BY ORDER OF THE COMMANDER
SPACE SYSTEMS COMMAND

SPACE SYSTEMS COMMAND MANUAL
91-710, VOLUME 5

27 DECEMBER 2022

Safety

RANGE SAFETY USER REQUIREMENTS MANUAL - FACILITIES, STRUCTURES AND REUSABLE LAUNCH VEHICLE/REENTRY VEHICLE OPERATING LOCATION REQUIREMENTS

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

ACCESSIBILITY: Publications and forms are available for downloading or ordering on the e-Publishing website at **www.e-Publishing.af.mil**.

RELEASABILITY: There are no releasability restrictions on this publication.

OPR: HQ SSC/SEK

Certified by: HQ SSC/SEK
(Mr. John G. Orpen)

Supersedes: AFSPCMAN91-710V5, 23 February 2018

Pages: 47

This manual implements AFI 91-202, *The U.S. Air Force Mishap Prevention Program*, and is consistent with DoDD 3100.10, *Space Policy*, DoDD 3200.11, *Major Range and Test Facility Base (MRTFB)*, DoDD 3230.3, *DoD Support for Commercial Space Launch Activities*, DoDI 3200.18, *Management and Operation of the Major Range and Test Facility Base*, AFPD 91-1, *Nuclear Weapons and Systems Surety*, AFPD 91-2, *Safety Programs*, AFPD 63-1, *Integrated Life Cycle Management*, and the *Memorandum of Agreement between the Department of the Air Force and the Federal Aviation Administration for Launch and Reentry Activity on Department of the Air Force Ranges and Installations*. This volume specifies minimum design, test, inspection, and data requirements for the construction and modification of conventional and critical facilities and structures at Space Systems Command (SSC) 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 requirements, 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 SSC 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 SSC ranges. Range Users include any individual or organization that conducts or supports any activity on resources (land, sea, or air) owned or controlled by SSC ranges. This includes such organizations as the DoD, U.S. government agencies, civilian launch operators, and foreign government agencies and other foreign entities that use SSC range facilities and test equipment; conduct pre-launch 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 Transportations 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 government organization or be a customer of a Range User. This volume does not apply to the Air National Guard or Air Force Reserve Command units.

Requirements identified for expendable launch vehicles, ballistics or suborbital vehicles, or space vehicles in this publication may also apply to reusable launch vehicles (RLVs) and reentry vehicles (RV) depending on their similarity in launch preparation, operations, or phase in flight; therefore, Range Safety should be consulted as to their applicability. In addition to the applicability of expendable launch vehicle (ELV) requirements to RLV/reentry vehicle, this publication may contain requirements unique to RLV/Reentry systems; and are identified as such.

In accordance with SSCI 91-701, *The Space Systems Command Launch and Range Safety Program,* all tailored versions of SSCMAN 91-710 are approved by the Space Launch Delta (SLD) Commander.

The authorities to waive SLD/unit level requirements in this publication are identified with a Tier ("T-0, T-1, T-2, T-3") number following the compliance statement. Waiver authority of non-tiered requirements may not be delegated below the Space Launch Delta Commander level unless specifically stated in this publication. See DAFMAN 90-161, *Publishing Processes and Procedures*, and any SSC supplements for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the OPR. Ensure all records generated as a result of processes prescribed in this publication adhere to AFI 33-322, *Records Management and Information Governance Program*, and are disposed IAW the Air Force Records Disposition Schedule, which is located in the Air Force Records Information Management System. Refer to SSCMAN 91-710, Volume 1, Attachment 6, for submitting/recommended supplemented changes and questions to HHQ SSC Directorate of Safety (HQ SSC/SE) using the Range Safety approved change request form or DAF Form 847, *Recommendation for Change of Publication*. Route the change request form through the appropriate functional chain of command.

This publication may be supplemented, but all supplements must be approved by HQ SSC/SE prior to certification and approval for publishing. Each range may incorporate range-unique or program-unique requirements into documents other than a supplement, such as an operating instruction,

which is only required to be coordinated internally within the local Range Safety organization structure and approved at the local level by the Chief of Safety.

Note: SSCMAN 91-710, 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 **paragraph 1.1** of this volume.

SUMMARY OF CHANGES

This document has been updated primarily to reflect organizational changes associated with the establishment of SSC as a USSF Field Command (FLDCOM), and the re-alignment of launch and range safety program management from the former Air Force Space Command publication to an SSC publication.

Chapter 1—INTRODUCTION **5**

1.1. Organization of the Volume..... 5

1.2. Range User Responsibilities. 6

Chapter 2—FACILITIES AND STRUCTURES DESIGN AND CONSTRUCTION SITE REQUIREMENTS **7**

2.1. Design, Construction, and Modification. 7

2.2. Location Planning Requirement. 7

2.3. Construction Site Safety. 7

Chapter 3—DOCUMENTATION REQUIREMENTS **9**

3.1. Conventional and Critical Facility Determination. 9

3.2. Documentation Review and Approval Process. 9

3.3. Conventional Facilities and Structures Documentation Requirements. 9

3.4. Critical Facilities and Structures Documentation Requirements. 9

Chapter 4—CONVENTIONAL FACILITIES AND STRUCTURES **11**

4.1. Design Standards. 11

4.2. Elevators. 11

4.3. Life Safety Code Requirements. 11

4.4. Electrical Equipment. 11

4.5. Personnel Anchorage and Anchorage Connectors. 12

4.6. Seismic Design. 12

4.7. Portable/Mobile Structures Design. 13

4.8. Structural Steel. 13

4.9. Design Load Criteria. 14
4.10. Antenna Towers. 15
4.11. Robot Systems. 15

Chapter 5—CRITICAL FACILITIES AND STRUCTURES AND RLV/REENTRY VEHICLE OPERATING LOCATIONS 16

5.1. Critical Facility and Structure and RLV/Reentry Vehicle Operating Location General Design Requirements. 16
Table 5.1. Class I, Division 2 Locations. 19
5.2. Special Critical Facility Systems and Structures. 21
Table 5.2. Individual Support System Component Considerations. 24
5.3. Explosives Storage, Handling, and Processing Facilities. 25
Table 5.3. Self-Contained Atmospheric Protective Ensemble (SCAPE) Suits. 32
Table 5.4. Control Room Considerations. 32
Table 5.5. Self-Contained Atmospheric Protective Ensemble (SCAPE) Suits. 37
Table 5.6. Control Room Considerations. 38

Chapter 6—FACILITY AND STRUCTURE INSPECTION AND SYSTEMS TEST REQUIREMENTS 39

6.1. Critical Facility and Structure Initial Inspection Requirements. 39
6.2. Facility and Structure Emergency and Critical Systems Test Requirements. 39

Attachment 1—GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION 41

Attachment 2—FACILITY SAFETY DATA PACKAGE 42

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. Attachments include additional requirements to supplement the main chapter.

1.1.2. Open Text. The open text contains the actual mandatory performance-based requirements. Tailoring expected for these requirements includes the deletion of non-applicable requirements, changes to an existing requirement due to a different design or process with rationale acceptable to Range Safety, or addition to a requirement when there are no existing requirements addressing a new technology, when unforeseen hazards are discovered, when federal or industry standards change and for similar reasons. 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, or text boxes, identified as tables and notes in this document, 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 SSCMAN 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 SSCMAN 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 IAW the provisions of this volume.

1.2.2. Ensuring construction and demolition 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/Fire Protection Engineer in the design of fire protection systems and conduct of fire protection activities.

1.2.5. Assisting in the preparation of explosive site plans (see **paragraph 5.3**).

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

1.2.7. Providing documentation (see **Attachment 2**) to support the rationale for designating facilities as either conventional or critical and obtaining Range Safety concurrence.

Chapter 2

FACILITIES AND STRUCTURES DESIGN AND CONSTRUCTION SITE REQUIREMENTS

2.1. Design, Construction, and Modification. All facilities and structures designed, constructed, and modified for use on the ranges shall meet the standards and provisions established in SSCMAN 91-710 Volumes 3 and 5 and in other nationally recognized codes and standards, including the National Environmental Policy Act (NEPA) and applicable state and local 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 or in RLV/reentry vehicle return flight paths to nominal or contingency landing 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 SSCMAN 91-710 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.

2.2.7. Location of facilities should assess the impact of adjacent facility or complex mishaps and resulting effects such as shockwaves and debris fall-out.

2.3. Construction Site Safety.

2.3.1. With the exception of **paragraph 2.3.1.4** below, construction and demolition site safety shall be the sole responsibility of the Range User or contractor when the construction contract is issued by one of the following:

2.3.1.1. The United States Army Corps of Engineers.

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

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

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

2.3.2. Construction site activities on the ranges shall comply with Occupational Safety and Health Administration (OSHA) General Industry and Construction Standards (29 Code of Federal Regulations [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.

2.3.3. Construction site activities on the ranges should be performed IAW U.S. Army Corps of Engineers Engineering Manual (EM) 385-1-1, *Safety and Health Requirements Manual* and the criteria stated below. Range Safety shall assume no liability for Range User or contractor compliance or noncompliance with this document or criteria.

2.3.3.1. The construction contractor project superintendent or a designated representative will 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.

2.3.3.2. Accidents and injuries shall be reported to the Administrative Contracting Officer and others as described in the Range User's Operations Safety Plan (OSP) and System Safety Program Plan (SSPP).

2.3.3.2.1. Serious mishaps shall be reported as soon as possible, IAW applicable reporting instructions and plans.

2.3.3.2.2. The Administrative Contracting Officer shall notify SLD 45/SEG or SLD 30/SEG, Occupational Safety, and the Pad Safety Officer (PSO) or Operations Safety Technician (OST) 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 at least 30 days prior to major design reviews and program milestones (e.g., System Requirements Review (SRR), Preliminary Design Review (PDR), Critical Design Review (CDR)), or equivalent program design activities.

3.2.1.1. 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 SLD 30/SEA or SLD 45/SEA reviewing official.

3.2.1.2. All review item discrepancies (RID) 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 IAW 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 IAW schedules jointly agreed upon by the Range User and Bioenvironmental Engineering.

3.2.4. Documentation requiring the review and approval of the Fire Marshal/Fire Protection Engineer (FPE) shall be submitted IAW MIL-STD-3007, *Standard Practice for Unified Facilities and Unified Facilities Guide Specifications* and Unified Facilities Criteria (UFC) 3-600-01, *Fire Protection Engineering for Facilities*.

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 SRR or equivalent activity, to ensure thorough identification of requirements, and corresponding cost, schedule, and performance impacts early on.

3.3.2. 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. Design Criteria Document.

3.4.1.1. Before facility and structure design, design criteria that clearly state Range User requirements and identifies 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. Test Plans and Test Reports.

3.4.2.1. Test Plans.

3.4.2.1.1. Test plans shall be submitted IAW the requirements specified in **Attachment 2**, **A2.2.3.14**.

3.4.2.1.2. The test plan for the fire protection system shall be submitted for review and approval to the Fire Marshal/Fire Protection Engineer 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 2**, **A2.2.3.14** 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 2**. As an alternative, a design package that contains all the elements specified in **Attachment 2**.

Chapter 4

CONVENTIONAL FACILITIES AND STRUCTURES

4.1. 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-STD-3007, UFC 1-200-01, *DoD Building Code (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 IAW UFC 1-200-01 and applicable American Concrete Institute (ACI) codes and standards.

4.1.3. Masonry construction shall be IAW UFC 1-200-01.

4.1.4. Timber construction shall be IAW UFC 1-200-01, Deutsches Institut Für Normung (DIN) [German Institute for Standardisation] EN 1995-1-1, Eurocode 5: Design of Timber Structures – Part 1-1: General – Common Rules and Rules for Buildings, or an equivalent standard.

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

4.1.6. Materials shall be compatible with the operational environment.

4.2. Elevators.

4.2.1. All elevators shall be designed, built, and installed IAW American Society of Mechanical Engineers (ASME) A17.1/Canadian Standards Association (CSA) B44, *Safety Code for Elevators and Escalators*.

4.2.2. All elevators shall be inspected, tested, and maintained IAW ASME A17.1/CSA B44, ASME A17.2, *Guide for Inspections of Elevators, Escalators, and Moving Walks*, and applicable state and local regulations.

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

4.3. Life Safety Code Requirements. The provisions of National Fire Protection Association (NFPA) 101, *Life Safety Code*, shall be incorporated in the design of each conventional facility and structure at the ranges.

4.4. Electrical Equipment.

4.4.1. Power distribution design shall comply with American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE) 141, *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants,* and NFPA 70, the *National Electric Code* (NEC) as applicable.

4.4.2. Interior electrical design shall comply with UFC 3-520-01, *Interior Electrical Systems*, ANSI/IEEE 241, *Recommended Practice for Electric Power Systems in Commercial Buildings*, and NFPA 70 (NEC).

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. 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 conforming to OSHA requirements and the applicable sections of ANSI/American Society of Safety Engineers (ASSE)/American Society of Safety Professionals (ASSP) Z359 fall protection standards shall be used.

4.5.3. Personnel anchorage system components shall be designed and tested IAW ANSI/ASSE A10.32, *Personal Fall Protection Used in Construction and Demolition Operations,* or ANSI/ASSP Z359.1, *The Fall Protection Code*, 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. **Exception:** Commercially procured anchorage systems conforming to OSHA and ANSI/ASSE Z359.1 standards, and installed in accordance with manufacturer's instructions, do not require additional load testing after installation.

4.5.7. Anchorage and anchorage connectors shall be located in accordance with OSHA requirements and ANSI/ASSE Z359.1 standards.

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.

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

4.6. Seismic Design.

4.6.1. Seismic design of all new or modified facilities, structures, and installed equipment shall be IAW UFC 1-200-01 and UFC 3-301-01, *Structural Engineering*. **Note:** The Western Range (WR) is classified as a seismic activity zone. Local geologic structure determines response spectrum, 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. Specific design information can be found in SSCMAN 91-710 Volume 3, Chapter 17, WR SEISMIC DESIGN.

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: Seismic Design Recommendations*, *International Building Code* (IBC), American Society of Civil Engineers (ASCE), and the Federal Emergency Management Agency (FEMA) E-74, *Reducing the Risks of Nonstructural Earthquake Damage* 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 to the risk importance factors in Table 2-2, Risk Category of Buildings and Other Structures, of UFC 3-301-01, *Structural Engineering*.

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 to cause the following events, directly or by propagation, shall be restrained to restrict movement and withstand a seismic event, but need not remain operational:

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/landing 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. **Note:** 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. **General Design Requirements:**

4.8.1.1. Steel facilities and structures shall be designed IAW the current ANSI/American Institute of Steel Construction (AISC) 360, *Specification for Structural Steel Buildings*.

4.8.1.2. Connections shall be designed IAW the current ANSI/AISC 360, *Specification for Structural Steel Buildings*.

4.8.2. **Bolts and Fasteners:**

4.8.2.1. Permanent bolted structural joints shall use high strength fasteners, American Society for Testing and Materials (ASTM) F3125/F3125M. ASTM A307 bolts may be used for connections in secondary structures.

4.8.2.2. Joints using ASTM A307 and ASTM F3125/F3125M bolts in exterior applications shall use galvanized fasteners. Joints using ASTM F3125/F3125M heat-treated high strength bolts shall use plain fasteners that are coated for corrosion protection.

4.8.2.3. ASTM F3125/F125M fasteners shall not be reused.

4.8.3. **Welding:**

4.8.3.1. Welded connections shall use prequalified welded joints IAW ANSI/AISC 360 and American Welding Society (AWS) D1.1/D1.1M, *Structural Welding Code - Steel*.

4.8.3.2. Welders, welding operators, and tackers shall be qualified IAW AWS D1.1/D1.1M.

4.8.3.3. All welds shall be inspected IAW the following criteria:

4.8.3.3.1. 100% of all welds shall be visually inspected IAW AWS D1.1/D1.1M 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% tested as follows: Full-penetration welds (groove or butt) - ultrasonically (UT) tested IAW MIL-STD-1699, *Nondestructive Evaluation of Butt Welds In Crane And Railroad Rails*, or the equivalent; other welds - magnetic particle tested IAW ASTM E1444/E1444M, *Standard Practice for Magnetic Particle Testing* or equivalent. If rejectable discontinuities are found, the weld shall be removed and replaced IAW AWS D1.1/D1.1M and the NDE Plan.

4.8.3.3.3. Nondestructive test personnel shall be qualified to American Society for Nondestructive Testing Standards (ASNT) Recommended Practice No. SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*, Level I (under supervision of a Level II) or above.

4.8.4. **Materials:**

4.8.4.1. Structural steel material shall be IAW 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 IAW ASCE/Structural Engineering Institute (SEI) 7, *Minimum Design Loads for Buildings and Other Structures*.

4.9.2. Wind loads for facilities and structures shall be designed IAW ASCE/SEI 7.

4.9.3. The design loads and load combinations used in the analysis shall be IAW ASCE/SEI 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 IAW applicable sections of 29 CFR 1910, ASCE/SEI 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 IAW the current ANSI/Telecommunications Industry Association (TIA) 222, *Structural Standard for Antenna Supporting Structures and Antennas*.

4.11. Robot Systems. Industrial robots and robot systems shall be designed, installed, tested, and operated IAW ANSI/Robotic Industries Association (RIA) R15.06, *Industrial Robots and Robot Systems – Safety Requirements*.

Chapter 5

CRITICAL FACILITIES AND STRUCTURES AND RLV/REENTRY VEHICLE OPERATING LOCATIONS

5.1. Critical Facility and Structure and RLV/Reentry Vehicle Operating Location 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. 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. 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. 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 NFPA 70, ANSI/IEEE 142, *Recommended Practice for Grounding of Industrial and Commercial Power Systems,* and AFMAN 32-1065, *Grounding & Electrical 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 IAW *Defense Explosives Safety Regulation* (DESR) 6055.09, DESR6055.09_AFMAN 91-201, *Explosives Safety Standards,* and AFMAN 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 IAW NFPA 77, *Recommended Practice on Static Electricity*.

5.1.4. Lightning Protection.

5.1.4.1. At a minimum, lightning protection requirements for critical facilities and structures shall comply with NFPA 780, *Standard for the Installation of 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. UFC 3-340-02, *Structures to Resist the Effects of Accidental Explosions*.

5.1.4.2.2. AFMAN 32-1065.

5.1.4.2.3. DESR 6055.09 and DESR 6055.09_AFMAN 91-201.

5.1.4.2.4. Civil Engineer Squadron (CES) – Lightning Protection System (LPS) – Guidelines (GLS), *Vandenberg SFB Lightning Protection Guidelines*, at the WR.

5.1.4.3. Launch Pad Catenary Lightning Protection Systems (LPS).

5.1.4.3.1. For launch pads with launch vehicles and spacecraft sensitive to worst case electromagnetic field strengths that can be generated by a direct lightning strike on one of the LPS support towers, the launch pad catenary LPS towers shall serve only as catenary wire supports and shall not be used as lightning down conductors.

5.1.4.3.2. Isolation masts shall be used on tops of towers to isolate the catenary wires from the tower structure and thus prevent lightning strike current from travelling down the towers. The isolation mast height separating the catenary wire and the tower shall be sufficient to prevent arcing from tops of masts to the tower structure (flashover) in case of a worst credible lightning strike.

5.1.4.3.3. Isolation mast construction shall be structurally capable of supporting properly tensioned catenary wires.

5.1.4.3.4. Where required, permanently attached non-conductive ladders shall be provided on the inside of the isolation mast to enable access to the tops of masts for service and maintenance.

5.1.5. Electrical Equipment.

5.1.5.1. Installation in Hazardous (Classified) Locations.

5.1.5.1.1. Hazardous (Classified) Locations. Hazardous (Classified) locations are defined in NFPA 70 (NEC), Article 500, *Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2*. NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, shall be used to identify and delineate Class I, Division 1 and Division 2 hazardous locations when listed criteria are more restrictive than in the following sections.

5.1.5.1.2. 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.

5.1.5.1.3. As determined by Range Safety and the Fire Marshal/Fire Protection Engineer, 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.

5.1.5.1.4. Explosives and Propellants Not Covered in NFPA 70, Article 500 (NEC). 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/Fire Protection Engineer shall approve all potential critical facility hazardous location designations.

5.1.5.1.4.1. Class I, Division 1. These locations include the following:

5.1.5.1.4.1.1. 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.

5.1.5.1.4.1.2. Below grade locations in a Class I, Division 2 area.

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

5.1.5.1.4.1.4. Locations in which there is a credible risk that ignitable concentrations of vapors or gases may be present in the air during abnormal operations due to a failure, leakage, or maintenance/repair. Credible risk shall be determined through the system safety processes described in SSCMAN 91-710 Volume 1, Attachment 2, as well as those specified in SSCMAN 91-710 Volume 3. The FSDP as discussed in **Attachment 2** shall be used as a record of this process. For programs that do not warrant a separate FDSP, this information shall be recorded in the Missile System Pre-Launch Safety Package (MSPSP) for the program.

5.1.5.1.4.2. Class I, Division 2. These locations include the following:

Table 5.1. Class I, Division 2 Locations.

Class I, Division 2 usually includes locations where volatile flammable liquids or flammable gases or vapors are used but, IAW NFPA 70, in the judgment of the Authority Having Jurisdiction (AHJ) (Range Safety and the Fire Marshal/Fire Protection Engineer), 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.

5.1.5.1.4.2.1. 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).

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

5.1.5.1.4.2.3. 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.

5.1.5.1.4.2.4. 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.

5.1.5.1.4.2.5. 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.

5.1.5.1.5. Hazardous Commodity Groups. Hazardous commodities are grouped by similar characteristics. A Safety Data Sheet (SDS) for each hazardous material and liquid on flight hardware or used in ground processing shall be available for review at each location in which the material is stored or used (see SSCMAN 91-710 Volume 3, Attachment 2, paragraph A2.2.4.13.2.9).

5.1.5.1.5.1. The following fuels shall be considered ignitable regardless of the ambient temperature, and be categorized as follows:

5.1.5.1.5.1.1. Group B: Liquid or gaseous hydrogen.

5.1.5.1.5.1.2. Group C: Hypergolic fuels such as hydrazine (N_2H_4), monomethylhydrazine (MMH), unsymmetrical dimethylhydrazine (UDMH), Aerozine 50 (A50).

5.1.5.1.5.1.3. Group D: Hydrocarbon fuels (rocket propellant (RP), jet propellant (JP), and liquefied natural gas (LNG)).

5.1.5.1.5.2. Exposed Solid Propellants. The atmosphere within 10 feet of exposed solid propellant shall be classified as a Class I, Division 1 location. Solid rocket motors are considered exposed in the following situations:

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

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

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

5.1.5.1.5.2.4. 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 IAW 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 (NEC), Article 501, *Class I Locations*, and ANSI/International Society of Automation (ISA) 12.12.01, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*, and are restricted to installation in Class I, Division 2 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 NFPA 70 (NEC), Article 504, *Intrinsically Safe Systems*, and Underwriters Laboratories (UL) 913, *Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1 Hazardous (Classified) Locations*, 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 IAW NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, for the purpose of eliminating or reducing the hazardous location classification as defined in NFPA 70 (NEC), Article 500 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 and visual alarm set to trigger when the pressure drops below 1/4 inch of water.

5.1.5.2.4.4. 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 shall not be allowed in that environment.

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 IAW NFPA 110, *Standard for Emergency and Standby Power Systems*, and NFPA 70 (NEC), Article 700, *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 IAW NFPA 70 (NEC), Article 702, *Optional Standby Systems*.

5.1.6. 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. 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 approval. Explosive vapor (flammability) monitoring shall be accomplished by permanently installed systems reporting vapor concentration data to a remote location. **Note:** The following are examples of locations requiring air monitoring if personnel entry is required: (1) enclosed areas, rooms, and vehicle compartments where pressurized inert gas systems are located and/ or routed that could deplete or displace oxygen; (2) enclosed areas, rooms, and vehicle compartments where propellant systems are located and/or routed; (3) storage tank entry points; (4) drain pits; and (5) tunnels.

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. Department of the Air Force personnel shall comply with Department of the Air Force Manual (DAFMAN) 91-203, *Air Force Occupational Safety, Fire, and Health Standards*, Chapter 23, *Confined Spaces*, for confined space management and entry procedures. All other personnel shall comply with OSHA 29 CFR 1910.146, *Permit-required Confined Spaces*.

5.2.1.2. 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. The alarm flashing lights shall not be covered, obscured, or locally disabled.

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. 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 IAW 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 and environmental exposure limits (OEELs) established in AFMAN 48-146, *Occupational and Environmental Health Program Management*, shall be used for the protection of Department of the 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 OEEL requirements.

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

5.2.1.5.2. If DAF 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 OEEL. Non-credible exposure to DAF and other government personnel shall be determined by Range Safety and the Range Bioenvironmental Engineers.

5.2.1.6. Explosive Vapor Monitoring Systems. For explosive hazard protection, 25% 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% LEL within 1 meter proximity of the leak source and have a response time of less than 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% of LEL at close proximities.

5.2.1.7. 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) have the following requirements:

5.2.2.1. MSTs without means of propulsion shall be moved only with approved tow vehicles sized properly to move the tower safely against the worst-case wind conditions under which the move is permissible. The tow connection points on the MST shall be designed with a minimum safety factor of 3:1 on yield.

5.2.2.2. MSTs shall be properly tied down in both parked and service positions and not be left on the runway between the parked and service position. Leading wheel hard stops shall be provided in both locations to prevent movement of the tower once it is secured. All provided tie-downs shall be secured regardless of wind conditions. An analysis shall be done on the anchoring system to demonstrate adequate margin against worst-case hurricane force winds. The anchoring system shall be initially proof tested to 125% of the highest expected load. The anchoring system shall be maintained per approved inspection and corrosion protection plan.

5.2.2.3. A Range Safety approved procedure is required for moving an MST.

5.2.3. Hazardous Commodity Lockers. Lockers or cabinets positioned for the purpose of storing flammable, toxic, reactive, or caustic materials shall be designed IAW NFPA 30, *Flammable and Combustible Liquids Code*, and DAFMAN 91-203.

5.2.4. Battery Storage and Processing Areas.

5.2.4.1. Battery shops shall be designed IAW DAFMAN 91-203, Chapter 31, *Batteries – Maintenance, Handling and Storage Requirements* and NFPA 70 (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% 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. 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 position.

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.

Table 5.2. Individual Support System Component Considerations.

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% 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. **Note:** 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. 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.

5.2.6. RLV and Reentry Vehicle Operations and Maintenance (RLV/reentry Vehicle O&M). Where RLV/reentry vehicle O&M activities take place, the facility design shall include, but is not limited to the unique hazards posed by recovery, decontamination, inspection, refurbishment, and/or overhaul of RLV/reentry vehicle systems and components. Facility design requirements include, but are not limited to, the ability to remotely determine the status of pressure systems, unexploded ordnance devices, flight termination system and hazardous vapors/fibers.

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 and Licenses.

5.3.1.1. All facilities, including launch complexes, and designated RLV/reentry vehicle nominal and contingency landing site, used to store, handle, or process ordnance items or propellants shall be properly sited and approved IAW DoD quantity distance criteria and explosives safety standards as specified in *Defense Explosives Safety Regulation* (DESR)

6055.09 and implemented in DESR 6055.09_AFMAN 91-201, *Explosives Safety Standards*.

5.3.1.1.1. Designated RLV/reentry vehicle nominal and contingency landing sites shall be identified in both the FSDP and MSPSP for evaluation and any required Explosive Site Plan (ESP) approval process.

5.3.1.2. Preparation of construction 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 explosive site plans through Weapons 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 and final approval. Final approval 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 or non-licensed location (See DESR 6055.09 and DESR 6055.09_AFMAN).

5.3.1.5. Hazard Class/Division 1.1 explosives shall not be approved by license or non-license.

5.3.1.6. 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 DESR 6055.09 and DESR 6055.09_AFMAN 91-201 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 and final approval. Final approval shall be obtained before the start of construction.

5.3.1.7. 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.

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

5.3.2. General Design Requirements.

5.3.2.1. Explosives storage, handling, and processing facilities shall be designed and constructed IAW DESR 6055.09, DESR 6055.09_AFMAN 91-201, AFMAN 32-1065, and UFC 03-340-02.

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 UFC 3-340-02.

5.3.3. Area Warning Systems.

5.3.3.1. 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 IAW DESR 6055.09_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. 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. **Note:** 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. 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 IAW UFC 3-340-02 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. 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. 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. **Note:** 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. **Note:** On the ER, the NASA/Kennedy Space Center (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 NASA-STD-5008B, *Protective Coating of Carbon Steel, Stainless Steel and Aluminum on Launch Structures, Facilities and Ground Support Equipment*.

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. 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, below grade and sloped to provide gravity flow to sump.

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. **Note:** 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 (GN2) purge interfaces shall be located at the drain system high points to facilitate draining to the system low point.

5.3.4.5. 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. 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%.

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. 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. 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-STD-3007, DESR 6055.09, DESR 6055.09_AFMAN 91-201, and AFI 32-2001, *Fire Emergency Services (FES) 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, sunlight, 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 IAW the requirements of NFPA 15, *Standard for 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/ft2 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/ft2 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 ordinary deluge system or wet pipe system shall be installed.

5.3.4.8.2.7. With Fire Marshal/Fire Protection Engineer 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. 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. The alarm flashing lights shall not be covered, obscured, or locally disabled.

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. 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/Fire Protection Engineer, and Bioenvironmental Engineering shall review and approve the performance characteristics of the foam and delivery system.

5.3.4.11. Personal Protective Equipment Support.

Table 5.3. Self-Contained Atmospheric Protective Ensemble (SCAPE) Suits.

For airline supplied SCAPE suits, facilities should be provisioned to supply breathing air 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. Control Room.

Table 5.4. Control Room Considerations.

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.
3. If used, limit personnel to mission essential if the control is adjacent to the hazardous operation.

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. 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.

5.3.5.1.1.1. Conductive floors shall be designed IAW 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 IAW DESR 6055.09 and DESR 6055.09_AFMAN 91-201, Section 5F, *Conductive Floors*.

5.3.5.1.2. Conductive floors shall be tested IAW AFMAN 32-1065.

5.3.5.2. 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. 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. **Note:** 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.

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

5.3.5.4. 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. **Note:**

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. **Note:** 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. 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. **Note:** 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. GN2 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. Transfer Areas. All transfer areas shall have safety showers, wash down hose, and eyewash stations.

5.3.5.7. 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. 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-STD-3007, DESR 6055.09, DESR 6055.09_AFMAN 91-201 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 IAW 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 ordinary deluge system or wet pipe system shall be installed.

5.3.5.8.2.6. With Fire Marshal/Fire Protection Engineer 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. 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. The alarm flashing lights shall not be covered, obscured, or locally disabled.

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. 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 I, Division 2, 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 location) 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. 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. Windsocks. Windsocks shall be provided adjacent to all enclosed hypergolic propellant processing facilities. Windsocks shall be clearly visible at night.

5.3.5.13. Personal Protective Equipment Support.

Table 5.5. Self-Contained Atmospheric Protective Ensemble (SCAPE) Suits.

For airline supplied SCAPE suits, facilities should be provisioned to supply breathing air 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. Control Room.

Table 5.6. Control Room Considerations.

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. If used: 1. 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. 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. 3. Limit personnel to mission essential if the control room is adjacent to the hazardous operation.

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 Pad Safety in carrying out required inspections IAW DESR 6055.09, DESR 6055.09_AFMAN 91-201, and 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 IAW approved test plans to verify compliance with the design standards and requirements for the system contained in **Chapter 4** and **Chapter 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.

PAUL J. MEJASICH, NH-04, DAFC
Director of Safety

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

See SSCMAN 91-710 Volume 7, *Range Safety User Requirements Manual - Glossary of References and Supporting Information*, which contains the references, forms, abbreviations, acronyms, office symbols, and terms used within all volumes of the 91-710 publication.

Attachment 2

FACILITY SAFETY DATA PACKAGE

A2.1. Introduction.

A2.1.1. Purpose. The Facility Safety Data Package (FSDP) provides a detailed description of the hazardous and critical systems of facilities or RLV/reentry vehicle operating locations assessed as critical. It is the medium from which final approval to activate the facility is obtained from Range Safety.

A2.1.2. Content.

A2.1.2.1. This attachment contains the content preparation instructions for the data generated by the requirements specified in this Volume.

A2.1.2.2. Critical systems, as identified in SSCMAN 91-710 Volume 3, 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.

A2.1.3. Applicability. Except as noted, the FSDP is applicable to all facilities or RLV/RV operating locations that are assessed as critical. The FSDP shall be submitted by the Range User responsible for overseeing the construction of these facilities.

A2.1.4. Submittal Process. The FSDP submittal periods are as follows:

A2.1.4.1. 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.

A2.1.4.2. The final submission shall be at least 30 calendar days before intended facility activation. Deliver as-built drawings in conjunction with the final submission of the FSDP.

A2.1.5. Final Approval. The FSDP shall be approved before the activation of the facility.

A2.2. Preparation Instructions.

A2.2.1. Content. The FSDP contains technical information on the facility. Where applicable, previously approved documentation shall be referenced throughout the package.

A2.2.2. Data Requirements.

A2.2.2.1. The data requirements of this volume and SSCMAN 91-710 Volume 3, as applicable, contain the information required in this attachment.

A2.2.2.2. The FSDP describes all hazardous and critical systems, subsystems, and their interfaces, or RLV/RV operating locations.

A2.2.2.3. The FSDP provides verification of compliance with the design requirements of this volume and SSCMAN 91-710 Volume 3, as applicable, and the critical design criteria agreed to in the project book and design criteria document.

A2.2.2.4. 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. The FSDP shall include a copy of any approved Explosive Site Plan (ESP) for RLV/reentry vehicle operating locations.

A2.2.2.5. The Range User shall provide Range Safety the FSDP via electronic means.

A2.2.3. Format. Range User format is acceptable provided the information below is provided.

A2.2.3.1. Table of Contents and Glossary. The FSDP shall contain a table of contents and a glossary.

A2.2.3.2. Introduction. The "introduction" section shall address the scope and purpose of the FSDP.

A2.2.3.3. 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:

A2.2.3.3.1. Layout of facility.

A2.2.3.3.2. Location of the facility at Cape Canaveral Space Force Station (CCSFS) or Vandenberg Space Force Base (VSFB) and explosives quantity distance siting information if the facility requires explosive siting.

A2.2.3.3.3. Location of major systems in the facility and outside the facility that provide direct support.

A2.2.3.3.4. Synopsis of each hazardous and critical system.

A2.2.3.4. Critical Facility and Structure Design Criteria Document. The final facility and structure design criteria shall be provided as an appendix to the FSDP.

A2.2.3.5. 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.

A2.2.3.6. WR Seismic Analysis. During the design process, the seismic design analysis for conventional and critical WR facilities, structures, and installed equipment shall be provided.

A2.2.3.7. 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.

A2.2.3.8. Hazard Analyses. Hazard analyses of facilities, structures, and emergency and critical systems shall be provided IAW SSCMAN 91-710 Volume 1, Attachment 3, 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.

A2.2.3.9. Demolition Plans. If applicable, demolition plans for conventional and critical facilities shall be referenced in or appended to the FSDP.

A2.2.3.10. 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.

A2.2.3.11. Individual System Descriptions.

A2.2.3.11.1. 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:

A2.2.3.11.1.1. Nomenclature.

A2.2.3.11.1.2. Function.

A2.2.3.11.1.3. Location.

A2.2.3.11.1.4. Operations.

A2.2.3.11.1.5. Design parameters.

A2.2.3.11.1.6. Acceptance testing.

A2.2.3.11.1.7. Operating parameters.

A2.2.3.11.1.8. Hazard analyses.

A2.2.3.11.2. Supporting data shall be included or summarized and referenced, as appropriate, with availability upon request.

A2.2.3.11.3. Tables, matrixes, and sketches are required for component data.

A2.2.3.12. 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.

A2.2.3.12.1. Fire protection system.

A2.2.3.12.2. Emergency egress.

A2.2.3.12.3. Emergency lighting.

A2.2.3.12.4. Elevators.

A2.2.3.12.5. Lightning protection system.

A2.2.3.12.6. Bonding and grounding system.

A2.2.3.12.7. Electrical equipment hazard proofing.

A2.2.3.12.8. Backup power sources.

A2.2.3.12.9. Robot system.

A2.2.3.12.10. Emergency eyewash and showers.

A2.2.3.12.11. Air monitoring system.

A2.2.3.12.12. Oxygen deficiency monitoring system.

A2.2.3.12.13. Toxicity monitoring system.

A2.2.3.12.14. Explosive vapor monitoring system.

A2.2.3.12.15. Hypergolic vapor detection system.

A2.2.3.12.16. Area warning (lights, audible alarms) system.

A2.2.3.12.17. Ventilation system.

A2.2.3.12.18. Propellant processing facility drain and sump system.

A2.2.3.12.19. Propellant processing facility scrubber/incinerator.

A2.2.3.12.20. Hazardous liquid leak detection and level indicator system for storage tanks.

A2.2.3.12.21. Conductive floors.

A2.2.3.12.22. Hazardous vapor suppression/control system.

A2.2.3.12.23. Room purge system.

A2.2.3.12.24. Emergency power cutoff system.

A2.2.3.12.25. Emergency monitor and control panel.

A2.2.3.12.26. Personnel anchorage and anchorage connectors.

A2.2.3.12.27. Breathing air system.

A2.2.3.12.28. Cranes and hoists.

A2.2.3.12.29. Cable-operated overhead doors.

A2.2.3.12.30. Decontamination, inspection, refurbishment, overhaul, etc., of RLV and reentry vehicle systems and components.

A2.2.3.13. SSCMAN 91-710 Volume 3 Data. Critical systems identified in SSCMAN 91-710 Volume 3 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 SSCMAN 91-710 Volume 3, Attachment 2 shall be included in the FSDP. Critical systems include the following:

A2.2.3.13.1. Material handling equipment.

A2.2.3.13.2. Systems with acoustic hazards.

A2.2.3.13.3. Ionizing radiation sources.

A2.2.3.13.4. Non-ionizing radiation sources.

A2.2.3.13.5. Hazardous materials.

A2.2.3.13.6. Pressure systems.

A2.2.3.13.7. Ordnance systems.

A2.2.3.13.8. Electrical and electronic systems.

A2.2.3.13.9. Motor vehicles.

A2.2.3.13.10. Operations safety console.

A2.2.3.13.11. Hazardous and safety critical computing systems and software.

A2.2.3.13.12. Unique RLV and reentry vehicle O&M systems.

A2.2.3.14. 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.

A2.2.3.14.1. Fire protection system.

A2.2.3.14.2. Emergency egress.

A2.2.3.14.3. Emergency lighting.

A2.2.3.14.4. Elevators.

A2.2.3.14.5. Lightning protection system.

A2.2.3.14.6. Bonding and grounding system.

A2.2.3.14.7. Electrical equipment hazard proofing.

A2.2.3.14.8. Backup power sources.

A2.2.3.14.9. Robot systems.

A2.2.3.14.10. Emergency eyewash and showers.

A2.2.3.14.11. Air monitoring system.

A2.2.3.14.12. Oxygen deficiency monitoring system.

A2.2.3.14.13. Toxicity monitoring system.

A2.2.3.14.14. Explosive vapor monitoring system.

A2.2.3.14.15. Hypergolic vapor detection system.

A2.2.3.14.16. Area warning (lights, audible alarms) system.

A2.2.3.14.17. Ventilation system.

A2.2.3.14.18. Propellant processing facility drain and sump system.

A2.2.3.14.19. Propellant processing facility scrubber/incinerator.

A2.2.3.14.20. Hazardous liquid leak detection and level indicator system for storage tanks

A2.2.3.14.21. Conductive floors.

A2.2.3.14.22. Hazardous vapor suppression/control system.

A2.2.3.14.23. Room purge system.

A2.2.3.14.24. Emergency power cutoff system.

A2.2.3.14.25. Emergency monitor and control panel.

A2.2.3.14.26. Personnel anchorage and anchorage connectors.

A2.2.3.14.27. Breathing air system.

A2.2.3.14.28. Cranes and hoists.

A2.2.3.14.29. Cable-operated overhead doors.

A2.2.3.14.30. Integrated end-to-end test of interrelated systems.

A2.2.3.15. Post-Activation Requirements. Post-activation requirements for use of a facility shall be addressed. This section includes the following topics:

A2.2.3.15.1. Operational restrictions such as personnel loading, clear areas, and mandatory sequences of use.

A2.2.3.15.2. Critical maintenance requirements such as recalibration of relief valves, servicing of hypergolic system, HVDS calibration, ordnance ground checks, and conductive floor checks.

A2.3. Compliance Checklist. The "compliance checklist" section contains a checklist of all design, test, and data submittal requirements in this volume and SSCMAN 91-710 Volume 3, as applicable and the critical facility, structure, and emergency and critical system design criteria. The following items are included in this section:

A2.3.1. Criteria/requirement.

A2.3.2. System.

A2.3.3. Compliance.

A2.3.4. Noncompliance.

A2.3.5. Not applicable (with rationale).

A2.3.6. Resolution.

A2.3.7. Reference (verifying compliance).

A2.3.8. Approved Noncompliances. Copies of all Range Safety approved noncompliances including waivers and equivalent levels of safety certifications shall be included.

A2.4. 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.