BY ORDER OF THE COMMANDER
AIR FORCE SPACE COMMAND

AIR FORCE SPACE COMMAND
MANUAL 91-710 VOLUME 5

1 JULY 2004

Safety

RANGE SAFETY USER REQUIREMENTS MANUAL VOLUME 5 - FACILITIES AND STRUCTURES

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Certified by: AFSPC/SE (Col Billy Colwell)
Pages: 43
Distribution: F

This instruction implements Department of Defense Directive (DoDD) 3100.10, ***Space Policy***, DoDD 3200.11, ***Major Range and Test Facility Base***, DoDD 3230.3, DoD ***Support for Commercial Space Launch Activities***, AFPD 91-1, ***Nuclear Weapons and Systems Surety***, AFPD 91-2, ***Safety Programs***, AFPD 63-12, ***Assurance of Operational Safety, Suitability, and Effectiveness***, AFI 91-202, ***The US Air Force Mishap Prevention Program*** (AFSPC Sup.1) and the ***Memorandum of Agreement between the Department of the Air Force and the Federal Aviation Administration on Safety for Space Transportation and Range Activities***." This volume incorporates information previously found in Eastern and Western Range 127-1, Chapter 5, ***Facilities and Structures***. It specifies minimum design, test, inspection, and data requirements for the construction and modification of conventional and critical facilities and structures at AFSPC ranges, including the Eastern Range (ER) and Western Range (WR). The following major topics are addressed: Range User responsibilities, facilities and structures design and construction site policies, documentation requirements, conventional facilities and structures; critical facilities and structures, facility and structure emergency and critical systems test requirements, and critical facilities and structures initial inspection requirements. All AFSPC range facilities and structures are subject to the requirements of this publication regardless of real property accountability or ownership, including the Department of Defense (DoD), National Aeronautics and Space Administration (NASA), and commercial users.

This volume applies to all Range Users conducting or supporting operations on the AFSPC ranges. Range Users include any individual or organization that conducts or supports any activity on resources (land, sea, or air) owned or controlled by AFSPC ranges. This includes such organizations as the Department of Defense (DoD), United States (US) government agencies, civilian launch operators, and foreign government agencies and other foreign entities that use AFSPC range facilities and test equipment; conduct prelaunch and launch operations, including payloads to orbital insertion or impact; and/or require on-orbit or other related support. Commercial users intending to provide launch services from one of the ranges shall have a license or license application in process from the Department of Transportation's Federal Aviation Administration (FAA) or have a DoD sponsorship and be accepted by the DoD to use the ER or WR. Foreign government organizations or other foreign entities shall be sponsored by an appropriate US govern-

ment organization or be a customer of a Range User. This volume applies to the Air National Guard. It does not apply to the Air Force Reserve Command.

NOTE: Volume 1 includes a complete table of contents for all the volumes of AFSPCMAN91-710. In addition, each individual volume contains its own table of contents. Volume 7 contains a glossary of references, acronyms and abbreviations, and terms for use with all the volumes. Special publication formatting features are described in 1.1. of this volume.

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CHAPTER 1

INTRODUCTION

1.1. Organization of the Volume:

1.1.1. Main Chapters. The main chapters of this volume include common requirements for all vehicle classes. Appendixes include additional requirements to supplement the main chapters.

1.1.2. Open Text. The open text contains the actual mandatory performance-based requirements. The only tailoring expected for these requirements would be the deletion of non-applicable requirements. For example, solid rocket motor performance requirements would be deleted for launch systems that do not use solid rocket motors.

1.1.3. Bordered Paragraphs:

1.1.3.1. Bordered paragraphs are non-mandatory and are used to identify some of the potential detailed technical solutions that meet the performance requirements. In addition, the bordered paragraphs contain lessons learned from previous applications of the performance requirement, where a certain design may have been found successful, or have been tried and failed to meet the requirement. These technical solutions are provided for the following reasons:

1.1.3.1.1. To aid the tailoring process between Range Safety and Range Users in evaluating a potential system against all the performance requirements.

1.1.3.1.2. To aid Range Safety and Range Users in implementing lessons learned.

1.1.3.1.3. To provide benchmarks that demonstrate what Range Safety considers an acceptable technical solution/implementation of the performance requirement and to help convey the level of safety the performance requirement is intended to achieve.

1.1.3.2. The technical solutions in the bordered paragraphs may be adopted into the tailored version of the requirements for a specific program when the Range User intends to use that solution to meet the performance requirement. At this point, they become mandatory requirements to obtain Range Safety approval. This process is done to:

1.1.3.2.1. Provide an appropriate level of detail necessary for contractual efforts and to promote efficiency in the design process.

1.1.3.2.2. Avoid contractual misunderstandings that experience has shown often occur if an appropriate level of detail is not agreed to. The level of detail in the bordered paragraphs is necessary to avoid costly out-of-scope contractual changes and to prevent inadvertently overlooking a critical technical requirement.

1.1.3.3. The Range User always has the option to propose alternatives to the bordered paragraph solutions. Range User proposed alternative solutions shall achieve an equivalent level of safety and be approved by Range Safety. After meeting these two requirements, the Range User proposed solutions become part of the tailored AFSPCMAN 91-710 for that specific program.

1.1.3.4. Range Safety has final decision authority in determining whether Range User proposed detailed technical solutions meet AFSPCMAN 91-710 performance requirements.

1.2. Range User Responsibilities. Range Users are responsible for the following:

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

1.2.2. Ensuring construction site safety.

1.2.3. Coordinating with Bioenvironmental Engineering in the design of scrubbers and incinerators, hypergolic propellant vapor control foam and delivery systems, and air monitoring systems

1.2.4. Coordinating with the Fire Marshal in the design of fire protection systems and conduct of fire protection activities.

1.2.5. Assisting in the preparation of explosive site plans.

1.2.6. Coordinating with and supporting Operations Safety in carrying out operations safety required inspections.

CHAPTER 2

FACILITIES AND STRUCTURES DESIGN AND CONSTRUCTION SITE POLICIES

2.1. 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 Volumes 3 and 5 of this publication and in other nationally recognized codes and standards, including applicable state regulations.

2.2. Location Planning Requirement. During the planning phase for construction or modification of facilities, the following requirements shall be taken into consideration:

2.2.1. The safety impact of the new facility operations to existing and planned nearby facilities, military installation and industrial complex areas, and off-base population centers as well as the impact of existing and planned nearby facilities on the new facility operations shall be addressed.

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

2.2.3. Overflight hazards to the facility and facility contents shall be addressed during facility siting and design, and critical facilities should not be located immediately downrange of existing launch sites.

2.2.4. Location of facilities shall address the operational impact from hypergolic transfer and storage operation in nearby facilities.

2.2.5. Location of facilities that may contain hypergolic commodities shall address Toxic Hazard Corridors (THC) (see Volume 6) and the potential impact on the general public and nearby facilities.

2.2.6. Location of facilities shall take into account any radio frequency (RF) hazards and the potential impact on the general public and nearby facilities.

2.3. Construction Site Safety Policy. With the exception of 2.3.4 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:

2.3.1. The United States Army Corps of Engineers.

2.3.2. A Range User or contractor where the accountability of an AFSPC facility or work area is transferred to another Range User or contractor for construction and modification purposes.

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

2.3.4. Range Safety reserves the authority to impose a hold (stop work) when unsafe conditions exist that may endanger the public or Air Force-owned high value equipment or flight hardware. Range Safety assumes no liability or responsibility for construction site safety.

2.3.5. 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, ***Occupational Safety and***

Health Standards*,** and 29 CFR 1926, ***Safety and Health Regulations for Construction). Range Safety shall assume no liability for Range User or contractor compliance or noncompliance with OSHA requirements.

2.3.6. United States Army Corps of Engineers Safety and Health Requirements Manual. Suggested criteria for compliance with the US Army Corps of Engineers Engineering Manual (EM) 385-1-1, ***Safety – Safety and Health Requirements*** is described below.

Construction site activities on the ranges should be performed in accordance with EM 385-1-1 and the criteria stated below. 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.

CHAPTER 3

DOCUMENTATION REQUIREMENTS

3.1. Conventional and Critical Facility Determination. The Range User shall evaluate all facilities, facility systems, and structures to determine if they are critical.

3.2. Documentation Review and Approval Process:

3.2.1. Unless otherwise agreed to by Range Safety and the Range User or otherwise stated in this volume, the facility design engineering documents described below shall be submitted to Range Safety for review and approval 30 days before the following design review meetings: conceptual (30 percent); Preliminary (60 percent); Critical (90 percent); and Final (100 percent).

3.2.1.1. 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).

3.2.1.2. All facility design engineering drawing and specification packages shall have a space or block on the first drawing sheet reserved for the coordination/approval signature of the 30 SW/SEG or 45 SW/SES reviewing official.

3.2.1.3. All Review Item Discrepancies (RIDs) shall be addressed at each design review and resolved as soon as possible.

3.2.2. 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.

3.2.3. 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.

3.2.4. Documentation requiring the review and approval of the Fire Marshal shall be submitted in accordance with MIL-HDBK-1008, ***Fire Protection for Facilities Engineering, Design, and Construction*.**

3.3. Conventional Facilities and Structures Documentation Requirements:

3.3.1. Determining Criticality. Range Users shall submit documentation justifying the non-critical determination of a facility and/or structure. This documentation shall be submitted at the introductory and conceptual (30 percent) design reviews.

3.3.2. Conventional Facility Design Drawings and Specifications. Facility design engineering drawings and technical specification packages for conventional facilities shall be submitted.

3.4. Critical Facilities and Structures Documentation Requirements:

3.4.1. Critical Facility and Structure Design Criteria Document:

3.4.1.1. Before 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.

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

3.4.2. Critical Facility and Structure Test Plans and Test Reports:

3.4.2.1. Test Plans:

3.4.2.1.1. Test plans shall be submitted in accordance with the requirements specified in Attachment 1, **A1.2.3.14** of this volume.

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

3.4.2.2. Test Reports. Test reports shall be submitted to Range Safety and the other agencies noted in Attachment 1, **A1.2.3.14** of this volume for review and approval at least 45 days before activation of the facility.

3.4.3. 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 **Attachment 1** of this volume. As an alternate, a design package that contains all the elements specified in **Attachment 1** is acceptable.

CHAPTER 4

CONVENTIONAL FACILITIES AND STRUCTURES

4.1. Conventional Facility and Structure Design Standards:

4.1.1. The design of new, rehabilitated, or modified conventional facilities and structures on the ranges shall comply with the requirements of MIL-HDBK-1190, ***Facility Planning and Design Guide*****;** the Unified Facilities Criteria (UFC 1-200-01) ***Design: General Building Requirements***, and the specifications, standards, codes, and practices of the documents cited in this volume to the extent stated in the text.

4.1.2. Concrete structures shall be in accordance with UFC 1-200-01 and applicable American Concrete Institute (ACI) codes and standards.

4.1.3. Masonry construction shall be in accordance with UFC 1-200-01.

4.1.4. Timber construction shall be in accordance with UFC 1-200-01 and applicable DIN 1052, ***Design of Timber Structures - General Rules And Rules For Buildings*****,** or equivalent standards.

4.1.5. Aluminum structures shall be in accordance with UFC 1-200-01 and the Aluminum Association ***Aluminum Design Manual*****.**

4.1.6. Materials shall be compatible with the operational environment.

4.2. Conventional Facility and Structure Elevators:

4.2.1. All elevators shall be designed, built, and installed in accordance with ANSI/ASME A17.1, ***Design, Construction, Installation, Operation, Inspection, Testing, Maintenance Safety Code, Alteration and Repair for Elevators, Waiters, Escalators, and Moving Walks*****.**

4.2.2. All elevators shall be inspected, tested, and maintained in accordance with ANSI/ASME A17.1 and A17.2, ***Inspector's Manual for Elevators and Escalators*****.**

4.2.3. Elevators shall be equipped with telephones to enable two-way communication.

4.3. Conventional Facility and Structure Life Safety Code Requirements. The provisions of NFPA 101, ***Life Safety Code***, shall be incorporated in the design of each conventional facility and structure at the ranges.

4.4. Conventional Facility and Structure Electrical Equipment:

4.4.1. Power distribution design shall comply with AFJMAN 32-1080, ***Electrical Power Supply and Distribution*****,** and ANSI/IEEE 141, ***Electrical Power Distribution for Industrial Plants*****.**

4.4.2. Interior electrical design shall comply with Unified Facilities Criteria (UFC) 3-520-01, ***Interior Electrical Systems***, ANSI/IEEE 241, ***Electric Power Systems in Commercial Buildings***, and the ***National Electrical Code*** (NEC) (NFPA 70).

4.4.3. 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.

4.5. Conventional Facility and Structure Personnel Anchorage and Anchorage Connectors:

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

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

4.5.3. Personnel anchorage system components shall be designed and tested in accordance with ANSI A10.14, ***Construction and Demolition Operations - Requirements for Safety Belts, Harnesses, Lanyards, and Lifelines for Construction and Demolition Use***, and/or ANSI Z359.1, ***Personnel Fall Arrest Systems, Subsystems, and Components***, as applicable.

4.5.4. Anchorage and anchorage connectors shall be load tested initially to 5,000 pounds static and shall not require retesting except for causes such as corrosion, damage, replacement, modification, repair, or exposure to launch heating.

4.5.5. 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 5,000 pounds per person. Such markings may be stenciled on the surrounding structure.

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

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

4.5.8. Anchorage and anchorage connectors shall be located (1) as high as practical to limit the distance of a potential fall; and (2) so that an individual can attach to the connectors at waist height or above; and (3) so that the connectors 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.

To preclude the above conditions, shielding or guarding of the components or system in question may be required.

4.5.9. Safety swivel hoist rings shall be the preferred connector rather than shouldered eye bolts.

4.6. Seismic Design:

AFM 32-1050, ***Seismic Design Guidelines for Upgrading Existing Buildings***, places the WR in Seismic Zone 4. 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.

4.6.1. Seismic design of all new or modified facilities, structures, and installed equipment shall be in accordance with UFC 1-200-01.

4.6.2. Where specific design guidance is not provided in these manuals, industry standards such as those of the Structural Engineers Association of California (***SEAOC Blue Book***), ***Uniform Building Code*** (UBC), Applied Technology Council, and the Federal Emergency Management Agency (FEMA) shall be used.

4.6.3. Seismic design shall consider both the vertical and horizontal components of seismic loading.

4.6.4. Facilities, structures, installed equipment, and trailers that must remain operational after a seismic event shall be designed with an importance factor of 1 of 1.5.

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

4.6.6. 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:

4.6.6.1. Severe personnel injury.

4.6.6.2. Catastrophic events.

4.6.6.3. Significant impact on space vehicle and/or missile processing and launch capability.

4.7. Portable/Mobile Structures Design:

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

Examples of such structures are job shacks, material storage containers, and trailers.

4.7.2. Such structures shall be anchored to withstand wind and seismic loading per the criteria in this volume.

4.8. Structural Steel:

4.8.1. Structural Steel General Design Requirements:

4.8.1.1. Steel facilities and structures shall be designed in accordance with the American Institute of Steel Construction (AISC) ***Manual of Steel Construction-Allowable Stress Design*** *(ASD),* or ***Manual of Steel Construction - Load and Resistance Factor Design*** (LRFD).

4.8.1.2. Steel connections shall be designed in accordance with AISC ASD or LRFD manuals and the ***Manual of Steel Construction, Volume II, "Connections."***

4.8.2. Bolts and Fasteners:

4.8.2.1. Permanent bolted structural joints shall use high strength fasteners (ASTM A325 or ASTM A390). ASTM A307 bolts may be used for connections in secondary structures.

4.8.2.2. 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.

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

4.8.3. Welding:

4.8.3.1. Welded connections shall use prequalified welded joints in accordance with AISC and AWS D1.1, ***Structural Welding Code.***

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

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

4.8.3.3.1. 100 percent of all welds shall be visually inspected in accordance with AWS D1.1 and the Nondestructive Examination (NDE) Plan.

4.8.3.3.2. Welded single failure point (SFP) connections or connections whose failure could propagate to a catastrophic event shall be 100 percent tested as follows: Full-penetration welds (groove or butt) - ultrasonically (UT) tested in accordance with MIL-STD-1699, ***Nondestructive Evaluation Of Butt Welds In Crane And Railroad Rails***, or the equivalent; other welds - magnetic particle tested in accordance with ASTM E1444, ***Magnetic Particle Inspection***, or equivalent. If rejectable discontinuities are found, the weld shall be removed and replaced in accordance with AWS D1.1 and the NDE Plan.

4.8.3.3.3. Nondestructive test personnel shall be qualified to ***American Society for Nondestructive Testing Standards*** SNT-TC-1A, Level 1 (under supervision of a Level 2) or above.

4.8.4. Structural Steel Materials:

4.8.4.1. Structural steel material shall be in accordance with AISC.

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

4.9. Design Load Criteria:

4.9.1. Design load assumptions for dead, live, and operational wind loads shall be in accordance with ANSI/ASCE 7, ***Minimum Design Loads for Buildings and Other Structures***.

4.9.2. Wind loads for facilities and structures shall be designed in accordance with ANSI/ASCE 7.

4.9.3. The design loads and load combinations used in the analysis shall be in accordance with ANSI/ASCE 7 and UFC 1-200-01 and include all unique loads such as personnel anchor points, equipment loads, impact loads, launch environment loads (rocket engine exhaust impingement, blast pressure, acoustics, or vibrations). Members shall be designed to withstand the most critical credible loads and load combinations.

4.9.4. Live loads shall be designed in accordance with applicable sections of 29 CFR 1910, ANSI/ASCE 7, and UFC 1-200-01.

4.9.5. Structural members shall be sized to accept additional moments for the installation of personnel anchor points as required.

4.10. Antenna Towers. Antenna towers shall be designed in accordance with ANSI/EIA/TIA 222, ***Structural Standards for Steel Antenna Towers and Antenna Supporting Structures***.

4.11. Robot Systems. Industrial robots and robot systems shall be designed, installed, tested, and operated in accordance with ANSI/RIA R15.06, ***Design, Installation, Testing, and Operation Requirements for Industrial Robots and Robot Systems.***

CHAPTER 5

CRITICAL FACILITIES AND STRUCTURES

5.1. Critical Facility and Structure General Design Requirements. The requirements for critical facilities and structure are in addition to those stipulated in Chapter 4 of this volume.

5.1.1. 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 the documents cited below to the extent stated in the text.

5.1.2. Critical Facility and Structure Elevators. All elevators in critical facilities shall be equipped with a public address (PA) speaker where a PA system is available. Emergency telephones shall be provided.

5.1.3. Critical Facility and Structure Electrical Design:

5.1.3.1. Electrical Systems:

5.1.3.1.1. Before being put into service, any electrical equipment that is not specifically listed or 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.

5.1.3.1.2. Copper conductors shall be used for all electrical wiring installations.

5.1.3.1.3. Transformers shall use copper winding and connections.

5.1.3.2. Bonding and Grounding:

5.1.3.2.1. Bonding and grounding design and installation requirements for all critical facilities and structures shall comply with the requirements of ANSI/NFPA 70, ANSI/IEEE 142, ***Recommended Practice for Grounding of Industrial and Commercial Power Systems***, and AFI 32-1065, ***Grounding Systems.***

5.1.3.2.1.1. In addition to a raceway (conduit, cable tray, or busway), a separate equipment-grounding conductor (NEC green wire) shall be used for all installations.

5.1.3.2.1.2. Grounding systems in critical facilities containing launch checkout and/or data processing equipment (including communications systems) shall follow the guidelines in MIL-HDBK-419, ***Grounding, Bonding, and Shielding for Electronic Equipment and Facilities***, for development of the grounding systems.

5.1.3.2.2. Resistance of the ground electrode system (counterpoise system) shall not exceed 10 ohms.

5.1.3.2.3. All facilities used to store, handle, or process ordnance items or propellants shall be bonded and grounded in accordance with AFMAN 91-201, *Explosives Safety Standards*, DoD 6055.9-STD, ***Ammunition and Explosives Safety Standards***, and AFI 32-1065.

5.1.3.3. Static Electricity. Facilities with equipment and personnel that require protection from the generation of static electricity shall be designed and operated in accordance with NFPA 77, ***Recommended Practices on Static Electricity***.

5.1.4. Critical Facility and Structure Lightning Protection:

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

5.1.4.2. 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:

5.1.4.2.1. TM 5-1300/NAVFAC P-397, ***Structures to Resist the Effects of Accidental Explosions***.

5.1.4.2.2. AFI 32-1065.

5.1.4.2.3. AFMAN 91-201 and DoD 6055.9-STD.

5.1.5. Critical Facility and Structure Electrical Equipment:

5.1.5.1. Installation in Hazardous (Classified) Locations:

5.1.5.1.1. Definition of Hazardous (Classified) Locations. Hazardous (Classified) locations are defined in Article 500 of the NEC, *Hazardous (Classified) Locations*.

5.1.5.1.2. Explosives and Propellants Not Covered in NEC Article 500. 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 present 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 Attachment 3 in Volume 3 of this publication for a flowpath for classifying hazardous areas.)

5.1.5.1.2.1. Class I, Division 1. Complete definitions of classified locations are found in NFPA 70. These include the following locations:

5.1.5.1.2.1.1. Within 25 feet 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 feet.

5.1.5.1.2.1.2. Below grade locations in a Class II, Division 1 area.

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

5.1.5.1.2.2. Class II, Division 1. Complete definitions of classified locations are found in NFPA 70.

Class II, Division 1 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, and the total area involved are all factors that merit consideration in determining the classification and extent of each location.

5.1.5.1.2.2.1. Piping without valves, checks, meters, and similar devices shall 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 shall not normally be considered hazardous unless also subject to other hazardous conditions.

5.1.5.1.2.2.2. As determined by Range Safety and the Fire Marshal, locations may actively change classification depending on 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.

5.1.5.1.2.2.3. Portable electrical equipment shall be designed for the worst case hazardous environment in which it will be used. Portable equipment that is not designated for use in a particular hazardous environment is not allowed in that environment.

5.1.5.1.2.2.4. Class II, Division 1 locations include the following equipment or areas:

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

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

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

5.1.5.1.2.2.4.4. 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. The quantity of fluids used in the analysis to determine vapor concentration for these locations shall be the maximum amount allowed in the explosives site plan.

5.1.5.1.2.2.4.5. Locations adjacent to a Class I, Division 1 location into 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.

5.1.5.1.2.3. Hazardous Commodity Groups. Hazardous commodities are grouped by similar characteristics.

5.1.5.1.2.3.1. These fuels shall be considered ignitable regardless of the ambient temperature.

5.1.5.1.2.3.2. The following fuels shall be categorized as follows:

5.1.5.1.2.3.2.1. Group B: Liquid or gaseous hydrogen.

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

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

5.1.5.1.2.3.2.4. Group D: Oxidizers. Oxidizers shall be considered Group D hazardous substances in addition to the fluids listed in NFPA 497, ***Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.***

5.1.5.1.2.3.2.5. Group D: Exposed Solid Propellants. The atmosphere within 10 feet horizontally and directly overhead of exposed solid propellant shall be classified as a Class II, Division 1, Group D location. Solid rocket motors are considered exposed in the following situations:

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

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

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

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

5.1.5.2. 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:

5.1.5.2.1. 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 per 29 CFR 1910.7, ***Definition And Requirements for a Nationally Recognized Testing Laboratory***.

5.1.5.2.2. Nonincendive apparatus shall meet the requirements of NFPA 70, Article 501, ***Class I Locations***, and ANSI/ISA - 12.12.01, ***Nonincendive Electrical Equipment for Use in Class I & II, Division 2 & Class III, Divisions I & 2 Hazardous Locations: S12.12***, and are restricted to installation in Class II, Division 1 locations only. They shall be listed and labeled by a nationally recognized testing laboratory per 29 CFR 1910.7.

5.1.5.2.3. Intrinsically safe equipment intended for any NEC Hazardous (Classified) location shall meet the requirements of NEC Article 504, ***Intrinsically Safe Systems***, and UL 913, ***Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Areas***, and be listed and labeled by a nationally recognized testing laboratory per 29 CFR 1910.7.

5.1.5.2.4. The use of purged and pressurized electrical enclosures designed in accordance with NFPA 496, ***Purges and Pressurized Enclosures for Electrical Equipment***, 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:

5.1.5.2.4.1. The purged and pressurized enclosure shall be constantly maintained at a positive pressure of at least 1/10 inch of water above the surrounding atmosphere during operation of the protected equipment.

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

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

5.1.5.2.5. Equipment inspected and tested to other government standards such as MIL-STD-810, ***Environmental Engineering Considerations and Laboratory Tests***, may be used if approved by Range Safety in coordination with Civil Engineering.

5.1.5.3. Backup Power Sources. Backup power sources shall be provided for critical load requirements when the following conditions apply:

5.1.5.3.1. Where the loss of power could result in injury and/or death to personnel, emergency power systems shall be provided in accordance with NFPA 110, ***Standard for Emergency and Standby Power Systems*****,** and NFPA 70, Article 700 (NEC), ***Emergency Systems*****.**

5.1.5.3.2. Where the loss of normal power would cause damage to or loss of government facilities and/or flight hardware, standby power systems shall be provided in accordance with NFPA 70, Article 702 (NEC), ***Optional Standby Systems*****.**

5.1.6. Critical Facility and Structure Fencing:

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

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

5.1.6.3. 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.

5.2. Special Critical Facility Systems and Structures. The following requirements are for unique critical facility systems and structures. These requirements supplement the general requirements in Chapter 4 of this volume.

5.2.1. Air Monitoring Systems:

5.2.1.1. Air Monitoring System General Design Requirements:

5.2.1.1.1. Locations in which there is a potential hazard of oxygen deficiency, toxicity, or explosive vapors that could result in personnel injury or death shall be provided with air monitoring systems. Portable monitoring units may be used before access in lieu of permanent systems with Bioenvironmental Engineering and Range Safety approval. Explosive vapor (flammability) monitoring shall be accomplished by permanently installed systems reporting vapor concentration data to a remote location.

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.

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

5.2.1.1.3. Air Force personnel shall comply with Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-25, *Confined Spaces*, for confined space management and entry procedures.

5.2.1.2. Air Monitoring Systems Locations Having Regular Access:

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

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

5.2.1.2.3. The remote alarm signal shall be transmitted to the blockhouse, operations control center, or range fire department where 24-hour continuous monitoring is provided.

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

5.2.1.3. Air Monitoring System Locations Having Infrequent or Temporary Access:

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

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

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

5.2.1.5. Toxicity Monitoring Systems. Toxicity monitoring systems shall be configured to provide measurements from a sampling location in proximity to the worker breathing zone.

5.2.1.5.1. Occupational Exposure Levels (OELs) established in AFOSHSTD 48-8, ***Controlling Exposures to Hazardous Materials***, shall be used for the protection of Air Force and other government personnel.

5.2.1.5.1.1. Monitoring Requirements. Monitoring shall be performed at time intervals and sampling points as designated by the Bioenvironmental Engineer to ensure workers are not exposed above OEL requirements.

5.2.1.5.1.2. Alarm Requirements. With the concurrence of the Bioenvironmental Engineer, an alarm value can be higher than the OEL so long as actual exposures do not exceed OEL dosage and concentration requirements.

5.2.1.5.2. If Air Force or other government personnel exposure is non-credible, the Permissible Exposure Level (PEL) established by OSHA for occupational worker health protection measures may be used in lieu of the OEL. Non-credible exposure to Air Force and other government personnel shall be determined by Range Safety and the Wing Bioenvironmental Engineers.

5.2.1.6. Explosive Vapor Monitoring Systems. For explosive hazard protection, 25 percent of the LEL shall never be exceeded.

5.2.1.6.1. Monitoring Requirements. The monitoring system shall be able to detect concentrations at 1 percent LEL within 1 meter proximity of the leak source and have a response time of less that 1 minute unless Range Safety concurs that engineering mitigations, such as sufficient air mixing, enables less stringent monitoring.

5.2.1.6.2. Alarm Requirements. Range Safety concurrence of the alarm activation level is required. The activation level shall be designed to prevent accumulation of explosive vapors to exceed 25 percent of LEL at close proximities.

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

5.2.2. Mobile Service Towers. Mobile service towers (MSTs) shall be anchored or tied down at all times, except when in a moving operation. MSTs shall have a margin of safety of 1.5 against overturning due to wind or seismic loading while in the moving configuration.

5.2.3. Hazardous Commodity Lockers. Lockers or cabinets positioned for the purpose of storing flammable, toxic, reactive, or caustic materials shall be designed in accordance with NFPA 30, ***Flammable and Combustible Liquids Code***, and AFOSHSTD 91-501, ***Air Force Consolidated Occupational Safety Standard.***

5.2.4. Battery Storage and Processing Areas:

5.2.4.1. Battery shops shall be designed in accordance with AFOSHSTD 91-20, ***Vehicle Maintenance Shops*****,** Chapter 2, "Battery Maintenance," and NEC Article 480, ***Storage Batteries.***

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

5.2.4.2.1. Emergency eyewash and shower systems.

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

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

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

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

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

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

5.2.5. Cable-Operated Overhead Doors:

5.2.5.1. Cable-Operated Overhead Door Design Requirements:

5.2.5.1.1. Cable-operated overhead doors shall be designed to the specified duty cycle.

5.2.5.1.2. The load path components, including such items as the fabric strap/rope, wire ropes, and belts, shall have a minimum ultimate safety factor of 5 to 1. If terminations that are capable of less than 100 percent of the strength of the support system are used (for example, clips and clamps), the safety factor reduction shall be compensated for.

5.2.5.1.3. If single failure points (SFPs) cannot be designed out of the system, the doors or individual door panels shall be equipped with secondary safety devices to prevent the door or panels from falling in the event of a single point failure. Fabric connections shall use rounded corner cuts, not square cuts, to prevent stress tearing.

5.2.5.1.4. The doors and/or individual door panels shall be designed to remain retained in the door guides even in the event of the door falling as a result of the support system failure.

5.2.5.1.5. If a counterweighted system is used, the counterweight travel path shall be caged at the building floor level to protect personnel and equipment. Where counterweight failure and floor impact could cause damage to flight hardware, damping devices shall be used.

5.2.5.1.6. Means shall be provided to secure the counterweight (if used) and unload the support system when the door is in a fully closed positions.

5.2.5.1.7. Individual support system components, including reeving such as sheaves, drive sprockets, ropes, and straps, shall be readily accessible for inspection and repair.

a. Access to door-mounted replaceable components such as guide rollers should be provided.

b. Considerations should be given to providing chain or cable-hoist anchor points where removal of heavy reeving system components may be required for servicing; for example, replacing a bearing on the sheaves.

5.2.5.1.8. A means to adjust the individual ropes/straps to compensate for stretch shall be provided.

5.2.5.1.9. A manual backup system to operate the doors in the event of the electric motor failure shall be provided.

5.2.5.1.10. Motor-holding brakes shall be a failsafe design; in other words, they will automatically set by spring action upon loss or removal of power to the motor.

5.2.5.1.11. The motor-holding brake shall be designed to hold at least 150 percent of the motor torque and the static torque exerted by the weight of the door.

5.2.5.1.12. Fabric doors over 100 feet high shall have an intermediate structural header the full width of the door. The structural header shall be placed mid-height and support the entire weight of the lower sections of the door when the door is closed. The upper fabric sections of the door shall never support the entire weight of the door.

For fabric overhead doors, consideration should be taken to prevent lightning-induced currents into flight hardware inside the building. Electrical magnetic pulses will travel through fabric doors and may induce electrical charges into metallic components.

5.2.5.1.13. All cable-operated overhead doors shall be equipped with sensors or a similar safety device to ensure that the door will not close if there is an obstruction in the door path.

5.2.5.1.14. The lowest panel edge of the door shall be equipped with a door stop trip switch that will automatically stop the door if the door hits an obstruction. The force required to stop the door shall not exceed 30 pounds.

5.2.5.2. Cable-Operated Overhead Door NDE, Maintenance, and Test Requirements:

5.2.5.2.1. An NDE/maintenance/test plan shall be prepared by the Range User and approved by Range Safety.

5.2.5.2.2. Initially, all load path SFP components and SFP welds shall be volumetrically and surface inspected.

5.2.5.2.3. Periodic NDE inspections, routine maintenance, and testing shall be performed as documented in the NDE/maintenance/test plan.

5.3. 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 Chapter 4 of this volume.

5.3.1. Explosives Site Plans:

5.3.1.1. 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.

5.3.1.2. 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 Department of Defense Explosives Safety Board (DDESB) through engineering safety channels for review and approval.

5.3.1.3. 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 before the start of construction.

5.3.1.4. 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.) Hazard Class/Division 1.1 explosives shall not be approved by license.

5.3.1.5. 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. 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 shall be obtained before the start of construction.

5.3.1.6. Range Safety shall approve movement or relocation of a hazardous operation and/or system into a facility. Even if the facility has been used for similar operations in the past, Range Safety review and approval is required.

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

5.3.2. Explosive Facilities General Design Requirements:

5.3.2.1. Explosives storage, handling, and processing facilities shall be designed and constructed in accordance with AFMAN 91-201,DoD 6055.9-STD, and AFI 32-1065.

5.3.2.2. 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 TM 5-1300/NAVFAC P-397.

5.3.3. Explosives Facilities Area Warning Systems:

5.3.3.1. Explosives Facilities Area Warning Systems General Requirements.
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. Range Safety shall make the determination on a case-by-case basis.

5.3.3.1.1. 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.

5.3.3.1.2. The warning system shall consist of warning lights and audible signals augmented by PA announcements.

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

5.3.3.1.4. The visual and audible warning systems shall be visible and audible throughout the facility in 360 degrees in direction and, at a minimum, the public traffic route (PTR) distance in accordance with AFMAN 91-201.

5.3.3.1.5. 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.

5.3.3.2. Explosives Facilities Area Warning Systems Specific Requirements:

5.3.3.2.1. 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.

5.3.3.2.2. 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.

5.3.3.2.3. 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.

Controlled area warning horns should be pressure or electrically operated.

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

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

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

5.3.4. Hypergolic Propellant Main and Ready Storage Facilities:

5.3.4.1. Hypergolic Propellant Facility Containment System:

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

5.3.4.1.2. Each containment bay shall be capable of holding at least 4 times the tank capacity.

5.3.4.1.3. 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 inches thick and constructed in accordance with TM 5-1300/NAVFAC P-397 unless engineering studies determine that less protection is acceptable for present and known future requirements.

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

5.3.4.1.5. 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 nearby facilities.

5.3.4.1.6. Propellant transfer areas shall be capable of containing 4 times the capacity of the largest mobile tanker to be used at the facility.

5.3.4.2. Hypergolic Propellant Facility Ventilation:

5.3.4.2.1. 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.

5.3.4.2.2. Closed or confined areas shall have adequate ventilation to prevent ignitable or toxic concentrations of vapors. If natural ventilation is inadequate, a mechanical exhaust ventilation system shall be provided.

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

5.3.4.2.4. Remote manual controls shall be provided for ventilation systems.

5.3.4.3. Hypergolic Propellant Facility Compatibility:

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

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

5.3.4.3.3. 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.

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

5.3.4.3.5. All hypergolic storage facilities and structures shall be designed to protect against hypergols contacting incompatible, static producing, or absorbent materials.

Areas of concern include floors, the first 4 feet of walls, doors, trenches, plumbing, caulking, sealants, and other items.

5.3.4.3.6. If the compatibility of a particular material is unknown, the Range User shall perform tests to develop compatibility data for review and approval by Range Safety.

On the ER, the NASA/KSC Materials Test Laboratory is available to perform these tests.

5.3.4.3.7. All exterior structural steel used in a hypergolic storage facility shall be coated with a hypergolic-compatible protective coating. Recommended coating procedures and materials are contained in KSC-STD-C-0001, ***Recommendations for Protective Coating Procedures and Materials for Exterior Structural Steel in Hypergolic Storage Facilities.***

5.3.4.3.8. 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 splashguard.

5.3.4.4. Hypergolic Propellant Facility Gravity Drain Sump Systems/Transfer Area:

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

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

5.3.4.4.3. Sump tanks shall be located below grade with a capacity to hold 4 times the volume of the largest mobile tanker to be used at the transfer station.

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

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

5.3.4.4.6. Welded drain fixtures, piping, and sump tanks shall be fabricated from 304L or 316L stainless steel.

In addition to compatibility, fabrication and the ability to accomplish field welding are considerations in material selection.

5.3.4.4.7. 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.

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

5.3.4.4.9. All drain valves shall be manually controlled.

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

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

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

5.3.4.6. Hypergolic Propellant Facility Emergency Storage Tanks:

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

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

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

5.3.4.7. Hypergolic Propellant Facility Scrubbers and Incinerators:

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

5.3.4.7.2. Bioenvironmental Engineering shall review and approve the scrubber and/or incinerator design.

5.3.4.7.3. Use of scrubbers and/or incinerators requires a Civil Engineering permit.

5.3.4.8. Hypergolic Propellant Facility Fire Protection Systems. For storage of hypergolic fuels such as N_2H_4, UDMH, MMH, and 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, ***The Fire Protection Operations and Fire Prevention Program*.**

5.3.4.8.1. Fire Detection:

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

5.3.4.8.1.2. 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.

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

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

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

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

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

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

5.3.4.8.2. **Extinguishment Systems (Fuel Side Only):**

5.3.4.8.2.1. 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, ***Water Spray Fixed Systems for Fire Protection*.**

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

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

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

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

5.3.4.8.2.6. An 0.5-second response time of the deluge system is required. 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.

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

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

5.3.4.9.1. Liquid Level Sensing and Indicator System:

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

5.3.4.9.1.2. A programmable controller shall be provided to interpret 1/16 inch liquid level deviations and send an alarm to the range fire department.

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

5.3.4.9.2. Hypergolic Vapor Detection System:

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

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

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

5.3.4.9.2.4. The remote alarm signal shall be transmitted to the blockhouse, operations control center, or the range fire department where 24-hour continuous monitoring is provided.

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

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

5.3.4.10. Hypergolic Propellant Facility Vapor Control Systems. If a facility vapor control system is installed, it shall meet the following requirements:

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

5.3.4.10.2. The system shall be manually controlled only.

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

5.3.4.10.4. Range Safety, the Fire Marshal, and Bioenvironmental Engineering shall review and approve the performance characteristics of the foam and delivery system.

5.3.4.11. Hypergolic Propellant Facility Personal Protective Equipment Support:

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

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

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

5.3.4.12. **Hypergolic Propellant 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. 1. 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. 2. 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.

5.3.5. 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. These areas include off-pad facilities and environmental enclosures on launch complexes except as noted.

5.3.5.1. Enclosed Hypergolic Propellant Facility Conductive Floors:

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

5.3.5.1.2. Conductive floors shall be designed in accordance with DoD 4145.26-M, *DoD **Contractors' Safety Manual for Ammunition and Explosives**. **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.*

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

5.3.5.2. Enclosed Hypergolic Propellant Facility Containment Systems:

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

5.3.5.2.2. The containment system shall have the capability to hold 4 times the volume of the largest hypergolic container used in the transfer area.

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

5.3.5.3. Enclosed Hypergolic Propellant Facility Purge Systems:

5.3.5.3.1. Enclosed areas used to process hypergols shall have a manually activated purge system. The performance and efficiency criteria for the purge system shall be reviewed and approved by Range Safety during the conceptual design phase.

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.

5.3.5.3.2. 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.

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

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

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

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

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

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

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

5.3.5.4. Enclosed Hypergolic Propellant Facility Compatibility:

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

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

5.3.5.4.3. 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.

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

5.3.5.4.5. All hypergolic processing areas shall be designed to protect against hypergols contacting incompatible, static producing, or absorbent materials.

Areas of concern include floors, the first 4 feet of walls, doors, trenches, plumbing, caulking, sealants, and other areas.

5.3.5.4.6. If the compatibility of a particular material is unknown, the Range User shall perform tests to develop compatibility data for review and approval by Range Safety.

On the ER, the NASA/KSC Materials Test Laboratory is available to perform these tests.

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

5.3.5.4.8. 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 splashguard.

5.3.5.5. Enclosed Hypergolic Propellant Facility Gravity Drain Sump Systems:

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

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

5.3.5.5.3. Sump tanks shall be located below grade with a capacity to hold 4 times the volume of the largest hypergol container to be used in the transfer area.

5.3.5.5.4. Welded piping and sump tanks shall be fabricated from 304L or 316L stainless steel unless otherwise approved by Range Safety.

In addition to compatibility, fabrication and the ability to accomplish field welding are considerations in material selection.

5.3.5.5.5. Sump tanks shall have offload capability.

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

5.3.5.5.7. All drain valves shall be manually controlled.

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

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

5.3.5.5.10. Environmental enclosures on launch complexes shall be designed to provide the capability to "mop and sop" hypergolic spills at the transfer areas. 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.

5.3.5.5.11. 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.

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

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

5.3.5.7. Enclosed Hypergolic Propellant Facility Scrubbers and Incinerators:

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

5.3.5.7.2. Bioenvironmental Engineering shall review and approve the scrubber and/or incinerator design.

5.3.5.7.3. Civil Engineering shall permit scrubbers and/or incinerators for use.

5.3.5.8. Enclosed Hypergolic Propellant Facility 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.

5.3.5.8.1. Fire Detection:

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

5.3.5.8.1.2. 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.

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

5.3.5.8.1.3.1. 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.

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

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

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

5.3.5.8.1.4.2. Time delay, voting, cross zoning and other methods may be used to reduce false alarms.

5.3.5.8.2. Extinguishment Systems:

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

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

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

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

5.3.5.8.2.5. An 0.5-second response time of the deluge system is required. 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.

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

5.3.5.9. Enclosed Hypergolic Propellant Facility Vapor Detection Systems:

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

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

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

5.3.5.9.4. The remote alarm signal shall be transmitted to the blockhouse, operations control center, or the range fire department where 24-hour continuous monitoring is provided.

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

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

5.3.5.10. Enclosed Hypergolic Propellant Facility Emergency Power Cutoff Systems:

5.3.5.10.1. Each enclosed hypergolic propellant processing area shall be equipped with an emergency power cutoff (EPC) system that permits manual shutdown of all non-essential electrical equipment in the event of a leak or other emergency.

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

5.3.5.10.2.1. A manual EPC switch shall be located at each exit from a processing area and shall be designed for use in a Class II, Division 1, Group C classified location.

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

5.3.5.10.2.2.1. Shutdown of the AHU for that area.

5.3.5.10.2.2.2. Shutdown of all electrical equipment except for one outlet receptacle (this outlet shall be designed for use in a Class I, Division 1, Group C classified loca-

tion) and those systems required for emergency response. The following emergency response systems shall not be shut down: emergency lights, crane, communication system, air monitoring system, purge system, and fire protection system.

5.3.5.10.2.3. A general alarm shall sound throughout the facility.

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

5.3.5.10.2.5. An alarm signal shall be sent to the range fire department.

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

5.3.5.10.2.6.1. EPC switches shall be mounted 4.5 feet above the floor.

5.3.5.10.2.6.2. EPC switches shall be covered to prevent inadvertent actuation.

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

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

5.3.5.11. Enclosed Hypergolic Propellant Facility Emergency Monitor and Control Panels:

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

5.3.5.11.2. The control panel shall provide the following functions:

5.3.5.11.2.1. EPC system monitor.

5.3.5.11.2.2. Purge system monitor.

5.3.5.11.2.3. HVDS monitor.

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

5.3.5.11.2.5. EPC system test control.

5.3.5.11.2.6. Area warning lights control.

5.3.5.11.2.7. Pushbutton silencing of all audible alarms except fire alarms.

5.3.5.12. Enclosed Hypergolic Propellant Facility Windsocks. Windsocks shall be provided adjacent to all enclosed hypergolic propellant processing facilities. Windsocks shall be clearly visible at night.

5.3.5.13. Enclosed Hypergolic Propellant Facility Personal Protective Equipment Support:

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

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

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

5.3.5.14. Enclosed Hypergolic Propellant 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.

1. 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.

2. 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 in-take.

CHAPTER 6

FACILITY AND STRUCTURE INSPECTION AND SYSTEMS TEST REQUIREMENTS

6.1. Critical Facility and Structure Initial Inspection Requirements. Before initial startup operations of new and modified facilities and structures, Range Users shall coordinate with and support Operations Safety in carrying out operations safety required inspections in accordance with AFMAN91-201, DoD 6055.9-STD, and at the ER only, the Range Safety Facility Activation Compliance Checklists.

6.2. Facility and Structure Emergency and Critical Systems Test Requirements:

6.2.1. Before facility activation, the functional capability of all emergency and critical systems in the facility shall be demonstrated.

6.2.2. 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 standards and requirements for the system contained in chapters 4 and 5 of this volume:

6.2.2.1. Fire protection system.

6.2.2.2. Emergency egress.

6.2.2.3. Emergency lighting.

6.2.2.4. Elevators.

6.2.2.5. Lightning protection system.

6.2.2.6. Bonding and grounding systems.

6.2.2.7. Electrical equipment hazard proofing.

6.2.2.8. Backup power sources.

6.2.2.9. Robot system.

6.2.2.10. Emergency eyewash and showers.

6.2.2.11. Air monitoring system.

6.2.2.12. Oxygen deficiency monitoring system.

6.2.2.13. Toxicity monitoring system.

6.2.2.14. Explosive vapor monitoring system.

6.2.2.15. Hypergolic vapor detection systems.

6.2.2.16. Area warning (lights, audible alarms) system.

6.2.2.17. Ventilation system.

6.2.2.18. Propellant processing facility drain and sump system.

6.2.2.19. Propellant processing facility scrubber/incinerator.

6.2.2.20. Hazardous liquid leak detection and level indicator system for storage tanks.

6.2.2.21. Conductive floors.

6.2.2.22. Hazardous vapor suppression/control system.

6.2.2.23. Room purge system.

6.2.2.24. Emergency power cutoff system.

6.2.2.25. Emergency monitor and control panel.

6.2.2.26. Personnel anchorage and anchorage connectors.

6.2.2.27. Breathing air supply.

6.2.2.28. Cranes and hoists.

6.2.2.29. Cable-operated overhead doors.

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

BILLY R. COLWELL, Col, USAF
Director of Safety

ATTACHMENT 1

FACILITY SAFETY DATA PACKAGE

A1.1. Introduction:

A1.1.1. 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.

A1.1.2. Content:

A1.1.2.1. This attachment contains the content preparation instructions for the data generated by the requirements specified in Volume 5.

A1.1.2.2. Critical systems, as identified in Volume 3 of this publication, 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. Duplicate information need not be incorporated in both the FSDP and MSPSP, but shall be referenced between the documents.

A1.1.3. 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 of these facilities.

A1.1.4. **Submittal Process.** The FSDP submittal periods are as follows:

A1.1.4.1. Drafts shall be provided at least 30 calendar days before each of the conceptual, preliminary, critical, and final (30, 60, 90 and 100 percent) design reviews.

A1.1.4.2. The final submission shall be at least 30 calendar days before intended facility activation.

A1.1.5. Final Approval. The FSDP shall be approved before the activation of the facility.

A1.2. Preparation Instructions:

A1.2.1. **Content.** The FSDP contains technical information on the facility. Where applicable, previously approved documentation shall be referenced throughout the package.

A1.2.2. Data Requirements:

A1.2.2.1. The data requirement of this volume and Volume 3 and Attachment 3 of Volume 3, as applicable, contain the information required in this attachment.

A1.2.2.2. The FSDP describes all hazardous and critical systems, subsystems, and their interfaces.

A1.2.2.3. The FSDP provides verification of compliance with the design requirements of this volume and Volume 3, as applicable, and the critical design criteria agreed to in the project book and design criteria document.

A1.2.2.4. 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.

A1.2.3. **Format.** Range User format is acceptable provided the information below is provided.

A1.2.3.1. **Table of Contents and Glossary.** The FSDP shall contain a table of contents and a glossary.

A1.2.3.2. Introduction. The "introduction" section shall address the scope and purpose of the FSDP.

A1.2.3.3. 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:

A1.2.3.3.1. Layout of facility

A1.2.3.3.2. Location of the facility at Cape Canaveral Air Force Stations (CCAFS) or Vandenberg Air Force Base (VAFB) and explosives quantity distance siting information if the facility requires explosive siting

A1.2.3.3.3. Location of major systems in the facility and outside the facility that provide direct support

A1.2.3.3.4. Synopsis of each hazardous and critical system

A1.2.3.4. Critical Facility and Structure Design Criteria Document. The final facility and structure design criteria shall be provided as an appendix to the FSDP.

A1.2.3.5. Critical Facility and Structure Design Calculations. During the design process, 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 provided.

A1.2.3.6. WR Seismic Analysis. During the design process, the seismic design analysis for conventional and critical WR facilities, structures, and installed equipment shall be provided.

A1.2.3.7. Portable/Mobile Structure Anchoring Analysis. The portable/mobile structure anchoring analysis shall be either referenced in, with a summary of results, or appended to the FSDP.

A1.2.3.8. Hazard Analyses. Hazard analyses of facilities, structures, and emergency and critical systems shall be provided in accordance with Volume 1, Attachment 2, 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.

A1.2.3.9. Demolition Plans. If applicable, demolition plans for conventional and critical facilities shall be referenced in or appended to the FSDP.

A1.2.3.10. Critical Facility and Structure Design Drawings and Specifications. Facility and design engineering drawings and technical specification packages shall be submitted with the latest revision dates.

A1.2.3.11. Individual System Descriptions:

A1.2.3.11.1. 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:

A1.2.3.11.1.1. Nomenclature.

A1.2.3.11.1.2. Function.

A1.2.3.11.1.3. Location.

A1.2.3.11.1.4. Operations.

A1.2.3.11.1.5. Design parameters.

A1.2.3.11.1.6. Acceptance testing.

A1.2.3.11.1.7. Operating parameters.

A1.2.3.11.1.8. Hazard analyses.

A1.2.3.11.2. Supporting data shall be included or summarized and referenced, as appropriate, with availability upon request.

A1.2.3.11.3. Tables, matrixes, and sketches are required for component data.

A1.2.3.12. 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. Design drawings and specifications for other systems identified by Range Safety shall also be referenced.

A1.2.3.12.1. Fire protection system.

A1.2.3.12.2. Emergency egress.

A1.2.3.12.3. Emergency lighting.

A1.2.3.12.4. Elevators.

A1.2.3.12.5. Lightning protection system.

A1.2.3.12.6. Bonding and grounding system.

A1.2.3.12.7. Electrical equipment hazard proofing.

A1.2.3.12.8. Backup power sources.

A1.2.3.12.9. Robot system.

A1.2.3.12.10. Emergency eyewash and showers.

A1.2.3.12.11. Air monitoring system.

A1.2.3.12.12. Oxygen deficiency monitoring system.

A1.2.3.12.13. Toxicity monitoring system.

A1.2.3.12.14. Explosive vapor monitoring system.

A1.2.3.12.15. Hypergolic vapor detection system.

A1.2.3.12.16. Area warning (lights, audible alarms) system.

A1.2.3.12.17. Ventilation system.

A1.2.3.12.18. Propellant processing facility drain and sump system.

A1.2.3.12.19. Propellant processing facility scrubber/incinerator.

A1.2.3.12.20. Hazardous liquid leak detection and level indicator system for storage tanks.

A1.2.3.12.21. Conductive floors.

A1.2.3.12.22. Hazardous vapor suppression/control system.

A1.2.3.12.23. Room purge system.

A1.2.3.12.24. Emergency power cutoff system.

A1.2.3.12.25. Emergency monitor and control panel.

A1.2.3.12.26. Personnel anchorage and anchorage connectors.

A1.2.3.12.27. Breathing air system.

A1.2.3.12.28. Cranes and hoists.

A1.2.3.12.29. Cable-operated overhead doors.

A1.2.3.13. Volume 3 Data. Critical systems identified in Volume 3 of this publication 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 applicable, data requirements from Volume 3, Attachment 1 shall be included in the FSDP. Critical systems include the following:

A1.2.3.13.1. Material handling equipment.

A1.2.3.13.2. Systems with acoustic hazards.

A1.2.3.13.3. Ionizing radiation sources.

A1.2.3.13.4. Non-ionizing radiation sources.

A1.2.3.13.5. Hazardous materials.

A1.2.3.13.6. Pressure systems.

A1.2.3.13.7. Ordnance systems.

A1.2.3.13.8. Electrical and electronic systems.

A1.2.3.13.9. Motor vehicles.

A1.2.3.13.10. Operations safety console.

A1.2.3.13.11. Hazardous and safety critical computing systems and software.

A1.2.3.14. Test Plans and Test Results. Test plans for the following applicable systems shall be submitted for review and approval to Range Safety and other applicable agencies 45 calendar days before the test. Test plans for other systems may be required as identified by Range Safety. 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.

A1.2.3.14.1. Fire protection system.

A1.2.3.14.2. Emergency egress.

A1.2.3.14.3. Emergency lighting.

A1.2.3.14.4. Elevators.

A1.2.3.14.5. Lightning protection system.

A1.2.3.14.6. Bonding and grounding system.

A1.2.3.14.7. Electrical equipment hazard proofing.

A1.2.3.14.8. Backup power sources.

A1.2.3.14.9. Robot systems.

A1.2.3.14.10. Emergency eyewash and showers.

A1.2.3.14.11. Air monitoring system.

A1.2.3.14.12. Oxygen deficiency monitoring system.

A1.2.3.14.13. Toxicity monitoring system.

A1.2.3.14.14. Explosive vapor monitoring system.

A1.2.3.14.15. Hypergolic vapor detection system.

A1.2.3.14.16. Area warning (lights, audible alarms) system.

A1.2.3.14.17. Ventilation system.

A1.2.3.14.18. Propellant processing facility drain and sump system.

A1.2.3.14.19. Propellant processing facility scrubber/incinerator.

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A1.2.3.14.21. Conductive floors.

A1.2.3.14.22. Hazardous vapor suppression/control system.

A1.2.3.14.23. Room purge system.

A1.2.3.14.24. Emergency power cutoff system.

A1.2.3.14.25. Emergency monitor and control panel.

A1.2.3.14.26. Personnel anchorage and anchorage connectors.

A1.2.3.14.27. Breathing air system.

A1.2.3.14.28. Cranes and hoists.

A1.2.3.14.29. Cable-operated overhead doors.

A1.2.3.14.30. ntegrated end-to-end test of interrelated systems.

A1.2.3.15. Post-Activation Requirements. Post-activation requirements for use of a facility shall be addressed. This section includes the following topics:

A1.2.3.15.1. Operational restrictions such as personnel loading, clear areas, and mandatory sequences of use.

A1.2.3.15.2. Critical maintenance requirements such as recalibration of relief valves, servicing of hypergolic system, HVDS calibration, ordnance ground checks, and conductive floor checks.

A1.3. Compliance Checklist. The "compliance checklist" section contains a checklist of all design, test, and data submittal requirements in this volume and Volume 3, as applicable and the critical facility, structure, and emergency and critical system design criteria. The following items are included in this section:

A1.3.1. Criteria/requirement.

A1.3.2. System.

A1.3.3. Compliance.

A1.3.4. Noncompliance.

A1.3.5. Not applicable (with rationale).

A1.3.6. Resolution.

A1.3.7. Reference (verifying compliance).

A1.3.8. Approved Noncompliances. Copies of all Range Safety approved noncompliances including waivers and equivalent levels of safety certifications shall be included.

A1.4. 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.