5 CHAPTER 5

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GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

30 CEG - 30th Civil Engineer Group

30 CEG/CEF - 30th Civil Engineer Group, Fire Protection

45 and 30 LG - 45th and 30th Logistics Group

45 and 30 MDG/SGPB - 45th and 30th Medical Group, Bioenvironmental Engineering

45 CES - 45th Civil Engineer Squadron

45 CES/CEF - 45th Civil Engineering Squadron, Fire Protection

45 and 30 SW - 45th and 30th Space Wings

45 and 30 SW/SEG - 45th and 30th Space Wing, Ground Safety

45 and 30 SW/SES - 45th and 30th Space Wing, Systems Safety

ACGIH - American Conference of Governmental Industrial Hygienists

A50 - aerozine 50; a 50-50 blend of hydrazine and unsymmetrical dimethyl hydrazine

AFI - Air Force Instruction

AFM - Air Force Manual

AFOSH - Air Force Occupational Safety and Health

AFR - Air Force Regulation

AFSC - Air Force Systems Command

AFSPC - Air Force Space Command

AHU - air handling unit

AISC - American Institute of Steel Construction

ANSI - American National Standards Institute

ASCE - American Society of Civil Engineers

ASME - American Society of Mechanical Engineers

ASTM - American Society for Testing Materials

ATC - Applied Technology Council

AWS - American Welding Society

CCAS - Cape Canaveral Air Station

cDR - Conceptual Design Review

CDR - Critical Design Review, Command Destruct Receiver

CFR - Code of Federal Regulations

conventional facility or structure - office buildings, libraries, auditoriums, warehouses, cafeterias, utility buildings, and other facilities whose structures are characterized by well established design precedents and loading conditions and whose function is non-hazardous

critical facility or structure - a hazardous facility or structure; a facility used to store or process explosives; a facility or structure used to process high value hardware; a facility or structure that contains or is used to handle or process systems determined by Range Safety to be critical; a facility or structure determined to be critical by Range Safety

critical hardware or system - any hazardous or safety critical equipment or system; non-hazardous DoD high value items such as a payload, launch vehicles, or any unique item identified by DoD as critical; high value non-hazardous hardware owned by Range Users other than DoD may be identified as critical or non-critical by the Range User

DDESB - Department of Defense Explosive Safety Board

DoD - Department of Defense

DOT - Department of Transportation

EM - engineering manual

EGSE - electrical ground support equipment

EMI - electromagnetic interference

EPC - emergency power cutoff

ER - Eastern Range

explosion proof apparatus - an enclosure that will withstand an internal explosion of gases or vapors and prevent those gases or vapors from igniting the flammable atmosphere surrounding the enclosure, and whose external temperature will not ignite the surrounding flammable atmosphere

explosives - all ammunition, demolition material, solid rocket motors, liquid propellants, pyrotechnics, and ordnance as defined in AFMAN 91-201 and DoD 6055.9-STD

explosives facility - any facility that contains ex-

GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

plosives or is quantity distance sited or licensed to contain explosives

explosives quantity distance site plan - a formal plan required for explosive facilities and areas required per AFM 91-201 and DoD-STD 6055.9 detailing explosives quantity operating and storage limits and restrictions, and resultant distance clearance requirements

FDR - Final Design Review

FM - Factory Mutual Corporation; frequency modulation

FSDP - Facility Safety Data Package

ft - foot, feet

GN_2 - gaseous nitrogen

h - hour, hours

hazardous facility or structure - a facility or structure used to store, handle, or process hazardous materials or systems and/or perform hazardous operations

hazardous materials - liquids, gases, or solids that may be toxic, reactive, or flammable or that may cause oxygen deficiency; either by themselves or in combination with other materials.

hazardous operations - those operations classified as hazardous according to the following criteria: (1) consideration of the potential or kinetic energy involved, (2) changes such as pressure, temperature, and oxygen content in ambient environmental conditions, (3) presence of hazardous materials. Hazardous operations include, but are not limited to, the following types of operations: propellant transport, transfer, handling and sampling; ordnance transport, handling, checkout, installation, and connection; launch vehicle stages, payloads, and other critical loads hoists; pressure systems operating at pressures above 150 psig use and maintenance; radioactive and toxic material storage, transport, and handling; confined space entry and cleaning; flight termination checkout (See Chapter 4); radio frequency (RF) transmission; laser operations; cryogenic operations; energized circuit work. **NOTE**: Some low pressure systems operations such as those involving flight hardware, large volume systems, or those containing hazardous commodities may be classified as hazardous by Range Safety.

hazard proof - a method of making electrical equipment safe for use in hazardous locations; these methods include explosion proofing, intrinsically safe, purged and pressurized, and non-incendive and must be rated for the degree of hazard present

HVDS - Hypergolic Vapor Detection System

hydraulic - operating by water or other liquids under pressure

in. - inch, inches

intrinsically safe - incapable of producing sufficient energy to ignite an explosive atmosphere and two fault tolerant against failure with single fault tolerance against its most hazardous failure at 1.5 times the maximum voltage or energy

IR - infrared

KSC - Kennedy Space Center

lb - pound, pounds

LEL - lower explosive limit

MIC - meets intent certification; a non-compliance designation used to indicate that an equivalent level of safety is maintained despite not meeting the exact requirements stated in this document

MIL-HDBK - military handbook

MIL-SPEC - military specification

MIL-STD - military standard

MSPSP - Missile System Prelaunch Safety Package; a data package demonstrating compliance with the system safety requirements of Chapter 3, serves as a baseline for safety related information on the system throughout its life cycle

MMH - monomethyl hydrazine

N_2H_4 - hydrazine

NASA - National Aeronautics and Space Administration

NEC - *National Electrical Code*

NFPA - National Fire Protection Association

GLOSSARY OF ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

non-incendive - will not ignite group of gases or vapors for which it is rated; similar to "intrinsically safe," but does not include failure tolerance ratings; used in rating electrical products for Class, Division 2 locations only

OSHA - Occupational Safety and Health Act

O&SHA - Operating and Support Hazard Analysis

PDB - Project Definition Book

PDR - Preliminary Design Review

PPE - Personal Protective Equipment

RAMP - Requirements Analysis Management Plan

RIDs - Review Item Discrepancies

safety critical facility - a hazardous facility or a facility that is used to store, handle, or process systems determined to be safety critical by Range Safety

SCAPE - Self-Contained Atmospheric Protective Ensemble

SEAOC - Structural Engineers Association of California

THC - Toxic Hazard Corridor

Toxic Hazard Corridor - a sector in which toxic materials may reach predetermined concentration levels

UDMH - Unsymmetrical Dimethyl Hydrazine

UEL - upper explosive limit

UL - Underwriters Laboratories

USAF - United States Air Force

UT - ultrasonic testing; umbilical tower of a launch pad

UV - ultraviolet

WR - Western Range

REFERENCED DOCUMENTS

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

29 CFR 1910.23, *Guarding Floor and Wall Openings and Holes*

29 CFR 1910.106, *Flammable and Combustible Liquids*

29 CFR 1926.104, *Safety Belts, Lifelines, and Lanyards*

AFI 32-1065, *Grounding Systems*

AFI 32-2001, *The Fire Protection Operations and Fire Prevention Program*

AFM 88, *Air Force Civil Engineering Series Manuals*

AFM 88-3, Chapter 1, "Structural Design Criteria Loads"

AFM 88-3, Chapter 13, “Seismic Design For Building”

AFM 88-3, Chapter 14, "Design Criteria for Facilities in Areas Subject to Typhoons and Hurricanes"

AFM 88-9, Chapter 3, "Electrical Design, Lightning, and Static Electricity Protection"

AFMAN 91-201, *Explosives Safety Standards*

AFOSH 91 and 127, *Air Force Occupational Safety and Health (Safety Series)*

AFOSH 91-25, *Confined Spaces*

AFOSH 91-66, *General Industrial Operations*

AFOSH 127-43, *Flammable and Combustible Liquids*

AFR 88-22, *Structures to Resist the Effects of Accidental Explosions*

AISC, *Manual of Steel Construction-Allowable Stress Design*

AISC Manual S337, *Specification for Allowable Stress Design of Simple Shear Connections*

AISC Manual S329, *High Strength Fasteners*

ANSI/ASME A10.14, *Construction and Demolition Operation-Requirements for Safety Belts, Harnesses, Lanyards, and Lifelines for Construction and Demolition Use*

ANSI/ASME A17.1, *Safety Code for Elevators and Escalators*

ANSI/ASME A17.2, *Inspectors Manual for Elevators and Escalators*

ANSI/ASME Z359.1, *Safety Requirements for Personnel Fall Arrest Systems, Subsystems, and Components*

ANSI/EIA/TIA 222, *Structural Standards for Steel Antenna Towers and Antenna Supporting Structures*

ANSI/RIA R15.06, *Design, Installation, Testing, and Operation Requirements for Industrial Robots and Robot Systems*

ASCE 7-95, *Minimum Design Loads for Buildings and Other Structures*

ASTM A36/A36M-96, *Standard Specification for Carbon Structural Steel*

ASTM A53-96, *Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Weldless and Seamless*

ASTM A307-94, *Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength*

ASTM A325-96, *Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength*

ASTM A325 M-93, *Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)*

ASTM A490-93, *Standard Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength*

ASTM A490M-93, *Standard Specification for High-Strength-Strength Steel Bolts, Classes 10.9 and 10.9.3 for Structural Steel Joints (Metric)*

ASTM A500-93, *Standard Specification for Cold-Formed Welded and Seamless Carbon Steel*

REFERENCED DOCUMENTS

Structural Tubing in Rounds and Shapes

ASTM A501-93, *Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing*

ASTM E1444, *Magnetic Particle Inspection*

ATC 3-06, *Tentative Provisions for the Development of Seismic Regulations for Buildings, National Bureau of Standards*

AWS D1.1, *Structural Welding Code Steel*

DoDI-4145.26, *DoD Contractors' Safety Requirements for Ammunition and Explosives*

DoD 4145.26-M, *DoD Contractors' Safety Manual for Ammunition and Explosives*

DoD 6055.9-STD, *Ammunition and Explosives Safety Standards*

EM 385-1-1, *US Army Corps of Engineers Safety and Health Requirements Manual*

KSC-STD-C-0001, *Recommendations for Protective Coating Procedures and Materials for Exterior Structural Steel in Hypergolic Storage Facilities*

KSC-STD-E-0012, *Standard for Bonding and Grounding*

MIL-B-5087, *Bonding, Electrical, and Lightning Protection for Aerospace Systems*

MIL-HDBK-419, *Grounding, Bonding, and Shielding for Electronic Equipment and Facilities*

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

MIL-HDBK-1190, *Facility Planning & Design Guide*

MIL-STD-188/124, *Grounding, Bonding, and Shielding for Electronic Equipment and Facilities*

MIL-STD-410E, *Non-Destructive Examination Personnel Qualification and Certification*

MIL-STD-810, *Environmental Test Methods and Engineering Guidelines*

MIL-STD-882, *System Safety Program Requirements*

MIL-STD-1472, *Human Engineering Design Criteria for Military Systems, Equipment, and Facilities*

MIL-STD-1542, *Electromagnetic Compatibility and Grounding Requirements for Space System Facilities*

MIL-STD-2154, *Ultrasonic Inspection for Wrought Metals*

NEC Article 480, *Storage Batteries*

NEC Article 500, *Hazardous (Classified) Locations*

NEC Section 500-3, *Hazardous Atmospheric Groups*

NEC Article 504, *Intrinsically Safe Systems*

NFPA 15, *Water Spray Fixed Systems for Fire Protection*

NFPA 30 *Flammable and Combustible Liquids Code*

NFPA 70, *National Electric Code*

NFPA 77, *Static Electricity*

NFPA 101, *Life Safety Code*

NFPA 780, *Lightning Protection Systems*

NFPA 496, *Purges and Pressurized Enclosures for Electrical Equipment*

NFPA 497, *Recommended Standard Practice for Classification of Class 1 Hazardous Locations (Classified) for Electrical Installations in Chemical Process Areas*

SEAOC, *Recommended Lateral Force Requirements and Tentative Commentary*

SNT-TC-1A, *American Society for Non-Destructive Testing Standards*

Society for Non-Destructive Testing Standards

Standard Building Code

Uniform Building Code

UL 913, *Construction and Testing: Intrinsically Safe Apparatus and Associated Apparatus*

CHAPTER 5
FACILITIES AND STRUCTURES DOCUMENTATION, DESIGN, CONSTRUCTION, TEST, AND INSPECTION REQUIREMENTS

5.1 INTRODUCTION

5.1.1 Purpose of the Chapter

Chapter 5 specifies minimum design, test, inspection and data requirements for the construction and modification of conventional and critical facilities and structures at the Eastern Range (ER) and Western Range (WR). The following major topics are addressed:

5.2 Responsibilities and Authorities
5.3 Facilities and Structures Design and Construction Site Policies
5.4 Documentation Requirements
5.5 Conventional Facilities and Structures
5.6 Critical Facilities and Structures
5.7 Facility and Structure Emergency and Critical Systems Test Requirements
5.8 Critical Facilities and Structures Initial Inspection Requirements

5.1.2 Applicability

All ER and WR facilities and structures are subject to the requirements of this document regardless of real property accountability or ownership, including Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and commercial users.

5.2 RESPONSIBILITIES AND AUTHORITIES

5.2.1 Systems Safety, 45th Space Wing and 30th Space Wing

Any design standard having a reference to the "authority having jurisdiction" shall be interpreted to mean the 45th and 30th Space Wing, Systems Safety (SES) with the exception of the National Fire Protection Association (NFPA) standards, but not NFPA 70, the *National Electrical Code* (NEC). **NOTE:** Unless otherwise noted, all references to *Range Safety* in this Chapter refer to 45 SW/SES or 30 SW/SES. Range Safety is responsible for the following:

a. Reviewing and approving the design, construction, modification, or demolition of all facilities and structures on the Ranges

b. Assisting Civil Engineering (45 CES and 30 CEG), in preparing explosive quantity distance site plans and for submitting them (with Civil Engineering assistance), to the Department of Defense Explosive Safety Board (DDESB) through engineering and safety channels for review and approval.

c. In conjunction with Civil Engineering (45 CES and 30 CEG), reviewing and approving facility or structure modification or operational changes that

affect explosive site plans or hazard level of the facility

d. Approving the movement or relocation of a hazardous operation and/or system into a facility or structure even if the facility or structure has been used for similar operations in the past

e. In conjunction with Bioenvironmental Engineering (45 and 30 MDG/SGPB) and the Fire Marshal, (45 CES/CEF, 30 CEG/CEF) reviewing and approving the performance characteristics of hypergolic propellant vapor control foam and delivery system design

f. In conjunction with Bioenvironmental Engineering (45 and 30 MDG/SGPB), reviewing and approving the requirements for and design of air monitoring systems

g. Performing surveillance and support of hazardous and safety critical operations as applicable to this Chapter. **NOTE:** Certain areas covered by AFI 31-101, Chapter 10, "Standard for DoD Space Lift Operations Systems are exempted.

5.2.2 Range Users

Range Users are responsible for the following:

a. Ensuring that all facilities and structures under their jurisdiction are designed, constructed, modified, and demolished in accordance with the provisions of this Chapter

b. Ensuring construction site safety

c. Coordinating with Bioenvironmental Engineering (45 and 30 MDG/SGPB) in the design of scrubbers and incinerators, hypergolic propellant vapor control foam and delivery systems, and air monitoring systems

d. Coordinating with the Fire Marshal (45 CES/CEF and 30 CEG/CEF) in the design of fire protection systems and conduct of fire protection activities

e. Assisting in the preparation of explosive site plans

5.2.3 Supporting Agencies

5.2.3.1 Civil Engineer Squadron, 45th Space Wing, and Civil Engineer Group, 30th Space Wing

The Civil Engineer Squadron, 45th Space Wing (45 CES) and the Civil Engineer Group, 30th Space Wing (30 CEG) are responsible for the following: **NOTE:** Unless otherwise noted, these agencies will be referred to as *Civil Engineering*.

a. Preparing explosive site plans in coordination with the Range User and Range Safety, and assisting Range Safety to submit them to the DDESB through engineering and safety channels. **NOTE:** The DDESB is responsible for reviewing and approving explosive site plans.

b. Obtaining permits for scrubbers and incinerators

c. In conjunction with Range Safety, reviewing and approving facility and structure modification or operational changes that affect explosive site plans

5.2.3.2 Fire Marshal, 45th Space Wing and 30th Space Wing

Any design standard in the NFPA standards with the exception of NFPA 70, having a reference to the "authority having jurisdiction" shall be interpreted to mean the 45th or 30th Space Wing, Fire Marshal (45 CES/CEF and 30 CEG/CEF). **NOTE:** Unless otherwise noted, these agencies will be referred to as the *Fire Marshal*. The Fire Marshals are responsible for the following:

a. Providing necessary information to Civil Engineering and Range Safety in regard to Range facilities and structures fire protection requirements

b. Coordinating with Range Safety to ensure that facilities and structures on the Ranges meet national fire protection standards

c. Reviewing and approving fire protection plans in accordance with AFI 32-2001

d. Conducting fire protection activities in accordance with MIL-HDBK-1008

e. In conjunction with Range Safety and Bioenvironmental Engineering, reviewing and approving the performance characteristics of hypergolic propellant vapor control foam and delivery systems design

5.2.3.3 Bioenvironmental Engineering, 45th Space Wing and 30th Space Wing

Bioenvironmental Engineering, 45th Space Wing (45 MDG/SGPB) and 30th Space Wing (30 MDG/SGPB) are responsible for the following: **NOTE:** Unless otherwise noted, these agencies will be referred to as *Bioenvironmental Engineering*.

a. Reviewing and approving the design of scrubbers and incinerators

b. In conjunction with Range Safety and the Fire Marshal (45 CES/CEF and 30 CES/CEF), review-

ing and approving the performance characteristics of hypergolic propellant vapor control foam and delivery systems design

c. In conjunction with Range Safety, reviewing and approving the requirements for and design of air monitoring systems

5.2.3.4 Operations Safety

The Range Support Contractor at the ER and the 30th Space Wing Ground Safety Section (30 SW/SEG) at the WR shall be referred to as *Operations Safety*. Operations Safety is responsible for inspecting new and modified facilities and structures prior to initial startup operations in accordance with AFMAN 91-201 and DoD 6055.9-STD.

5.3 FACILITIES AND STRUCTURES DESIGN AND CONSTRUCTION SITE POLICIES

5.3.1 Design, Construction, and Modification Policy

All facilities and structures designed, constructed, and modified for use on the Ranges shall meet the standards and provisions established in Chapters 3 and 5 of this document and in other nationally recognized codes and standards, including applicable state regulations.

5.3.2 Location Planning Requirements

During the planning phase for construction or modification of facilities, the following requirements shall be taken into consideration:

a. The impact of the new facility operations to existing and planned near-by facilities, base cantonment areas, and off-base population centers as well as the impact of existing and planned near-by facilities on the new facility operations shall be addressed.

b. Facilities shall not be located inside an existing explosive safety clear zone unless the facility is related to the existing explosive-sited facility.

c. Overflight hazards shall be considered and critical facilities should not be located immediately downrange of existing launch sites.

d. Location of facilities shall address operational impact from hypergolic transfer and storage operation in near-by facilities.

e. Location of facilities that may contain hypergolic commodities shall address Toxic Hazard Corridors (THC) (see Chapter 6) and the potential impact on the general public and near-by facilities.

f. RF hazards shall be addressed.

5.3.3 Construction Site Safety Policy

With the exception of item *d* below, construction site safety shall be the sole responsibility of the Range User or contractor when the construction contract is issued by one of the following:

a. The United States Army Corps of Engineers

b. A Range User or contractor where the accountability of a 45/30 SW facility or work area is transferred to another Range User or contractor for construction and modification purposes

c. A United States Department of Transportation (DOT) commercial contractor or other non-United States Air Force (USAF) agencies, such as NASA, involved in construction activities on their own accountable facilities and launch complexes

d. All construction activities conducted within or in the vicinity of sites used to store or handle hazardous systems, high value equipment, or flight hardware shall be monitored by Range Safety with the authority to impose a hold (stop work) when unsafe conditions exist. However, the Range User or contractor shall continue to have ultimate responsibility for safety on the site.

5.3.3.1 Compliance with Occupational Safety and Health Administration Regulations

Construction site activities on the Ranges shall comply with Occupational Safety and Health Administration (OSHA) General Industry and Construction Standards (29 CFR 1910 and 1926). **NOTE:** Range Safety shall assume no liability for Range User or contractor compliance or noncompliance with OSHA requirements.

5.3.3.2 Compliance with the United States Army Corps of Engineers Safety and Health Requirements Manual and Other Criteria

Construction site activities on the Ranges should be performed in accordance with EM 385-1-1 and the criteria stated below. **NOTE:** Range Safety shall assume no liability for Range User or contractor compliance or noncompliance with this document or criteria.

a. The construction contractor project superintendent or a designated representative should be at the work site when work is being performed and should serve as the single point of contact on all questions concerning job site safety.

b. Safety violations should result in Contract Administrator actions, including stopping work.

c. Accidents and injuries should be reported to the Administrative Contracting Officer.

1. Serious mishaps should be reported as soon as possible.

2. The Administrative Contracting Officer should notify 45 or 30 SW/SEG, Ground Safety, of serious accidents and injuries.

5.4 DOCUMENTATION REQUIREMENTS

5.4.1 Conventional and Critical Facility Determination

All facilities, facility systems, and structures shall be evaluated by the Range User to determine if they are critical.

5.4.2 Documentation Review and Approval Process

a. Unless otherwise agreed to by Range Safety and the Range User or otherwise stated in this Chapter, the facility design engineering documents described in this section shall be submitted to Range Safety for review and approval 30 days prior to the following design review meetings: introductory; conceptual (30 percent); Preliminary (60 percent); Critical (90 percent); and Final (100 percent). **NOTE 1:** The introductory documentation shall include, but is not limited to, such preliminary facility design documents as Requirements Analysis Management Plans (RAMPs) and Project Definition Books (PDBs) **NOTE 2:** All facility design engineering drawing and specification packages shall have a space or block on the first drawing sheet reserved for the approval signature of the 45 SW/SES or 30 SW/SEG reviewing official. **NOTE 3**: All Review Item Discrepancies (RIDs) shall be addressed at each design review and resolved as soon as possible.

b. Documentation requiring the review and approval of Civil Engineering shall be submitted in accordance with schedules jointly agreed upon by the Range User and Civil Engineering.

c. Documentation requiring the review and approval of Bioenvironmental Engineering shall be submitted in accordance with schedules jointly agreed upon by the Range User and Bioenvironmental Engineering.

d. Documentation requiring the review and approval of the Fire Marshal shall be submitted in accordance with MIL-HDBK-1008.

5.4.3 Conventional Facilities and Structures Documentation Requirements

5.4.3.1 Determining Criticality

Range Users shall submit documentation justifying the non-critical determination. This document-ation shall be submitted at the introductory and conceptual (30 percent) design reviews.

5.4.3.2 Conventional Facility Design Drawings and Specifications

Facility design engineering drawings and technical specification packages for conventional facilities shall be submitted.

5.4.3.3 Conventional Facility Demolition Plan

If applicable, a demolition plan shall be submit-ted.

5.4.4 Critical Facilities and Structures Documentation Requirements

5.4.4.1 Critical Facility and Structure Design Criteria Document

a. Prior to facility and structure design, design criteria that clearly state Range User requirements and identify the essential features and functions required in the facility shall be submitted.

b. The design criteria document shall be revised periodically to reflect the current status of design requirements as they are developed.

5.4.4.2 Critical Facility and Structure Design Calculations

a. The design of all structural steel buildings and other structures shall be based on documented, detailed, design calculations.

b. Seismic design analysis is required for WR facilities, structures, and installed equipment.

c. Trailer anchoring analysis shall be submitted.

d. The above design calculations and analyses shall be submitted when completed.

5.4.4.3 Hazard Analyses

Hazard analyses of facilities, structures, and emergency and critical systems shall be conducted in accordance with Appendix 1B, System Safety Pro-

gram, as jointly tailored by Range Safety and the Range User.

5.4.4.4 Critical Facility and Structure Design Drawings and Specifications

Facility and design engineering drawings and technical specification packages for critical facilities shall be submitted.

5.4.4.5 Emergency and Critical Systems Design Drawings and Specifications

The following applicable emergency and critical systems design drawings and specifications shall be submitted for review and approval to Range Safety and other agencies as noted: **NOTE**: Design drawings and specifications for other emergency and critical systems not identified below may be required by Range Safety.

a. Lightning protection
b. Bonding and grounding
c. Robots
d. Emergency eyewash and showers (Bioenvironmental Engineering)
e. Air monitoring systems (Bioenvironmental Engineering)
f. Area warning systems
g. Ventilation systems
h. Drain and sump systems (Civil Engineering and Bioenvironmental Engineering)
i. Scrubbers and incinerators (Civil Engineering and Bioenvionmental Engineering)
j. Liquid level indicators
k. Conductive floors
l. Hazardous vapor detection systems (Bioenvironmental Engineering)
m. Vapor control systems
n. Room purge systems
o. Emergency Power Cutoff Systems
p. Emergency Monitor and Control Panel
q. Personnel anchorage and anchorage connectors
r. Elevators
s. Fire Protection System (Fire Marshal)

5.4.4.6 Test Plans and Test Reports

5.4.4.6.1 Test Plans.

a. Test plans for the following applicable systems shall be submitted for review and approval to Range Safety and the other agencies noted 45 calendar days prior to the test: **NOTE**: Test plans for other systems may be required as identified by Range Safety.

1. Lightning protection in accordance with MIL-STD-1542
2. Bonding and grounding in accordance with MIL-STD-1542
3. Robots in accordance with ANSI/RIA R15.06
4. Emergency eyewash and showers (Bioenvironmental Engineering)
5. Air monitoring systems (Bioenvironmental Engineering)
6. Area warning systems
7. Ventilation systems
8. Drain and sump systems (Civil Engineering and Bioenvironmental Engineering)
9. Scrubbers/incinerators (Civil Engineering and Bioenvironmental Engineering)
10. Liquid level indicators
11. Conductive floors
12. Vapor control systems
13. Hazardous vapor detection systems (Bioenvironmental Engineering)
14. Room purge systems
15. Technical Power Cutoffs
16. Emergency Power Cutoff Systems
17. Emergency Monitor and Control Panels
18. Elevators in accordance with ASME/ANSI A17.1 and A17.2
19. Integrated end-to-end test of interrelated systems
20. Personnel anchorage and anchorage connectors

b. The test plan for the fire protection system shall be submitted for review and approval to the Fire Marshal 45 calendar days prior to the test.

5.4.4.6.2 Test Reports. Test reports shall be submitted to Range Safety and the other agencies noted above for review and approval at least 45 days prior to activation of the facility.

5.4.4.7 Critical Facility and Structure Demolition Plan

If applicable, a demolition plan shall be submitted.

5.4.4.8 Facility Safety Data Package

A Facility Safety Data Package (FSDP) providing detailed descriptions of the hazardous and critical systems in a facility or structure designated as critical shall be provided. Content requirements are found in Appendix 5A. As an alternate, a design

package that contains all the elements specified in Appendix 5A is acceptable.

5.5 CONVENTIONAL FACILITIES AND STRUCTURES

5.5.1 New, Rehabilitated, or Modified Conventional Facility and Structure Design Standards

At a minimum, the design of new, rehabilitated, or modified conventional facilities and structures on the Ranges shall comply with or be equivalent to the applicable standards of the current editions of the following documents:

a. MIL-HDBK-1190
b. MIL-HDBK-1008
c. *Standard Building Code* (ER only)
d. *Uniform Building Code*
e. 29 CFR 1910
f. 29 CFR 1926
g. AFOSH 127 Series and 91 Series
h. AFM 88 Series Manuals
i. ANSI/ASCE-7

5.5.2 Conventional Facility and Structure Elevators

a. All elevators in conventional facilities and structures shall be designed, built, and installed in accordance with ASME/ANSI A17.1.

b. All elevators in conventional facilities and structures shall be inspected, tested, and maintained in accordance with ASME/ANSI A17.1. and ASME/ANSI A17.2.

5.5.3 Conventional Facility and Structure *Life Safety Code* Requirements

The provisions of NFPA 101, the *Life Safety Code*, shall be incorporated in the design of each conventional facility and structure at the Ranges.

5.5.3.1 Emergency Egress

All emergency egress doors shall be equipped with panic hardware and shall not be locked in a manner that would bar emergency egress.

5.5.3.2 Emergency Lighting

Emergency lighting shall be designed and installed in all locations such as windowless rooms and offices, stairways, and exit corridors from which personnel egress would be hazardous in the event of a power failure.

5.5.4 Conventional Facility and Structure Electrical Equipment

At a minimum, electrical equipment and its installation shall comply with the requirements of the most recent edition of the NEC (NFPA 70) or the regulations of OSHA, whichever are more restrictive.

5.5.5 Conventional Facility and Structure Personnel Anchorage and Anchorage Connectors

a. Consideration shall be given to the use of fixed platforms in lieu of extensive use of personnel tie-offs.

b. If the design process determines that personnel tie-offs are necessary, then fixed, permanently installed anchorage connectors shall be used.

c. Personnel anchorage and anchorage connectors shall be designed and tested in accordance with ANSI A10.14 and ANSI Z359.1.

d. Anchorage and anchorage connectors shall be designed to withstand a static load of 5000 lb per person.

e. Design analysis shall consider all possible vectors of forces induced by a fall.

f. Anchorage and anchorage connectors shall be load tested initially to 5000 lb static and shall not require re-testing except for causes such as corrosion, damage, replacement, modification, repair, or exposure to launch heating.

g. Anchorage and anchorage connectors shall be stenciled or tagged with the maximum number of persons and/or total weight allowed to be attached to the anchor at a given time using 5000 lb per person. **NOTE**: Such markings may be stenciled on the surrounding structure.

h. Anchorage and anchorage connectors shall be stenciled or tagged with test weight and date. **NOTE**: Such markings may be stenciled on the surrounding structure.

i. Anchorage and anchorage connectors shall be located as close as possible to the work point as practical.

j. Anchorage and anchorage connectors shall be located as high as practical to limit the distance of potential fall.

k. Anchorage and anchorage connectors shall be located so that an individual can attach to the connectors at waist height or above.

l. Anchorage and anchorage connectors shall be located so that they do not endanger fluid or gas lines, electrical cabling, critical hardware, or flight components when the lifeline or lanyard is attached, in use, or under load. **NOTE**: To preclude the above conditions, shielding or guarding of the components or system in question may be required.

m. Safety swivel hoist rings shall be the preferred anchorage connector rather than eye bolts.

5.5.6 WR Conventional Facility and Structure Seismic Design

AFM 88-3, Chapter 13, places the WR in Seismic Zone 4. **NOTE**: Local geologic structure determines zone designation 1 through 4, considering the potential severity, frequency, and damage from a seismic event. This designation means that the WR is located in the most severe seismic region. The probability of being exposed to a great earthquake is large enough to require taking specific mitigating measures in design.

a. Seismic design of all new or modified facilities, structures, installed equipment shall be in accordance with AFM 88-3, Chapter 13 and Sections A and B. Where specific design guidance is not provided in these manuals, industry standards such as those of the Seismology Committee Structural Engineers Association of California (SEAOC), UBC, and Applied Technology Council (ATC 3-06) shall be used.

b. Seismic design shall consider both the vertical and horizontal component of seismic loading.

c. Facilities, structures, installed equipment, and trailers that must remain operational after a seismic event shall be designed in accordance with an importance factor of I of 1.5 in accordance with AFM 88-3, Chapter 13.

d. Equipment installed in facilities needed for post-earthquake recovery shall be designed to remain operational after a seismic event.

e. Installed equipment that has the potential, directly or by propagation, to cause the following events shall be restrained to restrict movement and withstand a seismic event, but need not remain operational after a seismic event:

1. Severe personnel injury

2. Catastrophic events

3. Significant impact on space vehicle and/or missile processing and launch capability. **NOTE**: This criteria does not apply to commercial programs.

5.5.7 Trailer Design

a. Trailers such as those used for offices, instrumentation, shop, or storage, remaining in position for longer than 24 hours shall be anchored and stabilized.

b. Trailers shall be secured against wind loads per the design criteria of AFM 88-3, Chapter 1 and ANSI/ASCE-7.

5.6 CRITICAL FACILITIES AND STRUCTURES

5.6.1 New, Rehabilitated, or Modified Critical Facilities and Structures General Design Requirements

5.6.1.1 Critical Facility and Structure Design Standards

At a minimum, the design of new, rehabilitated, or modified critical facilities and structures on the Ranges shall comply with or be equivalent to the applicable provisions of the current editions of the following documents:

a. MIL-HDBK-1190
b. MIL-HDBK-1008
c. *Standard Building Code* (ER only)
d. *Uniform Building Code*
e. 29 CFR 1910
f. 29 CFR 1926
g. AFOSH 127 Series and 91 Series
h. AFM 88 Series Manuals
i. AFMAN 91-201 and DoD 6055.9-STD
j. AFM 88-22
k. MIL-STD-1472
l. ANSI/ASCE-7

5.6.1.2 Critical Facility and Structure Elevators

a. All elevators in critical facilities on the Ranges shall be designed, built, and installed in accordance with ASME/ANSI A17.1.

b. All elevators in critical facilities on the Ranges shall be inspected, tested, and maintained in accordance with ASME/ANSI A17.1. and ASME/ANSI A17.2.

c. All passenger elevators in critical facilities shall be built to the code requirements for general purpose elevators approved for freight elevators in accordance with ASME/ANSI A17.1, Rule 207.l

d. All freight elevators in critical facilities shall be built to the code requirements for general purpose freight elevators approved for passengers in accordance with ASME/ANSI A17.1, Rule 207.4.

e. All elevators in critical facilities shall be equipped with a public address (PA) speaker where a PA system is available.

5.6.1.3 Critical Facility and Structure *Life Safety Code* Requirements

The provisions of NFPA 101, the *Life Safety Code*, shall be incorporated in the design of all critical facilities and structures at the Ranges.

5.6.1.3.1 Emergency Egress.

a. All side hinged doors that could be used as a means of emergency egress from a high hazard facility or structure shall be considered emergency exits and shall swing in the direction of exit travel.

b. All emergency egress doors shall be equipped with panic hardware and shall not be locked in a manner that would bar emergency egress.

5.6.1.3.2 Emergency Lighting. Emergency lighting shall be designed and installed in all locations such as windowless rooms and offices, stairways, and exit corridors from which person-nel egress would be made hazardous in event of a power failure.

5.6.1.4 Critical Facility and Structure Structural Steel

5.6.1.4.1 Critical Facility Structural Steel General Design Requirements.

a. Critical structural steel facilities and structures shall be designed in accordance with the American Institute of Steel Constructions (AISC) "Manual of Steel Construction-Allowable Stress Design."

b. Connections between structural members shall be designed to use welded or bolted joints in accordance with AISC M016 and S337.

5.6.1.4.2 Bolts and Fasteners.

a. Permanent bolted structural joints shall use high strength fasteners in accordance with AISC S329. *EXCEPTION: ASTM A307 bolts may be substituted for ASTM A325 and ASTM A490 fasteners in those applications where stresses are very low.*

b. Joints using ASTM A307 and ASTM 325 bolts in exterior applications shall use galvanized fasteners. Joints using ASTM A490 heat treated high strength bolts shall use plain fasteners that are coated for corrosion protection.

c. ASTM A325 and ASTM A490 fasteners shall not be reused.

5.6.1.4.3 Welding.

a. Welded connections shall use pre-qualified welded joints in accordance with AISC M016, AISC S337, and AWS D1.1.

b. Welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1.

c. All welds shall be inspected in accordance with the following criteria:

1. 100 percent of all welds shall be visually inspected in accordance with AWS D1.1.

2. A random selection of 10 percent of all fillet welds shall be inspected using magnetic particle testing techniques in accordance with ASTM-E1444 or the equivalent.

3. A random selection of 10 percent of all full penetration welds shall be ultrasonically (UT) tested in accordance with MIL-STD-1699 or the equivalent.

(a) If rejectable discontinuities are found, then a second random 10 percent UT of these welds shall be accomplished.

(b) If, on the second random 10 percent, UT rejectable discontinuities are uncovered, the remainder of the full penetration welds shall receive the UT to determine the extent of the weld defects.

4. Nondestructive test personnel shall be qualified to SNT-TC-1A, Level 1 (under supervision of a Level 2) or above.

5.6.1.4.4 Recommended Structural Steel Materials.

a. ASTM A36 for plates and shapes

b. ASTM A53 for pipe

c. ASTM A500 or ASTM A501 for structural tubing

d. Materials that are susceptible to stress corrosion cracking shall be avoided.

5.6.1.5 Critical Facility and Structure Design Load Criteria

a. Design load assumptions for dead, live, and operational wind loads shall be in accordance with AFM 88-3, Chapter 1.

b. Facilities and structures built in hurricane areas shall be designed in accordance with AFM 88-3, Chapter 14 and/or American Society of Civil

Engineers (ASCE) 7-95 or the most current edition.

c. Unique loads such as equipment loads, impact loads, launch environment loads (rocket engine exhaust impingement, blast pressure, acoustics, or vibrations) shall be clearly defined and analyzed.

d. Minimum live loads for stairs, floor opening covers, wall openings, handrails, fixed ladders, foot walks, and ramps shall be designed in accordance with applicable sections of 29 CFR 1910 and ASCE 7-95 or the most current edition.

e. As required, structural members shall be sized to accept additional moments for the installation of OSHA required personnel anchor points as described in 29 CFR 1926.502.

5.6.1.6 Critical Facility and Structure Bonding and Grounding

a. At a minimum, bonding and grounding requirements for all critical facilities and structures shall comply with the requirements of ANSI/NFPA 70. **NOTE:** The different types of facilities and structures at the Ranges require varying degrees of bonding and grounding beyond those specified by NFPA 70.

b. All facilities used to store, handle, or process ordnance items or propellants shall be bonded and grounded in accordance with AFMAN 91-201 and DoD 6055.9-STD.

c. Documents that may be used to design grounding and bonding systems for the protection of personnel and equipment from abnormal voltages are as follows:

1. MIL-STD-1542
2. MIL-B-5087
3. KSC-STD-E0012
4. MIL-STD-188/124
5. AFMAN 91-201 and DoD 6055.9-STD, Chapter 6
6. MIL-HDBK-419
7. AFM 88-9, Chapter 3
8. ANSI/NFPA 77

5.6.1.7 Critical Facility and Structure Lightning Protection

a. At a minimum, lightning protection requirements for critical facilities and structures shall comply with ANSI/NFPA 780.

b. Facilities and structures that require greater protection against direct or indirect lightning strikes such as launch pads or explosives storage areas, shall also comply with the following:

1. AFM 88-9, Chapter 3, "Electrical Design, Lightning and Static Electricity Protection"
2. AFI 32-1065

3. AFMAN 91-201 and DoD 6055.9-STD

4. MIL-STD-1542

5.6.1.8 Critical Facility and Structure Electrical Equipment

a. At a minimum, electrical equipment and its installation in critical facilities and structures shall comply with the requirements of the most recent edition of the NEC (NFPA 70) or the regulations of the OSHA, whichever are more restrictive.

b. Prior to being put into service, any electrical equipment that is not specifically labeled for the purpose or conditions of operation intended by a recognized testing agency or that is not manufactured or installed to meet the electrical classification of the area in which the equipment is to be operated shall be approved by Range Safety.

5.6.1.8.1 Definition of Hazardous (Classified) Locations. Hazardous (classified) locations are defined in Article 500 of the NEC; however, some explosives and propellants are not covered. For Range installations, the following paragraphs define the minimum requirements to be applied in the definitions of locations in which explosives, pyrotechnics, or propellants are or are expected to be present. These requirements shall be followed unless less stringent classifications are justified and approved as part of the design data submittal process. Range Safety and the Fire Marshal shall approve all potential critical facility hazardous location designations. (See Appendix 5B for a flowpath for classifying hazardous areas.)

a. Class 1, Division 1

1. Locations in which flammable liquids, vapors, or gases may be present in air during normal operations

2. Locations in which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage

3. Locations in which the breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors and might also cause simultaneous failure of electrical equipment

4. As a baseline, these include the following locations:

(a) Within 25 ft of any vent opening unless the discharge is normally incinerated or scrubbed to nonflammable conditions (less than 25 percent of Lower Explosive Limit (LEL)). This distance may be increased if the vent flow rate creates a flammability concern at a distance greater than 25 ft.

(b) Below grade locations in a Class 1, Division 2 area.

b. Class 1, Division 2

1. Locations in which volatile flammable liquids or flammable gases are handled, processed or used, but in which the liquids, vapors, or gases will normally be confined in closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or system or in case of abnormal operation of equipment

2. Locations in which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and which might become hazardous through failure or abnormal operation of ventilation equipment

3. Locations adjacent to a Class 1, Division 1 location and to which ignitable concentrations of gases or vapors might occasionally be communicated unless communication is prevented by adequate positive pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided. **NOTE 1:** This classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used but, in the judgment of Range Safety and the Fire Marshal, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of an accident, the adequacy of ventilating equipment, the total area involved, and the record of the Range User with respect to explosions or fires are all factors that merit consideration in determining the classification and extent of each location. **NOTE 2:** Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Locations used for the storage of flammable liquids or of liquefied or compressed gases in sealed containers would not normally be considered hazardous unless also subject to other hazardous conditions. **NOTE 3:** As determined by Range Safety and the Fire Marshal, locations may actively change classification depending upon the flammable fluid system activity and configuration. For these types of locations, fixed or permanently installed electrical equipment shall be designed for the worst case hazardous environment. **NOTE 4:** Portable electrical equipment shall be designed for the worst case hazardous environment in which it will be used. Portable equipment that is not designed for use in a particular hazardous environment is not allowed in

that environment or shall be locked out from use in that environment.

4. As a baseline, Class 1, Division 2 locations include the following equipment or areas:

(a) Storage vessels (including carts and drums): 25 ft horizontally and below to grade and 4 ft vertically above the vessel (25 ft in any direction for hydrogen)

(b) Transfer lines: 25 ft horizontally and below to grade and 4 ft above the line (25 ft in any direction for hydrogen)

(c) Launch vehicle (liquid fueled vehicle, stage, or payload): 100 ft radius horizontally from and 25 ft vertically above (100 ft for hydrogen) the highest leak or vent source and below the vehicle to grade

(d) Enclosed locations such as rooms, work bays, and launch complex clean rooms that are used to store and handle flammable and combustible propellants when the concentration of vapors inside the room resulting from a release of all fluids stored and handled equals or exceeds the LEL. **NOTE:** The quantity of fluids used in the analysis shall be the maximum amount allowed in the explosives site plan.

c. Hazardous Commodity Groups. Hazardous commodities are grouped by similar characteristics. **NOTE:** These fuels shall be considered ignitable regardless of the ambient temperature. The following fuels shall be categorized as follows:

1. Group B: Liquid or gaseous hydrogen

2. Group C: Hypergolic fuels such as N_2H_4, MMH, UDMH, A50

3. Group D: Hydrocarbon fuels (RP and JP)

4. Group D: Oxidizers. Oxidizers shall be considered Group D hazardous substances in addition to the fluids listed in Section 500-3 of the NEC.

d. Exposed Solid Propellants. The atmosphere within 10 ft of exposed solid propellant shall be classified as a Class 1, Division 2, Group D location. Solid rocket motors are considered exposed in the following situations:

1. The motor nozzle is not attached and the aft end of the motor does not have a cover.

2. The motor nozzle is attached but does not have a nozzle plug.

3. The unassembled motor segments do not have front and rear covers.

4. The igniter is removed from the motor and cover is not provided.

5.6.1.8.2 Electrical Systems and Equipment Hazard Proofing. Electrical systems and equipment used in hazardous locations shall be designed and listed for the locations in accordance with the following requirements:

a. Explosion proof apparatus shall meet the requirements of the NEC for Class I, Division 1 or 2, and be listed and labeled by a nationally recognized testing laboratory such as Underwriter's Laboratories (UL), Factory Mutual Corporation (FM).

b. Non-incendive apparatus shall meet the requirements of NEC Article 501, ANSI/ISA-S12.2, and are restricted to installation in Class I, Division 2 locations only. They shall be listed and labeled by a nationally recognized testing laboratory such as UL or FM.

c. Intrinsically safe equipment intended for any NEC Hazardous (Classified) location shall meet the requirements of NEC Article 504 and UL 913 and be listed and labeled by a nationally recognized testing laboratory such as FM or UL.

d. The use of purged and pressurized electrical enclosures designed in accordance with NFPA 496 for the purpose of eliminating or reducing the hazardous location classification as defined in Article 500 of the NEC is acceptable with the following additional requirements:

1. The purged and pressurized enclosure shall be maintained at a nominal 1/2 in. of water unless a lower pressure is approved by Range Safety. In no case shall the pressure in enclosures be less than 1/10 in. of water.

2. Rooms into which unprotected personnel may enter shall be purged with air only.

3. Purged rooms and enclosures shall be provided with an audible alarm set to trigger when the pressure drops below 1/4 in. water.

e. Equipment inspected and tested to other government standards such as MIL-STD-810 may be used if approved by Range Safety in coordination with Civil Engineering.

f. Exterior Interconnecting Cable

1. Exterior interconnecting cable installed in the "open" is acceptable for interconnecting electrical equipment in a hazardous location. **NOTE:** *Open* refers to open trays or raceways that cannot trap gases when installing exterior type cable to interconnect electrical equipment in a hazardous location.

2. Cable installation shall comply with the requirements of Article 504 of the NEC.

5.6.1.8.3 Backup Power Sources. Backup

power sources shall be provided for critical load requirements when the loss of the normal power source would cause injury and/or death to personnel or loss of flight hardware.

5.6.1.9 Critical Facility and Structure Fencing

a. Fencing encompassing critical facilities shall have emergency egress gates.

b. A sufficient number of gates shall be provided and located to preclude the necessity for personnel to egress toward or past any potential hazard.

c. If fencing can become electrically charged by lightning, falling electrical power lines, or component failure of adjacent electrical equipment, such as substation transformers or switchgear, fences shall be grounded and gates bonded.

5.6.1.10 Critical Facility and Structure Personnel Anchorage and Anchorage Connections

a. Consideration shall be given to the use of fixed platforms in lieu of extensive use of personnel tie-offs.

b. If the design process determines that personnel tie-offs are necessary, then fixed permanently installed anchorage connectors shall be used.

c. Personnel anchorage and anchorage connectors shall be designed and tested in accordance with ANSI A10.14 and ANSI Z359.1.

d. Anchorage and anchorage connectors shall be designed to withstand a static load of 5000 lb per person.

e. Design analysis shall consider all possible vectors of forces induced by a fall.

f. Anchorage and anchorage connectors shall be load tested initially to 5000 lb static and shall not require retesting except for causes such as corrosion, damage, replacement, modification, repair, or exposure to launch heating.

g. Anchorage and anchorage connectors shall be stenciled or tagged with the maximum number of persons and/or total weight allowed to be attached to the anchor at a given time using 5000 lb per person. **NOTE**: Such markings may be stenciled on the surrounding structure.

h. Anchorage and anchorage connectors shall be stenciled or tagged with test weight and date. **NOTE**: Such markings may be stenciled on the surrounding structure.

i. Anchorage and anchorage connectors shall be located as close as possible to the work point as practical.

j. Anchorage and anchorage connectors shall be located as high as practical to limit the distance of potential fall.

k. Anchorage and anchorage connectors shall be located so that an individual can attach to the connector at waist height or above.

l. Anchorage and anchorage connectors shall be located so that they do not endanger fluid or gas lines, electrical cabling, critical hardware, or flight components when the lifeline or lanyard is attached, in use, or under load. **NOTE**: To preclude the above conditions, shielding or guarding of the components or system in question may be required.

m. Safety swivel hoist rings shall be the preferred anchorage connector rather than eye bolts.

5.6.1.11 WR Critical Facility and Structure Seismic Design Requirements

AFM 88-3, Chapter 13, places the WR in Seismic Zone 4. **NOTE**: Local geologic structure determines zone designation 1 through 4, considering the potential severity, frequency, and damage from a seismic event. This designation means that the WR is located in the most severe seismic region. The probability of being exposed to a great earthquake is large enough to require taking specific mitigating measures in design.

a. Seismic design of all new or modified facilities, structures, installed equipment shall be in accordance with AFM 88-3, Chapter 13 and Sections A and B. Where specific design guidance is not provided in these manuals, industry standards such as SEAOC, UBC, and ATC 3-06 shall be used.

b. Seismic design shall consider both the vertical and horizontal component of seismic loading.

c. Facilities, structures, installed equipment, and trailers that must remain operational after a seismic event shall be designed in accordance with an importance factor of 1 of 1.5 in accordance with AFM 88-3, Chapter 13.

d. Equipment installed in facilities needed for post-earthquake recovery shall be designed to remain operational after a seismic event.

e. Installed equipment that has the potential, directly or by propagation, to cause the following events shall be restrained to restrict movement and withstand a seismic event, but need not remain operational after a seismic event:

1. Severe personnel injury

2. Catastrophic events

3. Significant impact on space vehicle and/or

missile processing and launch capability. **NOTE**: This criteria does not apply to commercial programs.

4. Damage to high value flight hardware. **NOTE**: This criteria does not apply to commercial programs.

5.6.2 Special Critical Facility Systems and Structures

The following requirements are for unique critical facility systems and structures. These requirements supplement the general requirements in the **New, Rehabilitated, or Modified Critical Facilities and Structures General Design Requirements** section of this Chapter.

5.6.2.1 Critical Facility and Structure Air Monitoring Systems

5.6.2.1.1 Critical Facility and Structure Air Monitoring System General Design Requirements.

a. Locations in which there is a potential hazard of oxygen deficiency, toxicity, or flammability that could result in personnel injury or death shall be provided with air monitoring systems. Portable monitoring units may be utilized prior to access in lieu of permanent systems with Bioenvironmental Engineering and Range Safety approval. **NOTE:** The following are examples of locations requiring air monitoring if personnel entry is required: (1) enclosed areas, rooms, and vehicle compartments where pressurized inert gas systems are located and/or routed that could deplete or displace oxygen; (2) enclosed areas, rooms, and vehicle compartments where propellant systems are located and/or routed; (3) storage tank entry points; (4) drain pits; and (5) tunnels.

b. Range Users, Bioenvironmental Engineering, and Range Safety shall evaluate and identify locations that require air monitoring systems.

c. AFOSH 91-25 and OSHA requirements shall be complied with.

5.6.2.1.2 Air Monitoring Systems Locations Having Regular Access.

a. Continuous monitoring equipment with local and remote alarms and primary power and backup battery power shall be installed in the hazardous area.

b. The alarm shall be audible above ambient noise levels and shall not be capable of being locally silenced.

c. The remote alarm signal shall be transmitted to the blockhouse, operations control center, or Range Fire Station where 24 hr continuous monitoring is provided.

d. Alarms at local and remote locations shall have visual and audible signals.

5.6.2.1.3 Air Monitoring System Locations Having Infrequent or Temporary Access.

a. Local warning indicators including signs and portable flashers shall be provided.

b. Portable monitors with battery power that provide continuous monitoring with a local alarm may be used.

5.6.2.1.4 Oxygen Deficiency Monitoring Systems. For oxygen deficiency monitoring systems, alarms shall be activated in accordance with minimum OSHA requirements.

5.6.2.1.5 Toxicity Monitoring Systems. For toxicity monitoring systems, alarms shall be activated at no greater than the threshold limit value of the particular vapor(s) being monitored as established by the American Conference of Governmental Industrial Hygienists (ACGIH) and as accepted by the Air Force Surgeon General.

5.6.2.1.6 Flammability Monitoring Systems. For flammability monitoring systems, alarms shall be activated at 25 percent of the LEL.

5.6.2.1.7 Air Monitoring Equipment Calibration. All air monitoring equipment shall be calibrated annually unless otherwise directed by Range Safety and Bioenvironmental Engineering.

5.6.2.2 Guyed Towers

Guyed towers shall be designed in accordance with ANSI/EIA/TIA 222.

5.6.2.3 Robot Systems

Industrial robots and robot systems shall be designed, installed, tested, and operated in accordance with ANSI/RIA R15.06.

5.6.2.4 Mobile Service Towers

For mobile service towers, the overturning moment due to wind load shall not exceed two-thirds of the dead load stabilizing moment of the tower unless the structure is anchored to resist the excess moment. **NOTE:** When the total friction force is insufficient to prevent sliding, anchorage shall be provided to resist the excess sliding force.

5.6.2.5 Hazardous Commodity Lockers

Lockers or cabinets positioned for the purpose of storing flammable, toxic reactive, or caustic materials shall be designed in accordance with OSHA 1910.106, NFPA 30, and AFOSH 127-43.

5.6.2.6 Battery Storage and Processing Areas

a. Battery shops shall be designed in accordance with AFOSH 91-66 and Article 480 of the NEC.

b. Dedicated storage and processing areas for batteries that have the potential for venting hazardous fluids shall be designed with the following:

1. Emergency eyewash and shower systems

2. A dedicated water system, hose and spray attachment, and floor drain and containment system for electrolyte spill

3. A ventilation hood located directly above the battery charging area and vented to a safe location outside the facility

4. Sufficient ventilation in the battery maintenance area to prevent accumulations of explosive vapor concentrations from exceeding 25 percent of the LEL

5. Floors constructed of a material compatible with the battery electrolyte and kept clean and dry

6. Battery racks constructed of a material resistant to corrosion due to contact with electrolyte

7. Separate areas for storage and servicing of batteries that have incompatible electrolytic solutions such as acid and alkaline

5.6.3 Explosives Storage, Handling, and Processing Facilities

The following requirements are for facilities used to store, handle, or process ordnance and/or propellants. These requirements supplement the requirements in the **New, Rehabilitated, or Modified Critical Facilities and Structures General Design Requirements** section of this Chapter.

5.6.3.1 Explosives Site Plans

a. All facilities, including launch complexes, used to store, handle, or process ordnance items or propellants shall be properly sited and approved in accordance with DoD quantity distance criteria and explosives safety standards as specified in DoD 6055.9-STD and implemented in AFMAN 91-201.

b. Preparation of site plans and construction of facilities affected by explosive criteria are the responsibility of Civil Engineering in coordination with the Range User and Range Safety. Civil Engineering shall assist Range Safety to submit site plans to the DDESB through engineering safety channels for review and approval.

c. A minimum of six months is required between the time the site plan is forwarded through channels to the DDESB and final approval. Final approval from the DDESB shall be obtained prior to the start of construction.

d. Any facility that contains explosives is considered an explosives facility; however, certain classes or divisions of explosives in small quantities may require only a Range Safety approved license. (See AFMAN 91-201 and DoD 6055.9-STD.) **NOTE:** Class/Division 1.1 explosives will not be approved by license.

e. If Range Safety determines that a facility modification or operational change affects the explosive site plan, the Range User shall provide the documentation required by AFMAN 91-201 and DoD 6055.9-STD to Range Safety and Civil Engineering for review and approval. An update to the explosives site plan may be required. **NOTE:** If an update is required, a minimum of six months is required between the time the site plan is forwarded through channels to the DDESB and final approval. Final approval from the DDESB must be obtained prior to start of construction.

f. Movement or relocation of a hazardous operation and/or system into a facility shall be approved by Range Safety. **NOTE:** Even if the facility has been used for similar operations in the past, Range Safety review and approval is required.

g. Temporary buildings or trailers shall not be placed inside an explosive safety clear zone without Range Safety approval.

5.6.3.2 Explosives Storage, Handling, and Processing Facilities General Design Requirements

a. Explosives storage, handling, and processing facilities shall be designed and constructed in accordance with AFMAN 91-201 and DoD 6055.9-STD.

b. When it is necessary to design explosives facilities in such a manner as to ensure against propagation of explosions between adjacent rooms or nearby facilities, analysis and design of walls, doors, roofs, and other similar items shall conform to AFM 88-22.

5.6.3.3 Explosives Facilities Area Warning Systems

5.6.3.3.1 Explosives Facilities Area Warning System General Requirements. **NOTE**: Dedicated explosives storage facilities not associated with operating areas may not require warning systems meeting all of the following requirements. Facilities used to store, handle, or process hazardous materials other than explosives may require area warning systems meeting all or some of the requirements. Determination shall be made by Range Safety on a case-by-case basis.

a. Each explosives facility shall have an area warning system to alert personnel near, entering, or in the area as to the hazard status of that area.

b. The warning system shall consist of warning lights and audible signals augmented by public address (PA) announcements.

c. Each facility shall have an instruction sign at the entry point explaining the area warning system.

d. The visual and audible warning systems shall be visible and audible throughout the facility in 360° in direction and for a distance of at least 2500 ft.

e. Area warning systems shall be used at work areas within overall controlled areas such as fuel or oxidizer storage areas, mobile service towers, and test cells to display locally controlled hazard status. Single flashing amber lights, activated during hazardous operations, may be used in these work areas.

5.6.3.3.2 Explosives Facility Area Warning Systems Specific Requirements.

a. All area warning system electrical circuits (warning lights, audible alarms) shall be designed with an independent backup power system that is activated by an automatic transfer switch.

b. Permanently installed area warning lights shall be designed to provide for flashing green, flashing amber, and flashing red lights to show the hazard status of the affected area.

c. Audible warning signals shall be provided in the form of an audible horn or tone device and PA system. These signals shall be audible throughout the controlled areas and immediate vicinity.

1. Controlled area warning horns shall be pressure or electrically operated.

2. Warning horn and/or tone oscillator controls shall be easily accessible for emergency use.

3. Audible alarms shall be capable of both local and remote activation.

4. Audible alarms shall sound both locally and at the monitoring station.

5.6.3.4 Hypergolic Propellant Main and Ready Storage Facilities

5.6.3.4.1 Hypergolic Propellant Storage Facility Containment System.

a. Each storage tank shall be located in its own reinforced concrete containment bay or compartment.

b. Each containment bay shall be capable of holding at least four times the tank capacity.

c. The containment walls shall be designed to withstand the hydraulic pressure created when the bay is filled to the top with liquid. These walls shall be at least 12 in. thick and constructed in accordance with AFM 88-22 unless engineering studies determine that less protection is acceptable for present and known future requirements.

d. Storage facilities that contain multiple tanks and their containment bays shall be designed so that the exterior walls of the structure are 12 in. higher than the interior bay walls. **NOTE:** This design will eliminate interior wall weirs and provide controlled overflow into adjacent bays.

e. The floor area for each containment bay shall be kept to a minimum to reduce the potential spill area and resulting evaporation rate to prevent exposing the general public and near-by facilities.

f. Propellant transfer areas shall be capable of containing four times the capacity of the largest mobile tanker to be used at the facility.

5.6.3.4.2 Hypergolic Propellant Storage Facility Ventilation.

a. Open shed construction shall be used for fuels to provide adequate shade and weather protection with maximum ventilation unless specific conditioning requirements require closed or confined storage.

b. Closed or confined areas shall have good ventilation. If natural ventilation is inadequate, a mechanical exhaust ventilation system shall be provided.

c. Forced draft ventilating systems shall be so arranged that a fire in the storage facility will automatically cause shut down.

d. Remote manual controls shall be provided

for ventilation systems.

5.6.3.4.3 Hypergolic Propellant Storage Facility Compatibility.

a. Facilities and structures that may contain hypergols shall be designed to provide isolation of the fuels and oxidizers.

b. Propellant transfer systems shall be designed to ensure that no single failure can cause mixing of the propellants.

c. Propellant transfer system design shall ensure that all non-compatible fuels and oxidizers are separated so that inadvertent operation of either the oxidizer or fuel subsystems cannot cause mixing of the propellants.

d. All incompatible propellant system connections shall be keyed or sized so that it is physically impossible to interconnect or cross connect them.

e. All hypergolic storage facilities and structures shall be designed to protect against hypergols contacting incompatible, static producing, or absorbent materials. **NOTE:** Areas of concern include floors, the first 4 ft of walls, doors, trenches, plumbing, caulking, sealants, and other items.

f. If the compatibility of a particular material is unknown, tests shall be performed by the Range User to develop compatibility data for review and approval by Range Safety. **NOTE:** The NASA Materials Test Laboratory is available to perform these tests.

g. All exterior structural steel used in a hypergolic storage facility shall be coated with a hypergolic compatible protective coating. Recommend-ed coating procedures and materials are contained in KSC-STD-C-0001.

h. Copper, bronze, or other alloys that might form copper oxides should not be used in hydrazine areas. If these alloys are used, they shall be positively protected by distance, sealing in a compatible material, or use of a splash guard.

5.6.3.4.4 Hypergolic Propellant Storage Facility Gravity Drain Sump Systems.

a. All hypergolic propellant storage facilities and structures shall be provided with a gravity drain sump system.

b. The gravity drain and sump system shall provide drain and containment capability for both containment bay floors and propellant transfer aprons.

c. Sump tanks shall be located below grade with a capacity to hold four times the volume of the largest mobile tanker to be used at the transfer station.

d. The drainage system from the containment bay floors and the transfer apron to the containment sump shall be underground and gravity fed.

e. Containment bay floors and transfer aprons shall be sloped to low point drain fittings.

f. Welded drain fixtures, piping, and sump tanks shall be fabricated from 304L stainless steel.

g. Sump tanks shall have an offload system capable of transferring the sump contents to each of the following locations: a dedicated emergency storage tank, a mobile waste tanker, and to grade.

h. The facility shall have the capability to sample the contents of each sump.

i. All drain valves shall be manually controlled.

j. All drain valves located below grade shall be provided with valve extensions.

k. Gaseous nitrogen (GN_2) purge interfaces shall be located at the drain system high points to facilitate draining to the system low point.

5.6.3.4.5 Hypergolic Propellant Transfer Areas. All hypergolic propellant storage facility transfer areas shall have concrete aprons, safety showers, wash down hoses, eyewashes, and windsocks.

5.6.3.4.6 Hypergolic Propellant Storage Facility Emergency Storage Tanks.

a. A dedicated emergency storage tank shall be provided in hypergolic propellant storage facilities.

b. The capacity of the dedicated emergency storage tank shall be equal to the largest storage tank, plus 10 percent.

c. A transfer system to move products from any storage tank to the dedicated emergency storage tank shall be provided.

5.6.3.4.7 Hypergolic Facilities Scrubbers and Incinerators.

a. All routine venting shall go through a scrubber and/or incinerator.

b. The scrubber and/or incinerator design shall be reviewed and approved by Bioenvironmental Engineering.

c. Scrubbers and/or incinerators shall be permitted for use through Civil Engineering.

5.6.3.4.8 Hypergolic Propellant Storage Facility Fire Protection Systems. For storage of hypergolic fuels such as N_2H_4, UDMH, MMH, A50, the

following requirements supplement the general fire protection requirements contained in MIL-HDBK-1008, AFMAN 91-201, DoD 6055.9-STD, and AFI 32-2001:

a. Fire Detection

1. Optical fire detectors shall be used to detect fires. Ultraviolet (UV), infrared (IR) or UV/IR combination may be used to sense hydrazine fires.

2. The detectors shall be set and/or filtered to the specific radiation wavelength of the fire to be detected: N_2H_4, MMH, UDMH, or A50.

3. The detectors shall be capable of performing self-checks. **NOTE:** At a minimum, these self-checks shall determine the internal status of the detector as well as the cleanliness of the detector window.

4. The detectors shall include manual remote and automatic self-testing capability.

5. All possible sources for false alarms shall be identified for the storage facility.

(a) The selection of detectors and the design of the detection system shall reduce the probability of these sources causing false alarms.

(b) Sources of false alarms that may require evaluation include lightning, arc welding, wind, rain, humidity, solar radiation, sunshine, x-radiation, and black body radiation.

(c) Time delay, voting, cross-zoning, and other methods may be used to reduce false alarms.

b. Extinguishment Systems.

1. The containment bays and transfer areas shall be protected by an automatic and manually activated water spray system in accordance with the requirements of NFPA 15.

2. The water spray system shall be of the deluge valve and open spray nozzle type.

3. The spray systems shall deliver a coarse spray of water not less than 0.5 gal/min/ft^2 of the exposed vessel surface area.

4. The spray system shall deliver a coarse spray of water not less than 0.5 gal/min/ft^2 of the transfer apron area.

5. The deluge system shall be capable of preventing propagation of a fire from the affected bay to adjacent bays.

6. A 0.5 sec response time of the deluge system is required. **NOTE:** The response time is the time from the sensing of a detectable event to the beginning of the flow of water from the heads of the deluge system.

7. Automatic fire suppression systems may be disengaged in the presence of high value national assets when the risk to personnel is minimal or mitigated, with the Fire Marshal and Range Safety approval.

5.6.3.4.9 Hypergolic Propellant Storage Facility Leak Detection Systems. One of the following leak detection systems shall be provided at the storage facility to detect hypergol leaks:

a. Liquid Level Sensing and Indicator System

1. Each storage vessel shall be equipped with a mechanical liquid level sensing and indicator system having remote readouts and alarm capabilities.

2. A programmable controller shall be provided to interpret 1/16 in. liquid level deviations and send an alarm to the Range Fire Station.

3. Readout of level and alarm shall be installed on site.

b. Hypergolic Vapor Detection System

1. A hypergolic vapor detection system (HVDS) shall be provided to detect hypergolic leaks from storage vessels.

2. Continuous monitoring equipment with local and remote alarms and primary power and backup battery power shall be installed in the hypergolic storage facility.

3. The alarm shall be audible above ambient noise levels and shall not be capable of being locally silenced.

4. The remote alarm signal shall be transmitted to the blockhouse, operations control center, or the Range Fire Station where 24-hr continuous monitoring is provided.

5. Alarms at local and remote locations shall have visual and audible signals.

6. The set point shall be determined on a case-by-case basis with a maximum set point of 25 percent of the LEL.

5.6.3.4.10 Hypergolic Storage Facility Vapor Control Systems. A facility vapor control system is recommended and, if installed, shall meet the following requirements:

a. A fixed foam vapor suppression system is provided to control the amount of vapor released from a large hypergol leak or spill.

b. The system shall be manually controlled only.

c. The system shall be installed in each containment bay and transfer area.

d. The performance characteristics of the foam and delivery system design shall be reviewed and approved by Range Safety, the Fire Marshal, and Bioenvironmental Engineering.

5.6.3.4.11 Hypergolic Storage Facility Personal Protective Equipment Support.

a. Provisions should be made to supply breathing air for Self-Contained Atmospheric Protective Ensemble (SCAPE) suits used during hypergolic transfer operations.

b. Change areas for "suiting up" and staging equipment and support personnel shall be provided. Communications support between these areas shall be provided.

c. Facilities shall be available for decontamination of equipment and personnel wearing personal protective equipment after operations.

5.6.3.4.12 Hypergolic Storage Facility Control Room. There are no firm requirements for a control room, but a remote room from which to conduct operations in "shirt sleeves" is highly desirable. Explosion-proof cameras are often used to monitor the loading area.

a. If used, a control room should have communications with transfer and support areas, camera monitoring capability, and communication with base support agencies, such as the fire department, hospital, weather, and command post.

b. If used, this room shall be shown to be protected from hypergolic vapor leakage into the room through wall openings, door seals, cracks, or other openings including ventilation systems intake.

5.6.3.5 Enclosed Hypergolic Propellant Processing Facilities

The following design requirements are for enclosed areas used to transfer hypergolic propellants to and from upper stages and payloads during launch processing. The areas include off-pad facilities and environmental enclosures on launch complexes except as noted.

5.6.3.5.1 Enclosed Hypergolic Propellant Facility Conductive Floors.

a. Enclosed facilities used for processing easily detonated or ignited explosives sensitive to static electricity shall have conductive, non-sparking floors.

b. Conductive floors shall be designed in accordance with DoD 4145.26-M. *EXCEPTION: The resistance from the facility ground to any point on the floor shall be in accordance with AFMAN 91-201 and DoD 6055.9-STD.*

c. Conductive floors shall be tested in accordance with DoD 4145.26-M.

5.6.3.5.2 Enclosed Hypergolic Propellant Processing Facility Containment Systems.

a. A containment system shall be provided for all areas where hypergolic transfer operations occur.

b. The containment system shall have the capability to hold four times the volume of the largest hypergolic container used in the transfer area.

c. The containment system area shall be kept to a minimum to reduce the potential spill area and resulting evaporation.

5.6.3.5.3 Enclosed Hypergolic Propellant Processing Facility Purge Systems.

a. Enclosed areas used to process hypergols shall have a manually activated purge system. **NOTE 1**: The performance and efficiency criteria for the purge system shall be reviewed and approved by Range Safety during the conceptual phase of design. **NOTE 2**: The purge system is normally activated after an accident (spill) has occurred, the situation is under control, and the emergency response team has decided to purge the toxic vapor to the atmosphere.

b. Activating the purge system shall energize the emergency exhaust fan for the selected area and set the corresponding air handling unit (AHU) in emergency mode.

1. The AHU shall go to maximum outside air intake.

2. The AHU shall close off its return air damper.

3. The AHU shall open its exhaust damper and exhaust fan.

c. Manual purge station boxes shall be located on the exterior of the enclosed area immediately adjacent to the exit door.

1. Manual purge station boxes shall be single action type switches with normally open contacts.

2. The manual purge station boxes shall be covered to prevent inadvertent activation.

d. Enclosed hypergol operating areas shall be designed to operate at a lower pressure relative to adjoining rooms during propellant transfer.

5.6.3.5.4 Enclosed Hypergolic Propellant Processing Facility Compatibility.

a. Facilities that may contain hypergols shall

be designed to provide isolation of the fuels and oxidizers.

b. Propellant transfer systems shall be designed to ensure that no single failure can cause mixing of the propellants.

c. The propellant transfer system design shall ensure that all non-compatible fuels and oxidizers are separated so that inadvertent operation of either the oxidizer or fuel subsystems cannot cause mixing of the propellants.

d. All incompatible propellant systems connections shall be keyed or sized so that it is physically impossible to interconnect or cross connect them.

e. All hypergolic processing areas shall be designed to protect against hypergols contacting incompatible, static producing, or absorbent materials. **NOTE:** Areas of concern include floors, the first 4 ft of walls, doors, trenches, plumbing, caulking, sealants, and other areas.

f. If the compatibility of a particular material is unknown, tests shall be performed by the Range User to develop compatibility data for review and approval by Range Safety. **NOTE:** The NASA Materials Test Laboratory is available to perform these tests.

g. Exhaust duct material shall be compatible with the vapors to be exhausted in the maximum predicted concentration.

h. Copper, bronze, or other alloys that might form copper oxides should not be used in hydrazine areas. If these alloys are used, they shall be positively protected by distance, sealing in a compatible container, or use of a splash guard.

5.6.3.5.5 Enclosed Hypergolic Propellant Processing Facility Gravity Drain Sump Systems.

a. All hypergolic propellant processing areas shall be provided with a gravity drain sump system.

b. The gravity drain sump system shall provide drain and containment capability for transfer areas and temporary storage areas.

c. Sump tanks shall be located below grade with a capacity to hold four times the volume of the largest hypergol container to be used in the transfer area.

d. Welded piping and sump tanks shall be fabricated from 304L stainless steel unless otherwise approved by Range Safety.

e. Sump tanks shall have offload capability.

f. The facility shall have the capability to sample the contents of each sump.

g. All drain valves shall be manually controlled.

h. All drain valves located below grade shall be provided with valve extensions.

i. GN_2 purge interfaces shall be located at the drain system high points to facilitate draining to the system low point.

j. Environmental enclosures on launch complexes shall be designed to provide the capability to "mop and sop" hypergolic spills at the transfer areas. **NOTE:** The "mop and sop" system shall be designed to transfer spilled propellant from catch basins, drip pans, and other areas to the interface with the facility gravity drain and sump system.

k. For off-pad facilities and structures, the drainage system from the transfer and storage areas to the containment sump shall be underground and gravity fed.

l. For off-pad facilities and structures, transfer and storage area floors shall be sloped to low point drain fittings.

5.6.3.5.6 Enclosed Hypergolic Propellant Processing Transfer Areas. All transfer areas shall have safety showers, wash down hose, and eyewashes.

5.6.3.5.7 Enclosed Hypergolic Propellant Processing Facility Scrubbers and Incinerators.

a. All routine venting shall go through a scrubber and/or incinerator.

b. The scrubber and/or incinerator design shall be reviewed and approved by Bioenvironmental Engineering.

c. Scrubbers and/or incinerators shall be permitted for use by Civil Engineering.

5.6.3.5.8 Enclosed Hypergolic Propellant Processing Fire Protection. The following requirements for enclosed hypergolic fuels such as N_2H_4, UDMH, MMH, and A50 processing areas supplement the general fire protection requirements contained in MIL-HDBK-1008, AFMAN 91-201, DoD 6055.9-STD, and AFI 32-2001:

a. Fire Detection

1. Optical fire detectors shall be used to detect fires. UV, IR, or a UV/IR combination may be used to sense hydrazine fires.

2. The detectors shall be set and/or filtered to the specific radiation wave length of the fire to be detected: N_2H_4, MMH, UDMH, or A50.

3. The detectors shall be capable of performing self-checks.

(a) At a minimum, these self-checks shall

determine the internal status (functional/non-functional) of the detector as well as the cleanliness of the detector window.

(b) The detectors shall include manual remote and automatic self-testing capability.

4. All possible sources for false alarms shall be identified for the processing area.

(a) The selection of detectors and the design of the detection system shall reduce the probability of these sources causing false alarms.

(b) Time delay, voting, cross-zoning and other methods may be used to reduce false alarms.

b. Extinguishment Systems.

1. Processing areas shall be protected by a water spray system in accordance with NFPA 15.

2. The water spray system shall be of the deluge valve and open spray nozzle type.

3. The fire protection system shall be designed to provide personnel protection from the most severe hazard anticipated during processing operations.

4. The deluge system shall be capable of preventing propagation of a fire from the affected bay to the adjacent bays.

5. A 0.5 sec response time of the deluge system is required. **NOTE:** The response time is the time from the sensing of a detectable event to the beginning of the flow of water from the heads of the deluge system.

6. Automatic fire suppression systems may be disengaged in the presence of high value national assets when the risk to personnel is minimal or mitigated, with the Fire Marshal and Range Safety approval.

5.6.3.5.9 Enclosed Hypergolic Propellant Processing Facility Vapor Detection Systems.

a. An HVDS shall be provided to detect hypergol leaks in processing areas.

b. Continuous monitoring equipment with local and remote alarms and primary power and backup battery power shall be installed in the hypergolic propellant processing facility.

c. The alarm shall be audible above ambient noise levels and shall not be capable of being locally silenced.

d. The remote alarm signal shall be transmitted to the blockhouse, operations control center, or the Range Fire Station where 24-hr continuous monitoring is provided.

e. Alarms at local and remote locations shall have visual and audible signals.

f. The set point shall be determined on a case-by-case basis with a maximum set point of 25 percent of the LEL.

5.6.3.5.10 Emergency Power Cutoff Systems.

a. Each enclosed hypergolic propellant processing area shall be equipped with an Emergency Power Cutoff (EPC) system that permits manual shutdown of all nonessential electrical equipment in the event of a leak or other emergency.

b. The EPC system shall meet the following design requirements:

1. A manual EPC switch shall be located at each exit from a processing area.

2. Actuation of any of the manual EPC switches shall result in the following:

(a) Shutdown of the AHU for that area

(b) Shutdown of all electrical equipment except for one outlet receptacle (this outlet must be designed for use in a Class 1, Division 1 location) and those systems required for emergency response. **NOTE:** The following emergency response systems shall not be shut down: emergency lights, crane, communication system, air monitoring system, purge system, and fire protection system.

3. A general alarm shall sound throughout the facility.

4. An alarm signal shall be sent to the facility emergency monitor and control panel.

5. An alarm signal shall be sent to the Range Fire Station.

6. The manual EPC switch shall be a surface mounted "slap" switch located immediately adjacent to each exit.

(a) EPC switches shall be mounted 4.5 feet above the floor.

(b) EPC switches shall be covered to prevent inadvertent actuation.

7. A single, twist lock outlet receptacle shall be marked to indicate that it is not controlled by the EPC system.

8. All other outlet receptacles shall be marked to indicate that they are controlled by the EPC system.

5.6.3.5.11 Enclosed Hypergolic Propellant Pro-cessing Facility Emergency Monitor and Control Panels.

a. An emergency control panel shall be provided in the facility at a convenient location.

b. The control panel shall provide the following functions:

1. EPC system monitor

2. Purge system monitor

3. HVDS monitor

4. Fire alarm monitor slaved from the master fire alarm control panel

5. EPC system test control

6. Area warning lights control

7. Push button silencing of all audible alarms except fire alarms

5.6.3.5.12 Enclosed Hypergolic Propellant Processing Facility Windsocks. Windsocks shall be provided adjacent to all enclosed hypergolic propellant processing facilities.

5.6.3.5.13 Enclosed Hypergolic Propellant Processing Facility Personal Protective Equipment Support.

a. Provisions should be made to supply breathing air for SCAPE suits used during hypergolic transfer operations.

b. Change areas for "suiting up" and staging equipment and support personnel shall be provided. Communication support between these areas shall be provided.

c. Facilities shall be available for decontamination of equipment and personnel wearing personal protective equipment after operations.

5.6.3.5.14 Enclosed Hypergolic Propellant Processing Facility Control Room. There are no firm requirements for a control room, but a remote room from which to conduct operations in "shirt sleeves" is highly desirable. Explosion-proof cameras are often used to monitor the loading area.

a. If used, a control room should have communications with transfer and support areas, camera monitoring capability, and communication with base support agencies, such as the fire department, hospital, weather, and command post.

b. If used, this room shall be shown to be protected from hypergolic vapor leakage into the room through wall openings, door seals, cracks, or other openings including ventilation systems intake.

5.7 FACILITY AND STRUCTURE EMERGENCY AND CRITICAL SYSTEMS TEST REQUIREMENTS

a. Prior to facility activation, the functional capability of all emergency and critical systems in the facility shall be demonstrated.

b. At a minimum, the following applicable emergency and critical systems shall be tested in accordance with approved test plans to verify compliance with the design requirements for the system contained in Sections 5.5 and 5.6 of this Chapter:

1. Fire protection system in accordance with NFPA

2. Elevators in accordance with ASME/ANSI A17.1 and A17.2.

3. Lightning protection system in accordance with MIL-STD-1542

4. Bonding and grounding systems in accordance with MIL-STD-1542

5. Robot systems in accordance with ANSI/RIA R15.06

6. Emergency eyewash and showers

7. Air monitoring system

8. Area warning system

9. Ventilation system

10. Drain and sump system

11. Scrubber/incinerator

12. Liquid level indicator system for storage tanks

13. Conductive floors

14. HVDS

15. Vapor control system

16. Room purge system

17. Emergency Power Cutoff system

19. Emergency Monitor and Control Panel

20. Personnel anchorage and anchorage connectors

c. As applicable, Range Users shall demonstrate in one integrated end-to-end test the proper interaction of all systems that are interrelated.

5.8 CRITICAL FACILITY AND STRUCTURE INITIAL INSPECTION REQUIREMENTS

a. Prior to initial startup operations, Operations Safety shall inspect new and modified facilities and structures in accordance with AFMAN 91-201, DoD 6055.9-STD, and Range Safety Facility Activation Compliance Checklists.

b. Inspection reports shall be forwarded to Range Safety within 15 calendar days after the conduct of the inspection.

APPENDIX 5A
FACILITY SAFETY DATA PACKAGE

5A.1 INTRODUCTION

5A.1.1 Purpose

The Facility Safety Data Package (FSDP) provides a detailed description of the hazardous and critical systems of a facility assessed as critical. It is the medium from which final approval to activate the facility is obtained from Range Safety.

5A.1.2 Content

a. This Appendix contains the content preparation instructions for the data generated by the requirements delineated in this Chapter.

b. Critical systems, as identified in Chapter 3 of this document, that will be part of a facility design and not addressed in any program Missile System Prelaunch Safety Plan (MSPSP), shall be addressed as part of the FSDP. Data requirements from Appendix 3A shall be included in the FSDP, as applicable.

5A.1.3 Applicability

Except as noted, the FSDP is applicable to all facilities that are assessed as critical. The FSDP shall be submitted by the Range User responsible for overseeing the construction for these facilities or the construction contractor.

5A.1.4 Submittal Process

The FSDP submittal periods are as follows:

a. Drafts shall be provided at least 45 days prior to each of the introductory, conceptual, preliminary, critical and final (0, 30, 60, 90 and 100 percent) design reviews.

b. The final submission shall be at least 45 days prior to intended facility activation.

5A.1.5 Final Approval

The FSDP shall be approved prior to the activation of the facility.

5A.2 PREPARATION INSTRUCTIONS

5A.2.1 Content

The FSDP contains technical information on the facility. Where applicable, previously approved documentation shall be referenced throughout the package.

5A.2.2 Data Requirements

a. The data requirement sections of this Chapter and Chapter 3 and Appendix 3A as applicable, contain the information required in this Appendix.

b. The FSDP describes all hazardous and critical systems, subsystems, and their interfaces.

c. The FSDP provides verification of compliance with the design requirements of this Chapter and Chapter 3 as applicable, and the critical design criteria agreed to in the project book and design criteria document.

d. Summaries of the analyses, test plans, and test results shall be provided in the FSDP as appendixes. The actual analysis, test plans, and test results shall be provided as separate documentation for review and approval.

5A.2.3 Format

Contractor format is acceptable provided the information below is provided.

5A.2.3.1 Table of Contents and Glossary

The FSDP shall contain a table of contents and a glossary.

5A.2.3.2 Introduction

The introduction section shall address the scope and purpose of the FSDP.

5A.2.3.3 General Description

The general description section shall present an overview of the facility and the major hazardous and critical systems as a prologue to the individual system descriptions. The following items are included in this section:

a. Layout of facility

b. Location of the facility at CCAS or VAFB and explosives quantity distance siting information if the facility requires explosive siting

c. Location of major systems in the facility and outside the facility that provide direct support

d. Synopsis of each hazardous and critical system

5A.2.3.4 Critical Facility and Structure Design Criteria Document

The final facility and structure design criteria shall be provided as an appendix to the FSDP.

APPENDIX 5A
FACILITY SAFETY DATA PACKAGE

5A.2.3.5 Critical Facility and Structure Design Calculations

The final design calculations for safety critical issues such as wind loading and the safety critical portions of facilities such as blast walls, doors, and windows shall be referenced, with a summary of results provided in the body of the FSDP. **NOTE:** When completed, the calculations shall be forwarded as a separate document for Range Safety review and approval.

5A.2.3.6 WR Seismic Analysis

For conventional and critical WR facilities, structures, and installed equipment, seismic design analysis shall be referenced with a summary of results provided in the body of the FSDP. **NOTE:** When completed, the calculations shall be forwarded as a separate document for Range Safety review and approval.

5A.2.3.7 Trailer Anchoring Analysis

The trailer anchoring analysis shall be either referenced in, with a summary of results, or appended to the FSDP.

5A.2.3.8 Hazard Analyses

Hazard analyses of facilities, structures, and emergency and critical systems shall be provided in accordance with Appendix 1B, System Safety Program, as jointly tailored by Range Safety and the Range User. At a minimum, a summary of each hazard analysis shall be provided in the FSDP.

5A.2.3.9 Demolition Plans

If applicable, demolition plans for conventional and critical facilities shall be referenced in or appended to the FSDP.

5A.2.3.10 Critical Facility and Structure Design Drawings and Specifications

Facility and design engineering drawings and technical specification packages shall be referenced with the latest revision dates.

5A.2.3.11 Individual System Descriptions

a. The individual system description section contains a description of each hazardous and critical system by giving an overview of each system and then describing each item in terms of the following criteria:

1. Nomenclature
2. Function
3. Location
4. Operations
5. Design parameters
6. Acceptance testing
7. Operating parameters
8. Hazard analyses

b. Supporting data shall be included or summarized and referenced, as appropriate, with availability upon request.

c. Tables, matrices, and sketches are required for component data.

5A.2.3.12 Emergency and Critical System Design Drawings and Specifications

Each of the following emergency and critical system design drawings and specifications shall be referenced in the FSDP. **NOTE:** Design drawings and specifications for other systems identified by Range Safety shall also be referenced.

a. Lightning protection
b. Bonding and grounding
c. Robots
d. Emergency eyewash and showers
e. Air monitoring systems
f. Area warning systems
g. Ventilation systems
h. Drain and sump systems
i. Scrubbers and incinerators
j. Liquid level indicators
k. Conductive floors
l. Hazardous vapor detection systems
m. Vapor control systems
n. Room purge systems
o. Technical Power Cutoffs
p. Emergency Power Cutoff Systems
q. Emergency Monitor and Control Panel
r. Personnel anchorage and anchorage connectors
s. Elevators
t. Fire protection system

5A.2.3.13 Chapter 3 Data

Critical systems identified in Chapter 3 of this document that will be a part of a facility design and will not be addressed as part of any program MSPSP shall be addressed in the FSDP. As appli-

APPENDIX 5A
FACILITY SAFETY DATA PACKAGE

cable, data requirements from Appendix 3A shall be included in the FSDP. Critical systems include the following:

a. Material handling equipment
b. Systems with acoustic hazards
c. Ionizing radiation sources
d. Non-ionizing radiation sources
e. Hazardous materials
f. Pressure systems
g. Ordnance systems
h. Electrical systems
i. Vehicles
j. Operations safety console
k. Hazardous and safety critical computing systems and software

5A.2.3.14 Test Plans and Test Results

Safety critical test plans and test reports shall be summarized in the FSDP. The actual plans and results shall be referenced in or provided as an appendix to the FSDP.

a. Lightning protection in accordance with MIL-STD-1542
b. Bonding and grounding in accordance with MIL-STD-1542
c. Robots in accordance with ANSI/RIA R15.06
d. Emergency eyewash and showers
e. Air monitoring systems
f. Area warning systems
g. Ventilation systems
h. Drain and sump systems
i. Scrubbers/incinerators
j. Liquid level indicators
k. Conductive floors
l. Vapor control systems
m. Hazardous vapor detection systems
n. Room purge systems
o. Technical Power Cutoffs
p. Emergency Power Cutoff Systems
q. Emergency Monitor and Control Panels
r. Elevators in accordance with ASME/ANSI A17.1 and A17.2
s. Integrated end-to-end test of interrelated systems
t. Personnel anchorage and anchorage connectors

5A.2.3.15 Post-Activation Requirements

Post-activation requirements for use of a facility shall be addressed. This section includes the following topics:

a. Operational restrictions such as personnel loading, clear areas, and mandatory sequences of use
b. Critical maintenance requirements such as recalibration of relief valves, servicing of hypergolic system, HVDS calibration, ordnance ground checks, and conductive floor checks

5A.3 COMPLIANCE CHECKLIST

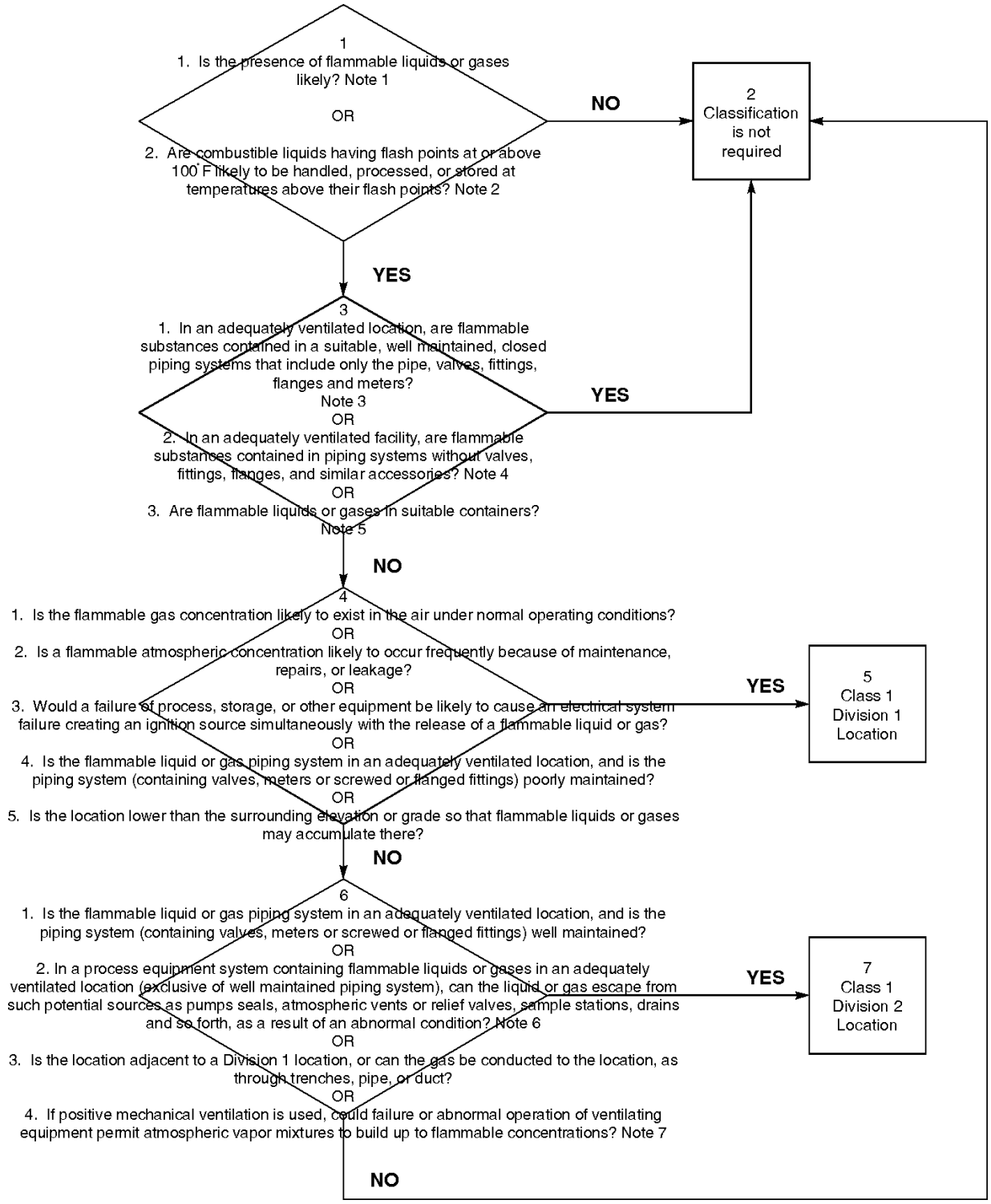
The compliance checklist section contains a checklist of all design, test, and data submittal requirements in this Chapter and Chapter 3, as applicable and the critical facility, structure, and emergency and critical system design criteria. The following items are included in this section:

a. Criteria/requirement
b. System
c. Compliance
d. Noncompliance
e. Not applicable (with rationale)
f. Resolution
g. Reference (verifying compliance)
h. Approved Noncompliances. Copies of all Range Safety approved noncompliances including deviations, waivers, and formal meets intent certifications (MICs) shall be included.

5A.4 MODIFICATIONS TO THE FSDP

The change section contains a summary of all changes to the last edition of the FSDP. All changes shall be highlighted using change bars or similar means of identification.

APPENDIX 5B
HAZARDOUS AREA CLASSIFICATION



APPENDIX 5B
HAZARDOUS AREA CLASSIFICATION

NOTES

1: The following are considered flammable liquids/gasses:
- *a*. Unsymmetrical dimethyl hydrazine (UDMH) - Flashpoint 34^0F
- *b*. Monomethyl hydrazine (MMH) - Flashpoint 62^0F

2: Hydrazine (N_2H_4) - is considered a combustible liquid.
- *a*. The surface temperature of potential spill areas must also be considered.
- *b*. Temperature in the area must be single fault tolerant to remain below 100^0F.
- *c*. Below grade locations may still accumulate enough N_2H_4 to become flammable at lower temperatures.

3: Adequate ventilation is defined by NFPA 30, *Flammable and Combustible Liquids Code*, as that which is sufficient to prevent the accumulation of significant quantities of vapor-air mixtures in concentrations over 25 percent of the lower flammability limit.
- *a*. An adequately ventilated location is one of the following:
  - *1*. An outside location
  - *2*. A building, room, or space that is substantially open and free of obstruction to the natural passage of air, either vertically or horizontally. Such locations may be roofed over with no walls, may be roofed over and closed on one side or may be provided with suitably designed wind breaks.
  - *3*. An enclosed or partly enclosed space provided with mechanical ventilation equivalent to natural ventilation. The mechanical ventilation system must have adequate safeguards against failure.
- *b*. Lower flammability limits of specific commodities are as follows:
  - *1*. N_2H_4 - 4.7 percent
  - *2*. MMH - 2.5 percent
  - *3*. UDME - 2.0 percent
- *c*. Payload propellant systems cannot normally be considered closed piping systems that include only the pipe, valves, fittings, flanges, and meters; they normally also include a pressure vessel.

4: Payload propellant systems cannot normally be considered piping without valves, fitting, flanges, and similar accessories.

5: Payload propellant systems cannot be considered suitable containers unless they meet DOT or ASME requirements or meet EWR 127-1, section 3.12 and are also protected from outside damage.

6: A payload propellant system would normally be considered a process equipment system. In a dynamic mode, the answer to this question will almost always be *yes*; in a static mode, the answer may be *yes* or *no* depending on past history and adequacy of protection from outside damage.

7: An analysis must be provided. Consideration must be given to the size of the containment area, credible potential size of the spill, adequacy of the ventilation equipment and its potential failure modes, and the specific gravity of the commodity in question.