Warrior Drive
Creek
Arnold Avenue
Arctic Warrior Drive
2nd Street
Fairchild Avenue
Vandenberg Avenue
Provider Drive
Elmendorf AFB Boundary
Municipality of Anchorage
Ship
Post Road
Alaska Railroad
Boniface Gate
0 1000 2000 4000
SCALE IN FEET
Elmendorf AFB
ALASKA
Knik Arm
Elmendorf AFB
Municipality of Anchorage
ST534 LOCATION MAP
ELMENDORF AFB, ALASKA
PROJECT MANAGER:
M. Pogany
DRAWN BY:
FILE NAME:
Report Sites
LAYOUT TAB:
ST534 Loc
FILE LOCATION:
Elmendorf \ 05M31201 \ Report Sites
DATE:
Jan. 28, 02
FIGURE NO.:
1-1

## 1.3 REMOVAL SUMMARY

The removal effort included excavation, transportation and thermal treatment of soil, field screening, confirmation sampling, and site restoration.

A total of 405 tons of soil were excavated and transported to Alaska Soil Recycling (ASR) in Anchorage, Alaska, for thermal treatment. A photoionization detector (PID) was used to evaluate the horizontal and vertical extent of the soil contamination. Five confirmation samples were collected from the floor of the excavation. The site was backfilled with clean fill material. A more detailed explanation of the work performed is provided in Section 2.0.

# 2.0 FIELD ACTIVITIES

Field activities were conducted at the site as described below. The project schedule is presented in Table 2-1.

**Table 2-1**
**Project Schedule**

| TASKS | DATES |
|---|---|
| Field screening and soil excavation and transportation to the thermal treatment facility | 6 – 10 August 2001 |
| UST removal | 9 August 2001 |
| Confirmation soil sample collection for laboratory analysis | 10 August 2001 |
| Excavation backfilling and site restoration | 20 – 21 August 2001 |

## 2.1 SOIL EXCAVATION

Prior to initiating activity at the site, the USAF obtained approval from ADEC to transport the POL-contaminated soil to ASR for thermal treatment, and a "Base Civil Engineer Work Clearance Request" form (Utility Clearance) was completed and approved for work at the site.

Soil excavation was initiated near the location of SERA soil boring SB-534-01, where the highest contamination levels were detected during the SERA investigation, and continued based on visible staining and PID field screening. As soil was removed from the excavation, direct PID readings were obtained by placing the tip of the PID probe adjacent to the freshly exposed soil (typically in the excavator bucket) to obtain a gross indication of volatile fuel contamination in the soil. Soil was also field screened in accordance with the UST Procedures Manual (ADEC 1999), Section 4.4.2 for headspace PID readings. These readings were obtained by partially filling resealable freezer bags with soil and allowing the vapors to volatilize in the headspace. The samples were heated by placing the freezer bags in a hot water bath for approximately 5 to 10 minutes. The tip of the PID was then placed inside the bags to collect a headspace reading.

Direct PID readings were 0 parts per million (ppm) up to 6 inches bgs at the site. Soil near the surface with no visible staining and PID readings of 0 ppm was stockpiled onsite as clean material to be used as backfill. Approximately 6 cubic yards were stockpiled for use as backfill. All other excavated material was transported to ASR for thermal treatment. PID readings increased with depth to a maximum of 168 ppm in the southern end of the excavation. The northern, eastern, and southern walls of the excavation showed naturally occurring strata indicating that the excavation extended beyond the original tank excavation. A layer of light gray/silver gravely sand was encountered at 4 feet bgs that had average direct PID readings of 130 ppm. Vertical and horizontal excavation continued based on field screening and visual observation. At 10 feet bgs a clay layer was encountered which appeared to be a confining layer. Soil excavation continued until visual observation indicated that contamination had been removed and PID field screening readings were less than 2 ppm along the north, east, and south sidewalls and on the bottom of the excavation. Excavation was limited on the west sidewall due to required sloping to protect the building foundation.

A low-pressure natural gas line was present in the eastern and southern portion of the excavation. The gas supply was shut-off during site activities, and the line was hand excavated to prevent damage to the line. The line was re-pressurized and inspected for leaks by pouring soapy water on the line before it was covered with backfill material.

A 6-inch-diameter transite drain line was encountered in the northeast portion of the excavation at 7.5 feet bgs. The portion of the line that traversed the excavation was damaged and approximately 16 linear feet of pipe were removed. The pipe material was disposed of as asbestos containing material at the Anchorage Regional Landfill; disposal documentation is provided in Appendix B. The drain line was repaired with polyvinyl chloride (PVC) pipe and pipe collars at the asbestos pipe connections.

A reinforced concrete pad (25 feet long by 7.5 feet wide by 10 inches thick) was located on the west side of the excavation, adjacent to Building 8675. A 250-gallon UST was discovered underneath the concrete pad during excavation activities. The concrete pad and UST were removed. The UST was split longitudinally along the top, possibly due to water freezing within the tank. The ends of the tank were hemispherical indicating that it was for storage of compressed gas. It was confirmed with the building manager that the tank was an unused natural gas tank for the building heating supply. There were two openings, excluding the split, which allowed water to enter the UST. The water in the tank did not have an odor or sheen. Approximately 140 gallons of water were pumped from the UST and transferred to the Contractor's Staging Facility where it was treated. The tank was crushed and recycled.

Soil removal resulted in an excavation measuring approximately 31 feet long, 23 feet wide, and 15 feet deep. A total of 405 tons of soil were excavated and transported to ASR for thermal treatment. All soil from the 2001 SERA removal actions was consolidated at ASR. Treatment of all soil was completed in September 2001 and confirmation of treatment is provided in Appendix B. Treated soil was returned to the Elmendorf AFB Municipal Solid Waste Landfill Closure Site in November 2001.

## 2.2 CONFIRMATION SAMPLE COLLECTION

Upon completion of the excavation, five confirmation samples were collected from the excavation. ADEC Underground Storage Tanks regulation 18 *Alaska Administrative Code* (AAC) 78 (ADEC 2000b) was used to determine the number of samples. Regulation 18 AAC 78.090 requires that at least two samples be collected for the first 250 square feet of excavated pit area and one sample collected for each additional 250 square feet of excavated pit area. The excavated pit area at ST534 was approximately 725 square feet. One additional sample was collected from the west sidewall to represent possible contamination remaining at the site due to excavation limitations near the building. Sample locations are identified in Figure 2-1. The samples were analyzed for the compounds and associated analytical methods listed in Table 2-2. Analytical results are presented in Section 3.0.

Sample analyses were selected based on the UST Procedures Manual (ADEC 1999), Table 2 for Diesel No. 1, SERA investigation analytical results, and ADEC regulations. The UST (removed prior to this investigation) contained heating oil for the building. GRO was only detected in one sample, 534-01-01, during the SERA investigation at a maximum concentration of 162 mg/kg below 18 AAC 75 Method Two cleanup criteria. It was anticipated that contamination remained on the west sidewall due to excavation limitations

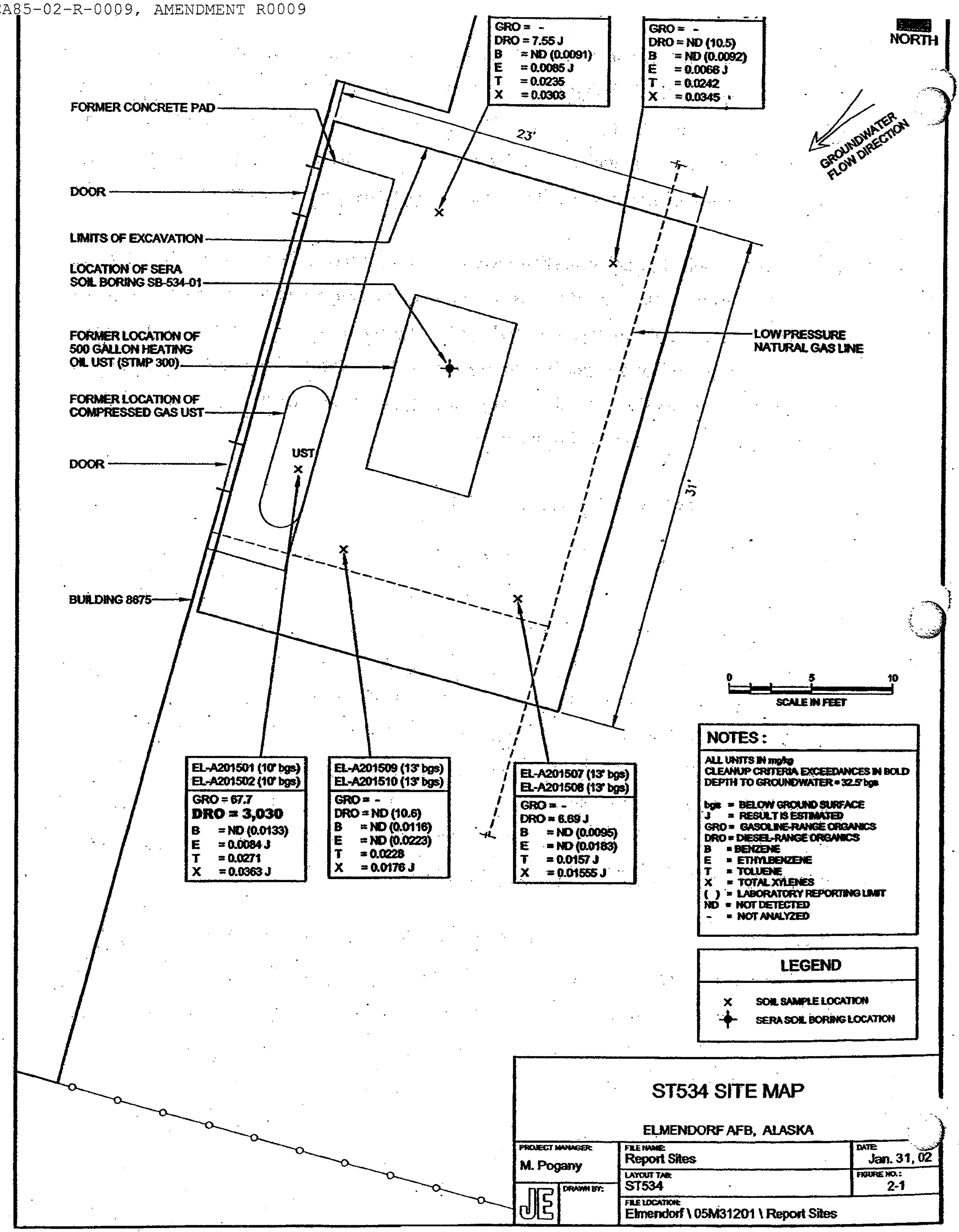

NORTH
GROUNDWATER FLOW DIRECTION
GRO = -
DRO = 7.55 J
B = ND (0.0091)
E = 0.0085 J
T = 0.0235
X = 0.0303
GRO = -
DRO = ND (10.5)
B = ND (0.0092)
E = 0.0068 J
T = 0.0242
X = 0.0345
23'
31'
FORMER CONCRETE PAD
DOOR
LIMITS OF EXCAVATION
LOCATION OF SERA SOIL BORING SB-534-01
FORMER LOCATION OF 500 GALLON HEATING OIL UST (STMP 300)
FORMER LOCATION OF COMPRESSED GAS UST
UST
DOOR
BUILDING 8675
LOW PRESSURE NATURAL GAS LINE
0 5 10
SCALE IN FEET
EL-A201501 (10' bgs)
EL-A201502 (10' bgs)
GRO = 67.7
DRO = 3,030
B = ND (0.0133)
E = 0.0084 J
T = 0.0271
X = 0.0363 J
EL-A201509 (13' bgs)
EL-A201510 (13' bgs)
GRO = -
DRO = ND (10.6)
B = ND (0.0116)
E = ND (0.0223)
T = 0.0228
X = 0.0176 J
EL-A201507 (13' bgs)
EL-A201508 (13' bgs)
GRO = -
DRO = 6.69 J
B = ND (0.0095)
E = ND (0.0183)
T = 0.0157 J
X = 0.01555 J
NOTES:
ALL UNITS IN mg/kg
CLEANUP CRITERIA EXCEEDANCES IN BOLD
DEPTH TO GROUNDWATER = 32.5' bgs
bgs = BELOW GROUND SURFACE
J = RESULT IS ESTIMATED
GRO = GASOLINE-RANGE ORGANICS
DRO = DIESEL-RANGE ORGANICS
B = BENZENE
E = ETHYLBENZENE
T = TOLUENE
X = TOTAL XYLENES
( ) = LABORATORY REPORTING LIMIT
ND = NOT DETECTED
- = NOT ANALYZED
LEGEND
SOIL SAMPLE LOCATION
SERA SOIL BORING LOCATION
ST534 SITE MAP
ELMENDORF AFB, ALASKA
PROJECT MANAGER: M. Pogany
FILE NAME: Report Sites
DATE: Jan. 31, 02
LAYOUT TAB: ST534
FIGURE NO.: 2-1
DRAWN BY:
JE
FILE LOCATION: Elmendorf \ 05M31201 \ Report Sites

**Table 2-2**
**Confirmation Sample Analytical Methods**

| Compound | Method | Frequency |
|---|---|---|
| GRO | AK101E | 1 sample (EL-A201501) |
| DRO | AK102E | 100 percent of samples |
| PAHs | SW8270CSIM | 1 sample (EL-A201502) |
| BTEX | SW8260B | 100 percent of samples |

Notes:
BTEX = benzene, toluene, ethylbenzene, and xylenes
DRO = diesel-range organics
GRO = gasoline-range organics
PAHs = polynuclear aromatic hydrocarbons

based on field screening readings. The sidewall sample (EL-A201501/EL-A2015002) was analyzed for GRO and PAHs to characterize possible contamination remaining at the site and for site evaluation under 18 AAC 75 Method Two. A summary of SERA analytical results is provided in Appendix A.

## 2.3 EXCAVATION BACKFILLING AND SITE RESTORATION

After receipt of sample results confirming that the maximum amount of contaminated soil had been removed within site limitations, the excavation was backfilled and the area regraded. Backfill material was transported from a fill source location on Elmendorf AFB; sieve analysis and modified proctor results for the material are provided in Appendix C. The material was placed in 12-inch lifts and compacted with the excavator bucket and by passing tracked equipment over the area. The drain line was repaired during excavation backfilling. A 6-inch layer of topsoil was placed and the area re-seeded with a mixture developed for the local climate.

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# 3.0 ANALYTICAL RESULTS

The confirmation soil samples collected from the excavation were submitted to CT&E Environmental Services, Inc., for analysis. A trip blank was not submitted in this sample shipment and is addressed in Appendix D, Data Quality Assessment. Quality control samples were collected at a frequency of 10 percent of all 2001 SERA site removal action samples. A data quality assessment is included as Appendix D.

The analytical results for the confirmation samples are presented in Table 3-1, and confirmation sample results for GRO, DRO, and benzene, toluene, ethylbenzene, and total xylenes (BTEX) are shown in Figure 2-1. Analytical results were compared to 18 AAC 75 (ADEC 2000a) Method Two regulatory criteria (18 AAC 75.341, Method Two, Tables B-1 and B-2, Under 40 Inch Zone, most stringent criteria). DRO exceeded the regulatory criteria in Sample EL-A201502 collected from the excavation sidewall at a depth of 10 feet bgs. This sample contained a DRO concentration of 3,030 mg/kg, exceeding the Method Two cleanup criteria of 250 mg/kg. All other constituents were below regulatory criteria. The analytical data are included in Appendix D.

# Table 3-1
## Confirmation Sample Analytical Results
## Site ST534

| | | | Location | West Sidewall | | NW Bottom | | NE Bottom | | SE Bottom | | SW Bottom | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample ID | EL-A201501<br>EL-A201502 | | EL-A201503<br>EL-A201504 | | EL-A201505<br>EL-A201506 | | EL-A201507<br>EL-A201508 | | EL-A201509<br>EI-A201510 | |
| | | | Depth BGS | 10.0 feet | | 13.0 feet | | 13.0 feet | | 13.0 feet | | 13.0 feet | |
| Analyte | Method | Units | Cleanup Criteria[1] | | | | | | | | | | |
| Gasoline Range Organics | AK101 | mg/kg | 300 | 67.7 | [2.55] | - | - | - | - | - | - | - | |
| Diesel Range Organics | AK102 | mg/kg | 250 | [redacted] | [110] | 7.55 | [10.4] J | ND | [10.5] | 6.69 | [10.6] J | ND | [1 |
| Acenaphthene | PAHSIM | ug/kg | 210000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Acenaphthylene | PAHSIM | ug/kg | | ND | [6.53] | - | - | - | - | - | - | - | |
| Anthracene | PAHSIM | ug/kg | 4300000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Benzo(a)anthracene | PAHSIM | ug/kg | 6000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Benzo(a)pyrene | PAHSIM | ug/kg | 1000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Benzo(b)fluoranthene | PAHSIM | ug/kg | 11000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Benzo(g,h,i)perylene | PAHSIM | ug/kg | | ND | [6.53] | - | - | - | - | - | - | - | |
| Benzo(k)fluoranthene | PAHSIM | ug/kg | 110000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Chrysene | PAHSIM | ug/kg | 620000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Dibenzo(a,h)anthracene | PAHSIM | ug/kg | 1000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Fluoranthene | PAHSIM | ug/kg | | 4.32 | [6.53] J | - | - | - | - | - | - | - | |
| Fluorene | PAHSIM | ug/kg | 270000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Indeno(1,2,3-cd)pyrene | PAHSIM | ug/kg | 11000 | ND | [6.53] | - | - | - | - | - | - | - | |
| Naphthalene | PAHSIM | ug/kg | 43000 | 80.3 | [6.53] | - | - | - | - | - | - | - | |
| Phenanthrene | PAHSIM | ug/kg | | ND | [6.53] | - | - | - | - | - | - | - | |
| Pyrene | PAHSIM | ug/kg | 1500000 | 6.21 | [6.53] J | - | - | - | - | - | - | - | |
| Benzene | SW8260B | mg/kg | 0.02 | ND | [0.0133] | ND | [0.0091] | ND | [0.0092] | ND | [0.0095] | ND | [0.01 |
| Ethylbenzene | SW8260B | mg/kg | 5.5 | 0.0084 | [0.0255] J | 0.0085 | [0.0174] J | 0.0066 | [0.0178] J | ND | [0.0183] | ND | [0.02 |
| Toluene | SW8260B | mg/kg | 5.4 | 0.0271 | [0.0255] | 0.0235 | [0.0174] | 0.0242 | [0.0178] | 0.0157 | [0.0183] J | 0.0228 | [0.02 |
| Total Xylenes | SW8260B | mg/kg | 78 | 0.0363 | [0.0255] | 0.0303 | [0.0174] | 0.0345 | [0.0178] | 0.0155 | [0.0183] J | 0.0176 | [0.022 |

Notes:

[1] ADEC regulatory criteria based on 18 AAC 75 Method Two (18 AAC 75.341, Method Two, Tables B1 and B2, Under 40-inch Zone, Most Stringent Criteria).

Highlighted values exceed 18 AAC 75 Method Two Cleanup Criteria

BGS = below ground surface

J = Result is below laboratory reporting limit.

mg/kg = milligrams per kilogram

ND = Analyte not detected

ug/kg = micrograms per kilogram

[ ] = laboratory reporting limit

- = Not Analyzed

3

## 4.0 CONCLUSIONS

The objective of the removal action at Site ST534 was to reduce risk by excavating soil with contaminant concentrations above regulatory criteria, as outlined in 18 AAC 75. Sample results from this removal action and the SERA investigation confirm that the site meets 18 AAC 75 (ADEC 2000a) Method Two cleanup criteria for GRO, BTEX, and PAHs. DRO exceeded the regulatory criteria in one out of five samples. This sample was collected from the west sidewall at 10 feet bgs. Contamination was not detected in the smear zone at 32.5 feet bgs during the SERA investigation.

Contaminated soil was excavated and removed to the maximum extent possible without compromising the integrity of the foundation of Building 8672.

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## 5.0 REFERENCES

Alaska Department of Environmental Conservation (ADEC). 2000a (October). *Oil and Hazardous Substances Control Regulations.* 18 AAC 75.

ADEC. 2000b (August). *Underground Storage Tanks.* 18 AAC 78.

ADEC. 1999 (December). *Underground Storage Tanks Procedures Manual.*

U.S. Air Force (USAF). 2001 (June). *Corrective Action Plan, SERA IV, V, VII, and VIII Sites (Draft).* Environmental Restoration Program. Elmendorf Air Force Base, Alaska.

USAF. 1999 (March). *Summary Report for Site Evaluations and Bioventing Studies at SERA Phase V Sites (Final).* Environmental Quality Program. Elmendorf Air Force Base, Alaska.

USAF. 1996 (September). *UST Decommissioning and Site Assessment Report, Building 33-385 (Draft).* Elmendorf AFB, Alaska.

U.S. Army Corps of Engineers (USACE). 1997 (October). *Environmental Quality – Chemical Quality Assurance for Hazardous, Toxic, and Radioactive Waste (HTRW) Projects.* EM200-1-6.

U.S. Environmental Protection Agency (EPA). 1999 (October). *USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review.* OSWER 9240.1-05A-P. Washington, D.C.

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# Appendix A

## SERA Investigation Results

# SOURCE AREA ST 534

ST 534 is a former UST site that contained a 500-gallon steel tank (STMP 300) which was used to store heating oil for Building 33-385 (Boy Scout Hut). This tank was removed in 1996, and environmental samples were taken during the excavation. The results of the excavation and sampling are presented in the *UST Decommissioning and Site Assessment - Building 33-385, Draft,* (USAF, September 1996d). This information is also summarized in the *Site Evaluation and Bioventing Studies for SERA Phase V Sites, 1997 Workplan* (USAF, June 1997b). Figure 1-2 shows the approximate former location of ST 534 at Elmendorf AFB, and Figure ST 534-1 presents a detailed location map with sampling results.

Soil encountered during the excavation of STMP 300 at ST 534 was described as a sandy, silty gravel with intervals of sandy clay according to the USCS soil classification system (USAF, September 1996d). The depth to the water table (i.e., top of the shallow aquifer) is approximately 32.5 feet bgs in the vicinity of ST 534, and groundwater flows west-southwest towards Ship Creek.

**Results of the Investigation at ST 534**

Four soil borings were advanced to the water table at ST 534 to investigate potential soil and groundwater contamination around the former UST (Figure ST 534-1). Soil samples were collected with a split-spoon sampler from the ground surface to the water table, and PID readings were measured for all intervals. A Hanby™ field sampling kit was also used to identify areas of contamination. Two samples were collected and analyzed from each soil boring. Analytical samples were taken from the intervals with the highest PID readings or Hanby™ concentrations, or from an interval that could have been contaminated based on field observations. Figure ST 534-1 shows the location of all soil borings at ST 534, and the contaminant concentrations found at each location.

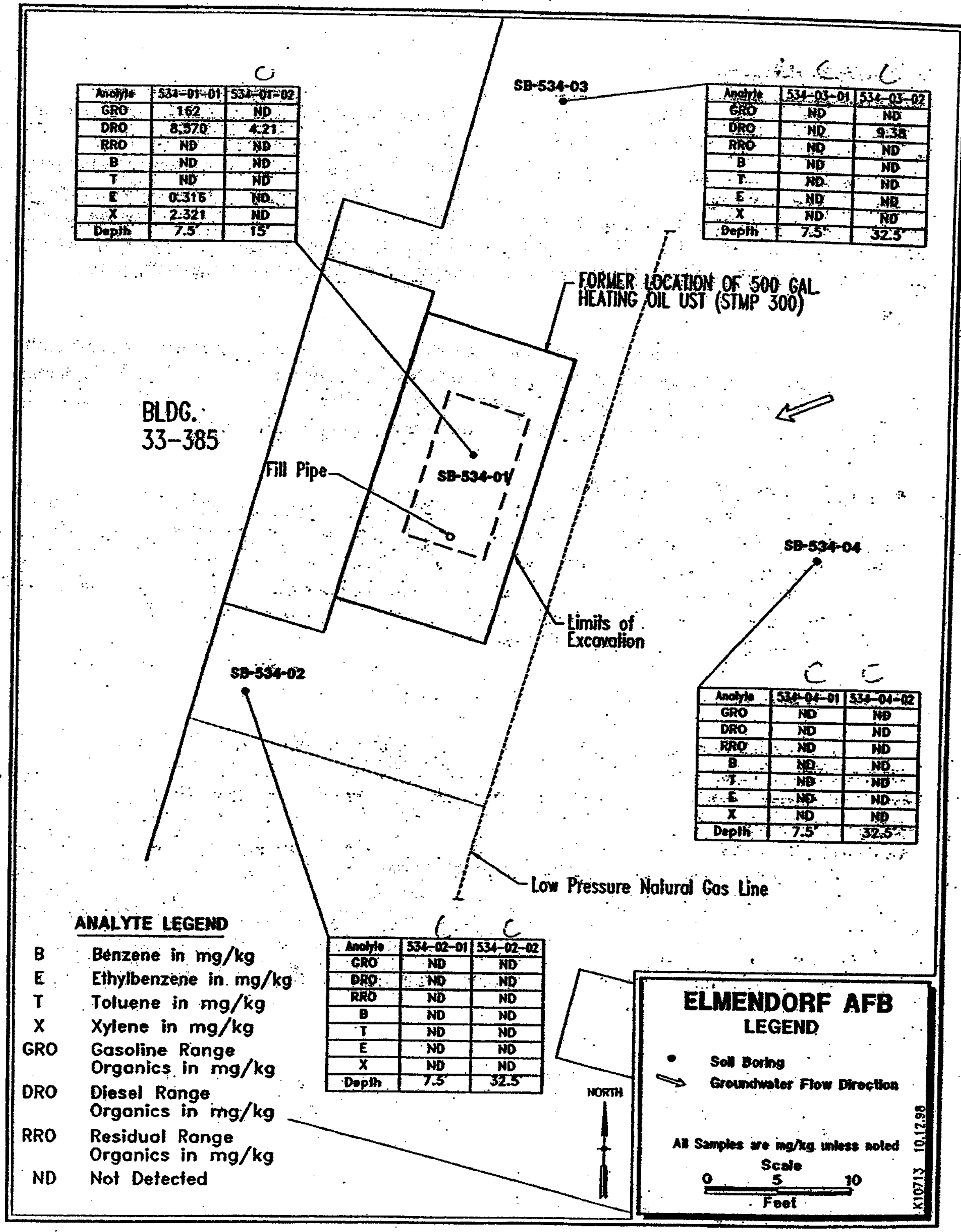
The Alaska Department of Environmental Conservation (ADEC) revised their UST regulations (18 AAC 78) in January 1999, and these new regulations reference the soil cleanup levels provided in *18 AAC 75, Articles 3 and 9, Oil and Hazardous Substances Pollution Control Regulations, As amended through 22 January 1999* (ADEC, 1999). Because ST 534 is located in the OU 5 Groundwater Study Area, groundwater is not a completed exposure pathway. Therefore, the analytical data for ST 534 was compared with the Method Two values in the regulations using the more stringent of the inhalation or ingestion pathways to determine if the site could be closed with no further action. No soil samples at ST 534 exceeded the ADEC Method Two soil cleanup levels. SVOCs were not detected in the soil at ST 534. Table ST 534-1 presents the soil results for ST 534. Polynuclear aromatic hydrocarbons (PAHs) were not detected in the soil at ST 534 above laboratory detection limits (Table ST 534-2).

**References**

Alaska Department of Environmental Conservation (ADEC). *18 AAC 75, Oil and Hazardous Substances Pollution Control Regulations, Articles 3 and 9, As amended through 22 January 1999.* January 1999.

United States Air Force (USAF). *UST Decommissioning and Site Assessment Report, Draft, Building 33-385.* September 1996d.

United States Air Force (USAF). *Site Evaluation and Bioventing studies for SERA Phase V Sites, 1997 Workplan, Final.* June 1997b.




| Analyte | 534-01-01 | 534-01-02 |
|---|---|---|
| GRO | 162 | ND |
| DRO | 8,370 | 4.21 |
| RRO | ND | ND |
| B | ND | ND |
| T | ND | ND |
| E | 0.316 | ND |
| X | 2.321 | ND |
| Depth | 7.5' | 15' |

| Analyte | 534-03-01 | 534-03-02 |
|---|---|---|
| GRO | ND | ND |
| DRO | ND | 9.38 |
| RRO | ND | ND |
| B | ND | ND |
| T | ND | ND |
| E | ND | ND |
| X | ND | ND |
| Depth | 7.5' | 32.5' |

| Analyte | 534-04-01 | 534-04-02 |
|---|---|---|
| GRO | ND | ND |
| DRO | ND | ND |
| RRO | ND | ND |
| B | ND | ND |
| T | ND | ND |
| E | ND | ND |
| X | ND | ND |
| Depth | 7.5' | 32.5' |

| Analyte | 534-02-01 | 534-02-02 |
|---|---|---|
| GRO | ND | ND |
| DRO | ND | ND |
| RRO | ND | ND |
| B | ND | ND |
| T | ND | ND |
| E | ND | ND |
| X | ND | ND |
| Depth | 7.5' | 32.5' |

**ANALYTE LEGEND**

| | |
|---|---|
| B | Benzene in mg/kg |
| E | Ethylbenzene in mg/kg |
| T | Toluene in mg/kg |
| X | Xylene in mg/kg |
| GRO | Gasoline Range Organics in mg/kg |
| DRO | Diesel Range Organics in mg/kg |
| RRO | Residual Range Organics in mg/kg |
| ND | Not Detected |

**Figure ST 534-1. Sampling Results at ST 534**

## Table ST 534-1

### Soil Analytical Results for Elmendorf SERA Phase V Site ST 534, August 1997

| Parameter | 534-01-01 | 534-01-02 | 534-02-01 | 534-02-02 | 534-03-01 | 534-[illegible]-02 | 534-[illegible]-01 | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|---|---|
| Depth | 7.5 ft. | 15 ft. | 7.5 ft. | 32.5 ft. | 7.5 ft. | 32.5 ft. | 7.5 ft. | 32.5 ft. | NA |
| **AK 101/SW8020, mg/kg** | | | | | | | | | |
| GRO | 162 | ND | ND | ND | ND | ND | ND | ND | 1,400[3] |
| Benzene | ND | ND | ND | ND | ND | ND | ND | ND | 9[4] |
| Toluene | ND | ND | ND | ND | ND | ND | ND | ND | 180[4] |
| Ethylbenzene | 0.316 | ND | ND | ND | ND | ND | ND | ND | 89[4] |
| Total Xylenes | 2.321 | ND | ND | ND | ND | ND | ND | ND | 81[4] |
| **AK 102/103, mg/kg** | | | | | | | | | |
| DRO | 8570 | 4.21 | ND | ND | ND | 9.38 | ND | ND | 10,250[5] |
| RRO | ND | ND | ND | ND | ND | ND | ND | ND | 10,000[5] |
| **SW8270, µg/g** | | | | | | | | | |
| All SVOCs | ND[1] | NA | NA | NA | NA | NA | NA | NA | NA |
| **Indicator Parameters** | | | | | | | | | |
| Total Solids, SM18 2540G (%) | 90.6 | 96.3 | 80.0 | 93.2 | 83.1 | 90.6 | 95.8 | 90.2 | NA |

[1] A complete SVOC analysis was performed for this sample, however, no compounds were found above detection limits.
[2] Cleanup levels are from 18 AAC 75.341, Tables B1 and B2, under 40 inch zone (ADEC, 1999).
[3] Ingestion and inhalation pathway, Table B2.
[4] Inhalation pathway, Table B1.
[5] Ingestion pathway, Table B2.
DRO - Diesel Range Organics
GRO - Gasoline Range Organics
NA - Not Analyzed
ND - Not Detected
RRO - Residual Range Organics

## Table 1
### All Results of Organic Analyses For Soil Samples, SERA V All Sites

| Parameter | | Site Id / Location Id / Sample Id / Beg. Depth - End Depth (t.): 534 / 534-SB-01 / 534-01-01 / 7.5-9.5 | |
|---|---|---|---|
| **Percent Solid (%)** | | | |
| Percent moisture | 7.07 | 0 | [1] |
| **SW8270 - Semivolatile Organics (ug/g)** | | | |
| 1,2,4,5-Tetrachlorobenzene | ND | ( 0.0384 | )[1] |
| 1,2,4-Trichlorobenzene | ND | ( 0.0423 | )[1] |
| 1,2-Dichlorobenzene | ND | ( 0.0580 | )[1] |
| 1,2-Diphenylhydrazine | ND | 0 | [1] |
| 1,3-Dichlorobenzene | ND | ( 0.0438 | )[1] |
| 1,3-Dinitrobenzene | ND | ( 0.189 | )[1] |
| 1,4-Dichlorobenzene | ND | ( 0.0464 | )[1] |
| 1,4-Naphthoquinone | ND | ( 0.135 | )[1] |
| 1-Chloronaphthalene | ND | 0 | [1] |
| 1-Naphthylamine | ND | ( 0.838 | )[1] |
| 2,3,4,6-Tetrachlorophenol | ND | ( 0.0441 | )[1] |
| 2,4,5-Trichlorophenol | ND | ( 0.0314 | )[1] |
| 2,4,6-Trichlorophenol | ND | ( 0.0312 | )[1] |
| 2,4-Dichlorophenol | ND | ( 0.0428 | )[1] |
| 2,4-Dimethylphenol | ND | ( 0.0496 | )[1] |
| 2,4-Dinitrophenol | ND | ( 1.27 | )[1] |
| 2,4-Dinitrotoluene | ND | ( 0.0393 | )[1] |
| 2,6-Dichlorophenol | ND | ( 0.0526 | )[1] |
| 2,6-Dinitrotoluene | ND | ( 0.105 | )[1] |
| 2-Acetylaminofluorene | ND | ( 0.0347 | )[1] |
| 2-Chloronaphthalene | ND | ( 0.0481 | )[1] |
| 2-Chlorophenol | ND | ( 0.0224 | )[1] |
| 2-Methylnaphthalene | ND | ( 0.0900 | )[1] |

| Parameter | 534 / 534-SB-01 / 534-01-01 / 7.5-9.5 | | |
|---|---|---|---|
| **SW8270 - Semivolatile Organics, cont. (ug/g)** | | | |
| 2-Methylphenol | ND | ( 0.0378 | )[1] |
| 2-Naphthylamine | ND | ( 0.462 | )[1] |
| 2-Nitroaniline | ND | ( 0.0590 | )[1] |
| 2-Nitrophenol | ND | ( 0.0283 | )[1] |
| 2-Picoline | ND | ( 0.182 | )[1] |
| 3,3'-Dichlorobenzidine | ND | ( 0.0697 | )[1] |
| 3,3'-Dimethylbenzidine | ND | ( 1.43 | )[1] |
| 3-Methylcholanthrene | ND | ( 0.319 | )[1] |
| 3-Nitroaniline | ND | ( 0.0922 | )[1] |
| 4,6-Dinitro-2-methylphenol | ND | ( 0.144 | )[1] |
| 4-Aminobiphenyl | ND | ( 0.176 | )[1] |
| 4-Bromophenyl phenyl ether | ND | ( 0.0291 | )[1] |
| 4-Chloro-3-methylphenol | ND | ( 0.0452 | )[1] |
| 4-Chlorophenyl phenyl ether | ND | ( 0.0453 | )[1] |
| 4-Methylphenol/3-Methylphenol | ND | ( 0.0486 | )[1] |
| 4-Nitroaniline | ND | ( 0.246 | )[1] |
| 4-Nitrophenol | ND | ( 0.234 | )[1] |
| 4-Nitroquinoline-1-oxide | ND | ( 1.56 | )[1] |
| 5-Nitro-o-toluidine | ND | ( 0.0634 | )[1] |
| 7,12-Dimethylbenz(a)anthracene | ND | ( 0.392 | )[1] |
| Acenaphthene | ND | ( 0.0533 | )[1] |
| Acenaphthylene | ND | ( 0.0278 | )[1] |
| Acetophenone | ND | ( 0.0338 | )[1] |
| Aniline | ND | ( 0.0868 | )[1] |
| Anthracene | ND | ( 0.0257 | )[1] |
| Aramite | ND | 0 | [1] |

Compiled: 11/05/97

0 = Detection Limit [] = Dilution Factor ND = Not Detected NA = Not Applicable

**Table 1**

**All Results of Organic Analyses For Soil Samples, SERA V All Sites**

| Site Id | | 534 | | Site Id | | 534 | |
|---|---|---|---|---|---|---|---|
| Location Id | | 534-SB-01 | | Location Id | | 534-SB-01 | |
| Sample Id | | 534-01-01 | | Sample Id | | 534-01-01 | |
| Beg. Depth - End Depth (f.) | | 7.5-9.5 | | Beg. Depth - End Depth (f.) | | 7.5-9.5 | |
| **Parameter** | | | | **Parameter** | | | |
| *SW8270 - Semivolatile Organics, cont. (ug/g)* | | | | *SW8270 - Semivolatile Organics, cont. (ug/g)* | | | |
| Benzenethiol | ND | () | [1] | Hexachlorobutadiene | ND | ( 0.131 ) | [1] |
| Benzidine | ND | ( 4.81 ) | [1] | Hexachlorocyclopentadiene | ND | ( 0.353 ) | [1] |
| Benzo(a)anthracene | ND | ( 0.0227 ) | [1] | Hexachloroethane | ND | ( 0.0792 ) | [1] |
| Benzo(a)pyrene | ND | ( 0.0280 ) | [1] | Hexachlorophene | ND | () | [1] |
| Benzo(b)fluoranthene | ND | ( 0.0255 ) | [1] | Hexachloropropene | ND | ( 0.0780 ) | [1] |
| Benzo(g,h,i)perylene | ND | ( 0.0271 ) | [1] | Indeno(1,2,3-cd)pyrene | ND | ( 0.0340 ) | [1] |
| Benzo(k)fluoranthene | ND | ( 0.0318 ) | [1] | Isophorone | ND | ( 0.0293 ) | [1] |
| Benzoic acid | ND | ( 0.664 ) | [1] | Isosafrole | ND | ( 0.281 ) | [1] |
| Benzyl alcohol | ND | ( 0.0390 ) | [1] | Methapyrilene | ND | ( 2.72 ) | [1] |
| Butylbenzylphthalate | ND | ( 0.0205 ) | [1] | Methyl methanesulfonate | ND | ( 0.0867 ) | [1] |
| Chlorobenzilate | ND | ( 0.0473 ) | [1] | N-Nitroso-di-n-butylamine | ND | ( 0.155 ) | [1] |
| Chrysene | ND | ( 0.0319 ) | [1] | N-Nitroso-di-n-propylamine | ND | ( 0.0379 ) | [1] |
| Di-n-butylphthalate | ND | ( 0.0335 ) | [1] | N-Nitrosodiethylamine | ND | ( 0.0637 ) | [1] |
| Di-n-octylphthalate | ND | ( 0.0228 ) | [1] | N-Nitrosodimethylamine | ND | ( 0.122 ) | [1] |
| Diallate | ND | ( 0.0333 ) | [1] | N-Nitrosomethylethylamine | ND | ( 0.0698 ) | [1] |
| Dibenz(a,h)anthracene | ND | ( 0.0256 ) | [1] | N-Nitrosomorpholine | ND | ( 0.0299 ) | [1] |
| Dibenz(a,j)acridine | ND | () | [1] | N-Nitrosopiperidine | ND | ( 0.0489 ) | [1] |
| Dibenzofuran | ND | ( 0.0377 ) | [1] | N-Nitrosopyrrolidine | ND | ( 0.187 ) | [1] |
| Diethylphthalate | ND | ( 0.0340 ) | [1] | Naphthalene | ND | ( 0.0438 ) | [1] |
| Dimethylphenethylamine | ND | ( 0.822 ) | [1] | Nitrobenzene | ND | ( 0.0323 ) | [1] |
| Dimethylphthalate | ND | ( 0.0330 ) | [1] | Pentachlorobenzene | ND | ( 0.0333 ) | [1] |
| Diphenylamine/N-NitrosoDPA | ND | ( 0.0603 ) | [1] | Pentachloroethane | ND | ( 0.0729 ) | [1] |
| Ethyl methanesulfonate | ND | ( 0.0425 ) | [1] | Pentachloronitrobenzene | ND | ( 0.201 ) | [1] |
| Fluoranthene | ND | ( 0.0322 ) | [1] | Pentachlorophenol | ND | ( 0.783 ) | [1] |
| Fluorene | ND | ( 0.0391 ) | [1] | Phenacetin | ND | ( 0.0500 ) | [1] |
| Hexachlorobenzene | ND | ( 0.0321 ) | [1] | Phenanthrene | ND | ( 0.0352 ) | [1] |

Compiled: 11/

() = Detection Limit [] = Dilution Fac[illegible] Not Detected NA = Not Applicable

## Table 1
## All Results of Organic Analyses For Soil Samples, SERA V All Sites

| Parameter | Site Id / Location Id / Sample Id / Beg. Depth - End Depth (ft.) | | |
|---|---|---|---|
| | 534 | | |
| | 534-SB-01 | | |
| | 534-01-01 | | |
| | 7.5-9.5 | | |
| **SW8270 - Semivolatile Organics, cont. (ug/g)** | | | |
| Phenol | ND | ( 0.164 ) | [1] |
| Pronamide | ND | ( 0.0620 ) | [1] |
| Pyrene | ND | ( 0.0378 ) | [1] |
| Pyridine | ND | ( 0.143 ) | [1] |
| Safrole | ND | ( 0.0725 ) | [1] |
| bis(2-Chloroethoxy)methane | ND | ( 0.0221 ) | [1] |
| bis(2-Chloroethyl)ether | ND | ( 0.0393 ) | [1] |
| bis(2-Chloroisopropyl)ether | ND | ( 0.0329 ) | [1] |
| bis(2-Ethylhexyl)phthalate | ND | ( 0.106 ) | [1] |
| o-Toluidine | ND | ( 0.0734 ) | [1] |
| p-Chloroaniline | ND | ( 0.0523 ) | [1] |
| p-Dimethylaminoazobenzene | ND | ( 0.0629 ) | [1] |
| p-Phenylenediamine | ND | () | [1] |
| sym-Trinitrobenzene | ND | ( 0.110 ) | [1] |

Compiled: 11/05/97

() = Detection Limit [] = Dilution Factor ND = Not Detected NA = Not Applicable

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# Appendix B

## Asbestos Pipe Disposal Certificate
## Soil Treatment Confirmation

# Municipality of Anchorage

George P. Wuerch,
Mayor

Solid Waste Services
1111 East 56th Avenue, 99518
P.O. Box 196650 Anchorage, Alaska 99519-6650
Telephone: (907) 343-6262
Fax: (907) 561-1357
email:wwsws@ci.anchorage.ak.us

August 16, 2001

Lisa Bishop, Project Coordinator
Central Environmental, Inc.
700 East 46th Avenue
Anchorage, Alaska 99503-0125

Re: ASBESTOS DISPOSAL AUTHORIZATION NUMBER AS01136 Elmendorf POL Upgrade, DACA85-95-D-0018, Elmendorf AFB, Anchorage, Alaska, CEI #00-12273 (your August 16, 2001 fax'd notification)

Dear Ms. Bishop:

This is in response to the CEI request for authorization to dispose up to 500 pounds of regulated friable ACM pipe fittings generated from the renovation activities at the referenced location (CEI #00-12273). You are authorized to dispose of this ACM at the Anchorage Regional Landfill (ARL) providing the following provisos are met:

1. Specific disposal arrangements are made via facsimile transmission with the ARL General Foreman, Mr. Nissen, 428-1697, at least 24 hours prior to bringing the ACM to the ARL. Please include the approximate delivery time by specifying the hour of the day between 09:00-12:00 AM and 13:00 –16:00 PM on Wednesdays or Thursdays. **If you are unable to deliver this material at the pre-arranged time, you must reschedule for a different time and date. If you miss the pre-arranged time, and do not reschedule for a different time and date, do not attempt to bring the material to the ARL, for the load will be considered as an unscheduled ACM disposal and refused at the Scalehouse.**

2. ACM will be accepted only on **Wednesdays and Thursdays** between 09:00 AM - 12:00 M and 13:00 - 16:00 PM. Off loading of ACM will not be permitted during the Noon Lunch hour; please adjust your transportation schedule accordingly. Regardless of the type of ACM, NO asbestos will be accepted at the working face after 16:00 P.M.; the ACM transporter MUST remove his vehicle from the working face no later than 16:00 P.M. If the ACM transporter is not finished off loading the ACM load by 16:00 P.M., he MUST leave the working face and reschedule another disposal date to finish the ACM off loading. Advise your ACM transporter that no transport vehicle or trailer will be left, either attended or unattended, at the working face without a means of being moved by the ACM transporter.

3. This letter and a copy of your ASBESTOS WASTE SHIPPING RECORD (AWSR) must be shown to the ARL Scalehouse Attendant at the time the Disposer brings the ACM to the Landfill. I ask that you clearly annotate the SWS ACM Authorization Number, AS01136 in the **Waste Disposal Site block** of the AWSR. I ask that you also provide SWS with a copy of the AWSR with Sections 1 through 11 completed when each load is brought to the Landfill.

4. ACM must be packaged, marked, transported and placed in the ARL in accordance with all Federal, State, and Municipal regulations.

... determined by SWS to be inadequate will be repackaged or removed immediately from the ARL by the Disposer.

7. The disposal fee for ACM generated within the Municipality of Anchorage is at a rate of ***$45.00 per ton***. A special ACM handling fee of ***$40.00 per one-half hour*** will be charged based on the time the ACM transporter arrives at the designated ACM disposal area until the transport vehicle departs the area for weigh out. If you have questions concerning the method of payment, please contact Ms. Nistler, SWS Customer Service Supervisor, 343- 6251.

8. Scrounging at the ARL is in violation of SWS regulations and the ADEC Operating Permit. Should a transporter be observed scrounging at the ARL working face, that individual will be subject to being barred from the landfill.

9. **This authorization expires at 16:00 PM, September 27, 2001.** The Authorization Number will be deactivated at the same time.

The Alaska Department of Environmental Conservation Landfill Operating Permit 9621 BA001 authorizes the Anchorage Regional Landfill to accept asbestos waste materials for disposal. Please call me if you have need of further assistance.

Sincerely,

Michael I. Blair
Project Administrator

cc: Rick Nissen, ARL General Foreman
Mia Nistler, Customer Service Supervisor
ARL Scalehouse Attendant
Ann Wawrukiewicz, Environmental Specialist, USEPA Region 10, 1200 Sixth Avenue, Seattle, WA 98101

2

CENTRAL ENVIRONMENTAL, INC.
700 EAST 46TH AVENUE, ANCHORAGE, ALASKA 99503 PHONE: (907) 561-0125 FAX: (907) 561-0178

## DISPOSAL LOG AND WASTE SHIPMENT MANIFEST

1. **Facility / Project Name:** TSI Pipe Removal, Site 534, Boy Scouts Bld **Project No.:** 12273
   **Physical Address:** Elmendorf AFB, AK , Outside of Building
2. **Facility Operator Name:** U.S. Air Force, 3rd CES
   **Operator Address:** 6325 Arctic Warrior Drive, Elmendorf AFB 99506 **Phone No.:** 552-7415
3. **Facility Owner Name:** U.S. Air Force
   **Operator Address:** Same **Phone No.:**

4. **Waste Disposal Site Name:** Anchorage Regional Landfill **Phone No.:**
   **Mailing Address:** P.O. Box 196650, Anchorage, AK 99519
   **Physical Address:** Hiland Road, Eagle River, Alaska * AS01136
5. **Governing Agencies:** ADEC, Central Region, 3601 C Street, Suite 1334, Anchorage, AK 99503
   ADEC, 610 University Avenue, Fairbanks, Alaska 99709-3643
   USEPA, Region 10, 1200 6th Avenue, Seattle, WA 98101
6. **Description of Materials:**

| Description of Materials (i.e., Asbestos, POL, Soils, Liquids) | Containers No. | Containers Type | Total Estimated Volume | Total Estimated Weight |
|---|---|---|---|---|
| Asbestos 9NA 2212 III RQ | | | 16 lf. | 500 lbs. |
| | | | | |
| | | | | |

7. **Special Handling Instructions or Additional Information:**

8. **Operator's Certification:** I hereby declare that the contents of this consignment are fully and accurately described by proper shipping name and area classified, packed, marked, and labeled, and are in all respects in proper conditions for transport by highway to applicable international and government regulations.

John C. Mahaffey — [signature] — 30 AUG 01
Name/Title (Print or Type) — Signature — Date

9. **Transporter #1:** (Acknowledgement of receipt of materials)
   Company Name: Central Environmental Inc. Address: 700 E. 46th Ave. Anch. AK Phone: 561-0125
   Destination: MOA Landfill Hiland Rd. Vehicle Description:
   RON CORNEILLE DRIVER — Ron D. Corneille — 09-20-01 ~~[date struck]~~ RC
   Name/Title (Print or Type) — Signature — Date

   **Transporter #2:** (Acknowledgement of receipt of materials)
   Company Name: Address: Phone:
   Destination: Vehicle Description:
   Name/Title (Print or Type) — Signature — Date

   **Transporter #3:** (Acknowledgement of receipt of materials)
   Company Name: Address: Phone:
   Destination: Vehicle Description:
   Name/Title (Print or Type) — Signature — Date

10. **Landfill Discrepancy:** (A list of all discrepancies to be filled out by the landfill operator) NONE
11. **Weigh Scale:** Weight
    Clock Type of Weight tons (pounds) Attached weight scale receipt
12. **Waste Disposal Site (WDS) Certification of Acceptance:** I hereby certify acceptance of the materials covered by this manifest and I am in agreement with statements on this manifest, except as noted in Item 10. The WDS must remain a completed copy of this form and forward completed copy to the operator/owner in Item 2 and Item 3.

CHUCK MASSAMBO / RD... — [signature] — 9/20/01
Name/Title (Print or Type) — Signature — Date



Inv 189985

Solid Waste Services

DATE: 09/20/2001 TIME: 10:[illegible] LOC: ANCHORAGE REGIONAL LANDFIL

BILL TO: CENTRAL ENVIRONMENTAL INC ACCT NBR: 10-502104.00

VEH ID: RDFLCE1 CONT: 42252 AS01136

COMMODITY: ASBESTOS COST PER TON: $45.00

GROSS WEIGHT: 7,220 AMOUNT: $10.00
TARE WEIGHT: 6,880 ADDTL CHARGES: $40.00
NET WEIGHT: 340 SURCHARGE:
TOTAL AMOUNT DUE: $50.00
AMOUNT PAID:

ADDITIONAL CHARGES DESCRIPTION:
SPECIAL HANDLING .5 HOUR $40.00

ALL LOADS MUST BE COVERED OR SECURED TO PREVENT SPILLAGE
If you don't do this, you may be fined a $10 or $30 charge
IT IS THE LAW AMC 26.80.050

DRIVER'S SIGNATURE INVOICE: 109985

45/40
10
17213

Municipality of Anchorage
## Solid Waste Services (SWS)

### Special Handling Log

| Customer Name | CET | Date/Time In | 9/20/01 |
|---|---|---|---|
| Vehicle Description | | Commodity | AS01136 |
| Services Requested | | | |

| | |
|---|---|
| SWS Operator Start Time | 10:05 |
| SWS Operator Finish Time | 10:10 |
| Total SWS Operator Time | 5 mins. |
| Special Handling Charge ($40.00 per 1/2 hour) | |

| SWS Operator Signature | Customer Signature |
|---|---|
| | |

**ALASKA SOIL RECYCLING**
A Division of Anchorage Sand & Gravel Co. Inc.
1040 O'Malley Road • Anchorage, Alaska 99515
Phone (907) 349-3333 • FAX (907) 344-2844

October 13, 2001

Jacobs Engineering
4300 B Street, Suite 600
Anchorage, Alaska 99533-5922

Attn: Ms. Mandy Pogany

Re: Soil Disposal From EAFB SERA Projects

Dear Ms. Pogany:

On July 5, 7, 9, 11,-14, 17-19, 23, 27-28, 2001 and August 6-10, 17, 20, 2001 and September 6-7,2001 Alaska Soil Recycling (ASR) received 2,121.71 tons of petroleum impacted soil from the above referenced site. On July 24, 2001, August 18, 2001, August 24, 2001 and September 9, 2001 thermal treatment of this soil was completed at ASR's Spar Avenue facility in Anchorage, Alaska. Post remedial analysis reveals that this soil meets the Alaska Department of Environmental Conservation's most restrictive level (Level A). Attached is a copy of the analysis summary and laboratory results.

This soil will be recycled for use in the construction industry.

Please contact me with any questions.

Sincerely,

ALASKA SOIL RECYCLING

James J. Rogers
Manager

JJR:rj

Attachments

# Oil Spill Consultants, Inc.

NOV - 5 2001
Jacobs Engineering Group Inc.
Alaska Operations

*The Environmental Cleanup Company*

August 2, 2001

Mr. James J. Rogers
Environmental Manager
Alaska Soil Recycling
1040 O'Malley Road
Anchorage, Alaska 99515

Subject: Laboratory Results for Third Party Sampling - Account No. 2506

Dear Mr. Rogers:

The results for our July 25, 2001 sampling for Account No. 2506 are attached. These results are summarized as follows:

| Sample ID Number | GRO (mg/kg) | Benzene (mg/kg) | Toluene (mg/kg) | Ethylbenzene (mg/kg) | Xylene (mg/kg) | DRO (mg/kg) | RRO (mg/kg) |
|---|---|---|---|---|---|---|---|
| 2001-ASR-2506-242-SL | U | U | 0.049 | U | U | 20.4 | 48.4 |
| 2001-ASR-2506-243-SL | U | U | 0.050 | U | U | 18.9 | 38.2 |
| 2001-ASR-2506-244-SL | U | U | 0.041 | U | U | 17.0 | 36.7 |
| 2001-ASR-2506-245-SL | U | U | 0.036 | U | U | 12.8 | 32.8 |
| 2001-ASR-2506-246-SL | U | U | 0.046 | U | U | 14.2 | 35.7 |
| 2001-ASR-2506-247-SL | U | U | U | U | U | U | U |
| 2001-ASR-2506-248-SL | U | U | U | U | U | U | U |
| 2001-ASR-2506-249-SLD | U | U | U | U | U | U | 24.1 |
| ADEC Level "A" Cleanup Criteria | 50 | - | - | - | - | 100 | 2,000 |
| ADEC Method Two Cleanup Criteria | - | 0.02 | 5.5 | 5.4 | 78 | - | - |

Note: 1. U means undetected. 2. - Means not applicable.

Please be advised that Account No. 2506 meets ADEC Level "A" Cleanup Criteria for GRO, DRO DRO and RRO under Method One in 18 AAC 75.341. This account also meets ADEC Method Two cleanup levels for benzene, toluene, ethylbenzene and xylene (BTEX) in 18 AAC 75.341.

Samples No. 2001-ASR-2506-248-SL and 2001-ASR-2506-249-SLD are duplicates. All samples were collected folllowing ADEC guidelines.

Sincerely,

Randy Easley
President

Attachments

P.O. Box 220412 • Anchorage, Alaska 99522-0412 • (907) 562-7169 • Fax (907) 562-7225

# Spill Consultants, Inc.

*The Environmental Cleanup Company*

September 11, 2001

Mr. James J. Rogers
Environmental Manager
Alaska Soil Recycling
1040 O'Malley Road
Anchorage, Alaska 99515

Subject: Laboratory Results for Third Party Sampling - Account No. 2506

Dear Mr. Rogers:

The results for our August 31, 2001 sampling for Account No. 2506 are attached. These results are summarized as follows:

| Sample ID Number | GRO (mg/kg) | Benzene (mg/kg) | Toluene (mg/kg) | Ethylbenzene (mg/kg) | Xylene (mg/kg) | DRO (mg/kg) | RRO (mg/kg) |
|---|---|---|---|---|---|---|---|
| 2001-ASR-2506-308-SL | U | U | U | U | U | 14.0 | 18.6 |
| 2001-ASR-2506-309-SL | U | U | U | U | U | U | U |
| 2001-ASR-2506-310-SL | U | U | U | U | U | U | U |
| 2001-ASR-2506-311-SL | U | U | U | U | U | U | U |
| 2001-ASR-2506-312-SL | U | U | U | U | U | 12.2 | 18.7 |
| 2001-ASR-2506-313-SLD | U | U | U | U | U | 13.6 | 21.6 |
| ADEC Level "A" Cleanup Criteria | 50 | - | - | - | - | 100 | 2,000 |
| ADEC Method Two Cleanup Criteria | - | 0.02 | 5.5 | 5.4 | 78 | | - |

Note: 1. U means undetected. 2. - Means not applicable.

Please be advised that Account No. 2506 meets ADEC Level "A" Cleanup Criteria for GRO, DRO, and RRO under Method One in 18 AAC 75.341. This account also meets ADEC Method Two cleanup levels for benzene, toluene, ethylbenzene and xylene (BTEX) in 18 AAC 75.341.

Samples No. 2001-ASR-2506-312-SL and 2001-ASR-2506-313-SLD are duplicates. The percentage difference for the DRO and RRO results for these samples is 10 percent and 13 percent, respectively. These results are acceptable under our quality control program and validates the laboratory results. All samples were collected following ADEC guidelines.

Sincerely,

Randy Easley
President

Attachments

P.O. Box 220412 • Anchorage, Alas • Fax (907) 562-7225

# Spill Consultants, Inc.

*The Environmental Cleanup Company*

September 27, 2001

Mr. James J. Rogers
Environmental Manager
Alaska Soil Recycling
1040 O'Malley Road
Anchorage, Alaska 99515

Subject: Laboratory Results for Third Party Sampling - Account No. 2506

Dear Mr. Rogers:

The results for our September 18, 2001 sampling for Account No. 2506 are attached. These results are summarized as follows:

| Sample ID Number | GRO (mg/kg) | Benzene (mg/kg) | Toluene (mg/kg) | Ethylbenzene (mg/kg) | Xylene (mg/kg) | DRO (mg/kg) | RRO (mg/kg) |
|---|---|---|---|---|---|---|---|
| 2001-ASR-2506-352-SL | U | U | 0.032 | U | 0.073 | 18.0 | 34.1 |
| 2001-ASR-2506-353-SL | U | U | U | U | U | 20.6 | 40.8 |
| 2001-ASR-2506-354-SL | U | U | U | U | U | 23.3 | 36.7 |
| 2001-ASR-2506-355-SLD | U | U | U | U | U | 21.8 | 37.2 |
| ADEC Level "A" Cleanup Criteria | 50 | - | - | - | - | 100 | 2,000 |
| ADEC Method Two Cleanup Criteria | - | 0.02 | 5.5 | 5.4 | 78 | | - |

Note: 1. U means undetected. 2. - Means not applicable.

Please be advised that Account No. 2506 meets ADEC Level "A" Cleanup Criteria for GRO, DRO, and RRO under Method One in 18 AAC 75.341. This account also meets ADEC Method Two cleanup levels for benzene, toluene, ethylbenzene and xylene (BTEX) in 18 AAC 75.341.

Samples No. 2001-ASR-2506-354-SL and 2001-ASR-2506-355-SLD are duplicates. The percentage difference for the DRO and RRO results for these samples is 6 percent and 1 percent, respectively. The comparability for the duplicate samples is acceptable under our quality control program and validates the laboratory results. All samples were collected following ADEC guidelines.

Sincerely,

Randy Easley
President

Attachments

P.O. Box 220412 • Anchorage, Ala

• Fax (907) 562-7225

# Appendix C

## Backfill Material Specifications

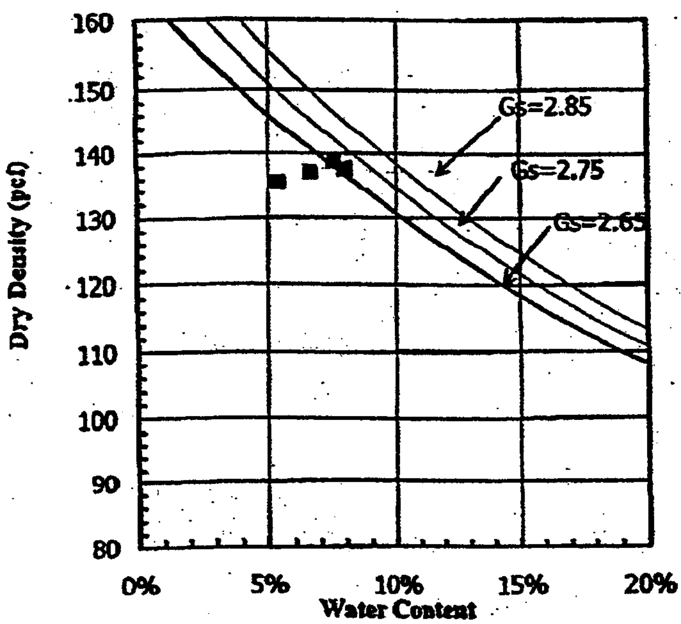
**ALASKA TESTLAB**
**A Division of DOWL LLC**

**ASTM D 1557 C**

Client: Jacobs Engineering
Project: EAFB Soil Remediation Task 12
Location: Summit Pit Import
East Stockpile, North Side

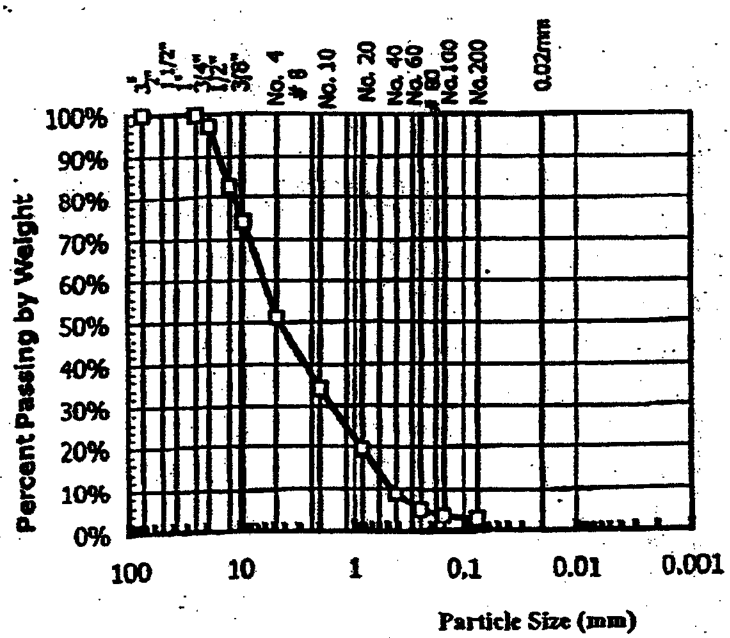
W.O. A29428
Lab No. 1338
Received: 7/26/01
Reported:

Engineering Classification: Poorly Graded GRAVEL with Sand, GP
Frost Classification: NFS (MOA)




Uncorrected
Maximum Density: 138.5 pcf
Optimum Water Content: 8 %

Moist Preparation
Mechanical Compaction




| SIZE | PASSING | SPECIFICATION |
|---|---|---|
| +3 in Not Included in Test = ~0% | | |
| 3" | | |
| 2" | | |
| 1 1/2" | | |
| 1" | 100% | |
| 3/4" | 97% | |
| 1/2" | 83% | |
| 3/8" | 74% | |
| No. 4 | 51% | |
| Total Wt. = 13999g | | |
| No. 8 | | |
| No. 10 | 34% | |
| No. 16 | | |
| No. 20 | 19% | |
| No. 30 | | |
| No. 40 | 9% | |
| No. 50 | | |
| No. 60 | 5% | |
| No. 80 | | |
| No.100 | 4% | |
| No.200 | 2.8% | |
| Total Wt. of Fine Fraction = 326.2g | | |
| 0.02 mm | | |

*David L Andersen*


4040 B Street Anchorage Alask
907/563-3953

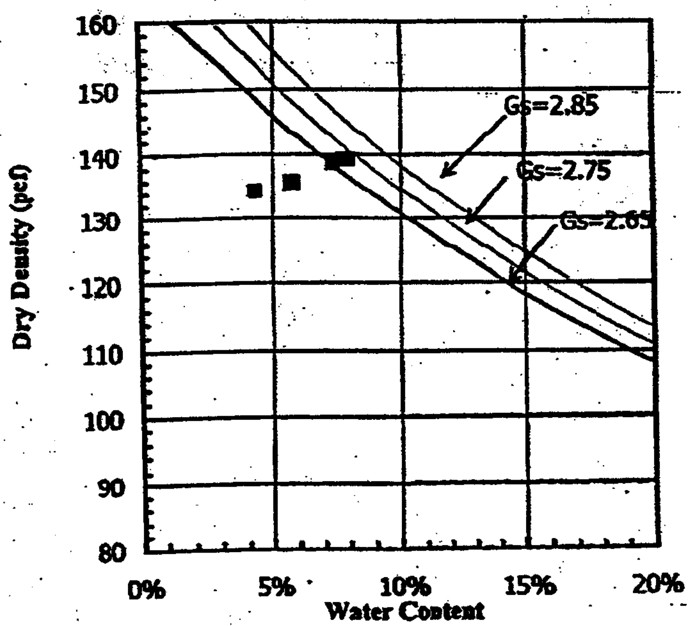
**ALASKA TESTLAB**
**A Division of DOWL LLC**

**MODIFIED PROCTOR**
**ASTM D 1557 C**

Client: Jacobs Engineering
Project: EAFB Soil Remediation Task 12
Location: Summit Pit Import
East Stockpile, South Side

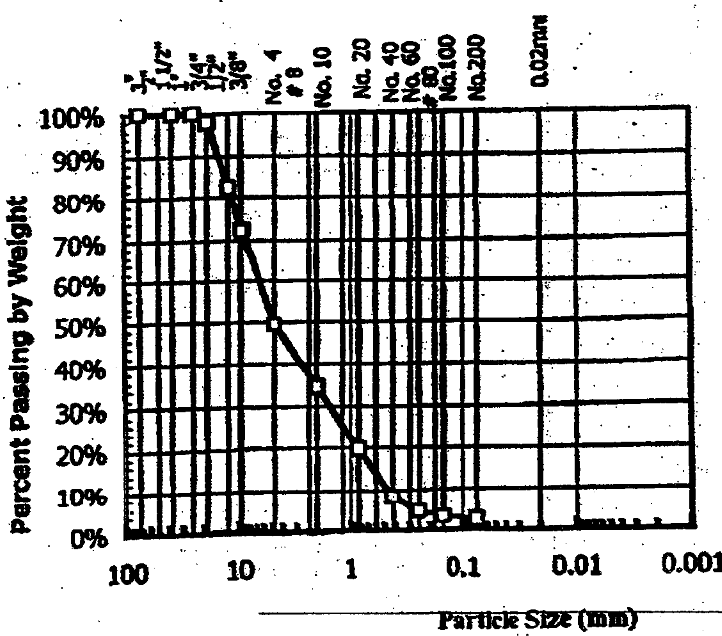
W.O. A29428
Lab No. 1337
Received: 7/26/01
Reported:

Engineering Classification: Poorly Graded GRAVEL with Sand, GP
Frost Classification: NFS (MOA)




Uncorrected
Maximum Density: 139.5 pcf
Optimum Water Content: 8 %

Moist Preparation
Mechanical Compaction




| SIZE | PASSING | SPECIFICATION |
|---|---|---|
| +3 in Not Included in Test = ~0% | | |
| 3" | | |
| 2" | | |
| 1 1/2" | 100% | |
| 1" | 100% | |
| 3/4" | 98% | |
| 1/2" | 83% | |
| 3/8" | 72% | |
| No. 4 | 49% | |
| Total Wt. = 56808g | | |
| No. 8 | | |
| No. 10 | 35% | |
| No. 16 | | |
| No. 20 | 20% | |
| No. 30 | | |
| No. 40 | 8% | |
| No. 50 | | |
| No. 60 | 5% | |
| No. 80 | | |
| No.100 | 3% | |
| No.200 | 2.7% | |
| Total Wt. of Fine Fraction = 333.3g | | |
| 0.02 mm | | |

*David L Andersen*





907/563-3953

# Appendix D

## Data Quality Assessment
## Analytical Data Package

| Location | Sample ID | Laboratory | Lab Sample ID | Collection Date | Matrix |
|---|---|---|---|---|---|
| JE01ELM-ST534SIDEWALL | EL-A201501 | CTE | 1015259001 | 8/10/01 | SO |
| JE01ELM-ST534SIDEWALL | EL-A201502 | CTE | 1015259002 | 8/10/01 | SO |
| JE01ELM-ST534NW-BOTTOM | EL-A201503 | CTE | 1015259003 | 8/10/01 | SO |
| JE01ELM-ST534NW-BOTTOM | EL-A201504 | CTE | 1015259004 | 8/10/01 | SO |
| JE01ELM-ST534NE-BOTTOM | EL-A201505 | CTE | 1015259005 | 8/10/01 | SO |
| JE01ELM-ST534NE-BOTTOM | EL-A201506 | CTE | 1015259006 | 8/10/01 | SO |
| JE01ELM-ST534SE-BOTTOM | EL-A201507 | CTE | 1015259007 | 8/10/01 | SO |
| JE01ELM-ST534SE-BOTTOM | EL-A201508 | CTE | 1015259008 | 8/10/01 | SO |
| JE01ELM-ST534SW-BOTTOM | EL-A201509 | CTE | 1015259009 | 8/10/01 | SO |
| JE01ELM-ST534SW-BOTTOM | EL-A201510 | CTE | 1015259010 | 8/10/01 | SO |

## DATA QUALITY ASSESSMENT

Sample collection, handling, analysis and reporting procedures were followed as defined in the Field Sampling Plan (FSP) and Quality Assurance Project Plans (QAPP). Most data acceptance criteria were met with the few exceptions defined in this section.

The analytical data was provided by the laboratory in both hardcopy and electronic formats. One hundred percent of the analytical hardcopy data and fifty percent of the electronic data was reviewed. The primary laboratory, CT&E Environmental Services, Inc. (CT&E), supported the analytical requirements of the 2001 field effort.

The completeness check and electronic data review was done by Jacobs. This process included a review of the analytical methodology, chain of custody (COC) and sample receipt records, sample holding times, laboratory and field blank results, analytical reporting limits, surrogates, laboratory control samples, calibrations, matrix spikes and duplicates, run logs, and extraction logs.

The quality assurance project plan (QAPP), laboratory acceptance criteria and the Environmental Protection Agency (EPA) *National Functional Guidelines* (EPA 1994, 1999) were referenced by Jacobs to assess the data usability and apply validation qualifiers to the summary tables. The Jacobs project chemist performed a completeness check on the hardcopy data and reviewed the hardcopy and electronic data to evaluate comparability and accuracy. The review process did not include verification of calculations. Data qualifications used to determine usability are based upon EPA *National Functional Guidelines* (EPA 1994, 1999).

The analytical data quality objectives (DQO) for this field investigation shall be met when the quality of the sample data meet precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) requirements as defined in the field sampling plan (FSP), QAPP, laboratory quality assurance project plan (LQAPP), and analytical methods. These DQO were evaluated by reviewing the following QA parameters and criteria:

- PRECISION
  - Matrix Spike Duplicates (MSD); and
  - Field Duplicates.
- ACCURACY
  - Calibrations - initial and continuing; acceptance, frequency;
  - Surrogates - recovery, frequency;
  - Lab Control Samples/Spikes (LCS);
  - Matrix Spikes (MS);
  - Retention Times;
  - Relative Response Factors (RRFs); Relative Standard Deviation (%RSD);
  - Method Blanks;
  - Tune Criteria gas chromatography/mass spectroscopy (GC/MS) - acceptability, frequency; and
  - Internal Standards (GC/MS) - acceptability, frequency.
- REPRESENTATIVENESS
  - Sample Chain-of-Custody;
  - Holding Times and Preservation; and
  - Work Plans.
- COMPARABILITY
  - Standard Operating Procedures (SOPs); and
  - Established analytical methods.
- COMPLETENES
  - Samples (field, QA, and QC);
  - Data Packages (forms, runlogs, extraction logs, etc.); and
  - Ninety-five percent completeness.
- SENSITIVITY
  - Analytical laboratory reporting limits

All reported data within this package should be considered valid unless otherwise noted and may be biased (qualifications noted in the body of this report). The qualifiers used to flag data are defined as follows:

- "U" - synonymous with "ND" for nondetect; not detected above the reporting limit (practical quantitation limit); final numerical result becomes the reporting limit flagged with "U."
- "J" - analyte was positively identified, but numerical value of concentration is approximate due to compromised quality control or inherent inability to analyze the sample (e.g. matrix effects).
- "UJ" - the analyte was not reported above the practical quantitation limit, but the reported quantitation limit is approximate (due to compromised quality control or inherent inability to analyze the sample).
- "UR" - the analyte was not detected above the reporting limit, but sample results were rejected due to significant deficiencies in quality control(s) or inherent ability to analyze the sample (e.g. matrix effects).

The qualifiers listed above, or "flags", are hyphenated in the report to reflect the basic rationale behind the qualification (e.g. "J-S"). The following qualifiers were used in the text of this report to indicate which QA/QC protocols were not met:

- S - surrogate recovery;
- L - lab control sample;
- C - calibration;
- T - instrument 12-hour tuning criteria;
- M - matrix spike and/or spike duplicate;
- I - internal standard;
- B - method blank;
- H - holding times;
- P - incorrect or inadequate preservation methods;
- E - value exceeds instrument calibration range;
- TE – sample cooler temperatures; and
- UB/RL – although the analyte was detected, the result should be considered nondetected at the reporting limit or reported value due to potential laboratory contamination.

## DATA QUALITY SUMMARY

In general, the overall quality of the data was acceptable. The data quality was determined as acceptable, estimated, or rejected. Acceptable data are associated with QC data that meet all QC criteria or with QC samples that did not meet QC criteria but data quality objectives were not affected. Estimated (J) results are considered inaccurate due to a bias created by matrix interference or QC acceptance criteria which were not met. Rejected data are not usable.

All Chain-of-Custody (COC) sample identification numbers include EL (Elmendorf – various sites), -A (Alaska), four numbers (COC number) followed by two additional numbers that identify the samples collected in sequence that are specific to the location and analytical suite of analyses (i.e. EL-A201501). This sample appears on COC number 2015, and is the first sample collected for GRO. For ease in referring to the results tables and readability of this report, the last six digits of the sample identification number will be used to identify each sample (i.e. 201501 would identify EL-A201501 found on COC # 2015). The original COC is on file in the Jacobs Anchorage office with the original data package. An extra dash was occassionally used on this project to separate the sample number from the COC number (e.g. EL-A2015-01) and will remain unchanged in this text as it appears in the analytical summary table, data tables, and COCs.

The term "positive result(s)" is used to identify all analytes that are detected above the laboratory reporting limit. The term "nondetected" refers to results that are less than the laboratory reporting limit and are therefore not reported by the laboratory. "All results" refers to both nondetected and positive results.

Details of the evaluation are provided in the following section by method and include the associated samples and analytes:

<u>Gasoline Range Organics (GRO) AK101.</u> Overall, the quality of the data are acceptable with the following qualifications:

- Holding Times and Sample Handling: All holding time and sample handling criteria were met.
- Method Blanks: Target analytes were not detected in the method blanks; therefore, data were not qualified based on this criteria.
- No trip blank was associated with this sample. Therefore, data can not be qualified onthis criteria.
- Reporting Limits: All minimum reporting limit requirements were met.
- Surrogates: Field surrogate exceeded control limits due to matrix interference in sample EL-A201501. The GRO result is considered estimated (J-S).
- LCS: All acceptance criteria were met.
- Calibration: All acceptance criteria were met.

Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) SW8260B. The quality of the data are acceptable.

- Holding Times and Sample Handling: All holding time and sample handling criteria were met.
- Method Blanks: Target analytes were not detected in the method blanks; therefore, data were not qualified based on this criteria.
- No trip blank was associated with these samples. Therefore, data were not qualified based on this criteria.
- Reporting Limits: All minimum reporting limit requirements were met.
- Surrogates: All acceptance criteria were met.
- LCS: All acceptance criteria were met.
- Calibration: All acceptance criteria were met.

Diesel Range Organics (DRO) AK102. Overall, the quality of the data are acceptable with the following qualifications:

- Holding Times and Sample Handling: All hold time criteria were met.
- Method Blanks: Target analytes were not detected in the method blanks; therefore, data were not qualified based on this criteria.
- Reporting Limits: All minimum reporting limit requirements were met.
- Surrogates: DRO surrogate exceeded control limits due to matrix interference for sample EL-A201502..The DRO result is considered estimated (J-S).
- LCS: All acceptance criteria were met.
- Calibration: All acceptance criteria were met.

Polynuclear Aromatic Hydrocarbons (PAH) SW8270C Selective Ion Monitoring (SIM). The quality of the data are acceptable.

- Holding Times and Sample Handling: All holding time and sample handling criteria were met.
- Method Blanks: Target analytes were not detected in the method blanks; therefore, data were not qualified based on this criteria.
- Reporting Limits: All minimum reporting limit requirements were met.
- Surrogates: All acceptance criteria were met.
- LCS: All acceptance criteria were met.
- Calibration: All acceptance criteria were met.

Considering these noncompliance issues the data are still considered usable. The overall project completeness goal of 95 percent was met.

| | | Location | E01ELM-ST534SIDEWALL | | JE01ELM-ST534SIDEWALL | | JE01ELM-ST534NW-BOTTOM | |
|---|---|---|---|---|---|---|---|---|
| | | Sample ID | EL-A201501 | | EL-A201502 | | EL-A201503 | |
| | | Laboratory | CTE | | CTE | | CTE | |
| | | Lab Sample ID | 1015259001 | | 1015259002 | | 1015259003 | |
| | | Collection Date | 8/10/01 | | 8/10/01 | | 8/10/01 | |
| | | Matrix | SO | | SO | | SO | |
| **Analyte** | **Method** | **Units** | | | | | | |
| Total Solids | A2540G | PERCENT | 91.6 | [0] | 91.6 | [0] | 96.2 | |
| Gasoline Range Organics | AK101 | MG/KG | - | - | - | - | - | |
| Diesel Range Organics | AK102 | MG/KG | - | - | 3030 | [110]J-S | 7.55 | [10.4 |
| Residual Range Organics | AK103 | MG/KG | - | - | - | - | - | |
| Acenaphthene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Acenaphthylene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Anthracene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Benzo(a)anthracene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Benzo(a)pyrene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Benzo(b)fluoranthene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Benzo(g,h,i)perylene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Benzo(k)fluoranthene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Chrysene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Dibenzo(a,h)anthracene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Fluoranthene | SW8270C SIM | UG/KG | - | - | 4.32 | [6.53] J | - | |
| Fluorene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Indeno(1,2,3-cd)pyrene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Naphthalene | SW8270C SIM | UG/KG | - | - | 80.3 | [6.53] | - | |
| Phenanthrene | SW8270C SIM | UG/KG | - | - | ND | [6.53] | - | |
| Pyrene | SW8270C SIM | UG/KG | - | - | 6.21 | [6.53] J | - | |
| Benzene | SW8260B | MG/KG | ND | [0.0133] | - | - | - | |
| Ethylbenzene | SW8260B | MG/KG | 0.0084 | [0.0255] J | - | - | - | |
| Toluene | SW8260B | MG/KG | 0.0271 | [0.0255] | - | - | - | |
| Total Xylenes | SW8260B | MG/KG | 0.3630 | [0.0255] | - | - | - | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Location | JE01ELM-ST534NW-BOTTOM | | JE01ELM-ST534NE-BOTTOM | |
| | | Sample ID | EL-A201504 | | EL-A201505 | |
| | | Laboratory | CTE | | CTE | |
| | | Lab Sample ID | 1015259004 | | 1015259005 | |
| | | Collection Date | 8/10/01 | | 8/10/01 | |
| | | Matrix | SO | | SO | |
| **Analyte** | **Method** | **Units** | | | | |
| Total Solids | A2540G | PERCENT | 96.2 | [0] | 95.2 | [0] |
| Gasoline Range Organics | AK101 | MG/KG | - | - | - | - |
| Diesel Range Organics | AK102 | MG/KG | - | - | ND | [10.5] |
| Residual Range Organics | AK103 | MG/KG | - | - | - | - |
| Acenaphthene | SW8270C SIM | UG/KG | - | - | - | - |
| Acenaphthylene | SW8270C SIM | UG/KG | - | - | - | - |
| Anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(a)anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(a)pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(b)fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(g,h,i)perylene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(k)fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Chrysene | SW8270C SIM | UG/KG | - | - | - | - |
| Dibenzo(a,h)anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Fluorene | SW8270C SIM | UG/KG | - | - | - | - |
| Indeno(1,2,3-cd)pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Naphthalene | SW8270C SIM | UG/KG | - | - | - | - |
| Phenanthrene | SW8270C SIM | UG/KG | - | - | - | - |
| Pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzene | SW8260B | MG/KG | ND | [0.0091] | - | - |
| Ethylbenzene | SW8260B | MG/KG | 0.0085 | [0.0174] J | - | - |
| Toluene | SW8260B | MG/KG | 0.0235 | [0.0174] | - | - |
| Total Xylenes | SW8260B | MG/KG | 0.0303 | [0.0174] | - | - |

| Analyte | Method | Units | Location: JE01ELM-ST534NE-BOTTOM<br>Sample ID: EL-A201506<br>Laboratory: CTE<br>Lab Sample ID: 1015259006<br>Collection Date: 8/10/01<br>Matrix: SO | | Location: JE01ELM-ST534SE-BOTTOM<br>Sample ID: EL-A201507<br>Laboratory: CTE<br>Lab Sample ID: 1015259007<br>Collection Date: 8/10/01<br>Matrix: SO | |
|---|---|---|---|---|---|---|
| Total Solids | A2540G | PERCENT | 95.2 | [0] | 94.3 | [0] |
| Gasoline Range Organics | AK101 | MG/KG | - | - | - | - |
| Diesel Range Organics | AK102 | MG/KG | - | - | 6.69 | [10.6] J |
| Residual Range Organics | AK103 | MG/KG | - | - | - | - |
| Acenaphthene | SW8270C SIM | UG/KG | - | - | - | - |
| Acenaphthylene | SW8270C SIM | UG/KG | - | - | - | - |
| Anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(a)anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(a)pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(b)fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(g,h,i)perylene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(k)fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Chrysene | SW8270C SIM | UG/KG | - | - | - | - |
| Dibenzo(a,h)anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Fluorene | SW8270C SIM | UG/KG | - | - | - | - |
| Indeno(1,2,3-cd)pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Naphthalene | SW8270C SIM | UG/KG | - | - | - | - |
| Phenanthrene | SW8270C SIM | UG/KG | - | - | - | - |
| Pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzene | SW8260B | MG/KG | ND | [0.0092] | - | - |
| Ethylbenzene | SW8260B | MG/KG | 0.0066 | [0.0178] J | - | - |
| Toluene | SW8260B | MG/KG | 0.0242 | [0.0178] | - | - |
| Total Xylenes | SW8260B | MG/KG | 0.0685 | [0.0178] | - | - |

| | | Location | JE01ELM-ST534SE-BOTTOM | | JE01ELM-ST534SW-BOTTOM | |
|---|---|---|---|---|---|---|
| | | Sample ID | EL-A201508 | | EL-A201509 | |
| | | Laboratory | CTE | | CTE | |
| | | Lab Sample ID | 1015259008 | | 1015259009 | |
| | | Collection Date | 8/10/01 | | 8/10/01 | |
| | | Matrix | SO | | SO | |
| **Analyte** | **Method** | **Units** | | | | |
| Total Solids | A2540G | PERCENT | 94.3 | [0] | 94.2 | [0] |
| Gasoline Range Organics | AK101 | MG/KG | - | - | - | - |
| Diesel Range Organics | AK102 | MG/KG | - | - | ND | [10.6] |
| Residual Range Organics | AK103 | MG/KG | - | - | - | - |
| Acenaphthene | SW8270C SIM | UG/KG | - | - | - | - |
| Acenaphthylene | SW8270C SIM | UG/KG | - | - | - | - |
| Anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(a)anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(a)pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(b)fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(g,h,i)perylene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzo(k)fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Chrysene | SW8270C SIM | UG/KG | - | - | - | - |
| Dibenzo(a,h)anthracene | SW8270C SIM | UG/KG | - | - | - | - |
| Fluoranthene | SW8270C SIM | UG/KG | - | - | - | - |
| Fluorene | SW8270C SIM | UG/KG | - | - | - | - |
| Indeno(1,2,3-cd)pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Naphthalene | SW8270C SIM | UG/KG | - | - | - | - |
| Phenanthrene | SW8270C SIM | UG/KG | - | - | - | - |
| Pyrene | SW8270C SIM | UG/KG | - | - | - | - |
| Benzene | SW8260B | MG/KG | ND | [0.0095] | - | - |
| Ethylbenzene | SW8260B | MG/KG | ND | [0.0183] | - | - |
| Toluene | SW8260B | MG/KG | 0.0157 | [0.0183] J | - | - |
| Total Xylenes | SW8260B | MG/KG | 0.0155 | [0.0183] J | - | - |

| | | | | |
|---|---|---|---|---|
| | | Location | JE01ELM-ST534SW-BOTTOM | |
| | | Sample ID | EL-A201510 | |
| | | Laboratory | CTE | |
| | | Lab Sample ID | 1015259010 | |
| | | Collection Date | 8/10/01 | |
| | | Matrix | SO | |
| **Analyte** | **Method** | **Units** | | |
| Total Solids | A2540G | PERCENT | 94.2 | [0] |
| Gasoline Range Organics | AK101 | MG/KG | - | - |
| Diesel Range Organics | AK102 | MG/KG | - | - |
| Residual Range Organics | AK103 | MG/KG | - | - |
| Acenaphthene | SW8270C SIM | UG/KG | - | - |
| Acenaphthylene | SW8270C SIM | UG/KG | - | - |
| Anthracene | SW8270C SIM | UG/KG | - | - |
| Benzo(a)anthracene | SW8270C SIM | UG/KG | - | - |
| Benzo(a)pyrene | SW8270C SIM | UG/KG | - | - |
| Benzo(b)fluoranthene | SW8270C SIM | UG/KG | - | - |
| Benzo(g,h,i)perylene | SW8270C SIM | UG/KG | - | - |
| Benzo(k)fluoranthene | SW8270C SIM | UG/KG | - | - |
| Chrysene | SW8270C SIM | UG/KG | - | - |
| Dibenzo(a,h)anthracene | SW8270C SIM | UG/KG | - | - |
| Fluoranthene | SW8270C SIM | UG/KG | - | - |
| Fluorene | SW8270C SIM | UG/KG | - | - |
| Indeno(1,2,3-cd)pyrene | SW8270C SIM | UG/KG | - | - |
| Naphthalene | SW8270C SIM | UG/KG | - | - |
| Phenanthrene | SW8270C SIM | UG/KG | - | - |
| Pyrene | SW8270C SIM | UG/KG | - | - |
| Benzene | SW8260B | MG/KG | ND | [0.0116] |
| Ethylbenzene | SW8260B | MG/KG | ND | [0.0223] |
| Toluene | SW8260B | MG/KG | 0.0228 | [0.0223] |
| Total Xylenes | SW8260B | MG/KG | 0.0176 | [0.0223] J |

# Case Narrative

**Customer: JACOBSE** **Jacobs Engineering Group**
**Project: 1015259** **Elmendorf SERA Sites 05M31201**
**NPDL WO: NA**

**1015259001 PS**
GRO/BTEX - Surrogate recovery is biased high due to matrix interference. Results are not affected.
No Trip Blank associated with this sample for volatiles analysis.

**1015259002 PS**
DRO - Pattern consistent with weathered middle distillate.
DRO - Surrogate recovery is outside controls due to matrix interference.

**1015259004 PS**
No Trip Blank associated with this sample for volatiles analysis.

**1015259006 PS**
No Trip Blank associated with this sample for volatiles analysis.

**1015259008 PS**
No Trip Blank associated with this sample for volatiles analysis.

**)15259010 PS**
No Trip Blank associated with this sample for volatiles analysis.

**385389 LCS**
DRO/RRO LCS/LCSD - Surrogate/s are biased high due to interference by method required petroleum spike.

CT&E Environmental Services Inc.
Laboratory Division

# Laboratory Analysis Report

200 W. Potter Drive
Anchorage, AK 99518-1605
Tel: (907) 562-2343
Fax: (907) 561-5301
Web: http://www.cteesi.com

Gloria Beckman
Jacobs Engineering Group
4300 B Street Suite 600
Anchorage, AK 99503

| | |
|---|---|
| **Work Order:** | 1015259 |
| | Elmendorf SERA Sites 05M31201 |
| **Client:** | Jacobs Engineering Group |
| **Report Date:** | August 27, 2001 |

Enclosed are the analytical results associated with the above workorder.

As required by the state of Alaska and the USEPA, a formal Quality Assurance/Quality Control Program is maintained by CT&E. A copy of our Quality Control Manual that outlines this program is available at your request.

Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth in our Quality Assurance Program Plan.

If you have any questions regarding this report or if we can be of any other assistance, please call your CT&E Project Manager at (907) 562-2343.

The following descriptors may be found on your report which will serve to further qualify the data.

| | |
|---|---|
| U | Indicates the analyte was analyzed for but not detected. |
| F | Indicates an estimated value that falls below PQL, but is greater than the MDL. |
| B | Indicates the analyte is found in the blank associated with the sample. |
| * | The analyte has exceeded allowable limits. |
| GT | Greater Than |
| D | Secondary Dilution |
| LT | Less Than |
| ! | Surrogate out of range |

| | |
|---|---|
| **CT&E Ref.#** | 1015259001 |
| **Client Name** | Jacobs Engineering Group |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 |
| **Client Sample ID** | EL-A201501 |
| **Matrix** | Soil/Solid |
| **Ordered By** | |

| | |
|---|---|
| **Client PO#** | |
| **Printed Date/Time** | 08/27/2001 11:41 |
| **Collected Date/Time** | 08/10/2001 14:46 |
| **Received Date/Time** | 08/10/2001 16:50 |
| **Technical Director** | Stephen C. Ede |
| **Released By** | Heather S Hall |

**Sample Remarks:**

GRO/BTEX - Surrogate recovery is biased high due to matrix interference. Results are not affected.
No Trip Blank associated with this sample for volatiles analysis.

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 91.6 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Volatile Fuels Department** | | | | | | | | |
| Gasoline Range Organics | 67.7 | 2.55 | mg/Kg | AK101 GRO | | 08/10/01 | 08/16/01 | RMV |
| **S gates** | | | | | | | | |
| 1,4-Difluorobenzene <Surr> | 93.1 | | % | AK101 GRO | 60-120 | 08/10/01 | 08/16/01 | RMV |
| 4-Bromofluorobenzene <Surr> | 239 ! | | % | AK101 GRO | 50-150 | 08/10/01 | 08/16/01 | RMV |
| **Volatile Gas Chromatography/Mass Spectroscopy** | | | | | | | | |
| Benzene | 0.0133 U | 0.0133 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| Toluene | 0.0271 | 0.0255 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| Ethylbenzene | 0.00842F | 0.0255 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| P & M -Xylene | 0.0258 | 0.0255 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| o-Xylene | 0.0105F | 0.0255 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| **Surrogates** | | | | | | | | |
| 1,2-Dichloroethane-D4 <surr> | 98.8 | | % | BTEX by SW8260B | 74-133 | 08/10/01 | 08/17/01 | KWM |
| Toluene-d8 <surr> | 97.8 | | % | BTEX by SW8260B | 78-134 | 08/10/01 | 08/17/01 | KWM |
| 4-Bromofluorobenzene <Surr> | 78.1 | | % | BTEX by SW8260B | 72-141 | 08/10/01 | 08/17/01 | KWM |
| Dibromofluoromethane <surr> | 99.5 | | % | BTEX by SW8260B | 78-128 | 08/10/01 | 08/17/01 | KWM |

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| | | | |
|---|---|---|---|
| **CT&E Ref.#** | 1015259002 | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | **Collected Date/Time** | 08/10/2001 14:46 |
| **Client Sample ID** | EL-A201502 | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | **Released By** | |

**Sample Remarks:**

DRO - Pattern consistent with weathered middle distillate.
DRO - Surrogate recovery is outside controls due to matrix interference.

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 91.6 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Semivolatile Organic Fuels Department** | | | | | | | | |
| Diesel Range Organics | 3030 | 110 | mg/Kg | AK102 DRO | | 08/14/01 | 08/17/01 | MCM |
| **Surrogates** | | | | | | | | |
| 5a Androstane <surr> | 272 ! | | % | AK102 DRO | 50-150 | 08/14/01 | 08/17/01 | MCM |
| **Polynuclear Aromatics GC/MS** | | | | | | | | |
| Naphthalene | 80.3 | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Acenaphthene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Pyrene | 6.21F | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Chrysene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Benzo[b]Fluoranthene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Acenaphthylene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Indeno[1,2,3-c,d] pyrene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Fluorene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Dibenzo[a,h]anthracene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Phenanthrene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Anthracene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Fluoranthene | 4.32F | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Benzo(a)Anthracene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Benzo[k]fluoranthene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Benzo[a]pyrene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| Benzo[g,h,i]perylene | 6.53 U | 6.53 | ug/Kg | PAH SIM | | 08/13/01 | 08/15/01 | SPM |
| **Surrogates** | | | | | | | | |
| Naphthalene-d8 <surr/IS> | 58.2 | | % | PAH SIM | 10-138 | 08/13/01 | 08/15/01 | SPM |

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| | | | |
|---|---|---|---|
| **CT&E Ref.#** | 1015259002 | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | **Collected Date/Time** | 08/10/2001 14:46 |
| **Client Sample ID** | EL-A201502 | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | | |

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Polynuclear Aromatics GC/MS** | | | | | | | | |
| Acenaphthene-d10 <surr/IS> | 70.3 | | % | PAH SIM | 10-147 | 08/13/01 | 08/15/01 | SPM |
| Chrysene-d12 <surr/IS> | 80.1 | | % | PAH SIM | 16-147 | 08/13/01 | 08/15/01 | SPM |

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| | | | |
|---|---|---|---|
| **CT&E Ref.#** | 1015259003 | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | **Collected Date/Time** | 08/10/2001 14:55 |
| **Client Sample ID** | EL-A201503 | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | **Released By** | Heather S Hale |

**Sample Remarks:**

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 96.2 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Semivolatile Organic Fuels Department** | | | | | | | | |
| Diesel Range Organics | 7.55F | 10.4 | mg/Kg | AK102 DRO | | 08/14/01 | 08/15/01 | MCM |
| **Surrogates** | | | | | | | | |
| 5a Androstane <surr> | 83.4 | | % | AK102 DRO | 50-150 | 08/14/01 | 08/15/01 | |

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|---|---|---|---|---|
| **CT&E Ref.#** | 1015259004 | | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | | **Collected Date/Time** | 08/10/2001 14:55 |
| **Client Sample ID** | EL-A201504 | | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | | **Released By** | Heather S Hall |

**Sample Remarks:**
No Trip Blank associated with this sample for volatiles analysis.

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 96.2 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Volatile Gas Chromatography/Mass Spectroscopy** | | | | | | | | |
| Benzene | 0.00906 U | 0.00906 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| Toluene | 0.0235 | 0.0174 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| Ethylbenzene | 0.00854F | 0.0174 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| P[illegible]-Xylene | 0.0216 | 0.0174 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| o-Xylene | 0.00871F | 0.0174 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| **Surrogates** | | | | | | | | |
| 1,2-Dichloroethane-D4 <surr> | 104 | | % | BTEX by SW8260B | 74-133 | 08/10/01 | 08/17/01 | KWM |
| Toluene-d8 <surr> | 101 | | % | BTEX by SW8260B | 78-134 | 08/10/01 | 08/17/01 | KWM |
| 4-Bromofluorobenzene <Surr> | 90.4 | | % | BTEX by SW8260B | 72-141 | 08/10/01 | 08/17/01 | KWM |
| Dibromofluoromethane <surr> | 106 | | % | BTEX by SW8260B | 78-128 | 08/10/01 | 08/17/01 | KWM |

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**CT&E Ref.#** 1015259005
**Client Name** Jacobs Engineering Group
**Project Name/#** Elmendorf SERA Sites 05M31201
**Client Sample ID** EL-A201505
**Matrix** Soil/Solid
**Ordered By**

**Client PO#**
**Printed Date/Time** 08/27/2001 11:41
**Collected Date/Time** 08/10/2001 15:00
**Received Date/Time** 08/10/2001 16:50
**Technical Director** Stephen C. Ede
**Released By** Heather S Hall

**Sample Remarks:**

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 95.2 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Semivolatile Organic Fuels Department** | | | | | | | | |
| Diesel Range Organics | 10.5 U | 10.5 | mg/Kg | AK102 DRO | | 08/14/01 | 08/15/01 | MCM |
| **Surrogates** | | | | | | | | |
| 5a Androstane <surr> | 84.2 | | % | AK102 DRO | 50-150 | 08/14/01 | 08/15/01 | M |

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| | | | |
|---|---|---|---|
| **CT&E Ref.#** | 1015259006 | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | **Collected Date/Time** | 08/10/2001 15:00 |
| **Client Sample ID** | EL-A201506 | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | **Released By** | Heather S Hall |

**Sample Remarks:**

No Trip Blank associated with this sample for volatiles analysis.

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 95.2 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Volatile Gas Chromatography/Mass Spectroscopy** | | | | | | | | |
| Benzene | 0.00925 U | 0.00925 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| To[illegible]e | 0.0242 | 0.0178 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| E[illegible]nzene | 0.00658F | 0.0178 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| [illegible]-Xylene | 0.0260 | 0.0178 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| o-Xylene | 0.00854F | 0.0178 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| **Surrogates** | | | | | | | | |
| 1,2-Dichloroethane-D4 <surr> | 103 | | % | BTEX by SW8260B | 74-133 | 08/10/01 | 08/17/01 | KWM |
| Toluene-d8 <surr> | 99.3 | | % | BTEX by SW8260B | 78-134 | 08/10/01 | 08/17/01 | KWM |
| 4-Bromofluorobenzene <Surr> | 90.1 | | % | BTEX by SW8260B | 72-141 | 08/10/01 | 08/17/01 | KWM |
| Dibromofluoromethane <surr> | 103 | | % | BTEX by SW8260B | 78-128 | 08/10/01 | 08/17/01 | KWM |

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| | | | |
|---|---|---|---|
| **CT&E Ref.#** | 1015259007 | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | **Collected Date/Time** | 08/10/2001 15:10 |
| **Client Sample ID** | EL-A201507 | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | **Released By** | (signature) |

**Sample Remarks:**

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 94.3 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Semivolatile Organic Fuels Department** | | | | | | | | |
| Diesel Range Organics | 6.69F | 10.6 | mg/Kg | AK102 DRO | | 08/14/01 | 08/15/01 | MCM |
| **Surrogates** | | | | | | | | |
| 5a Androstane <surr> | 82.1 | | % | AK102 DRO | 50-150 | 08/14/01 | 08/15/01 | [illegible] |

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| | | | | |
|---|---|---|---|---|
| **CT&E Ref.#** | 1015259008 | | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | | **Collected Date/Time** | 08/10/2001 15:10 |
| **Client Sample ID** | EL-A201508 | | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | | **Released By** | Heather S Hale |

**Sample Remarks:**

No Trip Blank associated with this sample for volatiles analysis.

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 94.3 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Volatile Gas Chromatography/Mass Spectroscopy** | | | | | | | | |
| Benzene | 0.00951 U | 0.00951 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| Toluene | 0.0157F | 0.0183 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| Et[illegible]nzene | 0.0183 U | 0.0183 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| [illegible]-Xylene | 0.0155F | 0.0183 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| o-Xylene | 0.0183 U | 0.0183 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/17/01 | KWM |
| **Surrogates** | | | | | | | | |
| 1,2-Dichloroethane-D4 <surr> | 104 | | % | BTEX by SW8260B | 74-133 | 08/10/01 | 08/17/01 | KWM |
| Toluene-d8 <surr> | 94.7 | | % | BTEX by SW8260B | 78-134 | 08/10/01 | 08/17/01 | KWM |
| 4-Bromofluorobenzene <Surr> | 85 | | % | BTEX by SW8260B | 72-141 | 08/10/01 | 08/17/01 | KWM |
| Dibromofluoromethane <surr> | 103 | | % | BTEX by SW8260B | 78-128 | 08/10/01 | 08/17/01 | KWM |

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**CT&E Ref.#** 1015259009
**Client Name** Jacobs Engineering Group
**Project Name/#** Elmendorf SERA Sites 05M31201
**Client Sample ID** EL-A201509
**Matrix** Soil/Solid
**Ordered By**

**Client PO#**
**Printed Date/Time** 08/27/2001 11:41
**Collected Date/Time** 08/10/2001 15:15
**Received Date/Time** 08/10/2001 16:50
**Technical Director** Stephen C. Ede
**Released By** Heather S Hall

**Sample Remarks:**

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 94.2 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Semivolatile Organic Fuels Department** | | | | | | | | |
| Diesel Range Organics | 10.6 U | 10.6 | mg/Kg | AK102 DRO | | 08/14/01 | 08/15/01 | MCM |
| **Surrogates** | | | | | | | | |
| 5a Androstane <surr> | 83.5 | | % | AK102 DRO | 50-150 | 08/14/01 | 08/15/01 | |

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| | | | |
|---|---|---|---|
| **CT&E Ref.#** | 1015259010 | **Client PO#** | |
| **Client Name** | Jacobs Engineering Group | **Printed Date/Time** | 08/27/2001 11:41 |
| **Project Name/#** | Elmendorf SERA Sites 05M31201 | **Collected Date/Time** | 08/10/2001 15:15 |
| **Client Sample ID** | EL-A201510 | **Received Date/Time** | 08/10/2001 16:50 |
| **Matrix** | Soil/Solid | **Technical Director** | Stephen C. Ede |
| **Ordered By** | | **Released By** | Heather S Hall |

**Sample Remarks:**

No Trip Blank associated with this sample for volatiles analysis.

| Parameter | Results | PQL | Units | Method | Allowable Limits | Prep Date | Analysis Date | Init |
|---|---|---|---|---|---|---|---|---|
| **Solids** | | | | | | | | |
| Total Solids | 94.2 | 0.00 | % | SM20 2540G | | | 08/17/01 | DMR |
| **Volatile Gas Chromatography/Mass Spectroscopy** | | | | | | | | |
| Benzene | 0.0116 U | 0.0116 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/18/01 | KWM |
| Toluene | 0.0228 | 0.0223 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/18/01 | KWM |
| Et[illegible]zene | 0.0223 U | 0.0223 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/18/01 | KWM |
| P[illegible]-Xylene | 0.0176F | 0.0223 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/18/01 | KWM |
| o-Xylene | 0.0223 U | 0.0223 | mg/Kg | BTEX by SW8260B | | 08/10/01 | 08/18/01 | KWM |
| **Surrogates** | | | | | | | | |
| 1,2-Dichloroethane-D4 <surr> | 98.2 | | % | BTEX by SW8260B | 74-133 | 08/10/01 | 08/18/01 | KWM |
| Toluene-d8 <surr> | 95 | | % | BTEX by SW8260B | 78-134 | 08/10/01 | 08/18/01 | KWM |
| 4-Bromofluorobenzene <Surr> | 87.5 | | % | BTEX by SW8260B | 72-141 | 08/10/01 | 08/18/01 | KWM |
| Dibromofluoromethane <surr> | 99.2 | | % | BTEX by SW8260B | 78-128 | 08/10/01 | 08/18/01 | KWM |

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USE A BALLPOINT PEN, BLACK INK, AND ... ON THE BACK

| | |
|---|---|
| PROJECT NAME: Elmendorf SERA Sites | LABORATORY NAME & ADDRESS: CTE Environmental Services |
| PROJECT NUMBER: 05M31201 | 200 W. Potter Drive |
| WBS CODE: / CONTRACT / D.O. No. | Anchorage, AK 99518 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | EL-A2015 01 | 8-10-01 | 1446 | KG SC | 1 | 4oz glass septum | Methol 4°C | So | AK 101, SW8260B (BTEX) | | |
| 2 | EL-A2015 02 | 8-10-01 | 1446 | KG SC | 2 | 8oz glass amber | 4°C | So | AK 102, SW8270SIM | | |
| 3 | EL-A2015 03 | 8-10-01 | 1455 | KG SC | 1 | 8oz glass amber | 4°C | So | AK/102 | | |
| 4 | EL-A2015 04 | 8-10-01 | 1455 | KG SC | 1 | 4oz glass septum | Methol 4°C | So | SW 8260B (BTEX) | | |
| 5 | EL-A2015 05 | 8-10-01 | 1500 | KG SC | 1 | 8oz glass Amber | 4°C | So | AK 102 | | |
| 6 | EL-A2015 06 | 8-10-01 | 1500 | KG SC | 1 | 4oz glass Septum | Methol 4°C | So | SW 8260B (BTEX) | | |
| 7 | EL-A2015 07 | 8-10-01 | 1510 | KG SC | 1 | 8oz glass Amber | 4°C | So | AK/102 | | |
| 8 | EL-A2015 08 | 8-10-01 | 1510 | KG SC | 1 | 4oz glass Septum | Methol 4°C | So | SW 8260B (BTEX) | | |
| 9 | EL-A2015 09 | 8-10-01 | 1515 | KG SC | 1 | 8oz glass Amber | 4°C | So | AK 102 | | |

COMMENTS:

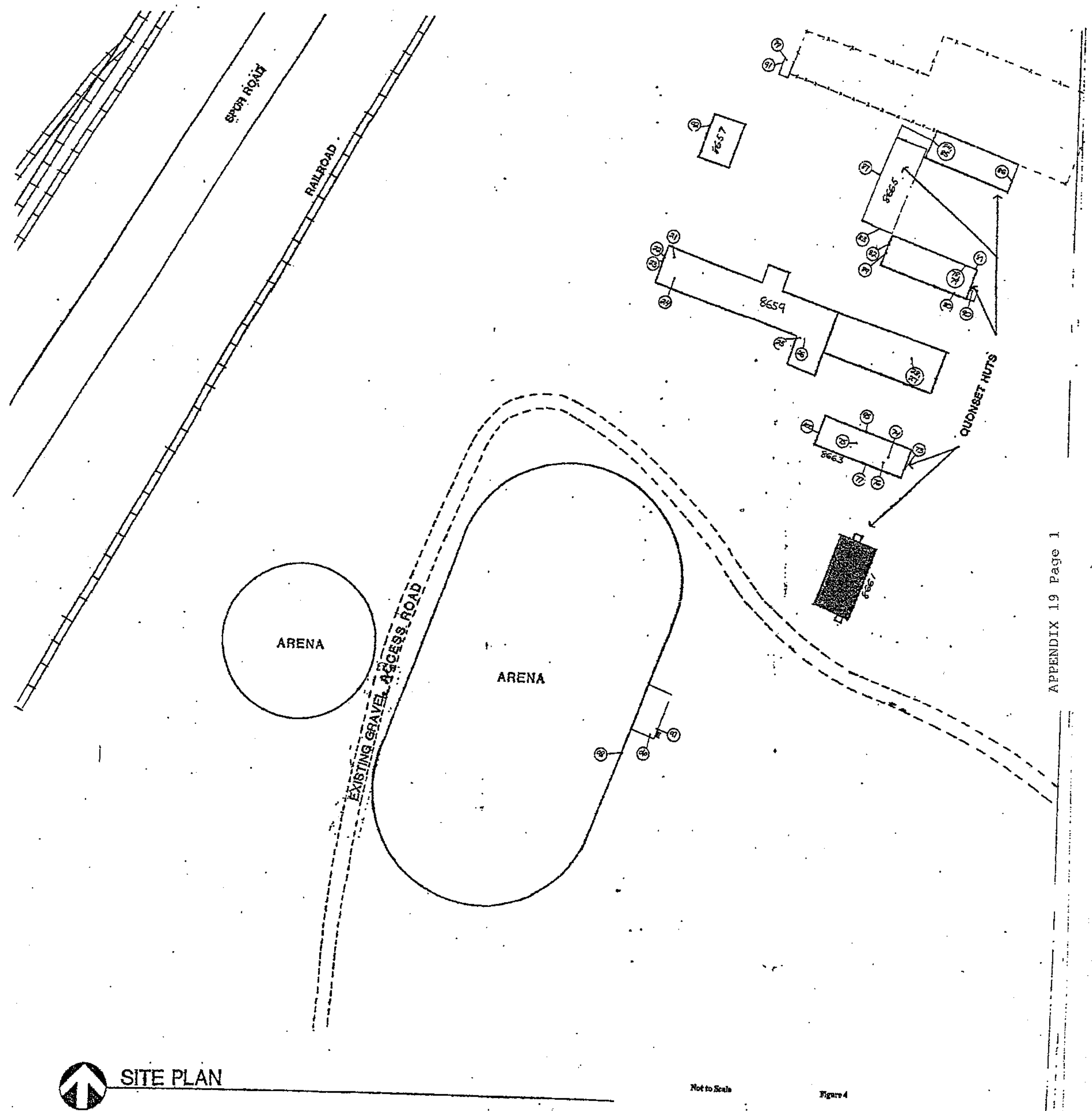
JE JACOBS ENGINEERING GROUP INC.
4300 B STREET, SUITE 600, ANCHORAGE, ALASKA 99503-5922
TELEPHONE (907) 563-3322 FAX (907) 563-3320

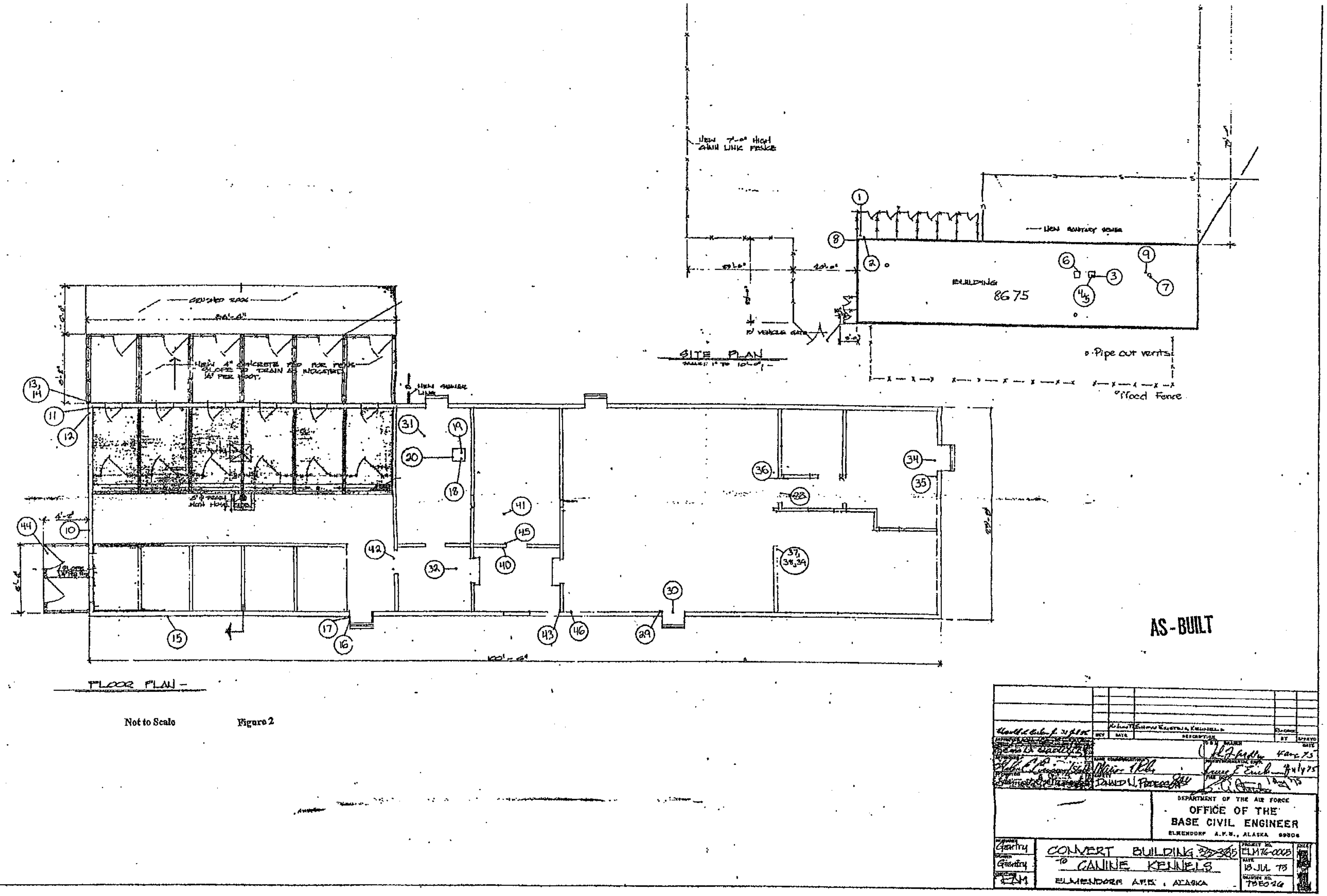
1015259 RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRML

| | |
|---|---|
| PROJECT NAME: ElmendorF AFB SERA Sites | LABORATORY NAME & ADDRESS: CTE |
| PROJECT NUMBER: 05M31201 | |
| WBS CODE: / CONTRACT / D.O. No. | |

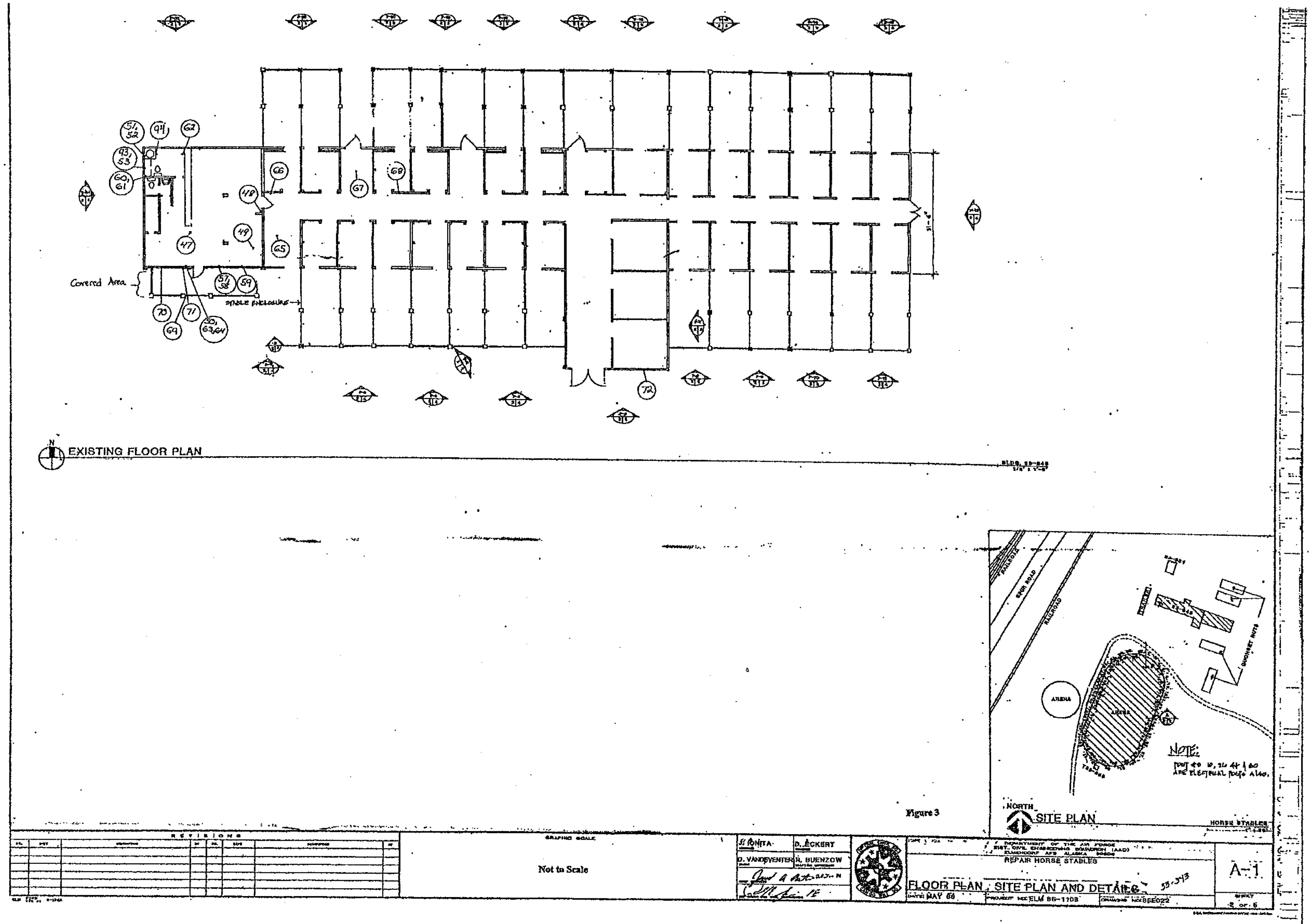
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | EL-A2015 10 | 8-10-01 | 1515 | KG SC | 1 | 4oz Septum | Methol 4°C | So | SW8260B (BTEX) | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |


SPUR ROAD
RAILROAD
8657
8665
8659
8663
8661
QUONSET HUTS
ARENA
ARENA
EXISTING GRAVEL ACCESS ROAD
SITE PLAN
NORTH
Not to Scale
Figure 4




Not to Scale

Figure 2


EXISTING FLOOR PLAN
Covered Area
STABLE ENCLOSURES
SITE PLAN
NORTH
ARENA
RAILROAD
NOTE:
Figure 3
Not to Scale
D. ECKERT
D. VANDEVENTER
R. BUENZOW
REPAIR HORSE STABLES
FLOOR PLAN, SITE PLAN AND DETAILS
A-1