



Armstrong Flight Research Center
Edwards, California 93523

AFG-7900.3-001, Revalidation Baseline-10
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SUBJECT:

**Airworthiness and Flight Safety Review,
Independent Review, Technical Brief, and Mini-
Tech Brief**

RESPONSIBLE OFFICE:

Office of the Director

**AFG-7900.3-001 Airworthiness and Flight Safety Review, Independent
Review, Technical Brief, and Mini-Tech Brief**

Concurrence Signatures

**By signing this concurrence, I accept the requirements that apply to my
organization.**

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1.0 PURPOSE & OBJECTIVES

This document presents the information needed to maximize the effectiveness of the airworthiness and flight safety review processes as practiced at the Armstrong Flight Research Center (hereafter referred to as the Center).

- Explain the functions of the Airworthiness and Flight Safety Review Board (AFSRB), the AFSRB chairperson, and the Flight Readiness Review Board (FRRB) when one is formed.
- A sample Flight Readiness Review (FRR) outline as a guide for the FRRB chairperson's consideration during the review process.
- Items that should be covered in the FRRB report to the AFSRB.
- Technical Brief and Mini-Tech Brief guidelines.

2.0 SCOPE & APPLICABILITY

2.1. Scope:

This process applies to all flight activities and hazardous ground tests involving aircraft, Unmanned Aerial Systems (UAS), critical flight systems, and/or experimental facilities for which the Center has any airworthiness, ground, flight or range safety responsibility or that involve Center personnel utilizing non-National Aeronautics and Space Administration (NASA) assets.

2.2. Applicability:

This guidance applies to all Center organizations involved in the conduct of flight or ground test projects.

3.0 AIRWORTHINESS & FLIGHT SAFETY REVIEW

The AFSRB performs certain review processes in order to ensure the flight safety of all projects conducted at the Center. All specific requirements to meet the Center's airworthiness and flight safety review process are contained in AFOP-7900.3-023.

3.1. Airworthiness & Flight Safety Review Board

The Center Director has appointed the chairperson and members of the AFSRB.

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The AFSRB members are:

- Center Chief Engineer, Chairperson
- Director, Flight Operations
- Director, Research and Engineering
- Director, Safety and Mission Assurance
- Director, Mission Operations
- Director, Programs and Projects
- Chief Pilot
- Aviation Safety Officer
- Range Safety Officer (UAS reviews only)
- Ex-officio and other U.S. Government personnel may be appointed to the AFSRB as necessary to provide a thorough and streamlined review.

A quorum for the AFSRB is considered to be the chairperson and directors. The chief pilot and aviation safety officer may be represented by the qualified director.

3.2. Airworthiness & Flight Safety Review

In order to accomplish their assigned task, the AFSRB is given the authority and responsibility to perform reviews. The AFSRB chairperson, in consultation with the AFSRB members and the Project under consideration, determine the appropriate level of review to be performed. There are four levels of review that vary depending upon the complexity and the criticality of the project.

- The first, though least extensive level of the AFSRB, review is that conducted solely by the AFSRB chairperson. The chairperson determines whether a specific project need be reviewed in any further depth or by any committee. If project plans and preparations are adequate for performance of their proposed operation with the necessary level of safety, the chairperson has the authority to cease reviews at that point. Flight release may be via a tech brief, Operational Readiness Review (ORR) or Flight Request.
- The second level of review is one step beyond the sole review of the AFSRB chairperson. If the chairperson decides that a specific project needs further review but does not require the full airworthiness board review, the chairperson may convene a small team of Center experts,

independent of the project, to assist in determining whether the proposed project is cleared for flight. If the chairperson and the small team agree that the project should be cleared for flight, a flight release may be via a tech brief, ORR or Flight Request.

- The third level of review is to have the plans and proposed conduct of the project presented to the entire AFSRB for review. In this case, the entire board makes a judgment as to whether a particular project has adequately considered and integrated flight safety into its proposed plans. This determination is based upon a presentation to the AFSRB by the project. The recommendation of the board to the Center director is based upon the general agreement of the members, with each major objection addressed and resolved or a minority report included with the recommendation.
- The fourth level of review is to have the plans and proposed conduct of the project presented to the AFSRB by an ad hoc team of experts, independent of the project, to determine whether the proposed project is cleared for flight. This team is called a FRRB. The entire committee renders a judgment as to whether a particular project has adequately considered and integrated flight safety into its proposed plans. The findings and recommendations of the FRRB are typically presented to the AFSRB by the FRRB chairperson and board members. The recommendation of the AFSRB to the Center Director are based on the general agreement of the members, with each major objection addressed, and resolved or a minority report included with the recommendation.

In any of the four review types, the AFSRB chairperson has the authority to obtain assistance from any part of the Center or any outside help that may be necessary to ensure that the project is conducted in the safest manner possible. This assistance can take many forms, such as the hiring of a consultant, using the aircraft manufacturer's expertise, using experts in various fields, or forming ad hoc committees to assess any or all parts of the proposed program.

3.3. Flight Readiness Review

The AFSRB chairperson may establish a formal FRRB to assist in evaluating whether a specific project is adequately prepared to proceed with its proposed program. Typically, a FRRB will be convened if any of the following criteria are present:

- A. Any new program or operation that can reasonably be assumed to contain significant risk to personnel or property.

- B. A phased program that is ready to enter a second or succeeding phase beyond that already approved by the AFSRB.
- C. A program that is preparing to exceed some limit previously approved by the AFSRB.
- D. A program that will require a major modification to an aircraft.

The FRRB is established at a time when credible review and assessment can be made without delaying the operational schedule of the project. A good estimate for the start of a FRR is two thirds to three quarters of the way through a project's integrated Verification & Validation (V&V) effort. In all cases, this takes place before the first flight or major operation of the project. FRRs are normally limited in scope to addressing safety as the main subject of review but may also include a review of the project's potential for mission success when included in its charter.

A FRR Board is charged with:

- 1) Conducting an independent review and assessment of the entire program or operation and ensure that proper planning and preparation have been accomplished, resulting in the project being conducted in a safe manner. This review should include, where applicable, the design, fabrication, performance, and documentation of all software and hardware associated with the project as well as ground and flight operational procedures. It should also include any substantiating wind tunnel, computational fluid dynamics, ground, and/or simulation testing that has been performed.
- 2) Verifying that the approved system safety plan has been followed and that all analyses and results have been properly integrated into the project's planning and tracking documentation.
- 3) Ensuring that all identifiable risks have been identified, assessed, and either adequately controlled or presented to Center management as risks to be accepted in order to conduct the program.
- 4) Providing engineering and technical recommendations to program personnel throughout the life of the FRR, while recognizing that it is not a function of the FRRB to direct actual work effort.
- 5) Maintaining ongoing communication among FRRB members, program personnel, Center management, and the AFSRB chairperson.
- 6) Submitting a final report on Board activity, findings, and recommendations to the AFSRB chairperson.

The membership of the FRRB is selected by the AFSRB chairperson in consultation with the directors on the AFSRB to represent specific

functions and disciplines necessary for an objective review and assessment of a project and its proposed plans. Broad experience and expertise are desirable among board members in order to ensure recognition of potential problems in a wide range of areas. Members are not associated with the program being reviewed in any manner such that their activities or recommendations may be influenced through such causes as an over familiarity with the project. The FRRB chairperson is a Center civil servant and a senior engineer with extensive experience and expertise in the project's primary discipline. Other members may be drawn from NASA field centers, academia, and the private sector as long as they are independent from the project under review.

The FRRB members may go to their respective director and/or the AFSRB chairperson for help or advice in interpretation of the board's charter. It is extremely important, however, that the individual member remain completely independent from line management biases while operating as a board member. Line management ensures that individuals working under them are given the time and priority necessary to do a thorough job as a board member.

The board should take advantage of other advisors and consultants to assist them in fully reviewing the project. If an outside consultant needs to be hired, the project should provide funding. Decisions and recommendations are the sole responsibility of the board and its chairperson.

One purpose of the FRR is to expose individual or board concerns to higher management and the project while there is still time to avert a mishap. Therefore, project team members are encouraged to reveal information freely, cooperate with the review team(s), and be completely open in all exchanges, including those detailing any doubts or uneasiness experienced by the project team. Inviting the FRRB members to attend pertinent project meetings wherever applicable can emphasize this. The Project Team and the FRRB have a common goal and often the FRRB can help the project in attaining this goal. Briefings by the project team should be presented by qualified personnel to familiarize the board with overall efforts and specifics of all areas under evaluation. Project personnel ensures that all information presented is current, complete, and accurate, that all hardware, software, and equipment submitted for evaluation is properly prepared and represents actual configuration and functional characteristics intended for use, and all known or suspected anomalies, deficiencies, or areas of concern are identified.

Constant communication between the FRRB and the project team can provide benefits in both directions. A concern or recommendation voiced

to the project team in a timely manner may allow the project to take action without delaying the project. Likewise, the proposed action of the project team, communicated to the FRRB in a timely manner, may expose areas of confusion or misunderstanding on the part of either the board or the project that could lead to unnecessary expenditure of valuable time and/or resources.

Upon completion of the board's review, the FRRB chairperson prepares a written report to the AFSRB chairperson. This report should include the board's recommendations, any unsatisfactory or marginal areas or conditions, any restrictions or limitations that should be imposed before the proposed operation may take place, and a discussion of any hazards to be presented to the Center Director for acceptance. Ordinarily, the report should be signed by all FRRB members, but the chairperson may sign in an individual's absence if he states that the absent member either concurred in the majority report or has filed a minority report. Per the requirements of AFOP-7900.3-023, any member not concurring with the majority report submits a minority report stating any areas of non-concurrence or additional claims or recommendations as appropriate. The written report is delivered to the AFSRB and the project manager at least two working days prior to the AFSRB meeting.

Typically, the FRRB led by the chairperson, presents an oral briefing to the AFSRB. The FRRB oral briefing to the AFSRB summarizes the material presented in the written report. Project team members may be present to answer very specific questions that may arise. Copies of the oral presentation are prepared and presented to the project manager and AFSRB members one working day prior to the AFSRB meeting. Hardcopies of the presentation for each AFSRB member are brought to the AFSRB meeting.

Along with the presentation of the FRRB's final report, the Project Manager of the affected project submits a report to the AFSRB chairperson addressing any open action items or recommendations that may have been in the FRRB report that requires action before the first flight or significant project operation. This report should be presented to the AFSRB members one working day prior to the AFSRB meeting. Following these two report submissions, the AFSRB makes final recommendations as to whether the project should be allowed to continue on the planned course or should undergo some plan modification before continuing.

Per the requirements of AFOP-7900.3-023, in order to allow sufficient time for the AFSRB to arrive at a decision without undue pressure, the final FRRB briefing to the AFSRB precedes the Project's Technical Briefing by

a minimum of three workdays. It is also important to note that the Technical Briefing precedes the first flight/operation by at least two working days. The FRRB should be present at the technical briefing in order to concur on closures of any issues that were deferred to the tech brief. For smaller projects, less broad in scope, the above times may be compressed upon consultation with the Center Chief Engineer.

3.3.1 FRR Outline

The outline in Appendix A is offered for the FRRB chairperson's consideration when conducting a FRR of an assigned project. The board's primary concern is to investigate all matters that affect public, flight, range, and ground safety. Any items noted that may affect mission success may be reported, but unless specifically chartered, are not the primary concern of the board.

4.0 TECHNICAL BRIEFS & MINI-TECH BRIEFS

The Technical Briefing, or tech brief, is one of the more important tools used by the Center to ensure the safe and efficient conduct of the flight test mission. Its major function is to continue the review process after the AFSRB has made its final recommendations and a program moves into the flight or test phase. All specific requirements to accomplish the Center's tech brief process are contained in AFOP-7900.3-022.

There are two primary purposes for holding tech briefs.

- First, the individual project office is given the opportunity to present its goals and plans to a group of peers. These peers represent all the various disciplines at the Center, with special emphasis on the particular areas of interest that are being explored during the proposed flight tests. A project, in this way, receives the benefit of the experience and expertise of projects conducted previously. The peer review, using past experiences, is a proven way of bringing overlooked items to light.
- The second purpose of tech briefs is to present a current assessment of project risks to the Center management team. It allows management to reconsider its understanding of the risks involved prior to each flight. This helps ensure that any risks that cannot be eliminated or reduced are accepted at the appropriate level of authority and responsibility.

Holding a tech brief prior to each flight of a research aircraft allows an adequate amount of time to process and thoroughly review data received from the previous flight. This forces a more comfortable and safe pace without project participants feeling they are

being rushed into proceeding with a flight program after only a cursory look at available data.

A tech brief may be held for a block of flights of a research aircraft. This is typically allowed for more well-established research projects if the flights being conducted contain similar maneuvers and are deemed to be low risk by the project and chief engineer. This can allow the project to proceed through the flight test plan more efficiently and present a more complete picture of the flight test results. A tech brief may be called for mid-block if unexpected results are encountered or flight test plan changes are proposed.

4.1. Tech Brief Board

The membership of the tech brief board (or their designated representative) is as follows:

- Center chief engineer (Board Chairperson)
- Director, Research and Engineering Directorate
- Branch Chiefs for Aeronautics Projects Branch, Science Projects Branch and Space Projects and Partnerships Branch.
- Director, Flight Operations Directorate
- Director, Safety & Mission Assurance Directorate
- Director, Mission Operations Directorate
- Chief Pilot
- Aviation Safety Officer
- Range Safety Officer (UAS activities only)

The Tech Brief Board quorum is considered the chairperson and directors of the Flight Operations Directorate, Research and Engineering Directorate and Safety & Mission Assurance Directorate. The chief pilot and aviation safety officer may be represented by a qualified director. In the event any quorum position or their designated representative is not present, the project manager cancels the tech brief and reschedules it.

The presence of the following project personnel or designated representative is expected at the tech brief:

- Project Manager
- Project Chief Engineer (if one is appointed)
- Project Operations Engineer (if one is appointed)
- Project Pilot

The presence of the following individuals or designated representative is considered highly desirable at the tech brief.

- Principal investigator
- Designated technical monitor(s) (for each project) from Research Engineering

It is desirable for FRRB members to attend the first tech brief after their report to the AFSRB to ensure that actions directed by the AFSRB have been complied with by the project. The FRRB chairperson notifies the members regarding the tech brief.

Directorate management ensures that designated representatives report issues and results to the directorate management to ensure continuity of directorate technical and safety monitoring.

4.2. Tech Brief

The project manager coordinates both scheduling and presenting the tech brief. The presentation includes, where applicable, the following:

A. Review of past flight(s)

This review should address the data analysis results from previous flights of the aircraft with particular emphasis on envelope expansions or any unexpected results, whether or not they are expected to present a problem. These results should provide a smooth transition to the objectives of the proposed flight plan. Pilot comments from past flights should be addressed, particularly where the flying qualities of the aircraft are unexpected or not as good as have been expected. Significant anomalies or failures from previous flights are also reviewed.

B. Objectives of the proposed flight(s)

The objectives of the flight or block of flights should be presented in light of the results of previous flight(s) and as part of overall program objectives. Rationale and justification for the proposed flight should be shown based on an orderly progression from data points already obtained.

C. Flight Plan

The planned approach to obtaining the data maneuvers should be explained with emphasis on the technique and rationale for using it. Any risks, limits, or constraints on the aircraft or maneuvering should be presented and clearly explained with no assumptions made as to understanding of these critical areas. Preplanned alternatives should be presented to allow for unforeseen contingencies that may occur during flight. This plan should cover the entire flight period from takeoff to landing and give a clear and concise understanding of the pilot's duties at all times. If there is to be a period of pilot familiarization during flight, that should be briefed at the tech brief. This is not meant to limit the pilot's freedom, but to constrain all research aircraft flying to activity that has been preplanned and briefed.

D. Configuration Changes

A brief review should be made of the configuration that the aircraft will be in for flight. This is particularly important where there has been a change made to the aircraft between flights, no matter how small or seemingly unimportant. The status of the configuration documentation and waivers should be briefed to verify the completion of the changes or to identify any incomplete work and its effect on the proposed flight test. Additional risks perceived to have been incurred because of the changes are to be briefed in the tech brief.

E. Control Room Operations

For those Projects requiring a control room, the presentation of the control room procedures should include the room layout, the required people involved in the flight and minimum staffing levels, data they will be looking at and for, and instrumentation requirements. Any changes to the room or its functions should be explained. The communication network, both with the aircraft and in the Control Room, should be briefed. Any required control room training accomplished prior to flight should be presented.

F. Accepted Risk List

Every tech brief presents the list of any risks that are knowingly being taken by the project. These risks may have arisen through various analyses such as a hazard analysis or may have shown up on previous flights or tests as discrepancies and processed through the normal discrepancy reporting system. In either case, it is wise to clearly explain and justify the level of the associated risks and the

rationale for accepting them. This list often takes the form of a Hazard Action Matrix (TEM-001 a-b) that shows risk to human safety and risk to assets supported with a table of risk title, category and probability, causes, and mitigations.

G. Mandatory Requirements

Every flight of a research aircraft has a specific set of conditions, personnel, instrumentation, and equipment required in order to conduct the flight as planned. These lists are presented at the tech brief along with the action to be taken in the event a condition is not met or a person or item is not present or not operating. These could include cancellation, flight abort, or deletion of a specific maneuver or series of tests, but the goal is that all possibilities are given detailed consideration in advance of the mission and precise alternatives planned and prepared for. These lists often take the form of the following:

- 1) Mission Rules – Required facilities, test systems, and their constraints.
- 2) Aircraft Operating Limitations – Test specific aircraft system or maneuver limits.
- 3) Weather Constraints – Test specific weather related limits or constraints.
- 4) Go/No-Go Instrumentation – Safety or mission critical instrumentation required to conduct the mission or specific portions of the mission.
- 5) Required Documentation – Specific documentation, checklists, or procedures for the mission.
- 6) Required Personnel – In addition to control room and flight crew, any ground crew required to conduct the operation.

H. Open Items

Occasionally, items may represent a major problem area and the Project is delayed until the items can be closed out satisfactorily. More often, the items are less severe and simply lack the necessary information at the time of the tech brief. These may normally be carried forward and closed out with the Center chief engineer before the project is cleared to proceed.

Technical briefings are scheduled a minimum of two working days, preferably five, in advance of the proposed flight date. If not, the project manager contacts each of the mandatory attendees and notifies them of

the upcoming briefing. Actual scheduling is done through the project's administrative office but remains the responsibility of the project manager. The keeper of the Center calendar should be notified as soon as a date and time has been established so that no conflicting meetings are scheduled. Center management has given the tech brief the highest priority.

A copy of the tech brief package is made available to each of the Board Member Offices at least two working days prior to the scheduled tech brief. Hard copies for the board members are presented at the tech brief meeting. It has been customary to circulate a draft of the proposed plan to all the interested parties a few days in advance of the tech brief. This is a desirable policy and should be exercised whenever possible. It provides the attendees with the benefit of being fully prepared at the tech brief as well as giving the project team the benefit of potential feedback at a much earlier point in the planning process. It also allows each of the mandatory attendees enough time to ensure that they, or their representatives, can attend the actual briefing. Following the tech brief, the directorate directors approves and signs AFRC70129, Flight Request. The chief engineer's signature on AFRC70129 indicates approval to conduct the operation.

Any of these rules may be altered to fit a special case through negotiation with the chief engineer's office. One example of a rule change that is permitted is the "Block Tech Brief," where a series of flights is briefed collectively. This would also include aerial refueling of a research aircraft where "one" flight is, in effect, two or three normal ones.

Although block briefing is often allowed, there is good reason and benefit from having the project take the necessary time between flights to analyze data before proceeding with the flight program. This is especially true where an envelope is being expanded and data maneuvers proposed for a flight are highly dependent upon results from a previous flight. The usual technique is to expand the envelope on the first flight of a series and then use the remaining flights to fill in data points, or to expand an envelope in a different disciplinary area. A tech brief is then conducted before further expansion takes place.

4.3. Mini-Tech

A "Mini-Tech" covers only a limited agenda aimed at a few items requiring approval before continuing with a flight series. Typically, a mini-tech can be conducted in less than 20 minutes. It is not a substitute for a technical briefing. Approved agenda items are prior flight results, relatively minor changes in configuration, prior flight anomaly explanation and analysis,

minor changes to the tech briefed flight plan or mandatory requirements, and closeout items from project reviews.

The "two day before flight" requirement is relaxed with mini-techs to facilitate a safe but rapid conduct of the mission. A mini-tech may be held immediately prior to the crew brief for most block-briefed flights, after the first flight.

The signatures of the appropriate entities on the previously briefed tech brief flight request are reaffirmed by initials and dated. The initials show approval of the flight as briefed at the tech and mini-tech briefings.

The final decision on what is or is not be allowed for any given project remains a decision to be made by the Center chief engineer, a decision based on what facilitates the safest and most efficient flight test program possible.

APPENDIX A – REVIEW BOARD CHECKLIST

The purpose of a review is to provide Center management assurance that a satisfactory approach has been taken to achieving safe and productive flight operations. Reviews communicate an approach, demonstrate an ability to meet requirements, and establish status.

The objectives of a review are to establish that all interfaces are compatible and function as expected, confirm that the system and support elements are properly configured and ready for flight, and receive assurance that flight operations can proceed with acceptable risk.

This checklist provides a partial list of items to address for review team guidance when conducting an independent review. The team may select only those items that apply to the project reviewed. The list draws heavily from the Mars Climate Orbiter investigation.

1.0 Personnel

A. Leadership

- 1) Emphasis on safety as the primary concern
- 2) Experience level of personnel
- 3) Clear line of authority to person in charge
- 4) Examine team working and external interfaces
- 5) Teamwork promotion
- 6) Training opportunities provided
- 7) Mentoring of new or inexperienced personnel

B. Organization and Staffing

- 1) Sound organizational structure
- 2) Staffing adequacy
- 3) Customer representation
- 4) S&MA representation

C. Communication

- 1) Ranking of safety and mission success over cost and schedule
- 2) Free exchange of information, opportunity to be heard
- 3) Tracking of top ranked issues and their resolution to everyone's satisfaction

- 4) Problem reporting encouraged
- 5) Line organization and project communications

D. Project Team

- 1) Key positions filled and continuity encouraged
- 2) Experience level of team members
- 3) Adequacy of project team's reviews: Preliminary Design Review (PDR), Critical Design Review (CDR), Wind tunnel, test readiness, simulation
- 4) Customer involvement in decision-making and trade-offs
- 5) Team acceptance of external ideas
- 6) Team metrics relation to requirements

2.0 Process and Execution

A. Systems Engineering

- 1) Risk trade-off system used by the project.
- 2) Risk management system used.
- 3) Ground test versus flight test trade-off.
- 4) Fault tree analysis used.
- 5) Margin adequacy for parameters.
- 6) Mission architecture provides data for failure analysis.
- 7) Emphasis on mission success over cost and schedule.
- 8) Formal review of past lessons learned.
- 9) Rigorous configuration control process in place.

B. Requirements

- 1) Mission success criteria established and baselined.
- 2) Requirements level sufficiently detailed.
- 3) Change process used and effective.
- 4) Derived requirements flow from base requirements.

C. Validation and Verification

- 1) Verification matrix structure and completeness.
 - Vertical: Mission phase or hardware part or software

- Horizontal: Function, qualification method (analysis, test, similarity, none), results
- 2) Sound verification processes.
 - 3) Evidence that processes are used.
 - 4) Safety critical software identified and treated as such.
 - 5) Mission critical software identified and treated as such.
 - 6) System interface validation and data handoff.
 - 7) Simulation as a verification and validation tool.
 - 8) Other validation and verification facilities.
 - 9) IV&V (or iV&V) for software.
 - 10) Normal and off-nominal (contingency and emergency) testing.
 - 11) Test repeats after configuration changes.
 - 12) End-to-end testing results and configuration freeze.
- D. Cost and Schedule
- 1) Funding adequate to accommodate program.
 - 2) Bottom-up budget and schedule.
 - 3) Cost and schedule reserves.
 - 4) Mission success compromise for cost.
- E. Government and Contractor Roles and Responsibilities
- 1) Roles and responsibilities defined (written), workable, and followed
 - 2) Experience level of contractor work force
- F. Risk Management, Analysis, Test
- 1) Risk relationship to cost, schedule, and content of project.
 - 2) Risk analysis tools used: Failure Mode and Effects Analysis (FMEA), Fault Tolerance Analysis (FTA), Probable Risk Analysis (PRA), etc.
 - 3) Problem reporting procedures.
 - 4) Single point failures identified and remedied or accepted.
 - 5) Hardware and software reuse certification.
 - 6) Day-of-flight configuration testing.
 - 7) Potential failures identified, modeled, and overcome or accepted.
 - 8) Thoroughness of failure postulation.

G. Independent Reviews

- 1) Review conducted by technical peers or experts.
- 2) Sustained support for review members.
- 3) Review independence from common management.
- 4) Review results reported to top management.

H. Operations

- 1) Contingency planning validated and tested (simulated).
- 2) Contingency training of personnel.
- 3) Mission rules formulation and reasonableness.
- 4) Telemetry and health monitoring during critical operations.

I. Center Infrastructure

- 1) Senior management mechanisms for visibility into the project.
- 2) Line organization accountability.

J. Documentation

- 1) Documentation of design decisions and limitations.
- 2) Decisions communicated to all concerned.
- 3) Documentation process continuous.
- 4) Electronic documentation distribution availability.

K. Continuity and Handover

- 1) Transition plan for handover.
- 2) Personnel transfer with handover.
- 3) Recipient team training by development team.
- 4) Training of recipients in procedures and databases.
- 5) Continuity in key positions; overlap.
- 6) New processes generated by the transition.
- 7) Transition risks.

L. Mission Assurance

- 1) Adequate mission assurance staffing.
- 2) Mission success processes in place and followed.

3.0 Technology

- Technology adequately matured
- Technology solutions alternatives considered
- Risk level of new technology
- New technology use and limitations

4.0 Technical Areas

View technical areas with the purpose, goals, and objectives of the Project in mind.

- Aerodynamics
 - Control surface effectiveness
 - External pylons, stores, protuberances, fixtures, mounts
- Alternate landing sites
- Aircrew
 - Aircrew evaluation of simulation results, aircraft readiness, problem areas
 - Guest aircrew in-briefing
 - Review of flight crew training, procedures, and qualifications
- Avionics
 - Redundancy, reliability
 - EMI testing
- Carrier aircraft (mothership)
 - Crew qualifications
 - Communications paths
 - Interfaces, launch panel
 - Pylon, hooks, sway braces
 - Separation analysis
 - Sling loads
- Computational fluid dynamics analysis
- Configuration control
 - Project requirements
 - Flight vehicle under configuration control
 - Hardware
 - Software
 - Hazard Reports

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- Waivers
- Control Room operations
 - Communications links and plans
 - Display and layout: monitoring and analysis
 - PAM3D
 - Key personnel and replacements
 - Personnel training
 - Security
 - Uplink capability
- Data acquisition and transmission
- Documentation
- Experiment(s) description
- Flight envelope and expansion plans
- Flight controls
 - Flight controls computers and software functions
 - V&V, Independent Verification and Validation (IV&V)
 - Certification Standard (Level A: Flight Critical)
- Fuels and oxidizers: hypergolics, pyrophorics, oxygen
- Ground operations and servicing
- Ground support
 - Airfield facilities
 - Communications equipment
 - Ground support equipment
 - Maintenance facilities
 - Navigation, guidance, and landing aids
- Ground testing
 - Communications
 - Drag chute and deploy mechanism
 - Free taxi operation (disconnected from tow)
 - Ground track
 - Outside air temperature limit
 - Steering method
 - Support vehicles
 - Tow operations and tow connector link

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- Wind and crosswind limits
- Guidance, navigation, and control onboard
- Handling qualities
 - Predictions: simulation, analog
- Hazard analysis
 - Hazards identified, mitigated, tracked, and monitored through System Safety Working Group
 - Hazards configuration controlled
 - Severity and probability levels
 - Risk matrix
 - Accepted risks
- Human factors
 - Cockpit operations
 - Unmanned Aerial Vehicle (UAV)/Remotely Piloted Vehicle (RPV) ground control station operations
 - Control room operations
- Hydraulics
 - Redundancy
- Inspection methods at contractor's location and at the Center
- Instrumentation
 - Mishap reconstruction capable
 - System power requirements versus aircraft power available
 - Data Requirements (parameters, sensors, rates)
 - System component environmental qualifications
 - Research data acquisition systems
 - Telemetry
 - Electromagnetic Interference (EMI)
 - Go/No-Go List
 - Documentation
- Life support
 - Anti-G suit
 - Egress capability
 - Parachute characteristics, fit compatibility
 - Pressure suit
 - Sharp edge survey

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- Mission rules
 - Limitations
 - Operational restrictions
- Operations
 - Checklists
 - Emergency procedures
 - Fact Sheet
 - Manuals
- Parachutes, vehicle
 - Construction
 - Pyrotechnics, mortar
- Pilot training (ground and flight)
- Project overview
 - Experiments planned
 - Facilities required
 - Hardware, software
 - Objectives
 - Procedures used
- Propulsion
 - Launch vehicle
 - Research vehicle
- Range requirements
- Range safety
 - Abort landing sites
 - Beacons
 - Command destruct system
 - Encryption
 - Expected casualty calculations
 - Flight termination system
 - Operating area
 - Trajectory
- Recommendations by the Review Board
 - Action Items
- Research vehicle
 - Vehicle purge

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- Landing gear
- Mass properties
- Pilot intervention for UAVs
- Thermal protection
- Risk management
 - Assessment of residual risk
 - Accepted risk list
 - Risk/Hazard identification
 - Severity and probability matrix
 - Pre-mishap contingency plan
 - Pre-declared risk list
- Simulation
 - Certification: qualified for use
 - Configuration management
 - Hardware in the Loop (HIL), Aircraft in the Loop (AIL)
 - Nominal, off-nominal testing
 - Verification
 - Validation
- Software
 - Configuration control
 - IV&V
 - Simulation
 - Formal code reviews
- Stage separation
 - Aerodynamics
 - EMI
 - Ordnance
- Structures
 - Aeroelastic effects
 - GVT
 - Structural Mode Interaction (SMI)
 - Sideslip-dynamic pressure combination (βq_{bar})
- Uncertainty analysis
 - Margins
 - Monte Carlo analysis

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- Validation and Verification
 - Validation: System performs adequately to accomplish the mission: test, analysis, demonstration, similarity, inspection, simulation
 - Verification: System performs according to the specification: test, analysis, demonstration, similarity, inspection, simulation
 - All-up, end-to-end check: thermal, vibration, shock, pressures, etc., combined
- Vehicle health monitoring
- Waivers
- Wind tunnel predictions
- Wiring
- Work Breakdown Structure

APPENDIX B – SAMPLE QUESTIONS FOR REVIEW BOARD MEMBERS

MODIFICATIONS

1. Can the type and amount of power available support the electrical requirements of the installations?
2. Have operating procedures and an inspection checklist been developed for the installation?
3. Is cooling air adequate to properly cool avionics in flight and on the ground?
4. Have partial flight manuals and checklist been prepared and approved?
5. Have weight and balance figures been computed and are they within recommended limits?
6. Does the installation of test equipment in the aircraft interior keep aisles and emergency exits clear for evacuation?
7. Do installed racks and test equipment have projections (bolts, rivets, knobs, handles) that could cause injury to aircrew personnel?
8. Does instrumentation installed in the cockpit obstruct vision or egress or add discomfort and distraction to the aircrew?

9. Is the aircraft properly placarded and has the test instrumentation in the cockpit been properly identified and marked?
10. Do any external modifications affect the pitot-static system?
11. Have magnetic interference (EMI) ramifications been considered? Will flight day EMI be different from other days?
12. Have modifications been photographically documented on film or video?
13. Review fact sheet. Are all changes incorporated?

INSTRUMENTATION

1. Has the proposed and/or completed installation been inspected by the project test aircrew to ensure that it offers the safest possible installation? Has a cockpit safety design board approved the changes and documented approval?
2. Has a complete set of operating instructions been formulated and published?
3. Are the instrumentation appendages (nose boom pitot head, vanes, etc.) ahead of the engine checked regularly for structural integrity?
4. Has proper consideration been given to the separation of shielding of instrumentation and aircraft wiring, especially in the area of weapons system control circuits?
5. Have provisions been made for coordinating the data when more than one recording device is to be used?
6. Have adequate written procedures been developed for the maintenance, inspection, and calibration of the instrumentation?
7. Has a complete set of emergency or alternate procedures for test instrumentation failures been formulated in order that some part of a scheduled mission can be accomplished safely with certain instrumentation inoperative?
8. Are you reasonable certain that this test can be conducted safely?
9. Is it necessary or advisable to monitor internal black box temperatures monitored in flight, on the ground, and during build-up and maintenance?
10. Are black boxes instrumented to reveal elapsed operating hours? On/off cycles? Are hours and cycles frequently monitored and documented?

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11. Are film/tape time limits on recorders and cameras understood? Speeds? Initiation and shutoff times?
12. Has the instrumentation installation been documented by photography/video prior to flight?

MAINTENANCE

1. Are there any special maintenance procedures required to support the test? Are they published as a requirement?
2. Have inspection requirements been compiled into preflight, postflight, and phase documents?
3. Have the aircraft and, in particular, the modification areas, been thoroughly inspected for foreign objects?
4. Have closeout photos been taken of areas that are difficult to access or of all areas for vehicles that are to be unrecoverable post flight?
5. In the case of joint maintenance support, who is in charge?
6. Are you reasonably certain that the test can be conducted safely?

FLIGHT CONTROL ROOM – FLIGHT OPS

1. For each flight test maneuver or event:
 - Who are the key people monitoring the event? Are they properly trained? Are back-up personnel identified and trained?
 - What recorders, channels, and parameters are being monitored for critical and precautionary indications?
 - What are the critical and precautionary limits for the given event?
 - Is there any question concerning whom you notify, how you notify them, what phraseology to use, and with what urgency? Are there any questions concerning how you expect people to react when you notify them of a critical or precautionary indication?
 - Is the control room team familiar and proficient with emergency procedures?

2. Is there any question concerning the parameters monitored, type of sensor used, or the method of display?
3. Are you satisfied with the limits and accuracy of the monitored parameters? With interfaces with other monitored parameters?
4. Have you checked scaling and sensing (direction) of the parameters you are to monitor?
5. Are you satisfied with your communication network, procedures and equipment?
6. Are flight envelope limits clearly defined and understood before flight by necessary persons?
7. Will you be able to detect faulty instrumentation indications of critical flight parameters?

AERODYNAMICS

1. Have all aspects of new design or modification been considered for effect on
 - Aerodynamics/drag
 - Acoustics/vibration
 - Surface shielding/ineffectiveness due to boundary layer/wake shedding
 - Weight
 - Center of Gravity (CG)
 - Inertia
 - Exterior Configuration
 - Shock interaction
 - Control surface movements
 - Pitot-static system
 - Other instrumentation (hot wires, pressure sensors/taps, hot films, etc.)
 - Etc.
2. Have effects of inflight unplanned alteration of appendages or flight surfaces (i.e., experiment breakup or impact on aircraft/fixture, etc.) been assessed?
3. Is the aero model satisfactory? Any undue or unaddressed concerns? How are you going to verify the aero model during envelope expansion flights?
4. Is simulation satisfactory? Have appropriate sensitivity changes been examined?

5. Is instrumentation and its calibration satisfactory? Does it tell you all you need to know for safety and mission accomplishment? What are the shortcomings?
6. Do you have any undue concerns about questions in the “Flight Control Room Flight Ops” section of this document?
7. Have all safety and mission concerns been adequately addressed?
8. Are you reasonably certain flight can be conducted safely?

AEROSTRUCTURES

1. Have all aspects of new design or modification been considered for effect on structure and vice versa?
2. Are ground load and ground vibration tests (GVT) adequate? Any evidence of airframe vibration (flutter, buffet, acoustics)?
3. Is instrumentation satisfactory? Does it tell you all you need to know for safety and mission accomplishment? What are the shortcomings?
4. Do you have any undue concerns about questions in the “Flight Control Room Ops” section of this document?
5. Have all safety and mission concerns been adequately addressed? What factor of safety in design or test? What Margin of Safety?
6. Are you reasonably certain flight can be conducted safely?

CONTROLS (FLIGHT, ENGINE, ETC.)

1. Have all “fail to operate” and full hardover impacts been assessed?
2. Is the system implemented as intended by the designer? How is it ensured?
3. Have end-to-end tests been conducted on the full-up total system? Have all credible inputs been accomplished to observe system response?
4. Do all lights and indicators obtain intelligence from credible sources?
5. How does failure or erroneous signal in a light or indicator impact safety or mission accomplishment?

6. Is simulation satisfactory? Have appropriate sensitivity changes been examined?
7. Is there a “last resort” provision to switch back to a previously annunciated failed system in the event vehicle loss is imminent regardless? (i.e., the system may be healthy with the warning system malfunctioning.)
8. Have all prudent efforts been considered to continue operating system in a degraded “get home” condition in lieu of switching to a dormant or benign backup system whose health is not utterly known?
9. Has consideration been given to using parallel-active dual systems rather than primary-active, backup-benign systems?
10. In the event of a failure, will an impacted item be automatically positioned at an optimum setting (i.e., engine speed, flight control surface, etc.)?
11. Do you have any undue concerns about questions in the “Flight Control Ops” section of this document?
12. Have all safety and mission concerns been adequately addressed? Has a system safety assessment been accomplished?
13. Are you reasonably certain flight can be conducted safely?

Guidance Navigation & Control

1. Have all aspects of new design or modification been considered for effect on
 - Dynamics and vice versa
 - Weight
 - CG
 - Inertia
 - Exterior configuration
 - Surface control movements
 - Pitot-static system
 - Other instrumentation
 - Etc.

2. Have effects of unplanned alteration of appendages or flight surfaces been assessed?
3. Is simulation satisfactory? Have appropriate sensitivity changes been examined?
4. Is instrumentation satisfactory? Does it tell you all you need know for safety and mission accomplishment? What are the shortcomings?
5. Do you have any undue concerns about questions in the "Flight Control Ops" section of this document?
6. Have all safety and mission concerns been adequately addressed?
7. Are you reasonably certain flight can be conducted safely?

PROPULSION

1. Are propulsion characteristics compatible with the
 - Intended flight envelope
 - Altitude
 - Speed
 - G-force
 - Angle of attack
 - Sideslip
2. Where is flameout or engine stall anticipated?
3. Are procedures adequate to avoid overtemp or other engine damage?
4. Are engine recovery procedures adequate?
5. Will testing be conducted in an area where emergency power-off landing can be safely performed?
6. Are flight control and electrical/hydraulic power adequate for power-off landing?
7. Is propulsion related instrumentation adequately installed and calibrated? Does it give the required information for safety monitoring and mission accomplishment?

PROJECT MANAGEMENT

1. Have all the policies of the Center Management System been addressed?
2. Have all project documents been completed at the appropriate life-cycle gates?
3. Has a review of all system safety documentation been accomplished?
4. What are your mission rules and accepted risks?
5. What configuration control process is utilized?
6. Has the Project utilized appropriate Lesson Learned databases?

APPENDIX C: RELEVANT DOCUMENTS

Authority Documents

NPR 7900.3 Aircraft Operations Management
AFOP- Tech Brief (T/B) & Mini Tech Brief (Mini T/B)
7900.3-022
AFOP- Airworthiness And Flight Safety Review Process
7900.3-023

Forms

AFRC70129 Flight Request

Templates

TEM-001 a- Hazard Action Matrix
b

APPENDIX D: ACRONYMS

AFSRB	Airworthiness and Flight Safety Review Board
AIL	Aircraft In the Loop
CDR	Critical Design Review
CG	Center of Gravity
EMI	Electromagnetic Interference
FMEA	Failure Mode and Effects Analysis
FRR	Flight Readiness Review
FRRB	Flight Readiness Review Board
FTA	Fault Tolerance Analysis
GVT	Ground Vibration Test
HIL	Hardware In the Loop
IV&V	Independent Verification and Validation
ORR	Operational Readiness Review
PDR	Preliminary Design Review
PRA	Probabilistic Risk Analysis
RPV	Remotely Piloted Vehicle
SMI	Structural Mode Interaction
UAV	Unmanned Aerial Vehicle
UAS	Unmanned Aerial System
V&V	Verification & Validation

Document History Log

Review Date: 10-15-10

This page is for informational purposes and does not have to be retained with the document.

Baseline, 10-15-10

- Replaces DHB-X-001

Admin Change Baseline-1, 11-17-10

- Corrected footer to show that document may be distributed outside of Dryden.

Admin Change Baseline-2, 08-16-11

- Corrected expiration date in header (pages 2-15).
- Fixed hyperlinks.

Admin Change Baseline-3, 02-07-13

- Updated to current template
- Updated ITAR labeling to show the document does not contain ITAR information.

Admin Change Baseline-4, 09-22-15

- Extended expiration date from 10-15-15 to 04-15-20.

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- Corrected incorrect expiration date (2020 is incorrect above). Should have been 04-15-16.
- Extended expiration date from 04-15-16 to 10-01-16.

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- Updated document number from G-7900.3-001 to AFG-7900.3-001.
- Updated owning branch code to name.

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- Updated footer.

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