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**AFRL SPACE TEST AND OPERATIONS**

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This instruction implements Air Force Policy Directive (AFPD) 61-1, *Management of Science and Technology*, Air Force Instruction (AFI) 99-103 Air Force Materiel Command (AFMC) Supplement, *Capabilities Based Test and Evaluation*, AFI 91-202 AFMC and AFRL Supplements, *The US Air Force Mishap Prevention Program*, Air Force Manual 91-222 *Space Safety Investigations and Reports*, and Air Force Policy Directive 13-6 *Space Policy*. It establishes policy for how the Air Force Research Laboratory (AFRL) conducts space flight activities in support of its research mission. This instruction applies to all AFRL personnel involved with the planning, management, or execution of space flight activities. This publication may be supplemented at any level, but all direct supplements must be routed to the Office of Primary Responsibility (OPR) of this publication for coordination prior to certification and approval. Refer recommended changes and questions about this publication to the OPR using DAF Form 847, *Recommendation for Change of Publication*. Route DAF Form 847 from the field through the appropriate functional chain of command. As this volume is directive across the entire AFRL enterprise, it constitutes Tier 3-level guidance IAW DAFMAN 90-161, *Publishing Processes and Procedures*, where the AFRL Commander (or AFRL/CV if delegated) exercises waiver authority at the wing commander or equivalent level. Waiver requests will be staffed through the Technology Directorate (TD) (i.e., two-letter mission organization or 711th Human Performance Wing (HPW) Test Lead or Deputy Director and submitted to the AFRL/DO staff for coordination by the CTA. Ensure all records created as a result of processes prescribed in this publication are maintained in accordance with (IAW) AFI 33-322, *Records Management and Information Governance Program*, and disposed

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<b>Chapter 1—PURPOSE, SCOPE, AND INTENT</b>	<b>5</b>
1.1. Purpose.....	5
1.2. Scope.....	5
1.3. Definitions. ....	6
1.4. Intent. ....	7
1.5. Authority.....	7
1.6. Process Assistance. ....	8
<b>Chapter 2—AFRL SPACE FLIGHT ACTIVITY PROCESS</b>	<b>9</b>
2.1. Overall Process and Terminology.....	9
Figure 2.1. AFRL Space Flight Activity Process.....	10
2.2. Implementation. ....	10
2.3. Space Activity and Chains of Authority in AFRL.....	12
Figure 2.2. SCA Chain of Command. ....	12
2.4. Roles and Responsibilities.....	13
<b>Chapter 3—PRELIMINARY PLANNING</b>	<b>17</b>
3.1. Test Concept Development.....	17
3.2. Test Strategy.....	17
3.3. Space Flight Test Planning Meeting (SFTPM).....	17
3.4. Program Schedule.....	17
3.5. Space Test Tracking.....	17
3.6. Major/Mandatory Planning Considerations.....	18
3.7. Other Planning Considerations.....	19
<b>Chapter 4—TEST PLAN DEVELOPMENT</b>	<b>22</b>
4.1. Introduction/Administration.....	22
4.2. Format/Style/Length.....	22
4.3. Test Plan Sections.....	22
4.4. Additional Sections as Required.....	26
4.5. Test Plan Amendments.....	26
4.6. Training Plans and Operations Plan.....	27

4.7.	Time/Amendment Limits.....	28
4.8.	Version Control.....	28
4.9.	Test Procedures.....	29
<b>Chapter 5—REVIEWS AND APPROVALS</b>		<b>30</b>
5.1.	Introduction to Reviews.....	30
5.2.	Technical Review. ....	31
5.3.	Safety Review. ....	32
5.4.	Operations Review.....	34
5.5.	Additional Reviews.....	35
5.6.	Spacecrew/Operator Training & Certification.....	36
5.7.	Approvals.....	37
Table 5.1.	Space Activity Test Execution Authority Approval Levels.....	38
<b>Chapter 6—SPACE FLIGHT EXECUTION</b>		<b>39</b>
6.1.	Introduction.....	39
6.2.	Mission Director (MD). ....	39
6.3.	Spacecrew. ....	39
Table 6.1.	Crew Duty Day Requirements.....	41
6.4.	Battle Rhythm/Test Conduct.....	42
Figure 6.1.	Spacecraft Operations Battle Rhythm.....	42
6.5.	Space Activity Authorizations. ....	46
6.6.	Space Operations. ....	46
6.7.	Deployed Operations. ....	47
6.8.	Test/Training/Operations Activities.....	47
6.9.	Space Activity Reporting.....	47
6.10.	Next Phase Approval. ....	48
6.11.	Test Plan Changes During Execution. ....	48
6.12.	Test Delay/Pause/Suspension. ....	48
6.13.	Unexpected Event or Result.....	49
6.14.	Mishaps and Mishap Reporting. ....	49
<b>Chapter 7—PROJECT REPORTING AND CLOSEOUT</b>		<b>51</b>
7.1.	Project Completion or Termination Notification.....	51
7.2.	Test Reporting.....	51

7.3. Project Completion .....	51
<b>Attachment 1—GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION</b>	<b>52</b>
<b>Attachment 2—SPACE UNEXPECTED EVENT WORKSHEET</b>	<b>61</b>
<b>Attachment 3—EXAMPLE TEST APPROVAL WORKSHEET</b>	<b>63</b>
<b>Attachment 4—SUGGESTED CRITERIA TO USE IN TECHNICAL RISK ASSESSMENTS</b>	<b>65</b>

## Chapter 1

### PURPOSE, SCOPE, AND INTENT

**1.1. Purpose.** The purpose of this volume is to standardize policy, establish roles and responsibilities, and define basic guidance for the conduct of space flight tests, experiments, and demonstrations within AFRL. This instruction complements existing AFRL instructions AFRLI 61-106, *Planning and Management of AFRL Space Experiments* and AFRLI 61-108, *Management and Control of Technology Development for AFRL*.

**1.2. Scope.** This volume applies to any space flight or space flight-related activity that wholly or partly meets any of the criteria listed below. Throughout this volume, the terms “space activity,” “space test,” and “space experiment” may be used interchangeably. Activities covered include any that:

1.2.1. Utilize resources owned, possessed, leased, expended, or operated by AFRL (personnel, spacecraft, equipment, facilities, funding, etc.) except as exempted in [paragraph 1.2.8](#).

1.2.2. Take place in space, characterized as orbital and lunar trajectory space flights, including beyond geosynchronous orbit (objects departing the influence of Earth’s gravity), and are arranged for use by AFRL or its partners, or where AFRL/CC (or delegated subordinate commander/director) has responsibility for the safety of the general public.

1.2.3. AFRL has Satellite Control Authority (SCA) as defined in [paragraph 1.3.5](#).

1.2.4. Are accomplished with AFRL as the assigned or acting as Lead Test Organization (LTO) responsible for the conduct of safe/efficient space activities, even if AFRL resources are not at risk (see [paragraph 3.6.3.1](#)).

1.2.5. Are executed by the organization under contract to AFRL where the Department of the Air Force is charged with mishap investigation responsibility, provides the mishap convening authority, or has more than a minimal risk of liability. The term “contract” in this context includes other similar legal instrumentalities such as Cooperative Research and Development Agreements, Other Transactions for Research, etc.

1.2.6. Utilize AFRL (or other) resources that present unique hazards, create commitments, or introduce liabilities not addressed by other published procedures or management directives.

1.2.7. Are specified for application of this volume by the AFRL Commander or Center Test Authority (CTA).

1.2.8. Do not meet one of the following exceptions. Contact the AFRL Operations Directorate (AFRL/DO) to confirm if any of these exceptions apply.

1.2.8.1. The activity is a service or deliverable provided to AFRL under a grant or is purchased by AFRL solely as a commodity. Under a commodity purchase, procedures are typically accomplished by the vendor in accordance with civil or industry standards out of AFRL’s purview.

1.2.8.2. AFRL resources are provided on a loan basis or as a consequence of being asked to develop or deliver a product for transfer to a customer to support their end use or objectives. This exception applies only when any AFRL support does not include operation or space flight of the resulting product(s) or the responsibility to arrange or oversee such

activities. In such cases, AFRL is not pursuing its own objectives, receives no benefit other than the goodwill generated by the service provided, and accepts the risk of loss or damage to its own resources.

1.2.8.3. Space experiments that do not involve flight, such as ground-based space domain awareness experiments.

1.2.8.4. The activity includes suborbital flight that is conducted IAW Air Force Research Laboratory Instruction (AFRLI) 61-103 Vol 1, *AFRL Flight Test and Evaluation*.

1.2.8.5. Space experiments solely related to testing launch vehicles.

1.2.8.6. Activities, planning, review, and approvals related to a launch vehicle or upper stage(s) employed to place a spacecraft in orbit.

### 1.3. Definitions.

1.3.1. **Space activity.** Any set of related events where a vehicle moves through space which apply to orbital, cislunar, lunar, and interplanetary trajectory space flights. AFRL space activities can include research, experiments, tests, demonstrations, standard operating procedures, military exercises, training, competitions, and real-world operations (e.g., long-term operational assessments and authorized support to domestic civil authorities).

1.3.2. **Spacecraft.** An independent (i.e., free flying) space vehicle designed to operate in space and orbit a celestial body (i.e., a planet, moon, or star). The term can be used interchangeably with “satellite” and often includes a payload in addition to the bus. A spacecraft is not dependent on another spacecraft for basic system functionality. The term spacecraft includes manned objects in space. This term can also refer to the object while it is still on the ground. This does NOT include launch vehicle components separated from the spacecraft. The source for a vehicle’s build (e.g., in-house construction, commercial-off-the-shelf (COTS), contracted design, etc.) does not matter in this context.

1.3.3. **Spacecraft bus.** A spacecraft bus is all non-payload satellite subsystems, i.e., power; thermal; Commands, Control, & Communications (C3); Guidance, Navigation & Control (GN&C); Commands & Data Handling (C&DH); and propulsion (if needed).

1.3.4. **Payload.** A spacecraft payload is that complement of equipment attached to the spacecraft bus that performs a particular mission in space (e.g., communications, observations, science). A payload is dependent on the spacecraft for many, if not all bus functions (i.e., power, thermal, C3, GN&C, C&DH, and propulsion (if needed)). A hosted payload is the term typically used for a payload on a satellite where the payload is not owned by the Satellite Control Authority. All experiments flown on the International Space Station (ISS) and X-37B are considered hosted payloads (until separation, if applicable).

1.3.5. **Satellite Control Authority (SCA).** Satellite Control Authority is the exclusive authority and responsibility for directing on-orbit spacecraft to take actions. SCA is the authority to execute Telemetry, Tracking, and Command (TT&C) and Payload Command Authority (PCA) of a designated free-flying satellite. SCA of a spacecraft is both the authority and the full responsibility for intended and unintended actions taken by a spacecraft. SCA is nominally in the hands of the owner of the on-orbit spacecraft. When granted by the spacecraft SCA, PCA is the independent authority to command a payload. This is often used for hosted payloads with a separate communications link from the spacecraft. For AFRL spacecraft, see

**Chapter 2** for description of who holds SCA. The term “SCA” can be used to refer both to the concept of the authority and to the person holding the authority. SCA for AFRL satellites may only be held by government personnel, as this is an inherently governmental function. SCA includes the exclusive authority and responsibility for deciding and implementing the following:

1.3.5.1. How, when, and in what manner(s) the associated on-orbit spacecraft will be employed.

1.3.5.2. How, when, and what directions (in the form of specific commands) will be sent to the on-orbit spacecraft.

1.3.5.3. How, when, and what actions will be taken during emergencies or anomalous behaviors involving the spacecraft.

1.3.5.4. Authority to accept operational risks for space vehicles, within the bounds of national and Department of Defense (DoD) policy.

**1.4. Intent.** AFRL activities require unique rule sets driven by its science and technology (S&T) mission. This volume is based on the core tenets of Department, Service, and Major Command (MAJCOM)-level policies and practices for Test and Evaluation (T&E), safety, space flight worthiness, mission assurance, cyber resiliency, etc., but with tailoring to enable agility and innovation balanced with risk tolerance appropriate to the S&T environment.

1.4.1. **Method and Assurance** . The intent of this volume is to ensure a suitable level of application of technical rigor to AFRL research involving space experiments along with providing assurance of safe and efficient execution with good stewardship of resources. Regardless of the level of complexity or rigor in an AFRL space test, there must be appropriate documentation of the objectives and method of test as well as identification and acceptance of risks by the proper authorities.

1.4.2. **Importance of Tailoring** . AFRL conducts space tests/experiments across a wide spectrum of investment, technology maturity, risk levels, and safety challenges. Accordingly, AFRL members managing these experiments shall tailor the level of planning, rigor, and oversight according to the complexity (safety, cost, design, operations, etc.) and risk of the space experiment. The principles of tailoring are exercised by those composing test plans, developing test procedures, and exercising process review and oversight. Approval authorities apply their judgment as to the suitability of the tailoring applied when they approve, disapprove, or direct changes to a proposed space test.

1.4.3. Regardless of complexity of the space experiment, all AFRL Program Managers (PM) and Scientists and Engineers (S&E) shall follow the review, approval, and execution processes outlined in this volume.

**1.5. Authority.** Authority to oversee and direct the AFRL Space Flight Activity Process and related policies as set forth in this volume is vested in the AFRL CTA who is appointed in writing by AFRL/CC IAW DAFI 99-103 with duties further delineated in AFMC Instruction (AFMCI) 36-2645, *Senior Functional Roles and Responsibilities*. Authority to oversee and direct spacecrew operations as set forth in AFI 13-602V3, *Spacecrew Operations* is delegated to the Mission Director who has SCA. Compliance with this volume does not otherwise provide authority to

violate Air Force, United States Space Force (USSF), AFMC, Space Systems Command (SSC), or AFRL instructions/directives.

**1.6. Process Assistance.** This volume provides policy and guidance for the overall AFRL space activity planning, review, approval, and oversight process. For specific detail on implementation of any aspect of the process and examples for the reference and emulation, contact the AFRL/DO staff for information and/or assistance.

## Chapter 2

### AFRL SPACE FLIGHT ACTIVITY PROCESS

**2.1. Overall Process and Terminology.** The AFRL Space Flight Activity Process involves five general phases: planning, review, approval, execution, and reporting/closeout. See Figure 1 in AFRLI 61-103, *AFRL Research Test Management* (Parent) for depiction of these phases and **Figure 2.1** below for how they are implemented. All AFRL space flight activities shall have a collection of governing documents generically referred to in this volume as the “test package.” The test package may include documents such as the test/experiment plan, the satellite operations plan, the launch and early operations plan, the on-orbit handbook, etc. All documentation developed, collected, and processed through the AFRL Space Activity Process to secure signature and approvals will be part of the “test package.”

**2.1.1. Planning.** The goal of the Planning Phase is to produce a quality test package that identifies the space experiment objectives, test methodology, and unique hazards with sufficient controls (within program constraints) to support approval in a timely manner. **Chapter 3** discussed Preliminary Planning and **Chapter 4** covers Test Plan Development.

**2.1.2. Review.** All space test packages require appropriate reviews before they are approved for execution. A technical review assesses the adequacy and soundness of the system design and experiment plan to verify that the overall method of test will meet test objectives at an acceptable level of technical risk. A safety review involves an independent assessment of the program safety planning and consideration of mitigation measures that establishes the residual safety risk per AFI 91-202 AFRL Supplement. Cyber assessments as applicable determine adequacy of measures taken to address these aspects of a test IAW AFRLI 17-130, *AFRL Cybersecurity Program Management*. The Review Phase is discussed in **Chapter 5** of this volume.

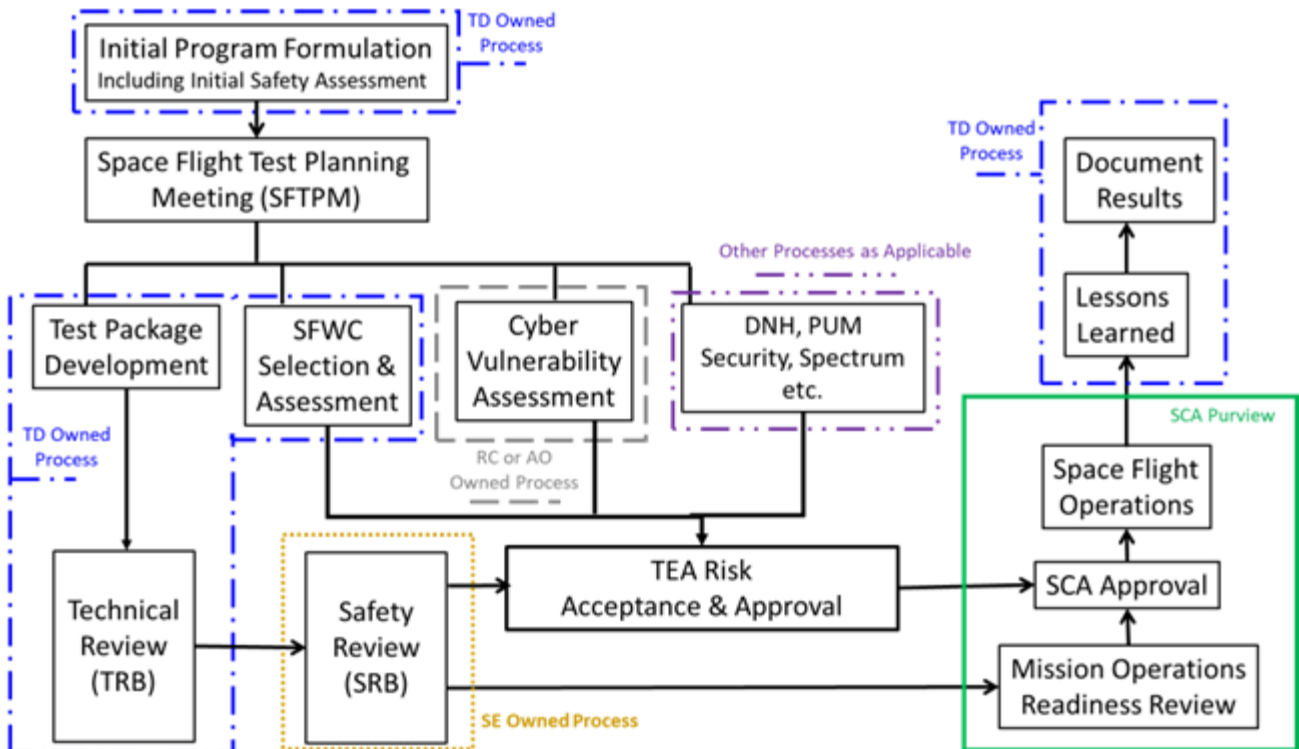
**2.1.3. Approval.** The Approval Phase requires the test package to be coordinated and approved by senior leadership prior to execution. The Test Execution Authority (TEA) accepts the residual risks identified to AFRL resources (funding, property, personnel). See **paragraph 5.7.3** for additional details on TEA risk acceptance. Per AFRLI 61-106, *Planning and Management of AFRL Space Experiments*, the TD Chief Engineer ensures the validity of the space flight worthiness assessment and provides space flight worthiness approval. The cyber Science and Technology Authorizing Official (AO) issues an Authorization to Operate (ATO) or Interim Authority to Test (IATT) to accept any residual cyber risk and permit operations that comply with any stipulated cyber mitigations. Both TEA and SCA holder approve the complete test package and give final overall approval to proceed with the flight test activity.

**2.1.4. Execution.** During space flight execution, changes to requirements or technical understanding, programmatic imperatives, or unexpected events (to include mishaps) may trigger revisions to test plans. Additionally, spacecraft procedure approval, operator qualifications, and space flight reporting must be properly secured or executed. **Chapter 6** presents considerations, requirements, and the standard battle rhythm for the Execution Phase.

**2.1.5. Reporting/Closeout.** When the experiment program is complete, the experiment team shall close and archive the test package and record lessons learned for other experiment

programs to leverage. Closeout and lessons learned documentation requirements are included in [Chapter 7](#).

**Figure 2.1. AFRL Space Flight Activity Process.**



**2.2. Implementation.** The AFRL Space Flight Activity Process is adapted from core tenets of the United States Air Force (USAF) and USSF T&E, safety, and space flight worthiness processes. It addresses the requirements of additional processes (spectrum, cyber, contracting, etc.) as well. The process is adapted to accommodate the unique S&T mission of AFRL.

**2.2.1. Testing/Training/Operations.** The AFRL Space Flight Activity Process shall be used for all space activities including, but not limited to, test, training, operational missions, and support to exercises.

**2.2.2. Tailoring.** In coordination with Headquarters (HQ) AFRL Functional Directorate Points of Contact (POC), the PM ensures all strategies for T&E, test plans, briefings, and reports are flexible and tailored to fit the specific needs of S&T programs consistent with sound systems engineering practices, program risk, statutory and regulatory requirements, the time-sensitive nature of user necessities, and common sense. Planning, execution, and reporting must also be tailored for emerging contingencies. Accordingly, Functional Directorate POCs will support tailoring of the AFRL Space Activity Process requirements and timeline according to the complexity and risk of the flight activity. The AFRL CTA retains the prerogative to review and recommend changes to the level of tailoring proposed for acceptance by approval authorities for any space flight activity.

**2.2.3. Collaboration and Early Functional Directorate POC Involvement.** Collaboration is the cornerstone to achieving safe, efficient space test. The test team is a key mechanism to achieve this collaboration. The test team consists of the PM, test team members, spacecrew,

and Functional Directorate POCs working as a team. While the AFRL Space Activity Process has built-in pre-planning engagements – the prime example being the Space Flight Test Planning Meeting (SFTPM) – additional formal and informal engagements with HQ POCs are necessary for success.

**2.2.4. Event-Driven Schedules** . Adequate time and resources should be anticipated and provided for all phases of the Space Activity Process.

**2.2.5. Objectivity** . All participants in AFRL space test activities must strive to be objective, unbiased, and free from outside influences to ensure the integrity of evaluation results.

**2.2.6. Combined Review Board (CRB)**. If the technical and safety discussions would be enhanced by collaboration of both boards, the test team may request a CRB in lieu of separate board reviews to minimize impact to resources and shorten the timeline. Teams should contact the Technical Review Board (TRB) and Safety Review Board (SRB) Chairs for final determination/concurrence on this course of action. When a CRB is held, the TRB and SRB Chairs will co-chair the forum. Teams will ensure the test plan is sufficiently mature prior to the CRB. Careful attention should be paid to fulfillment of all the roles and responsibilities outlined in this document during such combined forums.

**2.2.7. Accepting Other Government Space Test Organizations' Reviews** . To eliminate duplication of efforts, technical and safety reviews conducted by other government organizations partnered with AFRL, possessing mature, well-defined, and documented review procedures may be accepted at the discretion of the TD Chief Engineer (for technical review), site/detachment Chief of Safety (COS) for safety reviews, TEA, and CTA. The Test POC assigned by the AFRL/DO office to the program will be invited to attend these reviews and will assist these entities as necessary to document the results per AFRL processes for risk acceptance and approval.

2.2.7.1. Hosted payloads will need to participate in any reviews required by the organization that owns the spacecraft. Hosted payloads may have their own experiment plan or be part of the spacecraft's experiment plan. Hosted payloads will need to provide their spacecraft program office with inputs for various aspects of the spacecraft test package, but a tailored, individual payload test plan may be required. For example, hosted payloads would normally be covered under a spacecraft's cyber assessment or radio frequency license.

2.2.7.2. If parties to a space activity agree that the organization serving as Lead Developmental Test and Evaluation Organization (LDTO) will not conduct a TRB for an AFRL experiment/payload, then the sponsoring TD must do so.

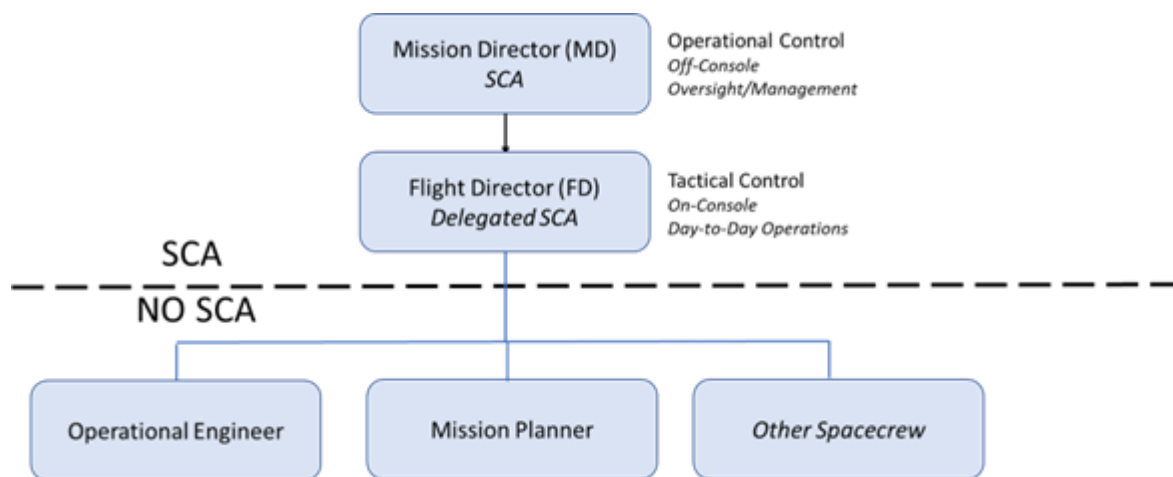
2.2.7.3. Mishap accountability should be negotiated and documented with launch vehicle and spacecraft providers in advance of the mission. Mishap investigative responsibilities will be determined in accordance with DAFI 91-204, AFMC Supplement. When appropriate, AFRL will participate in or conduct a safety investigation in accordance with the documented mishap agreement. If the organization with mishap accountability decides not to conduct a safety investigation, then AFRL must conduct one within the means and data available to AFRL. See AFI 91-202, AFRL Supplement for more information on requirements for accepting other organization's safety reviews.

### 2.3. Space Activity and Chains of Authority in AFRL.

2.3.1. The AFRL Space Activity Process intertwines multiple chains of authority: SCA/operations, programmatic, and functional (test, safety, space flight worthiness, cyber, etc.). Functional chains possess authorities commensurate with their types of expertise (e.g., residual safety risk determinations by the safety functional, etc.). Various aspects associated with test approval authorities are described below: the program chain and the SCA/operations chain.

2.3.2. **Operations Chain of Authority** . The operations chain of command oversees day-to-day space flight operations and ensures safe, efficient flight activities. This chain is based on Satellite Control Authority. [Figure 2.2](#) depicts the SCA chain of command.

**Figure 2.2. SCA Chain of Command.**



2.3.2.1. **SCA Delegation** . See [paragraph 1.3.5](#) for the definition of SCA. For AFRL experiments, SCA is ultimately held by AFRL/CC. However, the AFRL/CC may delegate SCA. Generally, the AFRL/CC will delegate SCA to a TD Director, who will in turn delegate to a specified Mission Director (MD) (e.g., the Integrated Experiments & Evaluation Division (RVE) Chief is Mission Director for the majority of the Space Vehicles Directorate (RV) free-flying spacecraft). Delegation must be done via a Letter of Delegation of Satellite Control Authority, provided the letter is signed by both the delegating/transferring authority and the receiving authority. For AFRL owned spacecraft, SCA shall never be delegated to contractor personnel. In the case of joint missions with satellites operated by an external organization, the MD should enter into a formal agreement with the external agency to designate SCA during joint operations.

2.3.2.1.1. **Mission Director (MD)** . The Mission Director holds SCA over the spacecraft. The MD oversees and manages all aspects of on-orbit operations of the space experiment to which he/she has been appointed. The Mission Director can be provided from the TD that is home to the program or an external agency, but they should possess applicable training or experience to successfully perform this duty. The Mission Director is responsible for the overall execution of the experiment plan, security, safety, training, and certification of spacecrew, and support aspects of the space flight activity, as identified in the test package.

2.3.2.1.2. **Deputy Mission Director (DMD)** . For most missions, the MD will appoint Deputy Mission Directors (DMD) in writing to act on behalf of the MD in the event that the MD is unavailable. The MD will determine the specific authorities of a DMD in a written document.

2.3.2.1.3. **Flight Director (FD)** . The MD delegates limited permissions (authorities) to the Flight Directors (FD), who represent the MD while on console in the Mission Operations Center (MOC). All non-emergency objectives executed by a FD must be within the bounds of risk previously accepted by a higher authority (i.e., MD/SCA). FDs have the authority to make any and all immediate safety decisions regarding the vehicle; additional authorities delegated to the FD should be documented. Any reference to the FD having SCA in this document is understood to be a limited subset of the MD's ultimate authority.

2.3.3. **Program Management Chain of Authority** . In accordance with AFRLI 61-106, the program management chain's responsibilities include setting and managing mission objectives, managing funding and schedule, interfacing with mission partners, delivering the space vehicle and ground system, providing space vehicle and ground system subject matter experts, participating in pre-launch operations readiness activities, conducting the long-term mission planning process (see [paragraph 6.3.2](#)), managing data and analysis, providing anomaly support, and resourcing and advocating for satellite operations requirements.

**2.4. Roles and Responsibilities.** All AFRL personnel involved in space activities are responsible for adhering to the AFRL Space Activity Process as outlined in this volume.

2.4.1. AFRL/CC will:

2.4.1.1. Delegate SCA to TD Directors or other appropriate entity.

2.4.1.2. Serve as TEA for HIGH risk tests.

2.4.2. AFRL CTA will:

2.4.2.1. Oversee and standardize Test and Evaluation (T&E) functional policy and processes as well as manage the T&E functional workforce within AFRL IAW DAFI 99-103 AFMC Supplement and AFMCI 36-2645.

2.4.2.2. Be the focal point to the Deputy Technology Executive Officer for Space Science and Technology (D-TEO), PM, and TD Test Lead for space activity guidance and assistance, and to Center-level leadership for issues concerning space activity policy, processes, and procedures.

2.4.2.3. Establish and oversee the AFRL Space Activity Process. Set policy for test plan development, review, and approval processes and ensure their adequacy in implementation.

2.4.2.4. Assist the PM and test team in identifying government organizations, as necessary, to help with space testing or any other required resources.

2.4.2.5. Maintain a cadre of trained/qualified space test Subject Matter Experts (SME) to provide programs with space activity expertise and advice. Support PMs as needed with: application of the principles of integrated test, preparation of test plans, development of technical and safety review documentation, and securing relevant approvals. Train and

guide test teams to properly implement all aspects of the process described in this volume and recommend appropriate space test techniques, procedures, and best practices.

2.4.2.6. Represent AFRL on T&E issues to USSF, HQ AFMC, SSC, AF/TE, USSF/TE, Space Training and Readiness Command (STARCOM), MAJCOMs, and other external agencies.

2.4.3. AFRL/DO will:

2.4.3.1. In the person of the Director (and Deputy Director) serve as AFRL Center Senior Functional for T&E and head of the CTA office (when appointed by AFRL/CC). As an organization serve as staff for CTA.

2.4.3.2. Assist the Inspector General (IG) in audit functions, ensuring review and approval process are properly executed and documented. Monitor space flight activities to ensure they proceed IAW approved test plans, approved technical and safety review documentation, all other relevant approvals, and the principles of integrated test.

2.4.4. AFRL Safety Office (AFRL/SE) and Site/Detachment Chief of Safety.

2.4.4.1. AFRL/SE and AFRL Chief of Safety roles and responsibilities in support of the AFRL Space Activity Process are described in AFI 91-202 AFMC and AFRL Supplements. Information about safety investigation processes can be found in DAFI 91-204 AFMC Supplement, *Safety Investigations and Reports* and AFMAN 91-222, *Space Safety Investigations and Reports*. Reference these documents for more information on mishap convening authority identification, SRB Chair selection and training, SRB conduct, mishap handling, and other activities relevant to space flight operations.

2.4.4.2. The AFRL Det 3/SE office will have at least one system safety personnel authorization dedicated to Space Safety. This System Safety Manager (SSM) will serve as the AFRL Space Safety Officer (SSO) and serve as AFRL's focal point and primary advisor to the AFRL/CC on all space safety issues. AFRL/SE will maintain oversight of the space safety program.

2.4.5. Technology Directorate Test Leads will:

2.4.5.1. Manage support to TD space flight activity review and approval processes and document processing. Assist CTA in training TD S&E workforce on the AFRL Space Flight Activity Process and test techniques, procedures, and best practices.

2.4.5.2. Serve as the central point of contact between TD PMs and AFRL/DO and the other Functional Directorates. Test Leads will serve to guide and assist individual program teams with meeting AFRL Space Flight Activity Process requirements.

2.4.5.3. Act as the primary POC within the TD for execution and oversight of any internally instituted TD space flight activity management processes.

2.4.5.4. Assist PMs in the development of test strategies. To the extent practical, participate as a member on program test teams to assist in test planning.

2.4.5.5. Assist the TD Chief Engineer with execution of TRBs and processing of resultant documentation.

2.4.6. AFRL Space Vehicles Directorate (AFRL/RV):

2.4.6.1. Maintains expertise and capabilities in space flight operations, space flight mission assurance, space flight worthiness, environmental stress testing and satellite command, control, and operations.

2.4.6.2. Provides space training and certification recommendations, flight execution, space flight worthiness and mission assurance services, upon request, for all AFRL space experiments.

2.4.7. AFRL TD Directors/Commanders will:

2.4.7.1. Appoint a TD Test Lead to serve as the central point of contact for the entire portfolio of TD space test programs.

2.4.7.2. Ensure compliance with the space test processes as defined in this instruction.

2.4.7.3. Provide resources to support space test processes: technical review, safety review, cyber vulnerability assessment, mission assurance, spaceflight worthiness, training, etc., as applicable.

2.4.7.4. Delegates SCA to a Mission Director.

2.4.8. AFRL TD Chief Engineers will:

2.4.8.1. Chair TRBs for space test activities within their TDs.

2.4.8.2. When unavailable, appoint TRB Chairs to perform such duties in their stead who possess the requisite knowledge and experience to satisfactorily assess the technical risk of space test activities within their TDs.

2.4.8.3. Ensure minutes are signed and published in a timely fashion for TRBs held within their TDs that document action items assigned and closed and that capture for the record the final technical risk level assessed for the space test activity reviewed.

2.4.8.4. Assess the adequacy of TRBs conducted by agencies outside of AFRL and when found to be unsatisfactory for whatever reason, conduct supplemental reviews to the extent necessary to ensure the requisite adequacy.

2.4.8.5. Assesses space vehicle compliance with the AFRL TD developed Spaceflight Worthiness Criteria (SFWC), per AFRLI 61-106.

2.4.9. PMs will:

2.4.9.1. Ensure program space activities are planned, documented, reviewed, approved, and conducted in accordance with this volume. PMs will ensure independent, government-led technical and safety reviews are adequately conducted by qualified organizations for all tests. When AFRL is not the LTO and these reviews are not conducted IAW such principles, PMs will utilize AFRL processes and resources to ensure adequacy in this regard.

2.4.9.1.1. In coordination with the TD Test Lead and AFRL/DO Test POC, ensure test plans are of sufficient quality before they are submitted for AFRL Space Activity Process reviews.

2.4.9.1.2. Ensure test plans are submitted for reviews/approvals with sufficient time based on this instruction to ensure the program meets requirements and planned schedules.

2.4.9.1.3. Ensure completion of technical and safety review action items and incorporation of changes directed to space activity packages.

2.4.9.2. Ensure program protection measures to include those for operations security, cybersecurity, and anti-terrorism are implemented as applicable when sponsoring space flight activities. Consult AFRLI 61-113, *Science and Technology Protection for the Air Force Research Laboratory*, for guidance in this area.

2.4.10. Mission Director (MD) will:

2.4.10.1. Hold SCA for assigned spacecraft.

2.4.10.2. Appoint a Deputy Mission Director and Lead Flight Director.

2.4.10.3. Delegate limited SCA to Deputy Mission Director, Lead Flight Director, and Flight Directors.

2.4.10.4. Oversee, manage, and direct all aspects of on-orbit operations for their spacecraft.

2.4.10.4.1. Ensure proper utilization and scheduling of all on-orbit operations resources.

2.4.10.5. Ensure the security, integrity, and validation of all resources to accomplish the project's on-orbit operations.

2.4.10.6. Certify personnel to fill key flight experiment operations positions.

2.4.10.7. Communicate activities and status to high-level stakeholders such as AFRL/CC and mission partners as appropriate.

2.4.10.8. Arbitrate disagreements between the operations team, the PM, and external mission partners/stakeholders as needed.

2.4.11. Additional Roles. There are many additional roles and responsibilities to operate a satellite on-orbit, including but not limited to: Lead Flight Director (LFD), Flight Director (FD), Principal Investigator (PI), Lead Mission Planner (LMP), mission planners (MP), Operational Engineers (OE), etc. These roles and responsibilities will be defined in detail in [Chapter 6](#).

## Chapter 3

### PRELIMINARY PLANNING

**3.1. Test Concept Development.** Each AFRL S&T program has its own unique and special requirements. This chapter lists the basic steps and long-lead planning considerations that are common to most AFRL space activities. The space test planning and management process is meant to fit seamlessly into the overall AFRL Test Process. The main difference is there are specific tailored mission assurance processes based on systems engineering and spaceflight worthiness processes (IAW AFRLI 61-106), which are included in order to address the unique environment for space experimentation. **Chapter 4** presents detailed test planning activities to accomplish once the basic strategy is complete.

**3.2. Test Strategy.** Document the overall objectives, System Under Test (SUT) description, proposed test team structure, and timeline of the program's space test activities. The overall objectives and programmatic baseline should be captured in a Mission Level Technical Baseline (MLTB) and Mission Level Programmatic Baseline (MLPB) or similar, in accordance with AFRLI 61-106. Additionally, PMs may contact TD Test Leads and/or the AFRL/DO staff for assistance in developing test strategies. These offices will share lessons learned from previous tests and advise PMs/S&Es on long-lead planning considerations.

**3.3. Space Flight Test Planning Meeting (SFTPM).** Early operator involvement is a key principle that undergirds the concept of the SFTPM. The SFTPM is held as a part of or soon after the Initial Program Formulation Phase that a program conducts when envisioning some future space flight activity. This meeting allows the PM and test team to introduce the space flight activity concept to the HQ AFRL organizations that oversee the test process (to include AFRL/DO/IZ/SE/TD CE). At the SFTPM, Functional Directorates, the PM, and the operations team work together to identify and tailor the AFRL Space Flight Activity Process requirements and milestones that will apply to the program. Prior to the SFTPM, an AFRL/DO POC will be assigned to help the PM transition from preliminary to detailed planning and facilitate the program's vetting through the AFRL Space Flight Activity Process. For space programs, it is mandatory that the AFRL/DO POC, a Safety (Det 3) POC, TD Test Lead, TD Chief Engineer, a cybersecurity POC, and AFRL spectrum management are involved in this meeting. Occasionally, as the programs plan for and proceed with their space experiment, significant changes in scope (objectives, procedures, participants, venues, etc.) may prompt a follow-on SFTPM to be convened to address these changes as appropriate. Scheduling a SFTPM as early as practical allows the PM to leverage AFRL subject matter expertise to properly manage the various risks encountered in space flight activities and to balance them with the programmatic risks the PM and the program management chain are willing to bear. Tailoring of systems engineering and space flight worthiness criteria will begin at this point. The development of the test's objectives and success criteria, along with the complexities, safety concerns, and nature of the test itself, along with the program requirements decomposition will help define the amount of rigor appropriate for the test.

**3.4. Program Schedule.** Every space activity requires various actions, resources, and approvals to enable it to go forward. PMs must consider these factors when formulating a schedule to meet program objectives.

**3.5. Space Test Tracking.** All approved space experiments shall be entered into a tracking system which uniquely identifies each test records completion dates for key experimentation,

spaceflight worthiness, systems engineering, and safety processes milestones that need to be accomplished, per AFRLI 61-106.

### 3.6. Major/Mandatory Planning Considerations.

3.6.1. **Ownership.** Ownership generally refers to the organization that designed, developed, built, and then tests and operates the satellite. Ownership is also defined by who will have SCA over the satellite once it launches as well as who has the authority to decide when to execute the satellite's end of life or deorbit procedures (free flying satellites only). It should be noted that hosted payloads rarely have SCA of the spacecraft, so though a PM may "own" their payload they do not own the spacecraft. Ultimately, the payload PM may have limited control over their payload and little to no control over the spacecraft. For more discussion on ownership and determining if AFRL owns the spacecraft, see AFRLI 61-106.

3.6.2. **Spacecrew.** The spacecrew must have appropriately documented training, qualification, procedures, and approval to operate the spacecraft.

3.6.3. **Test Organization.** Organizing to pursue a space test activity should be tailored to the complexity of the test. If required by extensive scope or if multiple organizations are involved, a formal test team may be formed. The test team should be constituted sufficiently early to shape the test requirements and strategies of the program. The test team membership will typically include the AFRL PM and representatives from the program office (as assigned), the requirements community (as involved), any associate test organizations, system contractors, and any others that add value. Not all of these are required for every space activity. Simpler tests may proceed with reduced membership. Responsibility to develop the test plan and execute it typically falls to the program's test team which may be organic or outsourced. Test teams may be organized using the following elements as appropriate.

3.6.3.1. **Lead Test Organization (LTO)** . The LTO is the construct used when the test team is organic to AFRL (to include its contractors) and possesses the qualifications and resources necessary for the planning, safety, execution, and reporting of a test activity. The AFRL TD that owns the program and maintains SCA is designated as the LTO. If more than one TD is involved, it is still the TD with SCA that is designated the LTO.

3.6.3.2. **Lead Developmental Test and Evaluation Organization (LDTO)** . An LDTO is a test team external to AFRL that functions as the lead integrator for a program's test activities. Since AFRL performs S&T and not formal Developmental Test and Evaluation (DT&E), LDTOs are usually used for their expertise in space test activities or for their unique test assets, but not for T&E as prescribed in DAFI 99-103. Examples of mechanisms to procure support include use of Program Introduction Document (PID), Statements of Capability, and Memoranda of Understanding (MOU). When an LDTO is to be employed, all AFRL programs are required to document the transfer of space test responsibility unless waived by AFRL CTA.

3.6.3.3. **Participating Test Organization (PTO).** A PTO is any test organization with whom a supporting relationship is established to provide specific test data, resources, or execution for a test program or activity.

3.6.3.4. **Test Operations Team** . A typical AFRL test operations team includes the Mission Director, Flight Director, and additional spacecrew as required.

3.6.4. **Satellite Control Authority Relationships** . When AFRL serves as the LTO and is supported by entities that possess their own space operations capability, the AFRL TD with SCA will provide overall space operations oversight unless SCA is delegated to one of the participating entities. This arrangement does not override the other organization's prerogatives with respect to oversight of their entity's participation in an AFRL-led test activity but allows for a single integrated perspective in the oversight function. Careful coordination of AFRL oversight prerogatives is needed so the test team has a clear picture of their duties with respect to reporting and otherwise being responsive to these authorities' requirements.

3.6.5. **Test Resources** . Space flight activities in support of S&T objectives may require use of specialized operations centers, ranges, etc. AFRL programs must ensure they schedule the correct resources, receive approval to conduct the test using that resource, and properly train the operators prior to execution to operate there. For assistance in this regard, see the TD Test Lead or AFRL/DO staff.

3.6.6. **Space Safety** . The AFRL Space Safety Program establishes a methodology for mishap prevention through risk management, and mishap reporting in order to enable mission success as safely as reasonably practical within the program's level of effort. Organizations with SCA shall appoint a Space Safety Manager to manage its SCA's Orbital Safety Program to include assessing and documenting risk levels of all planned space flight activities. See AFRLI 61-106 for more details.

3.6.7. **Certification and Training** . AFRL flight operations teams shall be appropriately trained and certified by the MD. Organizations with SCA shall track and maintain certified personnel. The Mission Director who holds SCA has both the authority and responsibility to establish, train, and certify the mission operations team. The mission operations team will undergo training on the functions, features, capabilities, and operations of the spacecraft and payloads. The operations team will also receive training on anomalies, contingency operations, and will exercise and rehearse the LEOPs (Launch and Early Operations) phase and other critical experimental operations.

### 3.7. Other Planning Considerations.

#### 3.7.1. Contracting.

3.7.1.1. **Contract Language** . When AFRL contracts include space activity tests conducted either by the contractor or in support of the government, consideration should be given to including specific language about AFRL space activity processes. The PM should highlight the plan or potential for space flight activity and provide necessary requirements to the Contracting Officer before contract solicitation so the latter may incorporate appropriate language as required. AFRL/DO will review the AFRL Form 4 and provide test specific contract language for the space test activity. If a contractor will be required to conduct the test or provide documents to support the test, the PM should consider contract language, including generation of DD Form 1423 *Contract Data Requirements List (CDRL)* that require the contractor to:

3.7.1.1.1. Write a test plan and submit it to the government for review and approval prior to first test.

3.7.1.1.2. Support the space flight worthiness process to include space flight worthiness risk assessment.

- 3.7.1.1.3. Participate in reviews (safety/technical) and approvals (TEA/SCA).
- 3.7.1.1.4. Follow AFRL processes for reporting/handling unexpected events/mishaps.
- 3.7.1.1.5. Document and provide the government with lessons learned.
- 3.7.1.1.6. Provide the government with any recorded data and analyses as required.

3.7.2. **Program Security/Cybersecurity** . PMs shall follow AFRL and TD program security measures as well as cybersecurity requirements as dictated by Department of the Air Force policy and instruction. If unsure how to proceed, contact the TD security lead or AFRL Security Office (AFRL/IP) for program security. Contact the TD Information System Security Manager (ISSM) or AFRL Cybersecurity Office (AFRL/IZC) for information technology security.

3.7.2.1. See AFRLI 61-113 for program security and AFRLI 17-130 for cybersecurity guidance.

3.7.2.2. Based on the level of sensitivity of transmitted data and commands, utilize appropriate level and type of encryption and other technical or procedural mechanisms to mitigate program and cyber risks.

3.7.3. **Frequency Management and the AFRL Spectrum Manager (SM)**. The PM should coordinate at the beginning of the program with the AFRL SM in AFRL/DO to ensure spectrum approvals are in place as needed, even if a contractor is intending to use a non-DoD frequency.

3.7.4. **Directed Energy (DE)/Laser Clearance and Safety** . Use of DE during testing requires special notifications/approvals. Engage a Laser Clearing House POC and comply with DoDI 3100.11 *Management of Laser Illumination of Objects in Space* when conducting any DE testing. Ensure the range safety or test site safety office has approved DE employment on any military range where it is intended to be used. Follow the instructions of Federal Aviation Administration (FAA) Advisory Circular (AC) Number 70-1B, *Outdoor Laser Operations*, for any laser operations that may affect aircraft operations in the national airspace system (NAS). See AFRL/SE for questions on DE safety protocols.

3.7.5. **Configuration Management** . Each mission organization that conducts space activities must have a spacecraft (or payload) Configuration Management (CM) process. CM implements the policies, procedures, techniques, and tools that manage, evaluate proposed changes, track the status of changes, and maintain an inventory of system and support documents as the spacecraft and/or payload system changes. Prior to launch, CM applies to modifications to the system's design, hardware, firmware, software, and documentation (see AFRLI 61-106 for more details). This is only slightly modified on-orbit in that hardware changes are usually limited to the selection of power and operational status changes (e.g., selection of the primary or secondary string of redundant hardware) while firmware, software and documentation changes remain common. The TD Chief Engineer is responsible for oversight of this process which ensures configuration changes will not result in unsafe conditions with the structural characteristics, the performance and flying qualities, control capabilities, or electrical features of the spacecraft. For complex space vehicles, consider establishing a Configuration Control Board (CCB). For assistance on configuration control, see the TD Chief Engineer or AFRL/EN.

3.7.6. **Logistics and Support** . Determine the support requirements to meet performance and readiness objectives. Areas to consider for planning purposes: maintenance; training and training support; manpower/personnel; Information Technology (IT)/computer support; supply; facilities; technical data; packaging, handling, storage, and transportation; support equipment; and design interfaces.

3.7.7. **Proper Use Memorandum (PUM)**. Requirements for PUMs stem from statute, Executive Orders, policies, and AFI 14-104, *Oversight of Intelligence Activities*. A PUM is required any time a space activity will result in the collection of data on U.S. persons whether by design or inadvertently. The intended purpose of the vehicle sensor that can collect such data is irrelevant – only its capability matters – so PUM requirements are applicable beyond those activities that are solely for intelligence collection. PUMs are approved at the MAJCOM A2 level so composition, staffing, and approval timelines can be significant (i.e., on the order of three to six months). PMs are highly encouraged to contact their TD Test Lead and/or AFRL/DO staff for guidance on PUM requirements for their test activities.

## Chapter 4

### TEST PLAN DEVELOPMENT

**4.1. Introduction/Administration.** Because of the nature of S&T and overlapping management within AFRL, test plan (or experiment plan) is defined as the approved package that combines: test approach, safety considerations, space worthiness information, operator training/qualification summaries, operational limits, and spacecraft limits. These can be combined into one document, but are often separated into a test plan, an operations plan, and an on-orbit handbook. Test plans in AFRL should be tailored to the complexity of the space activity but require a minimum of certain information to explain the objectives, the methodology, and the risk management/safety measures. A test plan may cover the life of the vehicle from launch and early operations until disposal or may be limited to a particular phase of the mission or experiment. Test plans document the following:

- 4.1.1. Objectives – to what ends tests will be accomplished
- 4.1.2. Test methodology – how tests will be accomplished
- 4.1.3. Measurement and instrumentation requirements – what data will be acquired
- 4.1.4. Data analysis plan – how data will be collected/processed to answer the objectives
- 4.1.5. Metrics – how success (or failure) will be assessed
- 4.1.6. Limitations – why the test may not be fully successful
- 4.1.7. Management information – resources, schedule, reporting, etc.
- 4.1.8. Safety – risks to personnel and property and how they will be mitigated

**4.2. Format/Style/Length.** Test plans come in a variety of formats, styles, and lengths; there is no required template in AFRL. Some considerations to keep in mind when composing test plans are as follows:

4.2.1. **Test Approach or Build-up** . During test plan development, the test team will carefully consider the test approach or build-up. The way the test approaches a hazardous or unknown condition must be clearly defined. If predictive analyses do not exist or have questionable validity, the test methodology may require a more refined build-up approach to offset the risk. Criteria to continue or more importantly when to stop, can provide good risk control by providing a clearly defined roadmap that governs the test team's decision-making. This decision-making process is extremely important and should be documented.

4.2.2. **Test Plan Size and Complexity** . The test team must consider the size and complexity of the test plan and assess whether a review of a large, complex test plan is more or less advantageous than several smaller phased test plans/reviews. When appropriate, teams may conduct test/safety planning for larger, complex test efforts using smaller, less complex plans and reviews matched to progressive phases of the test project. For example, for a spacecraft with multiple payloads, each payload may have an individual test plan, which could then be reviewed separated or as part of a bulk spacecraft plan.

**4.3. Test Plan Sections.** Regardless of format, the test plan should contain the following elements: overview, test objectives, a description of the SUT, orbit, the method of test, a data management plan, safety considerations, envelope/limitations, and operator training/qualification.

(As noted above, these can be different documents, but each document must be provided and reviewed.)

4.3.1. **Overview** . Summarize the purpose of the test, program objectives, and any pertinent background information (such as previous tests, simulations, or how this test affects other tests or broader research campaigns). If the program has a signed MLTB, the program objectives should correlate with the MLTB, per AFRLI 61-106.

4.3.2. **Test Objectives** . State and list, clearly and concisely, the primary test objective(s) and any sub-objectives. Identify the phenomena or events of prime importance expected to be observed or measured. Identify any critical questions or issues to be answered by the test program.

4.3.3. **System Under Test (SUT)/Test Item Description** . Describe the spacecraft and/or payload(s). Describe general capability of the various subsystems and/or capabilities directly relevant to the test (e.g., relevant instrumentation, critical components for the test, etc.). The description needs to be detailed enough so that the test can be easily understood.

4.3.4. **Orbit Description** . If the satellite only has one orbit (i.e., no propulsion system), describe the orbit (at least required altitude and inclination). If the satellite is capable of multiple orbits, describe the initial orbit and/or primary orbit. Orbits required for specific tests will be described in the Method of Test (MOT) section.

4.3.5. **Ground System Description** . Describe the ground system that will be used to communicate and control the satellite. If an additional ground system is necessary for completion of the experiment, separate from the communications ground station, describe that as well.

4.3.6. **Method of Test (MOT)**. Provide detailed test approach for each test/experiment to be performed consisting of:

4.3.6.1. Detailed description and discussion of each type or phase of test (checkout/early operations, calibration, experimentation, etc.).

4.3.6.2. Number of tests planned/required for each experiment, if applicable (e.g., if a test must be repeated three times to meet success, etc.).

4.3.6.3. Purpose, objective, and success criteria of each test.

4.3.6.4. Space vehicle configuration for each test, including: required orbital parameters; required vehicle attitude or pointing; required ground track/latitude/longitude (if required); any unique vehicle hardware configurations (i.e., any deployable or actuators); etc.

4.3.6.5. Unique ground station configurations for each test (if applicable). Not every space vehicle will have an experiment ground station outside of the TT&C ground station. However, if there is a payload ground system or unique settings required particularly for this test from the TT&C, the configuration and settings for those systems should be described here.

4.3.6.6. Discussion of how each test will be conducted from start to finish.

4.3.6.7. Any applicable spacecraft Flight Rules (see [paragraph 6.2.4.2](#)).

4.3.6.8. Test terminology

4.3.6.9. Experiment, safety go/no-go lists, and critical vehicle/operations limits.

4.3.6.10. Test execution success criteria.

4.3.7. **Spacecraft Envelope/Operations Manual/Limits** . Provide information on the spacecraft approved operating envelope(s). List or provide reference to spacecraft limitations for temperature, power availability/consumption, pointing accuracy, fuel, etc. Provide or reference any materials that describe the spacecraft operator's manual, operating handbook, procedures and/or checklist(s). This may be provided by referencing an On-Orbit Handbook or similar document.

#### 4.3.8. **Data Management Plan.**

4.3.8.1. Telemetry Requirements. Describe test telemetry (including payload and required vehicle telemetry), and its required precision/accuracy/update rate.

4.3.8.2. Data Analysis Plan. Regardless of format for the data analysis plan, clearly indicate: Measures of Performance (MOP) defined in terms that can be measured; required parameters; collection methods; initial quality check methods; algorithms and tools to be applied; tool validation methods; analysis methods (explaining why the method was selected); completion criteria; evaluation criteria stated in terms of the MOP (if applicable); analysis schedule; and evaluation products.

4.3.8.3. Data Archiving. Describe where and how telemetry and/or analyzed data will be archived and maintained post-mission, including the duration the program intends to maintain the data.

4.3.9. **Launch and Early Operations (LEOPs)**. Provide a detailed LEOPs plan, including deployments (i.e., solar array), vital bus system checkouts, payload checkouts, and applicable system calibrations. The LEOPs plan must include the sequence of events and include criteria for entry into nominal operations.

4.3.10. **End of Life (EOL)**. Describe general EOL plan (i.e., de-orbit into Earth's atmosphere, graveyard orbit and passivation, transition to other organizations, etc.), and reference the formal End of Life plan.

4.3.11. **Space Safety Planning** . The objective of safety planning is to identify and assess hazards and develop controls or mitigation measures to reduce the risk to an acceptable level. Document routine, contingency, and emergency operations plus identify points of contact if there is an anomaly and/or events of significance, e.g., remote proximity operations which require additional approvals, required operations training, etc. Programs should document what is considered anomalous versus nominal performance. Programs shall document actions if unable to execute the EOL plan and/or potential or actual creation of unintended space debris. Programs shall report anomalies per AFMAN 91-222. AFRL test plans typically include safety considerations rather than having them addressed in a separate safety plan, though use of a separate, complementary document is acceptable. The following items comprise the safety portion of the test plan. Refer to AFI 91-202 and its supplements or contact AFRL/DO or the local AFRL Safety office if you have questions.

4.3.11.1. **General Hazard Identification** . Some hazards will be inherent to operating the system and others will be induced by the test itself. For test safety planning, a goal is to employ standard procedures as much as possible for identifying and addressing general

and test-unique safety concerns. If the nature of the test increases the probability or severity of non-unique hazards they should be addressed, mitigated, and documented.

**4.3.11.2. Test-Unique Hazard Identification** . The team will identify unique hazards associated with each type of test or activity. In some cases, test activities may only elevate the risk associated with routine operational hazards while in others it introduces new sources of risk. In the safety documentation, descriptions of test-unique hazards should adequately capture the new source of risk including the act or condition itself and its effects. It is often helpful to assess the risk (probability and severity) prior to applying mitigations in addition to doing so after mitigations are in place. Sources for identifying test-unique hazards include:

4.3.11.2.1. Archived test and safety planning to include lessons learned and Test Hazard Analyses from similar tests.

4.3.11.2.2. Personnel or test teams with experience in similar test activities or testing in general to include staff within AFRL/DO and AFRL/SE.

4.3.11.2.3. Research data found in technical libraries, the internet, etc.

**4.3.11.3. Hazards Controls or Elimination** . Once the causes of each hazard have been identified, minimizing procedures or controls are used to reduce risk by reducing severity or probability or both. The following order of precedence should be applied to eliminate or control any hazards identified during the safety planning.

4.3.11.3.1. Design the test to eliminate the probability of the hazard occurring. This could include a decision to not perform the test if the risk is deemed to be unacceptably high. A redesign of the system to eliminate the hazard is another option.

4.3.11.3.2. Change the test methodology to reduce the probability, severity, or exposure to the hazard. For example, building up to the test condition can be a strong control method (per [paragraph 4.2.1](#)).

4.3.11.3.3. Incorporate safety devices (e.g., additional power sources, redundant systems).

4.3.11.3.4. Provide caution and warning devices to detect an unsafe condition or trend, or telemetry and data displays with active monitoring.

4.3.11.3.5. Develop procedures and training when it is impractical to change the design or test methodology.

**4.3.11.4. Hazard Mitigation.**

4.3.11.4.1. **General Minimizing Procedures (GMP)** . GMPs are stand-alone phrases/statements representing standards or best practices used to employ or comply with test build-up approaches, SUT restrictions, critical parameter monitoring, go/no-go criteria, space weather or environmental criteria, and/or other items of test safety concern.

4.3.11.4.2. **Test Hazard Analyses (THA)** . THAs are used to document and identify test-unique hazards and the actions necessary to minimize or control them to an acceptable level of risk. Use a separate THA for each test-unique hazard. If a hazard is not unique to a series of tests, no THA is required. However, should the very nature

of the test increase the probability of these hazards above that of normal operations, they should be addressed as test-unique hazards. See AFI 91-202 AFMC Supplement for THA formatting.

4.3.11.5. **Waivers** . If there are any AFI or Technical Order (TO) waivers associated with the space activity, note it in the test plan for consideration at the safety review.

4.3.11.6. **AFRL Unexpected Event Worksheet (see Attachment 2)**. This worksheet is used by the test team to provide a ready reference to guide reporting on an unplanned occurrence to the offices of AFRL/DO and/or AFRL/SE. Examples of such events are a near miss, spacecraft anomaly, mishap, or unplanned test suspension/stop. The worksheet guides affected parties to take appropriate response actions such as preserving mishap data, command logs, gathering witness statements, etc. It is also useful in supporting Operational Report/Commander Critical Information Requirement (OPREP/CCIR) submissions.

4.3.11.7. **Mishap Accountability** . This consideration identifies the Mishap Convening Authority (MCA) and/or any non-standard accountability information. The MCA for a particular space activity is not always obvious and, in some cases, may require a Memorandum of Agreement (MOA) assigning convening authority to a government agency other than AFMC. See AFI 91-202 and DAFI 91-204 as supplemented and/or contact the local site/detachment safety office or HQ AFRL/SE for further guidance.

4.3.12. **Spacecrew Qualification Documentation** . Identify the minimum qualifications all spacecrew must possess (documented on the Master Training List) to support the space activity and the training/certification plan.

4.3.13. **Cyber Vulnerability Mitigation** . AFRL systems under test almost invariably possess an information technology element. These IT elements must be evaluated for cyber vulnerabilities and any identified should be mitigated either through design or operational consideration. For example, telemetry links must be encrypted to eliminate or lessen the probability of sensitive data compromise. Accordingly, in the test plan include verbiage to describe all steps taken to mitigate cyber vulnerabilities in the SUT and in the MOT. If a cyber topology is not included with this verbiage, ensure one is provided to the TD ISSM, AFRL/IZC, or appropriate AO in the request for issuance of an ATO or IATT.

#### 4.4. Additional Sections as Required.

4.4.1. **Frequency Deconfliction Plan**. A frequency deconfliction plan should be developed for tests. All data/communication/voice links utilized in a test must be properly deconflicted from other transmission sources that may be authorized in the space environment.

4.4.2. **Security Considerations**. Identify any actions (operations security measures, communications security measures, etc.) to thwart hostile intelligence collection, protect data or test communications, or otherwise meet security requirements as necessitated by the S&T Protection Plan. If appropriate, develop a security plan, coordinate it with the appropriate security office, and include or reference it in the test plan.

4.5. **Test Plan Amendments**. By definition, amendments are changes to the originally reviewed/approved test or experiment plan and therefore must themselves also be reviewed/approved. The extent of the amendment approval process is determined by the impact

to safety. Amendments are documented using a Test Approval Worksheet (see [Attachment 3](#)) with the “Modification” selection made in the “Purpose” block.

4.5.1. **Administrative Revisions** . Clarity/grammar corrections, etc., may not require any approvals.

4.5.2. **Minor Revisions** . Minor revisions require TRB Chair, SRB Chair, and SCA signatures, but do not require the TEA signature on the AFRL Test Approval Worksheet. Examples include: changing conditions of test points as long as they remain close to existing points and within the envelope of test points approved in the original plan; adding test points within the envelope of test points and technical scope approved in the original plan; or, deleting test points if preliminary results validated by a technical expert show they are unnecessary and are not part of a safety build-up.

4.5.3. **Major Revisions** . A major revision is any substantive change to test objectives, technical approach or test methodology, changes to test procedures or test scope, or significant change to the spacecraft or SUT requiring further technical assessment. Technical/safety reviews may be accomplished outside of a board per [Chapter 5](#). Major revisions require TRB Chair, SRB Chair, TEA, TD Chief Engineer and SCA owner signatures on the AFRL Test Approval Worksheet.

**4.6. Training Plans and Operations Plan.** Per [paragraph 2.1](#), a governing document is required for all AFRL space activities. When warranted, a test plan may be modified to encompass more steady-state activities such as training or sustained operations. In these cases, test objectives may include training objectives or operational objectives, but the majority of the plan content as described herein is still required.

4.6.1. **Training and Operations Plan (T&O Plan).** As space operations become more prevalent and/or normalized within AFRL, the level of training requirements in any one TD may reach a level where a dedicated training and operations plan is preferred over authorizing such activities under a test plan or plans. T&O plans can be used to conduct on-orbit space operations for the purpose of providing either qualification or currency training to ensure proficiency of operational personnel and/or conducting nominal spacecraft health monitoring, station keeping, and other standard space vehicle maintenance tasks utilizing established procedures. Training that includes actual on-orbit operations should be limited to those activities that cannot be adequately performed via ground-based simulators, part-task-trainers, or other similar systems. T&O plans may include nominal, contingency, and emergency spacecraft operational procedures. Systems will be operated IAW published operating instructions, TOs, checklists, and procedures, where available. Development of a T&O plan and its subsequent review and approval will entail the same elements and processes as for a test plan with the following exceptions:

4.6.1.1. Since there is no experiment/test, no TRB is necessary. Only an Operations Review will be held, chaired by the MD/SCA, to assess the adequacy/compliance of the proposed training and operational objectives. These training and operational objectives will substitute for the test objectives and MOT.

4.6.1.2. Instead of a SUT, the T&O plan will provide descriptions of the spacecraft, ground control systems, and simulators to be employed to achieve training and operational

objectives. Spacecraft and operational limits associated with these systems will be listed as well.

4.6.1.3. A data management plan is optional.

4.6.1.4. Unit Standard Operating Procedures (SOP), approved by the MD/SCA will be referenced in addition to or in lieu of published technical data and operations procedures.

4.6.1.5. All other elements of the AFRL Space Flight Activity Process (space flight worthiness, safety review and residual risk assessment, TEA and SCA owner sign-off, procedure approval, etc.) will be followed.

**4.6.2. Real-World Operations Plan** . On occasion, AFRL technology development efforts will be employed in support of real-world peacetime or combat operations. Frequently, under these circumstances, transition of an AFRL system to a program office or a user will be delayed for an extended period of time. This may be due to a customer desire for the system to undergo an evaluation before assignment to and/or possession by the user is formally declared. In these instances, AFRL retains oversight of and liability for the system (including SCA) while it is undergoing evaluation. Such evaluations are governed by an AFRL operations plan which is a test plan tailored to the fielded environment and the more operational focus of the system's use. In an operations plan, the test objectives are typically listed as MOPs and/or Measures of Effectiveness (MOE) and address operational utility in terms of system effectiveness and suitability. It is highly desired that the test objectives be developed in concert with the operational customer and that this entity have a role in data collection, analysis, and evaluation. In all other respects, the operations plan possesses the elements of a test plan as delineated herein and follows the same AFRL Space Flight Activity Process. All AFRL authorities remain intact such as SCA responsibility to exercise continuing day-to-day oversight of space activities. The importance of adherence to these requirements and prerogatives is paramount for the safe and effective execution of AFRL programs in these environments.

4.6.2.1. If supporting a real-world peacetime or combat operations requires specialized ground equipment to be fielded and/or AFRL deploy any of its personnel such as civilian, contractor, or military liaison officers to the fielded ground system site, they must undergo a pre-deployment orientation provided by AFRL/DO staff to ensure they understand the extent and limits of their responsibilities, their chain of command, and the expectations for reporting on-going and unusual events.

**4.7. Time/Amendment Limits.** In general, test/operations plans shall only be valid for two years after TEA and SCA owner approvals. Space activity training plans are valid for three years after SCA owner approval. Because small changes add up over time and can create confusion within a space activity plan, once the aforementioned validity dates are exceeded, the plan should be revised as necessary and submitted for approval. Plans that require no revisions or updates must still be reviewed and reapproved to establish new validity dates and version numbers.

**4.8. Version Control.** The PM or test team will ensure a valid version control method is applied/enforced with all AFRL space activity plans. Version control is particularly important because AFRL practice is to include operations and spacecraft limits and procedures in the plan and supporting processes such as space flight worthiness depend on accurate knowledge of the most current plan. Poor version control of the plan could lead to a mishap.

**4.9. Test Procedures.** Test Procedures are documents describing space activity procedures in a step-by-step or checklist format. Used during execution, the purpose of such procedures is to ensure the entire test team works in concert to successfully complete space activities and has readily available access to critical information/limits. Inherently, procedures should be a synopsis of limits, settings, procedures, cautions, warnings, and other relevant data immediately available for reference by all members of the test team so they can execute space activities effectively, efficiently, and safely. Test procedures will include all relevant space vehicle commands, scripts and expected responses.

4.9.1. All space activities will be conducted from approved test procedures. For training and proficiency space activities where unit SOPs are available and sufficient for the circumstances, they may be used in lieu of test procedures IAW the T&O plan and with the approval of the Lead Flight Director.

4.9.2. Test teams may develop their own test procedure format to ensure maximum flexibility and ease of use. While no minimum information requirements exist, test teams should consider inclusion of the following elements:

- 4.9.2.1. Spacecraft configuration
- 4.9.2.2. Spacecraft operating limits critical to the test points
- 4.9.2.3. Test limits
- 4.9.2.4. Initial conditions
- 4.9.2.5. Challenge and response scripts for satellite commands
- 4.9.2.6. Test techniques
- 4.9.2.7. Allowable data bands or test condition parameter tolerances
- 4.9.2.8. Data acquisition system settings
- 4.9.2.9. Expected results
- 4.9.2.10. Risk level(s)
- 4.9.2.11. Go and/or No-Go criteria
- 4.9.2.12. Knock-it-off, test suspension, and/or test stop criteria
- 4.9.2.13. Space to allow manual recording of parameters or other notes
- 4.9.2.14. Appropriate program security markings

## Chapter 5

### REVIEWS AND APPROVALS

**5.1. Introduction to Reviews.** Independent technical and safety reviews shall be accomplished for all space activities where AFRL resources will be used or are at risk, AFRL has mishap accountability, or retains more than a minimal risk of liability.

5.1.1. If the space activity is either wholly or partly executed under an AFRL contract (for more discussions about ownership AFRLI 61-106), then AFRL will ensure government TRB and SRB reviews are conducted prior to approval of the government or contractor-developed test plan. Mishap investigative responsibility will be exercised IAW DAFI 91-204 and AFMC Supplement. The PM is responsible for ensuring the requirements for the contractor to provide an acceptable test plan and to support related government processes (space worthiness, TRB, SRB, mishap investigation, etc., as applicable) are included in the contract.

5.1.2. Per [paragraph 2.2.7](#), technical and safety reviews conducted by the other government organizations may be accepted as reciprocal and sufficient at the discretion of the TD Chief Engineer, Site/Detachment Chief of Safety, TEA, and CTA. When the decision is made to accept another organization's review processes, AFRL personnel will "shadow" those processes and use the resulting documentation to secure AFRL TEA approval (and that of the AFRL SCA if applicable) prior to the commencement of test activities. The term "shadow" entails the following duties: participation by AFRL personnel (typically the TD TRB Chair, the site/detachment/HQ SRB Chair, the AFRL/DO Test POC, and applicable experimental operations staff) in the other organization's reviews; collection of review board and other relevant documentation (briefings, minutes, THAs, etc.); review of such documentation for sufficiency; and preparation of space activity package for approval. Under circumstances where a LDTO is involved, AFRL TEA risk acceptance/approval is required, whereas AFRL SCA owner approval is only necessitated when AFRL has SCA.

5.1.3. If the other government agency does not conduct a technical or safety review or, in the opinion of the TD Chief Engineer, site/detachment/HQ Chief of Safety, or CTA any review (as applicable to their purview) is not acceptable, then AFRL will conduct the technical or safety review as required.

5.1.4. When AFRL is party to a space activity led or conducted by another organization and provides resources such as equipment and/or personnel, the TD Test Lead in consultation with the office of AFRL/DO will make a determination if AFRL involvement is as a PTO or is in some other role. If involvement is determined to be as a PTO, the shadow process will be employed—regardless if AFRL has any technical or operational objectives associated with its involvement—so a proper risk acceptance can be made by AFRL authorities. If AFRL involvement is assessed as not rising to the level of PTO and is not in pursuit of AFRL objectives, a memorandum for record documenting that the AFRL Space Flight Activity Process is not applicable will be processed for signature by the AFRL/DO Director or Deputy.

5.1.5. For space activities of medium to high complexity or risk, provide a draft test plan to the AFRL/DO Test POC and the TD Test Lead not less than one week prior to the TRB. For simple or urgent space activities this lead time may be reduced, but submission as early as

possible is highly encouraged to avoid delays and lack of time to make necessary changes as part of the review and approval process.

**5.2. Technical Review.** A technical review is the formal review and resulting documentation to ensure a thorough assessment of the test plan for technical soundness and adequacy. The technical review will verify the overall MOT is adequate to evaluate the requirements and verify that objectives can be met with acceptable technical risk.

**5.2.1. Office of Primary Responsibility (OPR).** The AFRL technical review process is primarily a TD function owned by the Chief Engineer. Typically, technical review chair responsibilities for space activities are exercised by the Chief Engineer, but chair responsibilities may be delegated to an individual independent from the program and who possesses the technical expertise to review it comprehensively. The TD Test Lead manages support to the TD's independent technical review process and unless relieved of the responsibility serves as the secretariat for proceedings and resultant documentation.

**5.2.2. Technical Review Board (TRB).** The TRB is the normal method for accomplishing a technical review. The TRB is a formal gathering of an independent group of knowledgeable individuals convened to ensure a thorough assessment of the test plan for technical soundness and adequacy. For large or complex efforts, review board members from outside the TD can be particularly valuable and are highly encouraged. The employment of a formal TRB is highly desired when: there are multiple engineering disciplines involved; the SUT, test method, or analyses are especially complex; envelope expansion or other elevated risk testing is involved; and/or, new test or analysis methods will be applied. Multiple TRBs may be held for phased efforts or those where significant changes become necessary.

**5.2.2.1.** The decision to conduct a formal TRB versus an assessment reduced in scope to that of a single reviewer is based primarily on the test plan size, complexity, maturity of test item/methodology, as well as expected technical risk level and is determined by the assigned TRB Chair. The extent of TRB membership is at the discretion of the TRB Chair. If the technical risk is negligible, the TRB Chair may elect to conduct a review without convening a formal board and this is known as an "informal TRB." Negligible risk activities are defined as space flight activities that are normal, routine, and operationally representative where the risks effectively reduce to those experienced in standard (non-test) operations.

**5.2.2.2. Combined Review Board (CRB).** Technical and safety review boards may be combined if the technical and safety discussions would be enhanced by collaboration of both boards. The test teams should contact the TRB and SRB Chairs for final determination/concurrence on this course of action. When a CRB is held, the TRB and SRB Chairs will co-chair the forum. Teams will ensure the test plan is sufficiently mature prior to the CRB. Careful attention should be paid to fulfillment of all the roles and responsibilities outlined in this document during such combined forums.

**5.2.3. Technical Review Conduct .** At a minimum, technical reviews will assess objectives, test approach, requirements, techniques, measures, and success criteria. This review will also ensure that any environmental assessments required by statute or regulation have been completed and referenced in the test plan. The technical review board members will advise the TRB Chair who will assign a technical risk to the program.

5.2.3.1. For a formal TRB, allow participants sufficient time to review the documentation. The PM should distribute the documents to TRB members not less than one week prior to the TRB or with greater lead time if directed by the TRB Chair or TD policy. The TRB is conducted according to a prepared agenda.

5.2.3.1.1. The TRB Chair appoints someone to record and publish the minutes, typically the TD Test Lead. Minutes of the meeting are recorded for the record and contain the items of discussion, an overall technical assessment in regard to readiness to start testing, and a technical risk level. Action items and recommendations will be specified and included in the minutes. The minutes are signed by the TRB Chair and the PM after closure of all action items. Minutes are required for both formal and informal TRBs.

5.2.3.1.2. The TRB Chair will ensure the appropriate AFRL/DO Test POC or suitable substitute from that office is invited to the TRB with sufficient lead time to secure representation.

5.2.4. **Technical Review Outcomes** . Changes to the test plan, other than strictly editorial, must be discussed and agreed upon by the TRB members during the TRB meeting or during the action item closure phase. The test team will modify the test plan to incorporate the appropriate recommendations from the technical review. Through signature (and comment as necessary) on the AFRL Test Approval Worksheet, the TRB Chair recommends to the TEA an overall technical risk level and whether or not to execute the space activity based on the technical review. See [Attachment 5](#) for suggested criteria to use in assessing technical risk.

**5.3. Safety Review.** The purpose of the safety review is to allow an independent team to formally review the test team's safety planning to ensure all test hazards have been identified and mitigated to the extent practical, and then recommend the residual safety risk level. The documentation from the safety review should reflect a suitable level of clarity and maturity for the TEA to make an informed decision on whether to accept the risk of the test and to approve (with SCA owner) entrance into test execution. The safety review process is fully developed in AFI 91-202 AFMC and AFRL Supplements. This section provides a short summary of relevant highlights.

5.3.1. **Office of Primary Responsibility (OPR).** The AFRL safety review process is primarily a Safety Office function and is chaired by a qualified safety review chair as assigned by the TD's local Site/Detachment Safety Office or HQ AFRL/SE.

5.3.2. **Safety Review Board (SRB).** For most space activities, the SRB is a formal safety review meeting attended by independent safety reviewers and project personnel and is presided over by a designated SRB Chair. Multiple SRBs may be held for phased efforts or those where significant changes to the manner or scope of a space activity become necessary.

5.3.2.1. **Combined Review Board (CRB).** Technical and safety review boards may be combined if the technical and safety discussions would be enhanced by collaboration of both boards. The test teams should contact the TRB and SRB Chairs for final determination/concurrence on this course of action. When a CRB is held, the TRB and SRB Chairs will co-chair the forum. Teams will ensure the test plan is sufficiently mature prior to the CRB. Careful attention should be paid to fulfillment of all the roles and responsibilities outlined in this document during such combined forums.

**5.3.3. Safety Review Conduct.** The safety review process ensures a thorough assessment of the adequacy of test safety planning. The process evaluates the extent to which the test plan addresses the severity and the probability of occurrence of known hazards and assists in minimizing them to the extent reasonably possible. It results in the recommended residual risk level.

5.3.3.1. Safety Risk is defined as a combination of mishap severity and mishap probability. The overall residual safety risk level is the degree of risk assumed by leadership in allowing the proposed test to be accomplished in the manner described and under the conditions specified. Test teams will propose a residual safety risk level. The independent reviewers of the SRB will evaluate test-unique hazards identified by the test team or in the course of the safety review process, assess proposed mitigations and corrective actions, and affirm or modify the test team's proposed overall residual safety risk level. If any board members have concerns about the test proceeding at the assigned risk level, they should document and communicate them to the test approval authorities in the SRB minutes and Test Approval Worksheet.

5.3.3.2. Test teams use system safety techniques, prior experience, legacy system research, lessons learned, and overall engineering judgment to identify test hazards and assess risk by evaluating the credible outcome (mishap severity) of each hazard together with the associated probability of occurrence. The mishap severity and probability are then plotted on the Test Hazard Matrix published in AFI 91-202 AFMC Supplement Attachment 4 to determine the hazard's overall risk level. Although the goal is to minimize risk through good test and safety planning/review processes, the resulting residual risk must be accepted by the TEA, or the test may not proceed to execution.

5.3.3.3. When considering space activity safety risk, the safety reviewers will consider the qualifications and experience of personnel executing the space activity.

5.3.3.4. IAW AFI 91-202 AFRL Supplement, a T&E representative is a recommended member of the SRB. A best practice is for this board member to be a representative from the AFRL CTA staff who possesses the requisite two-years' experience in T&E. Whether or not a CTA representative serves as an SRB member, the SRB Chair will extend an invitation to the AFRL/DO Test POC for the program being reviewed to attend the SRB.

#### **5.3.4. Safety Review Administration.**

5.3.4.1. The AFRL PM is responsible for ensuring a safety review is conducted for space activities.

5.3.4.2. Contact AFRL/SE for a sample SRB agenda, questions to ask during a safety review and other notes. Also reference AFI 91-202 AFRL Supplement Attachments 5-7 for a comprehensive SRB checklist, standardized AFRL Space SRB Minutes format, Space SRB slide formats and training documentation for SRB member training.

5.3.4.3. The AFRL SRB should be held four to six weeks prior to the intended date for the launch. SRB members are required to review the most current, sufficiently mature version of the test plan prior to the SRB. IAW AFI 91-202 AFRL Supplement, the SRB can be scheduled no earlier than 5 working days from the day of the SRB Chair's receipt of the draft test plan unless the site/detachment/HQ Chief of Safety approves a shortened

timeline. Coordinate SRB schedule and deliverables with the site/detachment/HQ safety office or the LDTO safety office (when applicable) IAW their requirements.

5.3.4.4. IAW AFI 91-202 AFMC and AFRL Supplements, the site/detachment/HQ Chief of Safety will either serve as the SRB Chair or designate one. The SRB Chair will select board members.

5.3.4.5. An AFRL safety review chair will be assigned to AFRL tests conducted by partner organizations.

5.3.4.6. IAW AFI 91-202 AFRL Supplement, SRB minutes are required and must be signed by the SRB Chair and the PM. Signature by the SRB Chair establishes the recommended residual safety risk level. Signature by the PM signifies acknowledgment. Both signatures reflect assertion the action items resulting from the SRB have been closed.

5.3.5. Action items involving changes to the test plan, other than strictly editorial, must be discussed and agreed upon by the SRB members during the meeting or during the action item closure phase. Once test plan changes resulting from SRB action items are incorporated into the test plan, that version reflecting all directed changes will become the authorized test plan submitted for TEA and SCA owner approval.

5.3.6. **Safety Review Outcomes** . The SRB Chair ensures all hazards are identified, controls are developed, certifies the completeness of the safety plan, and establishes a risk level for each individual hazard and event. Through signature (and comment as necessary) on the AFRL Test Approval Worksheet (TAW), the SRB Chair recommends an overall residual safety risk level to the TEA and SCA owner along with any concerns they have with the space activity proceeding to execution based on their review. Although residual safety risk level is properly characterized by probability and consequence, qualitative descriptions of safety risk levels are as follows:

5.3.6.1. **LOW risk** : Tests or activities that present little to no greater risk than normal operations (such as operating the system using proven procedures) after all precautionary measures have been taken.

5.3.6.2. **MEDIUM risk** : Tests or activities that present a greater risk to personnel, the space environment, spacecraft, equipment, and/or property than normal after all precautionary measures have been taken.

5.3.6.3. **HIGH risk:** Tests or activities that present a significant risk to personnel, the space environment, spacecraft, equipment, and/or property after all precautionary measures have been taken.

**5.4. Operations Review.** Operations Review is the formal review and resulting documentation to ensure the readiness of the operations team for operating the vehicle on-orbit. This includes presenting the vehicle, ground system, training program, processes, and procedures, as well as spacecrew for readiness approval.

5.4.1. **Office of Primary Responsibility** . The operations review is primarily a TD function owned by the MD. The chair for the operations review is the MD and cannot be delegated, as certification for readiness for flight must come from the SCA. The MD will ensure the appropriate AFRL/DO Test POC or suitable substitute from that office is invited to the operations review with sufficient lead time to secure representation.

5.4.2. **Mission Operations Readiness Review (MORR).** For most space activities, the MORR is the formal operations review meeting.

5.4.2.1. A MORR must take place at least 2 weeks prior to launch and/or planned space test. For more complex missions, MORRs typically take place earlier. Participants must be given sufficient time to review documentation. The Lead FD should distribute documents to the MD not less than one week prior to the MORR or with greater lead time if directed by the MD. The MORR is conducted according to a prepared agenda.

5.4.2.2. The MD appoints someone to record and publish minutes. Minutes of the meeting are recorded for the record and contain items of discussion, particularly any liens or actions that must be closed out prior to launch. Minutes of the meeting are recorded for the record and contain the items of discussion; readiness of spacecraft, ground systems, etc.; review of the Master Training List (MTL), review of the delegated FD approval authority; and review of the spacecrew certification. Action items and recommendations will be specified and included in the minutes. The minutes are signed by the MD and the Lead FD after closure of all liens and actions times.

5.4.3. **MORR Outcomes :**

5.4.3.1. **Authorities Memorandum .** A critical outcome of the MORR is that the MD documents the levels of SCA that has been delegated to the FD. The MD shall sign an authority's memorandum detailing activities that can be executed by spacecrew with FD approval.

5.4.3.2. **MTL Certification .** The MD shall formally certify the Master Training List (see [paragraph 5.6.1](#)) for each spacecrew position.

5.4.3.3. **Individual Crew Certification .** The MD shall sign a formal memorandum certifying individual spacecrew for specific crew positions (e.g., Crew Certification Memo, the Letter of Xs, etc.).

5.4.3.4. **Overall Team Readiness Certification .** The MD shall certify overall operations team readiness for flight. This is often contingent on the successful completion of the Mission Dress Rehearsal (MDR) (see [paragraph 5.6.3.3](#)).

5.4.3.5. **Flight Rules .** The MD shall formally approve the spacecraft Flight Rules ([paragraph 6.2.4.2](#)).

5.5. **Additional Reviews.**

5.5.1. Internal TD program reviews, processes, and approvals beyond the scope of this instruction are included AFRLI 61-106 and other guidance documents. Reviews required by the launch vehicle integrator for launch readiness are the purview of the launch provider and are also not addressed in this instruction.

5.5.2. **Program Design Reviews .** The use of a mission assurance process that includes a tailored systems engineering approach is described in AFRLI 61-106. The PM is encouraged to invite participation from HQ AFRL Functional Directorate POCs in program design reviews.

5.5.3. **Test Readiness Reviews (TRR ).** TRRs are a best practice to ensure that all preparations for initiating a test have been completed and known anomalies will not

compromise the execution of the test. Readiness reviews should be conducted before the commencement of elevated risk (MEDIUM or HIGH) and/or complex test activities or after an extended break in test activity. All reasonable efforts to minimize risk should be made and verified to the TEA and SCA owner. It is highly encouraged that an invitation be extended to the AFRL/DO Test POC and TD Test Lead to attend test readiness reviews.

**5.6. Spacecrew/Operator Training & Certification.** As discussed in [paragraph 3.6.7](#), certain spacecrew positions must be certified to ensure the safe operation of the vehicle. The training and process required for certification will be unique for each satellite mission, depending on its complexity.

**5.6.1. Master Training List (MTL)** . Every certified position shall have a list detailing the certification criteria for that position. The MTL specifies tasks and missions spacecrews need to conduct. The MTL will specify each crew position's tasks and required performance standards by experience level.

**5.6.2. Classroom Training** . A typical training campaign begins with classroom training that covers the SUT, the requirements for each position, and imparts knowledge of how the different positions interact with each other. This training often details reporting requirements specific for each mission. All personnel who will be involved even peripherally with operations (i.e., non spacecrew personnel who have access to the Mission Operations Center) shall receive basic operations training to include roles and responsibilities and an overview of the mission. This precludes confusion about authorities or appropriate operations floor conduct.

**5.6.3. Pre-Launch Training Events** . The pre-launch training campaign typically begins four-to-six months in advance of launch. The training campaign will consist of many different types of events, giving opportunity for personnel to learn about the SUT, the requirements for their position, and to practice the skills necessary for their position.

**5.6.3.1. Mission Exercises** . A Mission Exercise is a pre-launch training event. In an exercise, the spacecrew simulate execution of parts of the mission to gain familiarity with the mission's processes and procedures. A Mission Exercise can be run as a paper exercise, though using a Satellite Simulator that can be commanded by the ground system results in a more realistic training environment.

**5.6.3.2. Mission Rehearsal** . A Mission Rehearsal is a pre-launch training event in which independent reviewers observe and assess the operations team as they simulate mission execution. A Mission Rehearsal can be run as a paper exercise, though using a Satellite Simulator that can be commanded by the ground system results in a more realistic training environment.

**5.6.3.3. Mission Dress Rehearsal (MDR)**. The MDR is a required rehearsal that typically takes place in the 10-14 days prior launch (with appropriate crew rest scheduled between the end of MDR and the launch). MDR should be a real-time event focusing particularly on the first few days of mission life, matching the shift scheduling for the actual launch and early mission. The intent of MDR is to practice those critical first three-to-five days with all personnel who will be on shift for the event, to ensure that everyone understands the processes and procedures expected of them.

5.6.3.4. All personnel shall participate in multiple training event shifts. The number of exercises and rehearsals held should be sufficient to give multiple training shifts to all personnel being trained and to enable completion of the MTL.

5.6.4. **Post-Launch Training Events** . It is necessary to have a process in place to certify new spacecrew post launch. Since the spacecraft is already on orbit and ideally most of the spacecrew is certified pre-launch, the post-launch training process of individual spacecrew does not require mission exercises, rehearsals, and dress rehearsals. Instead, the shadowing process will be utilized to train new spacecrew. In lieu of exercises, the trainee will shadow the on-shift crewmember. The on-shift crewmember will teach, explain actions, and answer questions during the shift. In lieu of a rehearsal, the trainee will act in the position, with a fully certified crew member overseeing/evaluating them.

5.6.5. **Written Tests** . Written tests for spacecrew are highly recommended as a best practice, as the final test to demonstrate that each member of the spacecrew has attained the knowledge of procedures, operating procedures, and theory necessary for their position. These tests should be tailored to the mission in question and to meet the specifications of the MTL.

5.6.6. **Certification** . The Lead FD shall collect the results of all training events and ensure that every member of spacecrew has met the requirements of their position's MTL. The Lead FD shall then nominate the list of personnel to be certified to the MD. Per [paragraph 3.6.7](#), the MD shall sign a formal memorandum certifying personnel. Pre-launch this is accomplished after the MORR. Post-launch, the formal memorandum shall be updated as new crewmembers complete training.

**5.7. Approvals.** The approval phase provides appropriate leadership the opportunity to make informed risk acceptance and test approval decisions based on the technical, space flight worthiness, cyber, and safety assessments completed in the review phase. The approvals delineated below are required before the start of any space activity. These approvals will be documented using the latest variant of the Test Approval Worksheet (which can be found in [Attachment 4](#)). NOTE: Not all approval authorities are within AFRL; therefore, PMs should ensure time for these approvals is included in the test schedule.

5.7.1. Approval is defined as permission to conduct or participate in the space activity or space test project. A signed safety package does not authorize deviation from DoD, Air Force, USSF, AFMC, or AFRL Instructions/Directives.

5.7.2. The TEA, SCA, or any other authority on the approval path may require a Test Approval Briefing (TAB) to assist in making an informed decision. A TAB should be an executive-level presentation that provides a test project overview and highlights test objectives, overall test approach, test unique hazards, mitigation measures, discussion points during the independent reviews, and any contention or disagreement among the members of the independent board(s) or the test team.

5.7.3. **Test Risk Acceptance and Plan Approval by Test Execution Authority (TEA).** The TEA is a senior leader in the supervisory/programmatic chain who can attest to the validity of the test, approve the test plan (along with the SCA), and accept the residual risk to government resources. The senior leader serving as TEA is based on the assessed residual safety risk level as outlined in [Table 5.1](#) below and AFI 91-202 AFMC and AFRL Supplements. For the purposes of space activity risk acceptance, when the assessed technical space flight worthiness

risk is different from the assessed residual safety risk, the higher of the two required acceptance authority levels will dictate who the TEA for a space activity will be.

**Table 5.1. Space Activity Test Execution Authority Approval Levels.**

Organization Level	LOW Risk	MEDIUM Risk	HIGH Risk
<b>SRB Chair</b>	Coord	Coord	Coord
<b>Division Chief</b>	Approve	Coord	Coord
<b>TD CC/Director</b>	Info	Approve	Coord
<b>AFRL/SE</b>	Not Required	Not Required	Coord
<b>AFRL/CC</b>	Not Required	Not Required	Approve
<b>HQ AFMC/A3/6 &amp; SE</b>	Not Required	Not Required	Info

**5.7.4. Space Flight Worthiness Approval** . The appropriate space flight worthiness authority validates the independent space flight worthiness assessment and provides approval. See AFRLI 61-106 for more discussion of Space Flight Worthiness Criteria.

**5.7.5. Cyber Approval** . AFRL test teams are responsible for complying with AFRLI 17-130 in order to secure an ATO or IATT from the proper AO who through their approval accepts any residual cyber risk. An ATO or IATT should be included in the test package for SCA approval.

**5.7.6. Spectrum Approval** . AFRL test teams are responsible for complying with required spectrum approvals and providing adequate documentation of such.

**5.7.7. SCA Approval** . SCA approval for the mission is secured at the MORR, as described in [paragraph 5.4](#). Per the memorandum signed at the end of the MORR, specific experiments or space activities may require further SCA approval. That process is described in [Chapter 6](#).

**5.7.8. Other Approvals.** While SCA approval is the final step in the pre-launch approval process and the AFRL space test team is cleared to execute, additional approvals will be required during execution, which will be covered in [Chapter 6](#).

## Chapter 6

### SPACE FLIGHT EXECUTION

**6.1. Introduction.** With an approved test/training/operations plan and a certified operations team, AFRL space activity teams are cleared to execute. However, there are still coordination, approval, and reporting requirements to be accommodated during space flight operations. This chapter introduces the operations processes required while on orbit as well as other standard considerations and requirements that must be addressed.

**6.2. Mission Director (MD).** The role of the MD is described in [paragraph 2.4.10](#). The MD has approvals as described in the previous chapter and this chapter. The MD will ensure that sufficient quantity and types of spacecrew members are trained and available to meet mission needs.

**6.2.1. Deputy Mission Director (DMD).** The role of the DMD is to serve as the acting MD when the MD is unavailable or as otherwise specified by the MD.

**6.3. Spacecrew.** Large, complex satellites often require large complex teams; however, simple experiments on small spacecraft can often operate with much leaner spacecrews. This section describes the role of spacecrew and various spacecrew positions.

**6.3.1. Certified Spacecrew Positions.** AFRL spacecrews will include at a minimum a Flight Director, and an Operations Engineer. Spacecrew members may be qualified in multiple positions but will only serve in one position at a time. MDs shall define, in writing, the minimum spacecrew required to conduct operations and will further specify which spacecrew are required to be present in the MOC or available in an “on-call” status.

**6.3.1.1. Flight Director (FD).** The FD currently on shift holds delegated and emergency SCA within the bounds established by the MD. The FD is responsible for tactical command and control as well as the health and safety of the on-orbit asset. The FD is responsible for the actions of the operations team and for controlling the MOC, including leading briefs/debriefs, overseeing planning activities, and ensuring floor discipline. The FD has the responsibility to maintain oversight over the safety and effectiveness of the crew and the operations environment. The FD position is an inherently government function and may not be performed by contractor personnel.

**6.3.1.1.1. Lead Flight Director (LFD).** The LFD is a certified flight director who is appointed by the MD. The LFD is responsible for operations team management, including training and management (i.e., scheduling, discipline, operations processes, lessons learned, etc.) of the flight director team and other spacecrew members.

**6.3.1.2. Operations Engineer (OE).** The OE is responsible for monitoring the health and safety of and sending commands to the spacecraft. This includes interfacing with the Satellite Control Network (SCN) or other ground network to schedule contact time; for enacting all commanding on the vehicle, including real-time and time-tagged objectives; for producing operations documents and records such as passplans; and for performing approved tasks on the vehicle (e.g., memory management, state of health checks, uploading contact schedules, etc.). Only certified OEs may send commands to the vehicle after those commands have been properly verified by another certified spacecrew member.

**6.3.2. Additional Certified Spacecrew Positions** . More complex space activities may require a more robust spacecrew. The following spacecrew position may be developed as a specific certified crew position or for less complex missions, the defined duties may be included in the duties of the FD or OE.

**6.3.2.1. Mission Planner (MP).** The MPs run the mission planning process on a daily basis, taking experiment inputs and constraints and generating weekly and daily plans as well as commands for certain predefined objectives, depending on the mission. While mission planning is normally accomplished via a defined schedule during business hours, some missions require on-call mission planners to rapidly create or modify plans out of the normal mission planning cycle.

**6.3.2.1.1. Lead Mission Planner.** For teams large enough to have a Mission Planning team, a Lead Mission Planner shall be appointed. The Lead MP is responsible for coordinating the entire mission planning process, including incorporation of inputs, constraints, and priorities from several sources; and for staffing, training, and scheduling the rest of the Mission Planners. This position typically works closely with the Lead FD.

**6.3.2.2. Satellite Systems Expert.** The Satellite Systems Expert provides vehicle system, subsystem, and commanding expertise during checkout, first-time, and intensive activities. They often draft procedures and commands for vehicle usage and track required space activities to keep the vehicle in good health and operational. They may provide critical expertise during anomaly resolution efforts.

**6.3.3. Other MOC Personnel.** Non-spacecrew personnel are authorized to be in the MOC and serve an important role in supporting certain ongoing space flight activities. These personnel are not formally certified by the MD and therefore may not send or verify commands sent to the spacecraft or payload. They may have direct access to ground systems in order to view telemetry or other data necessary to complete their duties. These personnel will comply with paragraphs [6.3.4.6.2](#) and [6.3.4.6.3](#) while performing duties in the MOC. A minimum set of training, per [paragraph 5.6](#), in order to be granted access to MOC and ground system is required. A non-exclusive list of other MOC personnel include:

**6.3.3.1. Program Manager (PM).** The Program Manager is not a member of the operations team (certified spacecrew IAW [paragraph 6.3.1](#)) but provides a critical role as described in [paragraph 2.4.9](#).

**6.3.3.2. Principal Investigator (PI).** On large scale missions, typically the PI is the developer of the Experiment Plan and the Long-Term Plan (see paragraphs [6.4](#) and [6.4.2](#)) and therefore establishes the program's day-to-day experimentation priorities. It is the PI's role to determine when certain aspects of the Experiment Plan must be done and which aspects of the experiment take priority in relation to other aspects, especially for spacecraft with multiple payloads. For smaller teams, the Program Manager often acts as the Principal Investigator.

**6.3.3.3. Payload POC.** It is not unusual for payloads on a spacecraft to be owned by another team or even organization with their own experimentation goals. The Payload POC, sometimes called the Payload PI, provides not only technical support for the payload

but also typically provides desired experiment objectives, and/or payload configurations and command inputs/parameters to support the experiment.

6.3.3.4. **Orbit Analyst (OA).** The OAs provide ephemeris information to be used in scheduling contacts with the SCN or other ground network. They also provide other astrodynamics expertise as needed.

#### 6.3.4. Other Operational Considerations.

6.3.4.1. No spacecraft shall ever be operated with less than two people. Two-person integrity is critical, and no command shall ever be sent to the vehicle that has not been verified by two people. This does not preclude automation, where the automation processes have gone through the appropriate two-person verification.

6.3.4.2. **Flight Rules** . A set of defined rules, constraints, and considerations intended ensure safe space and ground system operation in addition to successful completion of the mission objectives. The MD approves all Flight Rules.

6.3.4.3. **Crew Rest** . MDs, FDs, and supervisors will ensure spacecrew are provided a 12-hour rest opportunity prior to beginning the crew duty period. Crew rest is free time and includes time for meals, transportation, and an opportunity for at least 8 hours of uninterrupted sleep. Crew rest cannot begin until after the completion of official duties. Crew rest is compulsory for spacecrew members prior to performing any duties involving spacecraft operations and is a minimum of 12 non-duty hours before the duty period begins. Spacecrew members must inform the FD if not sufficiently rested for spacecrew duties.

6.3.4.4. **Crew Duty Day.** The duty day begins when a spacecrew member first reports for official duty and ends after their departure from the MOC. The maximum crew duty day is 12 hours; however, the FD may authorize an extension of the crew duty day to 16 hours to meet critical or urgent mission needs. Under no circumstances may a crew member perform spacecrew duties or other work duties for more than 16 hours. The maximum number of consecutive days a crewmember may work and the required recovery period after working that time period is described in [Table 6.1](#). The required recovery period is the amount of time without official duties before a crewmember may resume spacecrew duties.

**Table 6.1. Crew Duty Day Requirements.**

Scheduled Shift Duration	Day/Swing Shifts	Required Recovery Period	Mid Shifts	Required Recovery Period
<b>8-hours</b>	6- 7 consecutive days	72 hrs	5-6 consecutive days	72 hrs
	5 consecutive days	48 hrs	4 consecutive days	48 hrs
<b>12-hour</b>	4 consecutive days	48 hrs	4 consecutive days	72 hrs
Note:				
1- If switching from night to day shift, a minimum of 48 hours is required between the end of the last night shift and the beginning of the next day shift for the crewmember.				

2- Crew members shall not be scheduled for more than 7 consecutive shifts.

6.3.4.5. **On-Call Spacecrew.** MDs shall ensure sufficient personnel are available in an “on-call” status to meet mission needs in the case of unplanned unavailability of regularly scheduled spacecrew members. Spacecrew who are on-call must remain within reasonable commuting distance of the MOC, and in compliance with [paragraph 6.2.4.6.2](#).

6.3.4.6. Spacecrew will not operate or assume control of a spacecraft:

6.3.4.6.1. When appropriate crew rest was not obtained in accordance with [paragraph 6.2.4.3](#).

6.3.4.6.2. If any alcohol was consumed within 8 hours prior to the start of a crew duty period or if impaired by alcohol or any other intoxicating substance, to include the effects or after-effects.

6.3.4.6.3. Anytime a physical or psychological condition is suspected or known to be detrimental to the safe performance of space operations duty.

**6.4. Battle Rhythm/Test Conduct.** The procedures, restrictions, and mitigations documented in an AFRL-approved test plan must be followed while conducting space flight activities in order to maintain the accepted level of risk. The test plan is a contract between the test team, the TEA, and the SCA owner. As satellite operations are persistent over the entire mission life, a unique battle rhythm is required for normal and experimental operations in order to ensure that every space activity is appropriately approved and in-line with the overall test package. Operations teams must be able to balance long and short-term planning as well as pass-by-pass execution in order to successfully meet the objectives laid out in the test plan. This section describes the nominal planning and execution battle rhythm for a spacecraft mission, which can be expanded or tailored for the needs of a specific satellite mission. The overall battle rhythm process is described in [Figure 6.1](#).

**Figure 6.1. Spacecraft Operations Battle Rhythm.**



6.4.1. **Mission Phases.** Generally, all satellites have at least three mission phases: Launch and Early Operations, Nominal Operations, and End-of-Life. The Battle Rhythm can and does change with the phases of the mission.

6.4.1.1. **Launch and Early Operations (LEOPs).** LEOPs encompasses the time from the launch of the space vehicle through the completion of spacecraft checkout and beginning of the planned mission. Some spacecraft may also require unique system/subsystem/payload calibrations as part of the LEOPs plan. Every LEOPs phase shall have an overarching LEOPs plan showing the required flow of procedures to ensure the spacecraft is operating as expected. It is anticipated that many lessons about the spacecraft will be learned during LEOPs and those will need to be incorporated in nominal

operations procedures. These lessons may also have ramifications on the later long-term planning and/or the test plan.

6.4.1.2. **Nominal Operations.** This is the period between LEOPs and EOL and is usually the phase the spacecraft will be in the longest. This is the phase in a spacecraft's life cycle where the experiment is conducted, and the test plan is executed.

6.4.1.3. **End Of Life.** EOL is the final phase. After all space experimentation/the test plan is complete, a satellite must be passivated and/or de-orbited appropriately. EOL operations are generally planned prior to launch and should be included in the test package (per [paragraph 4.3.10](#)). AFRL may transition the space vehicle to another organization in lieu of passivation/de-orbit.

#### 6.4.2. Long-Term Plan

6.4.2.1. **Purpose.** The Long-Term Plan (sometimes called the Year in the Life) is essentially a schedule including nominal operations and experiment activities. This can be derived from the Test/Experiment Plan, On-Orbit Handbook, and any lessons learned/Flight Rules. The Long-Term Plan exists to ensure that all objectives of the test plan are met during the spacecraft's mission life. Often the Long-Term plan focuses on Nominal Ops, as LEOPs and EOL may have their own specific plans; however, they can be combined into one. The Long-Term Plan is a living document, taking into account the realities of what has already been accomplished with the spacecraft and the current spacecraft state in order to plan out the long-term mission goals. Delayed launches, vehicle events, and anomalies can ripple through the original sequence of events postulated in the test plan. A reorganization of the Long-Term Plan and the sequence of test events does not necessarily require a test plan amendment. While the Long-Term Plan usually focuses on experiment objectives, it can incorporate other planned spacecraft activities, especially if those activities affect the scheduling of experiment objectives (i.e., a software update, a critical manning issue, eclipse season, etc.). The Long-Term Plan should be published to the operations and program management teams after changes are made. The format of the Long-Term Plan will be defined by the test team to best meet program needs.

6.4.2.2. **Long-Term Plan Updates.** Changes to the long-term plan should be coordinated with all payload POCs, the Lead Flight Director, and the Lead Mission Planner. The Long-Term Plan update is a process initiated and coordinated by the PI. Long-Term Plan updates do not require a formal meeting and may be coordinated via email.

6.4.2.3. **Required Approvals.** Changes to the Long-Term plan are approved and published by the PI and are coordinated with the MD. Changes to the Long-Term Plan may necessitate an amendment to the Experiment Plan (see [paragraph 4.5](#)).

6.4.2.4. **Frequency.** Long-Term planning meetings/reviews should be held at least once a month or when space vehicle events necessitate re-visiting of the long-term plan.

#### 6.4.3. Short-Term Planning Cycle

6.4.3.1. **Purpose.** The Short-Term Plan (e.g., Weekly Plan) shall delineate near term experiment objectives as well as necessary spacecraft activities (e.g., momentum balancing, state updates, maneuvers, etc.). It shall dictate the priority of these activities and lay them out into a high-level nominal schedule, so that payload and systems support

personnel can schedule payload support and provide inputs/parameters as necessary. It should also contain the current period's objectives and execution status. The Short-Term Plan should also be used to communicate any information a payload science team member may need to plan their science (e.g., spacecraft state, ground path, local mean time, etc.). The format of the Short-Term Plan should be agreed upon in advance by the PI/PM and the operations team. This plan is created to communicate with the operations, payload/science, and program management team. The plan should be made accessible to all team members.

**6.4.3.2. Planning Meetings.** Short-Term planning generally requires two formal meetings but can be done informally over email for simple missions. Short-term planning generally begins during LEOPs.

**6.4.3.2.1. Short-Term Plan Requirements Meeting .** In this meeting, the spacecraft activity priorities for the short-term period are established and specific scheduling needs/constraints are agreed upon. This includes experiment objectives and vehicle objectives (e.g., momentum balancing, vehicle updates, maneuvers, etc.). The Mission Planners will later use these inputs to generate the Short-Term Plan. Attendees of this meeting are typically the Principal Investigator, Systems Engineer, Lead Flight Director, and Lead Mission Planner. Ultimately the PI approves the final selection of experiment requirements and priorities for the next planning period.

**6.4.3.2.2. Short-Term Plan Approval Meeting .** In this meeting, the Short-Term Plan developed by the Mission Planners is presented and approved. Any last-minute changes or deconflictions may be red lined in the Short-Term Plan that is approved/signed.

**6.4.3.3. Required Approvals.** The short-term plan must be signed by the Principal Investigator, Lead Flight Director, and Lead Mission Planner. On smaller, less complex missions where roles are combined, this can be minimized to the Lead Flight Director and the Program Manager. Activities that require MD authorization (per the Authorities Memorandum) necessitate the MD approving the Short-Term Plan. Short-Term Plans must be approved at least 24 hours in advance of their execution. By signing the Short-Term Plan, the Lead FD and/or MD approves the operations team to execute the plan.

**6.4.3.4. Frequency.** A standard cycle should be agreed upon for the Short-Term Plan (e.g., weekly, bi-weekly, etc.); however, short-term planning meetings can be held out of cycle to support specific objectives.

**6.4.3.5. Replan.** Substantial changes to the Short-Term Plan may require out of cycle replanning and re-approval. An objective not being met in the weekly plan or slipping to a different day than originally outlined does not necessarily constitute a replan where the Short-Term Plan needs to be modified. Unmet objectives should be communicated back to the PI prior to the next Short-Term Plan Requirements meeting, so the PI can add them to the priority list for the next week or add them back to the Long-Term plan.

#### **6.4.4. Daily Schedule .**

**6.4.4.1. Purpose.** The daily schedule, sometimes referred to as the 24-Hour Board (24HB), outlines the daily tasks and objectives, including spacecraft contacts in a schedule format. It can also capture important non-vehicle schedule items occurring in the 24-hour

period that the team needs to be aware of (i.e., eclipses, ground system outages, etc.). The primary daily schedule should be made as a human readable document for the FD and crew's use throughout the day.

6.4.4.2. **Meeting** . The daily schedule meeting is a small, but formal meeting between the MP who generated the daily schedule, the OE who is accepting it, and the FD who is approving it. This meeting must happen before the plan is to be executed and any commands related to the Daily Schedule are uploaded to the vehicle.

6.4.4.3. **Required Approvals** . The Daily Schedule must be signed by at least the MP who generated it, the OE who is accepting it, and the FD who is approving it. Daily Schedule must be approved in advance of their execution.

6.4.4.4. **Frequency** . While there must be a Daily Schedule for every day, multiple days can be approved at one-time (i.e., approving 3 days at a time to cover weekends during nominal ops).

6.4.4.5. **Replan**. Small changes to the daily schedule that do not necessitate a change to commands that have been uploaded to the vehicle can be redlined into the Daily Schedule (i.e., a contact being cancelled, a memogram (see [paragraph 6.3.7](#)) being run, etc.). However, substantial changes to the daily schedule or any change that necessitates re-uploading commands to the vehicle require a formal approval before the new schedule is executed.

#### 6.4.5. **Pass Plans** .

6.4.5.1. **Purpose**. The pass plan includes procedures, memograms, and/or possibly even individual commands that are to be executed on the pass. The pass plan serves as both the plan of what is to be done on a pass and a record of what was accomplished on the pass. Prior to each pass, the FD and OE (or another OE if authorized by the authorities memorandum) should review all procedures, memograms, and commands that will be used on the pass. Sometimes, especially for low earth orbit vehicles, an entire procedure cannot be executed on a single pass. It is important the team understand how much of the procedure they expect to accomplish on each pass and on which procedural steps it is acceptable to pause until the next pass.

6.4.5.2. **Meeting** . The Pre-Pass meeting is a meeting to review and approve the pass plan. This meeting should take place in the MOC where the team can review the appropriate procedures and screens as necessary. Anyone required to be on-console for the pass is required to be present at the pre-pass meeting.

6.4.5.3. **Required Approvals** . The FD will approve all pass-plans objectives. The FD has the authority to cancel scheduled procedures and may redline the Daily Schedule as needed to ensure the health and safety of the spacecraft and the completion of the mission.

6.4.5.4. **Frequency** . A pass-plan should be generated for every vehicle pass, even if the plan is simply "download stored state of health." A pre-pass meeting should be held in advance of every pass, discussing the specific events of the upcoming passes. Pre-pass meetings may discuss back-to-back passes when the contact schedule does not allow for sufficient time between passes.

6.4.5.5. **Recording.** For each pass, a record of events as executed shall be recorded on the as-run pass plan (i.e., “checking off” items on the pass plan). Pass plans shall be maintained throughout the life of the spacecraft.

#### 6.4.6. Procedures and Scripts.

6.4.6.1. Procedures are written documents in checklist form that specify individual commands sent to the spacecraft, telemetry to be verified, and actions/tasks to be completed by spacecrew. Procedures are used for real-time command objectives to provide a regimented, configuration-controlled method of executing space activities. Procedures range from extremely simple (e.g., turn off a component) to extremely complex (e.g., thruster calibration of all individual thrusters on the vehicle). Procedure development is accomplished by a team of personnel with vehicle and ops expertise and is beyond the scope of this document.

6.4.6.2. Scripts are essentially a sequence of individual commands, capable of being executed in order. Scripts are often used as an automated way of executing procedures.

6.4.6.3. **Required Approval.** The Lead FD shall review and approve all scripts and procedures prepared by the satellite support team.

#### 6.4.7. Memograms.

6.4.7.1. A memogram is a procedure that is created by the spacecrew and approved by the FD in near real time for unanticipated and urgent space activity needs. When the need arises for quick action that has not been previously outlined in a procedure, a memogram may be created that outlines the commands and tasks to be accomplished. Memograms should not be used as a substitute for the formal procedure planning process. Memograms that need to be executed on a recurring basis shall be developed into procedures using the process described in [paragraph 6.3.6](#).

6.4.7.2. **Required Approval.** After the memogram is created by one spacecrew member and verified by another, the FD on-duty must approve the memogram before it can be executed on the vehicle.

6.4.8. **Position Logs.** Every spacecrew position shall keep a log in order to ensure communication across shifts. These logs should track information that the next person coming on shift will need in order to maintain situational awareness.

**6.5. Space Activity Authorizations.** Each AFRL or AFRL-sponsored space activity requires a space activity authorization.

6.5.1. In accordance with, AFI 13-602V3, the AFRL TD Director/Commander (or Mission Director with delegated SCA) will ensure operations, training, standardization, evaluation, and crew force management programs are developed and managed to provide adequate support to the new or upgraded system operations prior to space test activities or initial operations. Within AFRL, the intent of this guidance will be considered met through the memogram/procedure approval process.

**6.6. Space Operations.** All AFRL and AFRL-sponsored space activities shall adhere as appropriate to the 13-series AFIs. At a minimum, AFRL programs will comply with AFI 13-602V3. All waivers to AFIs must be accomplished before test execution. Route all waiver requests through the office of AFRL/DO IAW [paragraph 1.7](#) above.

**6.7. Deployed Operations.** AFRL space flight operations conducted in support of contingency or named operations require some additional considerations and approvals. Typically, such operations are conducted under the auspices of an Integrated System Evaluation (ISE), Early Operational Assessment (EOA), or Advanced Development Program Office (ADPO) operational demonstration – all forms of space testing focused on operational measures of effectiveness. The program customer or user will frequently assess the results of such tests to determine if the deployed capability demonstrates military value and should be considered for handover to the operational community or transition to an acquisition program. Given the unique challenges of the deployed environment, such programs must:

6.7.1. Gain AFRL/CC approval before deploying personnel and equipment OCONUS or utilizing a AFRL spacecraft in support of a contingency or named operation. Be prepared to provide a TAB to the Commander if requested. Notify HQ AFMC/A3/6 through the office of AFRL/DO of the deployment as well.

6.7.2. Gain Geographic Combatant Command (e.g., United States Central Command) and USAF Component Command (e.g., United States Air Forces Central Command) approval before deploying equipment OCONUS. Unless deploying in Temporary Duty status, all government employees (military and civilian) must be on General Commanding-approved unit line numbers and receive proper area of responsibility (AOR) deployment training before traveling OCONUS.

6.7.3. Integrate into local base and host nation operations procedures (e.g., local Operations Support Squadron guidance for airspace and ground operations).

6.7.4. Integrate into theater command and control (C2) processes (e.g., Space Tasking Order) and applicable Rules of Engagement/Special Instructions. Such integration may require formal MOA/MOU or other instrumentalities to clarify C2 authorities. In certain situations, deployed personnel from AFRL or under contract to AFRL may be directed by local operational authorities to take actions that put space activity mission at risk, or which may be contrary to contractual obligations. These circumstances should be anticipated to the greatest extent possible, and measures put in place to deal with them in a timely manner so personnel know what orders are legitimate and what liabilities may ensue.

6.7.5. Address other considerations critical to mission success: logistics, base operating support (to include IT, bed-down coordination, and other host-tenant relationships), frequency management, mishap response plans, mishap convening authority assignment, etc.

**6.8. Test/Training/Operations Activities.** IAW [paragraph 2.2.1](#), the test package substitutes for the lack of system and operator documentation (TOs, operating handbooks, SOPs, etc.) normally expected to accompany a mature space vehicle but absent for the developmental systems and technologies being researched. Given this lack of supporting materials, the test package becomes critical to safe and effective space operations. In this vein, the approved test plan, memograms/procedures, safety plan and balance of test package documentation form the basis by which the TEA and SCA owner can expect the test team to perform the space flight activity.

**6.9. Space Activity Reporting.** The following requirements hold regardless if the space activity involves AFRL as LTO or PTO. In the case of AFRL sponsored spacecraft/payloads (i.e., Type 3 and 4 space experiments IAW AFRLI 61-106), reporting requirements will be in accordance with the written agreement between AFRL and the owning institution.

6.9.1. **Preflight Reporting.** The expected launch date, anticipated mission duration, and initial Long-Term Plan should be provided by the TD Test Lead or PM to the AFRL/DO Records Manager before flight.

6.9.2. **On-Orbit Reporting .** Updates to the Long-Term Plan shall be provided by the PI or PM to the AFRL/DO Records Manager quarterly or as required to ensure currency. The Short-Term Plan shall be provided to the AFRL/DO POC when published.

6.9.3. The AFRL/DO Records Manager will provide test teams with the preferred means to report space activity information.

**6.10. Next Phase Approval.** Test plans that have defined phases of testing often specify criteria or thresholds for progressing from phase to phase. Before progressing to the next phase (i.e., Nominal Operations, EOL, etc.), the test team shall demonstrate that they met their prescribed phase (i.e., LEOPs) exit criteria and next-phase entrance criteria to the MD, and the MD will formally approve entry into the next phase.

**6.11. Test Plan Changes During Execution.** Changes to the test plan during execution must be approved through amendments which require appropriate level review as discussed in [paragraph 4.5](#). Consult with AFRL/DO staff for advice, but ultimately test teams must secure buy-in from the technical and safety review chairs (and potentially SCA if the changes are major in scope) on the nature of changes and the extent of necessary review. Resulting actions may vary from no action to electronic review/approval, to reaccomplishing a full set of reviews/approvals followed by applicable approval signatures.

**6.12. Test Delay/Pause/Suspension.** Specific space experiments may be delayed, paused, or suspended and eventually resumed depending on the circumstances involved. However, it is not practical or appropriate to fully pause or suspend all on-orbit vehicle operations. A spacecraft must be maintained to ensure vehicle safety, and therefore, some minimal operations (i.e., contacts, state updates, stored state of health downloads, momentum dumps, etc.) will be conducted to ensure the health and safety of the vehicle during a test pause or suspension.

6.12.1. **Delays.** Causes for delay include ground equipment issues, personnel unavailability, priority conflicts, vehicle resource limitations, and similar benign considerations. Delays are typically called by the PI or mission planning team for programmatic or scheduling reasons, and it is they who reschedule and/or make the decision to resume the activities when conditions become more favorable or meet requirements.

6.12.2. **Pauses.** Pauses involve more deliberation than delays. Pauses can be called by anyone on the test team or in the programmatic (supervisory), operational, or functional management chains. Potential reasons for calling a pause include: actions not in compliance with the test/training/operations plan; anomalous test results; operating in an unsafe manner; experience an unexpected event including those that may qualify as a mishap, etc. Once instituted a space experiment pause (that has not been elevated to a suspension due to being assessed as an unsafe event or mishap) may only be resumed with concurrence of the MD. Notify AFRL/DO of all test pauses as soon as practicable (NLT 8 hours after pause initiation).

6.12.3. **Suspensions.** Suspensions are declared by the TEA or MD typically after notification of a test pause that is then determined to merit elevation to a suspension; however, a test pause need not be declared prior to putting a suspension into effect. Testing will be suspended in the event of a mishap declared as such by AFRL/SE or the site/detachment safety offices or if

the test team encounters a significant hazard or experiences an unsafe event. A supplemental safety review may be required to resolve the unsafe condition. Suspensions require a return-to-fly (RTF) action via test/training/operations plan amendment which must be processed for approval by TEA and SCA owner. Corrective actions/mitigating measures will be documented via this amendment. A test plan amendment does not take the place of a safety event investigation as required by DAFI 91-204.

**6.13. Unexpected Event or Result.** An unexpected event or result is any unplanned occurrence (to include events that are ultimately assessed to be mishaps) that warrants a temporary hold in the space test activity. If an unexpected event occurs, the test team will put the space activity on hold; complete and submit an Unexpected Event Worksheet (see [Attachment 3](#)); and consult with the MD, TD Test Lead, AFRL/DO staff, and AFRL/SE (if the event/result has safety implications). While the test points or space activity conditions associated with the unexpected event will not be reaccomplished until cleared to do so, other unrelated test points can continue if the test team and the operations/safety team agree. Unexpected test results include, but are not limited to:

6.13.1. Unexpected or unplanned damage to the system under test or support equipment.

6.13.2. Exceeding safety or test limits or experiencing a significantly unfavorable departure from predicted simulation/analysis. NOTE: For all measurements that impact test safety, a predefined set of yellow/red limits and corrective action(s) to be taken in response should be defined ahead of time so that the test team does not debate the significance of an exceedance and instead immediately implements corrective action(s).

6.13.3. Occurrence of a THA hazard whether or not the anticipated corrective action(s) was employed.

6.13.4. Occurrence of a hazard not already identified and mitigated by the procedures defined in a THA that required or will require corrective action.

**6.14. Mishaps and Mishap Reporting.** A mishap is an unplanned occurrence, or series of occurrences, that results in damage or injury and/or meets mishap reporting criteria as described in AFMAN 91-222. Space system anomalies, which do not meet any of the AFMAN 91-222 criteria, will be reviewed by AFRL Safety to determine if they shall be investigated based on their potential for causing injury, loss of mission, or degradation of mission in future occurrences on similar operational capabilities and systems.

6.14.1. Per AFMAN 91-222, for any mission experiencing an unresolved space anomaly (i.e., on-orbit malfunction or deviation from what is consistent with normal operations extending past 72 hours at any time during the mission), a notification to AFRL Det 3/SE is required. AFRL Det 3/SE shall observe the anomaly resolution process and transition to a safety investigation after the anomaly has been determined to be a hazard and when/if enough information exists to classify as a mishap (Class A-E). AFRL Det 3/SE will then proceed with notification procedures to senior leadership for conduct of a mishap investigation.

6.14.2. Report all mishaps IAW the test plan, the associated range procedures, and the AFRL Unexpected Event Worksheet.

6.14.3. Equipment destruction is not considered a mishap if destruction/damage was an expected or desired outcome of the test, it occurred at the planned time, for anticipated reasons, and it served to meet the test objectives as documented in the test plan.

6.14.4. After safety office declaration of a mishap, the MD or TEA will issue a notice of suspension of test operations. If it has not already done so, the AFRL program that experienced the mishap will discontinue test operations immediately.

6.14.5. The program/test team will work with AFRL/DO/EN/SE in support of mishap and/or RTF investigations to present findings and recommend actions to ensure future mishaps do not occur from the same or similar hazards.

6.14.6. RTF investigations and follow-on recommendations for action/change resulting from a mishap are separate from mishap investigations and recommendations specified by DAFI 91-204. RTF actions may incorporate mishap investigation recommendations, but the RTF investigation is a parallel effort and is not necessarily contingent upon mishap investigation results.

## Chapter 7

### PROJECT REPORTING AND CLOSEOUT

**7.1. Project Completion or Termination Notification.** The PM will notify the appropriate TD Test Lead, TRB Chair, SRB Chair, SCA owner, and AFRL/DO Test POC when the test is complete, or test activity has been terminated. Additionally, notify the MLTB Chair and the Lead Space Experimentalist of final project status IAW AFRLI 61-106.

**7.2. Test Reporting.** Because of the nature of S&T, no unique or formal final test reports are required for AFRL projects separate from what is required by existing S&T management guidance. That said, there are two major types of documents identified below that may be appropriate for test teams to create that are distinct from what is required for archival purposes in a research and development (R&D) case file. Test teams should compose such reports when circumstances warrant following AFRL and TD Scientific and Technical Information guidance. The report types are:

7.2.1. Reports intended primarily for AFRL-wide or TD use, such as handbooks and technical information memoranda.

7.2.2. Reports intended primarily for external customers.

**7.3. Project Completion.** Upon project completion, the PM shall ensure test-related activities are properly documented IAW AFRL program management and case file requirements. (See AFRLI 61-201, *AFRL Research and Development Work Unit Records and Science and Technology [S&T] Reporting*, and higher-level instructions as referenced therein.) This includes capturing and archiving as appropriate test planning artifacts, test review and approval documentation, raw and/or processed telemetry data, test results, supporting media (e.g., electronic, photographic, etc.), lessons learned, and other relevant documentation. In addition to program management and R&D case file requirements, PMs should provide AFRL site/detachment safety offices with safety lessons learned, assessments of the effectiveness of hazard controls or minimizing procedures, descriptions of unexpected hazards encountered, and suggestions for improving the safety review process. Finally, programs that are no longer collecting data, have completed all planned experiments, or have transitioned to other organizations, are required to provide a “close out” briefing to the AFRL Space Experiments Review Board IAW AFRLI 61-106.

SCOTT A. CAIN, Brigadier General, USAF  
Commander, Air Force Research Laboratory

**Attachment 1****GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

AFPD 61-1, *Management of Science and Technology*, 18 August 2011

DODI5000.89\_DAFI 99-103 (with AFMC Supplement), *Capabilities Based Test and Evaluation*, 17 October 2022

AFI 91-202 (with AFMC and AFRL Supplements), *The US Air Force Mishap Prevention Program*, 27 September 2022

AFMAN 91-222, *Space Safety Investigations and Reports*, 17 June 2019

AFPD 13-6, *Space Policy*, 13 August 2013

AFI 33-363, *Records Management and Information Governance Program*, 28 July 2021

AFRLI 61-103 Vol 1, *AFRL Flight Test and Evaluation*, 5 October 2020

AFMCI 36-2645, *Senior Functional Roles and Responsibilities*, 20 June 2014

AFI 13-602V3, *Spacecrew Operations*, 6 September 2019

AFI 33-360, *Publication and Forms Management*

AFRLI 61-103, *AFRL Research Test Review, Approval, and Oversight*, 5 October 2022

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DAFI 91-204 (with AFMC Supplement), *Safety Investigations and Reports*, 6 January 2022

AFRLI 61-113, *Science and Technology Protection for the Air Force Research Laboratory*, 3 June 2022

DODI 3100.11, *Management of Laser Illumination of Objects in Space*, 24 October 2016

FAA AC 70-1B, *Outdoor Laser Operations*, 14 February 2022

AFI 14-104, *Oversight of Intelligence Activities*, 4 October 2018

AFRL 61-201, *AFRL Research and Development (R&D) Work Unit Records and Science and Technology [S&T] Reporting*, 9 February 2016

***Adopted Forms***

DAF Form 847, *Recommendation for Change of Publication*

***Abbreviations and Acronyms***

**24HB**—24 Hour Board

**AC**—Advisory Circular

**ADPO**—Advanced Development Program Office

**AF**—Air Force

**AFI**—Air Force Instruction  
**AFMAN**—Air Force Manual  
**AFMC**—Air Force Material Command  
**AFMCI**—Air Force Material Command Instruction  
**AFPD**—Air Force Policy Directive  
**AFRIMS**—Air Force Records Information Management System  
**AFRL**—Air Force Research Laboratory  
**AFRL/CC**—Air Force Research Laboratory Commander  
**AFRL/DSI**—Air Force Research Laboratory Security Office  
**AFRL/DO**—Air Force Research Laboratory Operations Directorate  
**AFRL/RCCS**—Air Force Research Laboratory Cybersecurity Office  
**AFRL/RV**—Air Force Research Laboratory Space Vehicles Directorate  
**AFRL/SE**—Air Force Research Laboratory Safety Office  
**AF/TE**—Air Force Director of Test and Evaluation  
**AO**—Authorizing Official  
**AOR**—Area of Responsibility  
**ATO**—Authorization to Operate  
**C2**—Command and Control  
**C3**—Command, Control, and Communication  
**C&DH**—Command and Data Handling  
**CCB**—Configuration Control Board  
**CDRL**—Contract Data Requirements List (CDRL)  
**CM**—Configuration Management  
**COS**—Chief of Safety  
**COTS**—Commercial Off the Shelf  
**CRB**—Combined Review Board  
**CTA**—Center Test Authority  
**D-TEO**—Deputy Technology Executive Officer for Space Science and Technology  
**DAF**—Department of the Air Force  
**DE**—Directed Energy  
**DMD**—Deputy Mission Director  
**DOD**—Department of Defense

**DODI**—Department of Defense Instruction  
**EOA**—Early Operational Assessment  
**EOL**—End of Life  
**FAA**—Federal Aviation Administration  
**FD**—Flight Director  
**GMP**—General Minimizing Procedures  
**GN&C**—Guidance Navigation and Control  
**HPW**—Human Performance Wing  
**HQ**—Headquarters  
**IATT**—Interim Authority to Test  
**IAW**—In Accordance With  
**IG**—Inspector General  
**ISE**—Integrated System Evaluation  
**ISS**—International Space Station  
**ISSM**—Information System Security Manager (ISSM)  
**IT**—Information Technology  
**LDTO**—Lead Developmental Test and Evaluation Organization  
**LEOPs**—Launch and Early Operations  
**LFD**—Lead Flight Director  
**LTO**—Lead Test Organization  
**MAJCOM**—Major Command  
**MCA**—Mishap Convening Authority  
**MD**—Mission Director  
**MDR**—Mission Dress Rehearsal  
**MLPB**—Mission Level Programmatic Baseline  
**MLTB**—Mission Level Technical Baseline  
**MOA**—Memoranda of Agreement  
**MOC**—Mission Operations Center  
**MOE**—Measure of Effectiveness  
**MORR**—Mission Operations Readiness Review  
**MOP**—Measure of Performance  
**MOT**—Method of Test

**MOU**—Memoranda of Understanding

**MP**—Mission Planner

**MTL**—Master Training List

**NAS**—National Airspace System

**OA**—Orbit Analyst

**OE**—Operations Engineer

**OPR**—Office of Primary Responsibility

**OPREP/CCIR**—Operational Report/Commander Critical Information Requirement

**PCA**—Payload Command Authority

**PI**—Principal Investigator

**PID**—Program Introduction Document

**PM**—Program Manager

**POC**—Point of Contact

**PTO**—Participating Test Organization

**PUM**—Proper Use Memorandum

**R&D**—Research and Development

**RDS**—Records Disposition Schedule

**RTF**—Return-to-Flight

**RV**—Space Vehicles Directorate

**RVE**—Integrated Experiments & Evaluations Division

**S&E**—Scientists and Engineers

**S&T**—Science and Technology

**SCA**—Satellite Control Authority

**SFTPM**—Space Flight Test Planning Meeting

**SFWC**—Space Flight Worthiness Criteria

**SM**—Spectrum Manager

**SOP**—Standard Operating Procedure

**SRB**—Safety Review Board

**SSC**—Space Systems Command

**SSM**—System Safety Manager

**SSO**—Space Safety Officer

**SUT**—System Under Test

**T&E**—Test and Evaluation

**T&O**—Training and Operations Plan

**TAB**—Test Approval Briefing

**TAW**—Test Approval Worksheet

**TEA**—Test Execution Authority

**TD**—Technical Directorate

**THA**—Test Hazard Analysis

**TO**—Technical Order

**TRB**—Technical Review Board

**TRR**—Test Readiness Review

**TT&C**—Telemetry, Tracking, and Command

**USAF**—United States Air Force

**USSF**—United States Space Force

**USSF/TE**—United States Space Force Director of Test and Evaluation

### *Terms*

**Air Force Launch**—Any space launch operation with significant oversight or insight by the Department of the Air Force and not subject to licensing requirements of Title 14 CFR, Part 415, *Launch License*, current edition. The Air Force may or may not be the space system owner.

**Anomaly**—Unexpected events that may or may not result in damage, injury, or mission impact, but do not reach the level of a reportable mishap.

**Center Test Authority (CTA)**—Center-level office which serves as focal point to the TEO and/or DTEO, TD Test Lead, PM, and program test team for test program assistance and to center leadership for issues concerning T&E policy and procedures as they relate to S&T decision making. Per DAFI 99-103 AFMC Supplement and AFMCI 36-2645, CTA also provides senior functional management of the T&E workforce.

**Contact**—The period during which a satellite is communication with the satellite control center (i.e., mission operations center) through a tracking station in order to support execution of telemetry, tracking and commanding operations. Additionally, a contact may occasionally be referred to as a “pass” or a “support.”

**Debrief**—The debrief is the process in which a crew can determine root causes leading to lessons learned and fix actions in order to increase spacecrew proficiency and knowledge. Spacecrew members debrief after training events, evaluations, or real-world events.

**Flight Rules**—A set of defined rules, constraints, and considerations intended ensure safe space and ground system operation in addition to successful completion of the mission objectives. The MD approves all Flight Rules.

**General Procedure (GMP)**—A mitigation measure for general (i.e., not test-unique) hazards. GMPs are stand-alone phrases/statements and are used to address SUT restrictions, test build-up,

critical parameter monitoring, go/no-go criteria, weather or environmental criteria, range-unique hazards, and chase aircraft requirements among other items of flight safety concern.

**Independent**—Being in a position with respect to some matter where one cannot be influenced or controlled by others because one is not subject to the others' authority or jurisdiction or has not had a significant role in the evolution of the matter under consideration. In the context of the AFRL Space Flight Activity Process, the principle of independence effectively precludes program personnel or those who have had a significant role in supporting them from being members of review boards.

**Launch Vehicle**—Any means of transportation used to place an object into Earth orbit or deep space, including ballistic missiles.

**Lead Test Organization (LTO)**—The designation given an AFRL program team when it decides to lead the conduct of a test and/or be responsible for overseeing other organizations supporting their flight research program. The LTO designation accrues when the AFRL program team elects not to turn over test execution leadership for their program to an LDTO.

**Lead Developmental Test and Evaluation Organization (LDTO)**—The lead government organization that is most qualified, resourced, and/or capable to conduct a test and/or be responsible for overseeing a confederation of T&E organizations, each with different but necessary skills, in support of a test program. LDTO designations are made by the TEO (or when delegated within AFRL by TD Directors/ Deputies) and approved by HQ AFMC/A3/6.

**Lessons Learned**—An observation that, when validated and resolved, becomes an evaluated insight resulting in an improvement in military operations or activities at the strategic, operational, or tactical level. It results in long-term, internalized change to an individual or an organization.

**Mission-Level Technical Baseline (MLTB)**—A technical baseline consisting of the space experiment objectives with associated threshold/objective criteria if applicable as well as success/scoring criteria. The MLTB is a focused on fully defining the experimental objectives, defining success criteria, and holding those details under configuration control. See AFRLI 61-106.

**National Airspace System (NAS)**—The NAS is a network of both controlled and uncontrolled airspace, both domestic and oceanic. It also includes air navigation facilities, equipment, and services; airports and landing areas; aeronautical charts, information, and services; rules and regulations; procedures and technical information; and manpower and material.

**Orbital Pass**—An orbital pass (or simply a pass) is the period in which a spacecraft is above the local horizon, and thus available for line-of-sight communication with a given ground station, receiver, or relay satellite, or for visual sighting. The beginning of a pass is termed acquisition of signal (AOS); the end of a pass is termed loss of signal (LOS).

**Payload**—A spacecraft payload is that complement of equipment attached to the spacecraft bus that performs a particular mission in space (e.g., communications, observations, science). A payload is dependent on another spacecraft for many, if not all bus functions (i.e., power; thermal; Commands, Control, & Communications (C3); Guidance, Navigation & Control (GN&C); Commands & Data Handling (C&DH), and propulsion (if needed)). A hosted payload is the term typically used for a payload on a satellite where the payload is not owned by the Satellite Control

Authority (SCA). All experiments flown on the International Space Station (ISS) and X-37B are considered hosted payloads (until separation, if applicable).

**Payload Command Authority (PCA)**—When granted by the spacecraft SCA, the independent authority to command a payload. Often used for hosted payloads with a separate communications link from the spacecraft.

**Participating Test Organization (PTO)**—Any test organization required to support a lead test organization by providing specific data or resources for a test program or activity.

**Pass**—See “Contact” definition.

**Program Manager (PM)**—As used within this volume, the designated individual with responsibility for and authority to accomplish S&T program objectives. The PM is accountable for credible cost, schedule, and performance reporting to the TEO.

**Safety Review Board (SRB)**—A gathering of subject matter experts under the leadership of an appointed Chair whose function is to ensure hazards of a test activity are identified, appropriate risk controls are applied, and residual risk is clearly communicated for acceptance by the appropriate TEA. The SRB is designed as the primary mechanism to ensure an objective, independent, and unbiased safety review. The primary outcome of the SRB is the assessed residual safety risk level of the flight activity.

**Safety Risk**—The relative probability and consequence that an endeavor will experience damage to or destruction of resources, and/or injury or death by the personnel involved in or affected by the activity. A mitigated safety risk results when measures are applied to reduce the probability of occurrence or severity of consequence associated with the hazard(s). Residual safety risk is the level of risk which remains after all mitigation measures have been applied.

**Satellite Control Authority (SCA)**—SCA is defined as a transferable authority and ability to provide Telemetry, Tracking and Commanding (TT&C) of a satellite's bus and to provide control and management of a satellite's payload. SCA includes the authority to plan, schedule, and perform satellite commanding. SCA is delegated to the commander (or equivalent) who is responsible for the oversight of day-to-day space activity operations and compliance with DAF and AFMC operations policies.

**Space Anomaly**—An on-orbit malfunction of a space system or a deviation from what is consistent with normal operations. May utilize the anomaly resolution process when initially investigating an anomaly. A space anomaly may or may not result in damage, injury, or mission impact that reaches the level of a reportable mishap. A space anomaly may be a reportable event.

**Space Flight Test Planning Meeting (SFTPM)**—A meeting held as a part of or subsequent to the Initial Program Formulation Phase of the AFRL Space Flight Activity Process to permit the PM and test team to introduce their space activity concept to the HQ AFRL organizations that oversee the process (AFRL/DO/RC/SE/TD CE). At the SFTPM, headquarters functionals, the PM, and test team work together to identify and tailor the AFRL Space Flight Activity Process requirements and milestones that will apply to the program. A primary goal is to identify long-lead items the program must address to ensure they are resolved in time to meet program goals.

**Space Operations**—All activities that involve the operation of satellites or the performance of missions that primarily utilize or support space-based systems, to include space control; space surveillance; space-based intelligence, surveillance, and reconnaissance; satellite

communications; space-based missile warning; space-based missile defense; spacelift; space-based environmental monitoring; space weather; and space-based positioning, navigation, and timing.

**Space System**—Any system supporting space operations or support. Space system is a generic term encompassing all ground, space, and link segment systems and their components. All the devices and organizations forming the space network are space systems. These consist of: launch vehicles; launch ranges; launch and range support equipment and systems; spacecraft; ground and airborne stations; and data links among spacecraft, mission, and user terminals.

**Space Vehicle**—A vehicle which orbits or travels beyond the earth's atmosphere or a system for lifting other space vehicles into orbit. Examples of space vehicles include boosters (i.e., launch vehicles, etc.), spacecraft (e.g., satellites, orbiters, payloads, etc.) and reusable spacecraft. Do not consider Intercontinental Ballistic Missiles (ICBMs) space vehicles.

**Spacecraft**—An independent (i.e., free-flying) space vehicle designed to operate in space and orbit a celestial body (i.e., a planet, moon, or star). The term can be used interchangeably with "satellite" and often includes a payload in addition to the bus. A spacecraft is not dependent on another spacecraft for basic system functionality. The term spacecraft includes manned objects in space. This term can also refer to the object while it is still on the ground. This does NOT include launch vehicle components separated from the spacecraft.

**Spacecrew**—Consists of US Space Force and US Air Force officers, enlisted, Department of Defense civilian personnel, civilian contractors (as applicable per contract documentation), allied mission partners (as applicable per international agreement), Air Reserve Components, and other selected personnel who conduct space operations. Spacecrew is a general term used to encompass the entire body of qualified space professionals, similar to an aircrew. The total complement of personnel is responsible for the safe operation of ground and on-orbit space systems and associated infrastructure.

**Technical Review Board (TRB)**—A gathering of subject matter experts under the leadership of an appointed Chair whose function is to assess the method being employed by a test team on a research activity. The TRB ensures the objectives are properly formulated, the method of test is appropriate for the test objectives, the data management plan sufficiently addresses the data acquisition and analysis requirements, and the overall approach is executable within the constraints of resources and time. The primary outcome of the TRB is the assessed technical risk level of the test approach.

**Technical Risk**—The relative probability and consequence that an endeavor will fail to achieve the research or test objectives that have been defined for it.

**Test Approval Briefing (TAB)**—An executive-level presentation that provides a flight test activity overview and highlights test objectives, overall test approach, test-unique hazards, mitigation measures, discussion points during the independent reviews, and any contention or disagreement among the members of the independent board(s) or the test team.

**Test Execution Authority (TEA)**—The government individual at the management level identified in AFI 91-202 AFRL Supplement responsible for accepting the risks assessed in reviews (technical and safety) and authorizations (cyber, PUM, spectrum, etc.) as documented in a space flight activity package and for approving the test to proceed. Within AFRL, SCA approval must also be obtained before a space flight activity may actually proceed to execution.

**Unexpected Event**—Any unplanned or unanticipated occurrence, or series of occurrences, during space flight operations that results in (or has the potential to cause) injury or death, damage to the SUT (excluding normal wear and tear), property damage, or anomalous performance. An unexpected event may or may not be classified as a mishap.

## Attachment 2

## SPACE UNEXPECTED EVENT WORKSHEET

**A2.1.** This worksheet is used by the test team to provide a ready reference to guide reporting on an unplanned occurrence to the offices of AFRL/DO and/or AFRL/SE. Examples of such events are a near miss, spacecraft anomaly, mishap, or unplanned test suspension/stop. The worksheet guides affected parties to take appropriate response actions such as preserving mishap data, command logs, gathering witness statements, etc. It is also useful in supporting Operational Report/Commander Critical Information Requirement (OPREP/CCIR) submissions.

A2.1.1. Use the following worksheet, or similar format, to report the following information via email to AFRL/DO ([afrl.do.workflow@us.af.mil](mailto:afrl.do.workflow@us.af.mil)) and AFRL/SE ([afrl.se.workflow@us.af.mil](mailto:afrl.se.workflow@us.af.mil)). If necessary, provide additional classified information via appropriate channels.

**Table A2.1. Space Unexpected Event Worksheet.**

Space Unexpected Event Worksheet		
1	Program Title	
2	AFRL Tracking #	
3	Name and contact information of Flight Director on duty during event	
4	Name and contact information of Mission Director	
5	Name and contact information of Program Manager / Principal Investigator	
6	Name and contact information for all other personnel in the MOC	
7	Spacecraft Type	
8	Date and Time of Unexpected Event:	
9	Record Narrative Summary of Event:	
10	Provide detailed timeline of events starting at appropriate time prior to unexpected event or mishap continued through the event sequence	
11	Provide details of immediate actions (if any) taken in response to the event and current status of the affected vehicle and/or payload	

Secure all telemetry data, command/position logs, written procedures and memograms in use during unexpected event or mishap.

**Attachment 3**  
**EXAMPLE TEST APPROVAL WORKSHEET**

**Figure A3.1. Example Test Approval Worksheet.**

**TEST APPROVAL WORKSHEET**

1. AFRL Tracking #	2. Program Manager (Name, Office Symbol)	3a. Commercial Phone #	3b. DSN Phone #
4. Purpose <span style="float: right;">▼</span>			
<b>SECTION I: PROGRAM INFORMATION</b>			
5. Program Title	6. LTO/AIR-LD TO/LD TO	7. Contract #	8. GFR <span style="float: right;">▼</span>
9. MESP <span style="float: right;">▼</span>			
10. Description of Test and/or Test Modification (to include # and types of vehicles, AFRL assets, other involved organizations, and program-level objectives).			
<b>SECTION II: PLANNING PHASE</b>			
11. Signature indicates reviewer certifies test planning and documentation are mature and test should proceed to formal review phase.			
	Name, Office Symbol	Signature	
AFRL/DO Test POC			
TD Test Lead			
<b>SECTION III: REVIEW PHASE</b>			
12. Technical Review Board			
<input type="checkbox"/> As the TRB Chair, I certify that an Environmental Impact Analysis has been conducted and reviewed.		Technical Risk Level <span style="float: right;">▼</span>	
TRB Chair Name, Grade/Rank, Office Symbol		Signature	
<input type="checkbox"/> See reverse side for remarks			
13. Safety Review Board			
<input type="checkbox"/> Board Member(s) non-concurred with risk level. See reverse side for remarks		Residual Safety Risk Level <span style="float: right;">▼</span>	
SRB Chair Name, Grade/Rank, Office Symbol		Signature	
<input type="checkbox"/> See reverse side for remarks			
14. Airworthiness Assessment/Space Flight Worthiness Criteria			
<input type="checkbox"/> Civil Aircraft Operation <input type="checkbox"/> Public Aircraft Operation <input type="checkbox"/> Space		Airworthiness Technical Risk Level/SFWC <span style="float: right;">▼</span>	
Name, Grade/Rank, Office Symbol		Signature	
<input type="checkbox"/> See reverse side for remarks			
<b>SECTION IV: APPROVAL</b>			
15. Test Execution Authority			
In the role of Test Execution Authority for this test, I accept the risks as assessed in Section III, and I approve this test to execute.			
Name, Grade/Rank, Office Symbol		Signature	
<input type="checkbox"/> See reverse side for remarks			
16. CAO or MFR #	17. Date of ATO or IATT	<input type="checkbox"/> ATO/IATT Not Required	
18. Flight Operations Authority/Satellite Control Authority			
As AFRL FOA/SCA, I certify the AFRL test review process is complete and I approve this test to execute.			
Name, Grade/Rank, Office Symbol		Signature	Final Risk Level <span style="float: right;">▼</span>

Figure A3.2. Example Test Approval Worksheet (con't).

Block 19 - Test Description/Test Team Remarks

Block 20 - TRB Chair Remarks

Block 21 - SRB Chair Remarks (as well as those of non-concurring SRB members if applicable)

Block 22 - Airworthiness/Space Flight Worthiness Criteria Remarks

Block 23 - TEA Remarks

Block 24 - FOA/SCA Remarks

Block 25 - Test Plan Title, Version, and Date

Attachment 4

SUGGESTED CRITERIA TO USE IN TECHNICAL RISK ASSESSMENTS

Figure A4.1. Suggested Criteria to Use In Technical Risk Assessments.

Risk Area	LOW	MEDIUM	HIGH
SUT Maturity	Mature, <b>FULLY</b> -proven design (i.e., software, hardware, and components) or a design with few/minor changes from a known, Analogous design peer or baseline. <b>SIGNIFICANT</b> previous testing in Lab, Field and/or Flight Test environments.	Less mature, <b>PARTIALLY</b> -proven design (i.e., software, hardware, and components) or a design with some significant changes from known/analogous design peer or baseline. <b>SOME</b> previous testing in Lab, Field and/or Flight Test environments.	Immature or new, <b>UNPROVEN</b> design (i.e., software, hardware, and components) or "first of" with little to no known/analogous design peer or baseline. <b>LITTLE</b> previous testing in Lab, Field and/or Flight Test environments.
SUT Performance	Performance is stable, understood, and predictable with <b>HIGH CONFIDENCE</b> across all areas of planned test envelope.	Performance is somewhat stable, understood, and predictable with at least <b>MEDIUM CONFIDENCE</b> across all areas of planned test envelope.	Performance is somewhat stable, understood, and predictable with <b>LOW CONFIDENCE</b> across all areas of planned test envelope.
Test Objectives, Methodology & Data Analysis	<b>SIGNIFICANT</b> buildup approach events completed (M&S, HITL, SIL, Lab/Ground/Flight Test). <b>STRONG</b> traceability between test objectives, requirements, previous test results, and design of the test. <b>HIGH CONFIDENCE</b> in test methodology, test point selection, MOPs, evaluation criteria, data analysis and/or predicted results. Few if any test changes anticipated.	<b>SOME</b> buildup approach events completed (M&S, HITL, SIL, Lab/Ground/Flight Test). <b>SOME</b> traceability between test objectives, requirements, previous test results, and design of the test. <b>MEDIUM CONFIDENCE</b> in test methodology, test point selection, MOPs, evaluation criteria, data analysis and/or predicted results. Some changes to test are anticipated after analysis of initial results.	<b>LITTLE</b> test buildup or significant lack of relevant M&S, HITL, SIL, Lab/Ground/Flight Test prior to the current test events. <b>WEAK</b> traceability between test objectives requirements, previous test results, and design of the test. <b>LOW CONFIDENCE</b> in test methodology, test point selection, MOPs, evaluation criteria, data analysis and/or predicted results. Significant changes to test are likely after analysis of initial results.
Instrumentation	Mature, proven data parameters, sample rates, resolution, truth sources/sensors, data acquisition system(s), etc.  All available and known <b>HIGH CONFIDENCE</b>	Less mature or partially proven data parameters, sample rates, resolution, truth sources/sensors, data acquisition system(s), etc.  Some available or known <b>MEDIUM CONFIDENCE</b>	Immature or unproven data parameters, sample rates, resolution, truth sources/sensors, data acquisition system(s), etc.  Few available or known <b>LOW CONFIDENCE</b>

Figure A4.2. Suggested Criteria to Use In Technical Risk Assessments (con't).

Risk Area	LOW	MEDIUM	HIGH
SUT Operations, Maintenance & Sustainment	Operation, maintenance, and troubleshooting procedures documented and complete with <b>MINOR</b> omissions in key SUT operational areas.  Operators and maintainers have significant, recent experience and have <b>HIGH CONFIDENCE</b> in ability to operate, maintain, and sustain SUT as required for test.	Operation, maintenance, and troubleshooting procedures have <b>SIGNIFICANT</b> omissions in key SUT operational areas.  Operators and maintainers have some/fairly, recent experience and have <b>MEDIUM CONFIDENCE</b> in ability to operate, maintain, and sustain SUT as required for test.	Operation, maintenance, and troubleshooting procedures documented and complete with <b>CRITICAL</b> omissions in key SUT operational areas.  Operators and maintainers have little/no, recent experience and have <b>LOW CONFIDENCE</b> in ability to operate, maintain, and sustain SUT as required for test.
Test Vehicle Modification & Integration	Modification and integration procedures are <b>FULLY</b> defined. Test vehicle has been previously modified in <b>HIGHLY</b> similar fashion with analogous SUT integrated successfully.  Modification and integration team are <b>HIGHLY</b> experienced with vehicle/SUT and have <b>HIGH CONFIDENCE</b> in their ability to modify test vehicle and integrate while maintaining cost and schedule.	Modification and integration procedures are <b>SOMEWHAT</b> defined. Test vehicle has been previously modified in a <b>SOMEWHAT</b> similar fashion and similar SUT integrated successfully.  Modification and integration team are <b>SOMEWHAT</b> experienced with vehicle/SUT and have <b>MEDIUM CONFIDENCE</b> in their ability to modify test vehicle and integrate while maintaining cost and schedule.	Modification and integration procedures are <b>POORLY</b> defined. Test vehicle may have been previously modified with limited similarity and no analogous SUT has been integrated successfully.  Modification and Integration team have <b>LITTLE</b> experience with vehicle/SUT and have <b>LOW CONFIDENCE</b> in their ability to modify test vehicle and integrate while maintaining cost and schedule.
Test Resources Airspace/Range Availability	Few schedule issues or concerns, <b>HIGH CONFIDENCE</b> regarding test resources, airspace or range availability.	Some schedule issues or concerns, <b>MEDIUM CONFIDENCE</b> regarding test resources, airspace or range availability.	Serious schedule issues or concerns <b>LOW CONFIDENCE</b> regarding test resources, airspace or range availability.
Test Events & Schedule Adequacy	Schedule is adequate to accomplish the number/types of events.  <b>HIGH CONFIDENCE</b> that contingencies can be mitigated within current schedule.	Schedule is somewhat aggressive to accomplish the number/types of events.  <b>MEDIUM CONFIDENCE</b> that contingencies can be mitigated within current schedule.	Schedule is highly aggressive to accomplish the number/types of events.  <b>LOW CONFIDENCE</b> that contingencies can be mitigated within current schedule.