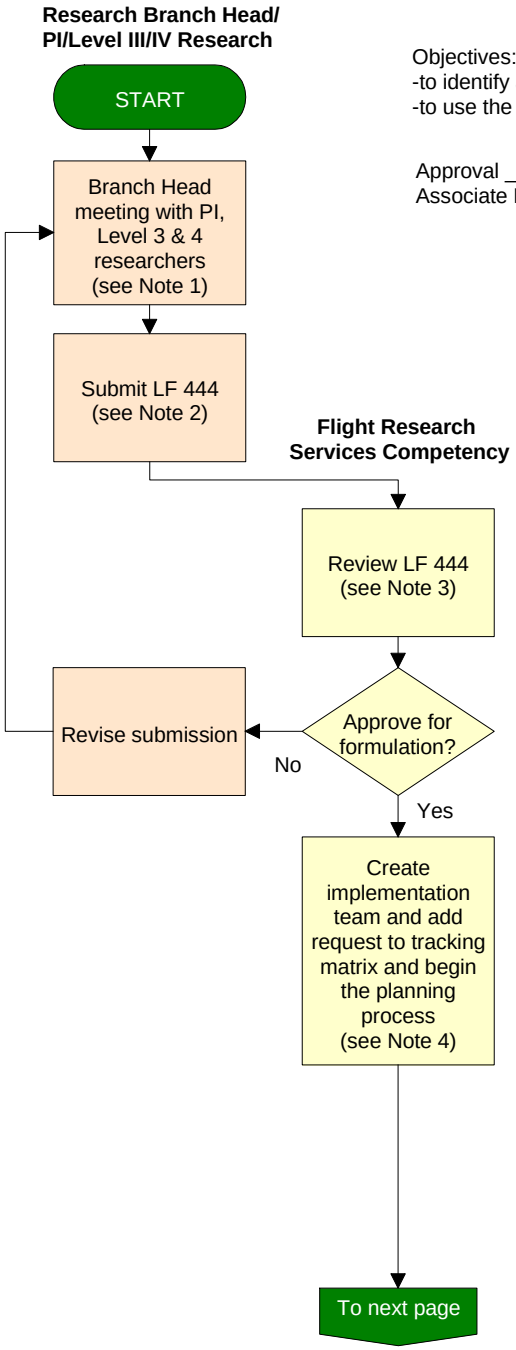
CONDUCTING SIMULATOR AND AIRCRAFT SERVICE ACTIVITY EXPERIMENTS



Objectives:
-to identify all LMS processes, forms and documents required
-to use the Simulator and Aircraft Service Activity (SASA)

Approval Original signed on file
Associate Director for Research and Technology Competencies

Overview
For non-research requests such as demonstrations or tours, submit the request verbally or by e-mail to FSSB for simulators and Chief of Research Operations for aircraft. This process lays out a series of steps required to perform Simulation and/or Flight Experiments. Many steps will be done in parallel. In some cases the sequence of events may be changed and some events may be waived. The review of the initial request will determine when changes in sequencing activities or step waivers can be made. Any out of sequence changes will be documented in the tracking matrix. It is the intent of the process to allow flexibility so that the experiment can be accomplished in a safe but timely, cost efficient manner.

Documentation will be streamlined wherever possible depending on the complexity of the Simulation and/or Flight Experiment. Information may be conveyed via viewgraph presentations, charts, and diagrams in place of formal documentation (Requirements Document, Plan of Test Document) and for reviews (SRR, PDR, CDR, etc.). Although content is generally more important than format, certain standards will be maintained.

Note 1
Any request for research (LF 444) which utilizes an asset of the SASA must be sponsored/supported by one of the Program Offices at LaRC. A list of all assets is included in Appendix F.

For complex integrated experiments, participants should include: Program Office, Branch Head(s), PI(s), participation from FSSB and/or AEB is encouraged.

This meeting should include a discussion of the following:
-Level II objectives/scope (including program milestones with exit criteria)
-Level III plan or equivalent (including milestones with exit criteria), and program office priorities
-operations concepts
-groundrules and assumptions
-PRD for funding non-SASA work, equipment, etc.
-non-SASA workforce

Complex experiments should be submitted using one integrated LF 444.

General Information
A list of acronyms can be found in Appendix E.

The following records are generated by this procedure and should be maintained in accordance with CID 1440.7:
-ASRB Package
-Flight Test and Operation Safety Report (FTOSR)
-Project File
-Requirement Review Results
-Tracking Matrix
-Simulation Modification Request (LF 393)
-Simulation Readiness and Performance Report (LF 394)
-Aircraft Work Order Request and Approval (LF 432)
-Experimental Systems Work Request (LF 436)
-Simulation and Aircraft Service Activity (SASA) Work Request (LF 444)
-Simulator and Aircraft Service Activity Requirements Document Change Request Form (LF 506)

Note 2
A LF 444 should be filled out for each simulation or flight experiment. One or more PRD should be associated with each LF 444 (see LMS-CP-1903).

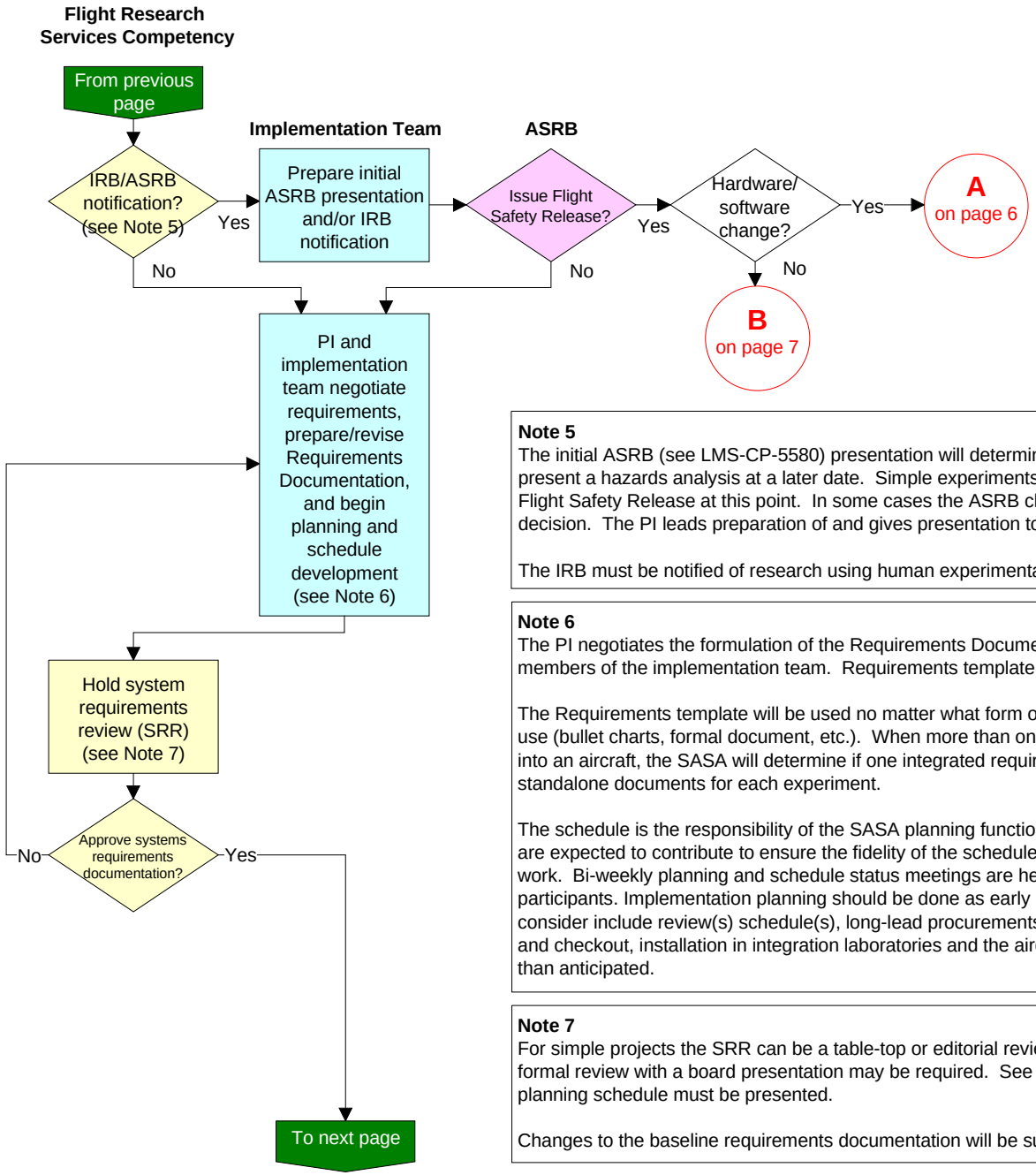
Information provided should be complete enough for a determination of the scope of the request so initial civil service and contractor workforce estimates can be made. The PRD writer should be sure the Program Office is notified early if the experiments require aircraft deployments (overnight trips).

Note 3
Reviewers include SASA, Head FSSB and/or AEB, and Chief of Research Operations.

Note 4
Implementation Team Members:
Simulation Experiment only: researchers and FSSB
Flight Experiment: researchers, FSSB & AEB (will coordinate support from SEC), Operations Engineering (will coordinate support from FOB, ASB, and QAO) and Airworthiness Engineer.

Once approved, Competency Office will issue a memorandum naming team leads.

Tracking matrix and SASA schedule will be posted at the following URL: http://www-sdb.larc.nasa.gov/flight/sim.html



Note 5
The initial ASRB (see LMS-CP-5580) presentation will determine if the experiment needs to present a hazards analysis at a later date. Simple experiments with lower risk may be given a Flight Safety Release at this point. In some cases the ASRB chairman may make an out of board decision. The PI leads preparation of and gives presentation to ASRB.

The IRB must be notified of research using human experimental subjects.

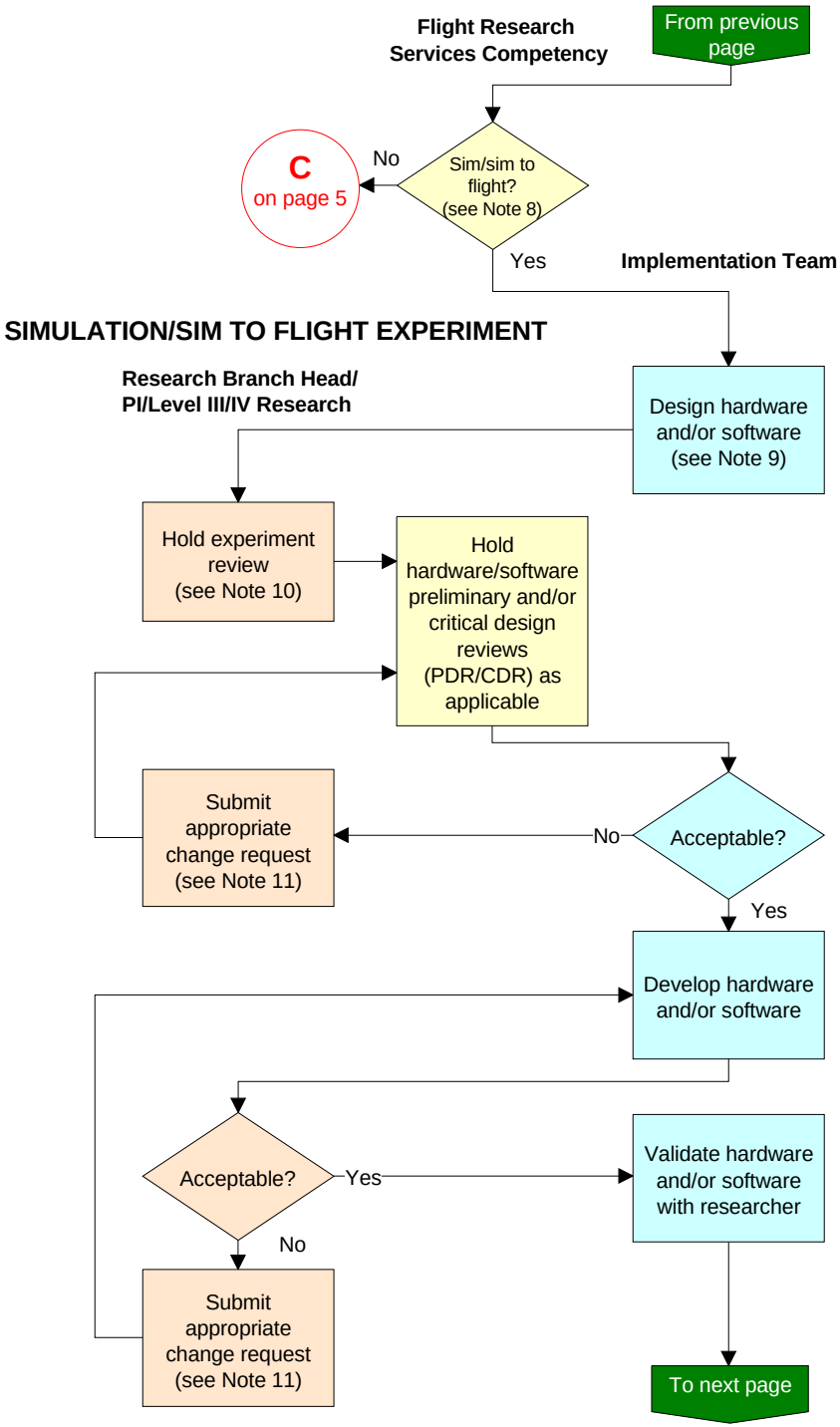
Note 6
The PI negotiates the formulation of the Requirements Documentation with consensus with other members of the implementation team. Requirements template is included in the LF 444.

The Requirements template will be used no matter what form of documentation the team decides to use (bullet charts, formal document, etc.). When more than one flight experiment will be integrated into an aircraft, the SASA will determine if one integrated requirements document is required vs. standalone documents for each experiment.

The schedule is the responsibility of the SASA planning function. Researchers and Implementers are expected to contribute to ensure the fidelity of the schedule which will be used to manage the work. Bi-weekly planning and schedule status meetings are held with representatives from all participants. Implementation planning should be done as early in the process as possible. Items to consider include review(s) schedule(s), long-lead procurements, experimental systems build-up, test and checkout, installation in integration laboratories and the aircraft all of which often take longer than anticipated.

Note 7
For simple projects the SRR can be a table-top or editorial review. For more complex projects a formal review with a board presentation may be required. See Appendix A for SRR template. A planning schedule must be presented.

Changes to the baseline requirements documentation will be submitted using LF 506.



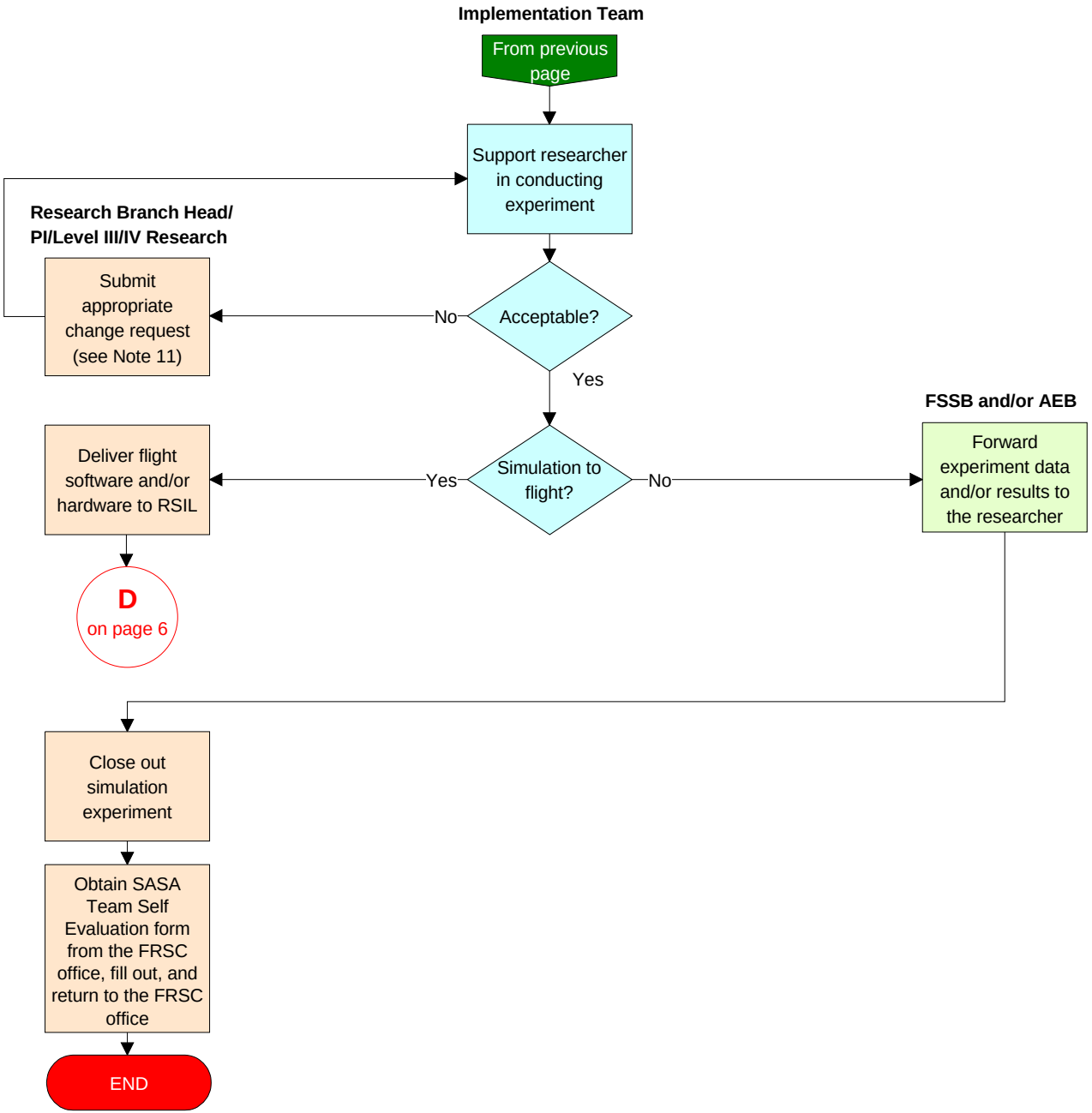
Note 8
FSSB is responsible for both simulation studies and development of simulation-to-flight software. Flight only may involve researcher provided software. See page 5, Note 12.

Note 9
Software will be developed per LMS-CP-5528, LMS-CP-5529, and LMS-CP-5532. The PDRs and CDRs will be held to the same standards as in Appendix A. If previously approved hardware or software is being modified, a simple delta review may be all that is required.

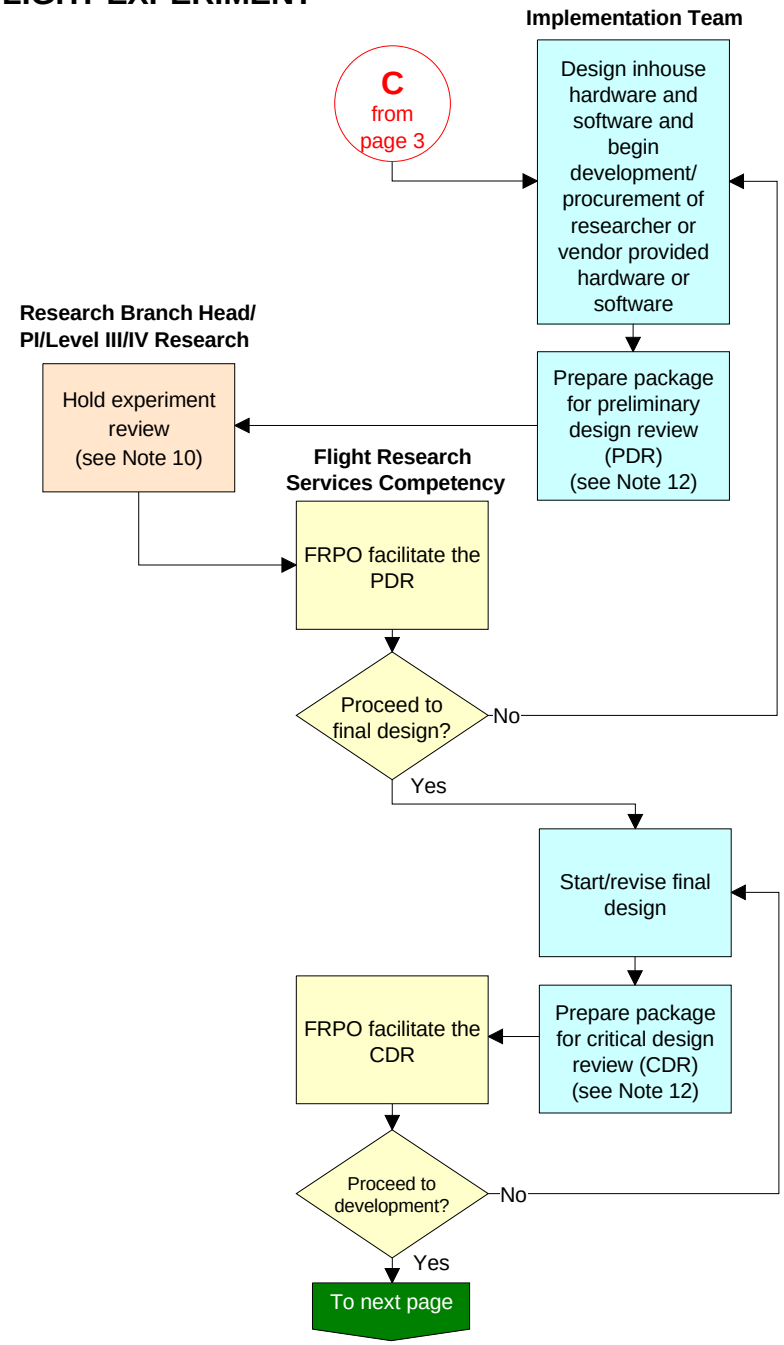
For in-house FSSB developed software, PDR and CDR are required. For researcher-provided software, one review is typically required. If the software system is significantly complex, PDF and CDR may be required. See Appendix B1 for software review instructions.

Note 10
The Experiment Review will include an evaluation of the Plan of Test (which should be developed with participation from the FOB) and review of items in Note 1. Assess researcher/PI readiness to commence requirements negotiations with core "implementing organization" members of the Implementation Team (typically FSSB, AEB, and FOB).

Note 11
Modifications to simulator hardware should be made using Simulation Modification Request, LF 393. All changes in the simulator configuration as specified in the request must be documented per LMS-OP-0914. Requirements document changes are submitted using LF 506.


Implementation Team
From previous page
Support researcher in conducting experiment
Research Branch Head/ PI/Level III/IV Research
Submit appropriate change request (see Note 11)
No
Acceptable?
Yes
FSSB and/or AEB
Deliver flight software and/or hardware to RSIL
Yes
Simulation to flight?
No
Forward experiment data and/or results to the researcher
D
on page 6
Close out simulation experiment
Obtain SASA Team Self Evaluation form from the FRSC office, fill out, and return to the FRSC office
END

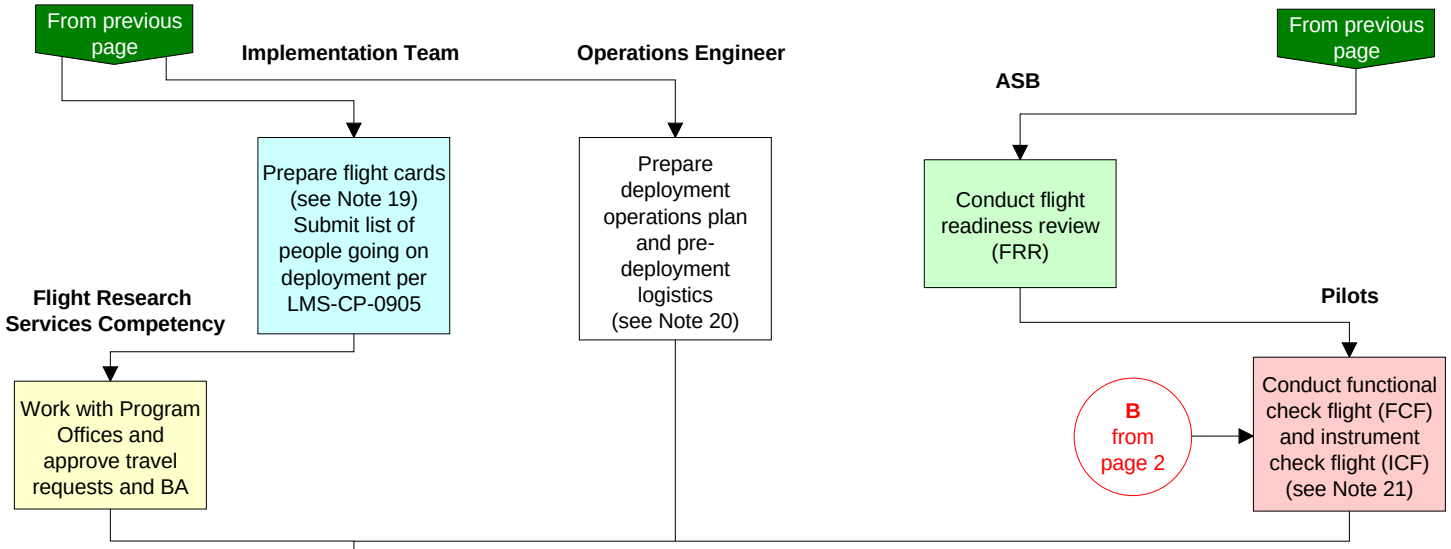
FLIGHT EXPERIMENT

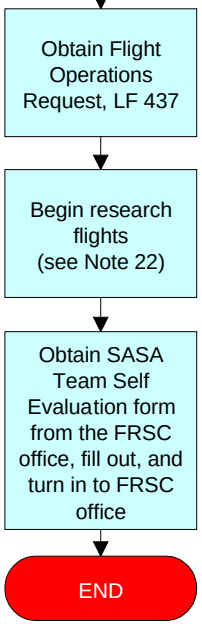


Note 12
The Preliminary and Critical Design Reviews (PDR/CDR) will follow guidelines in Appendix A.

Researcher or vendor provided software will be developed per LMS-CP-5528, LMS-CP-5529, and LMS-CP-5532. If previously approved hardware or software is being modified, a simple delta review may be all that is required.

For in-house FSSB developed software, PDR and CDR are required. For researcher-provided software, one review is typically required. If the software system is significantly complex, PDR and CDR may be required. See Appendix B1 for software review instructions.





Note 18
To ensure LaRC research and program support aircraft operations are conducted in a safe, efficient, productive manner the Director, Flight Research Services Competency, the Chief of Research Operations and the Aviation Safety Officer maintain direct oversight of the planning and implementation of these activities. Their specific responsibilities can be found in Appendix C, Roles and Responsibilities of key personnel and organizations. FTOSR outline - See Appendix D. The fundamental premise of system safety at LaRC is that hazards will be reduced to the lowest practical level with remaining risks identified and managed to prevent or ameliorate consequences of hazardous situations. Hazards Analysis is an iterative effort with participation from QA, all flight disciplines, MAO, and researchers.

Note 19
PI/researcher provides input for the flight cards to the Operations Engineer who will prepare the final version prior to flight.

Note 20
Operations Engineers will provide all logistics (including hotel reservations) and ground operations coordination for NASA personnel. Operations Engineers also coordinate logistics planning for day trips to Wallops which has its own set of operations requirements, Operations Engineers to provide ATC coordination.

Note 21
FCF may be conducted prior to issuance of flight safety release. Software changes to delivery after initial ICF will be tracked through LF 436. See Appendix B3 for software field change instructions.

Note 22
Research Flight Roles and Responsibilities:
Competency Office - provides management support
PI Researchers - conduct flight research
FSSB & AEB - provides technical support
ASB - maintenance and aircraft operations
Airworthiness Engineers - tracks changes (ESWR, LF 436, is used for in-field software changes)
Operations Engineers - pre-flight briefings and logistics support
QAO - technical support

APPENDIX A

System Requirement Review Template

-Research Objectives (including expected products, demos, etc.)
-Key Milestones/Deliverables
-Facility Requirements
-Workforce Requirements (Researchers only)
-Overall Implementation Requirements
  --Hardware (including pallets)
  --Software
-Video/Audio/Display Requirements
-Simulation requirements
-Operational Requirements (include constraints)
-Current Status

An expanded version of this template can be accessed from the following URL:
http://www-sdb.larc.nasa.gov/flight/sim.html

Preliminary Design Review (PDR)

(1) Purpose

(a) The PDR is held at the system, subsystem, and component level to demonstrate preliminary designs meet system requirements with acceptable risk. All verification and validation methodologies and interfaces must be identified.

(b) Successful completion of the PDR will result in approval of baselines for the system performance allocations. The preliminary design will also serve as a prerequisite to proceeding with detailed design.

(2) Timing

The project/experiment is ready to baseline the system performance and functional allocations, budget, and schedule. All system, subsystem and component preliminary designs are complete and meet system performance requirements. Some development build/test and detail design may have been done.

(3) Contents

(a) Science/mission objectives review
(b) System performance and functional allocations baseline
(c) RFA status
(d) Design solution
  (i) Subsystem review reports
  (ii) Design description
  (iii) Satisfaction and traceability of performance requirements

APPENDIX A
(continued)

- (iv) Changes from the SRR design approach
- (v) Supporting analyses and tests
- (vi) Trade-off studies
- (vii) Acceptable risk
- (viii) System architecture
- (ix) Technical standards used and impacts of revisions/changes

(e) Safety, including design considerations, e.g., margin and redundancy, flight, range, and operations

(f) Project plan baseline
- (i) WBS
- (ii) Cost
- (iii) Schedule
- (iv) Resources
- (v) Configuration management plan
- (vi) Product assurance plan
- (vii) Risk management

(g) Procurement plan
- (i) Subcontracts
- (ii) Components

(h) Mission operations, including ground operations

(i) Ground support equipment

(j) Development plan
- (i) Breadboard, engineering model, and flight build schedule and strategy
- (ii) System performance requirement verification and validation plan
- (iii) Integrated test plan
- (iv) Calibration plan

(k) Logistics
- (i) Servicing
- (ii) Spares
- (iii) Testing
- (iv) Transportation
- (v) Assembly and integration
- (vi) Repairability
- (vii) Facilities

(l) De-scope plan

(m) Lessons learned

APPENDIX A
(continued)

(4) Criteria for Successful Completion

(a) There is evidence that the preliminary design will meet performance, cost, and schedule as planned.
(b) Overall system architecture has been established and all the external interfaces have been identified and defined.
(c) All system, subsystem, and significant component functional allocations are complete and ready for formal approval.
(d) The proposed design does not violate any safety requirements, which will endanger human life or mission success.
(e) The reliability analysis is based on a sound methodology and presents realistic predictions for logistics planning and life cycle cost analysis.
(f) The design solution is producible based on existing processes and techniques; if not, risk areas which require unique and unproven processes are identified and plans established.
(g) Long-lead items that threaten schedule compliance have been fully justified, and contingency plans have been provided.
(h) Required resources (workforce and facilities) are available to proceed further.
(i) An acceptable operations concept has been developed.
(j) All assembly, integration, and verification test plans have been presented.

Critical Design Review (CDR)

(1) Purpose

The CDR is to demonstrate successful completion of the detailed design phase and readiness to proceed with fabrication of the flight system. All technical problems and design anomalies must be resolved without compromising science/mission objectives, reliability, and safety.

(2) Timing

The detail design phase has been completed to 100 percent and all supporting analyses are complete. The project/experiment is ready to start fabrication, integration, testing, and go under configuration management based on this design baseline. As outlined in the fabrication plan at PDR, fabrication and/or procurement of some long-lead flight items may need to be started prior to this review. In these exceptional cases, the maturity of the design and the necessity of early start should be carefully evaluated before proceeding. Drawings and analyses shall be available to panel members 2 weeks in advance of review.

(3) Contents

(a) Science/mission objectives review
(b) RFA status
(c) Baseline detail design
  (i) Subsystem review reports
  (ii) Changes from the PDR baseline design
  (iii) Supporting analyses
  (iv) Performance requirements

APPENDIX A
(continued)

(d) Safety (status of design safety review(s), if any, and preliminary hazard analysis)
(e) Project plan status
  (i) Cost
  (ii) Schedule
  (iii) Resources
  (iv) Configuration management status
  (v) Product assurance plan
  (vi) Risk management
(f) Procurement plan status
  (i) Subcontracts
  (ii) Components
(g) Mission operations plan, including ground operations
  (i) Flight operations team/training plans
  (ii) Deployment activities
(h) Ground support equipment
(i) Development plans and status
  (i) Build plan and status
  (ii) System performance verification plan and status test results
  (ii) Calibration plan and status
(j) Logistics
  (i) Servicing
  (ii) Spares
  (iii) Testing
  (iv) Transportation
  (v) Assembly and integration
  (vi) Repairability
  (vii) Facilities
(k) Data retrieval and analysis
(l) Lessons learned

(4) Criteria for Successful Completion

(a) There is substantial evidence that the detailed design will meet performance, cost, and schedule as planned.
(b) All fabrication drawings have been completed with a complete inventory of bill of materials including any long lead items.
(c) All development testing successfully concluded; solutions are identified or in hand.
(d) All appropriate engineering analyses are complete and accurate; the detailed design is based on these results.
(e) Integrated safety analysis shows that any outstanding hazards can be controlled and are within an acceptable risk level.
(f) A comprehensive system verification and validation approach has been established.

APPENDIX B1
Software Review Instructions

A software design review presentation is to be conducted at LaRC where a panel consisting of LaRC pilots, principal investigator, software managers, software quality assurance personnel, and configuration management personnel can meet at a common location for a productive and effective review and discussion. The presentation should be scheduled with Victoria Chung (757-864-6406) as soon suggested review materials outlined below are completed. A test plan shall be prepared for verification and validation of all signals required by a flight experiment. The test plan shall be executed and deficiencies resolved using a simulator (e.g. Integration Flight Deck Simulator or Research Flight Deck Simulator) and/or laboratory (Research Systems Integration Lab or Flight Systems Integration Lab) prior to onboard ARIES testing. Signals unavailable in the simulation environment will be identified for subsequent verification on the ARIES. The actual test is to be performed at a simulator or a lab according to the test plan no later than two months before the deployment. Checkout of software onboard ARIES at LaRC is also required during local flight tests, generally no later than a month before deployment.

1. FRSC/FSSB In-house Developed Software
   Preliminary and Critical Design reviews are required.

Preliminary Design Review

This review is scheduled after the functional design is complete and before the detailed design phase begins

Key issues to be addressed
Have alternative design approaches been examined?
Are all requirements traceable to subsystems in the functional design?
Is the subsystem partitioning sensible in view of the required processing?
Are all interface descriptions complete at the system and subsystem level?
* Are operational scenarios completely specified?
Is the error handling and recovery strategy comprehensive?
Is the estimate of resources realistic?
Is the schedule reasonable?
Have technical risks, including any TBD requirements, been adequately addressed?
Has the design been elaborated in baseline diagrams to a sufficient level of detail?
Does the design facilitate testing?

* Presentation of operational scenarios should be limited to the nominal operating and significant contingency cases

Here is a suggested outline

1. Agenda - outline of review material

2. Introduction - background of project and system objectives

3. Design Overview
   a. Design drivers and their order of importance (e.g. performance, reliability, hardware, memory considerations, programming language)
   b. Results of reuse tradeoff analyses
   c. Critique of design alternatives

APPENDIX B1
Software Review Instructions
(continued)

d. Diagram of selected design. Shows products generated, interconnections among subsystems, external interfaces. Emphasis should be on differences of system to be developed and existing, similar systems.
e. Mapping of external interfaces to ICDs and ICD status

4. System Operation
   a. Operations scenarios - one for each product that is generated. Includes the form of the product and the frequency of generation. Panels and displays should be annotated to show what various selections will do.
   b. System performance considerations

5. Major software components - one diagram per subsystem

6. Requirements Traceability Matrix - one diagram per subsystem

7. Testing Strategy
   a. How test data are to be obtained
   b. Drivers/simulators to be built
   c. Other resources

8. Design Team assessment - technical risks and issues/problems internal to the software development effort; areas remaining to be prototyped

9. Software development/management plan - brief overview of how development effort is conducted and managed; e.g. CM, documentation, programming standards, tools

10. Software size estimates - one slide
    a. “Margins”

11. Milestones and schedule - one slide

12. Issues, Problems, TBD items beyond the control of the software team
    a. Review of any TBDs outstanding
    b. Dates by which TBDs must be resolved

Some of the above, such as reuse trades, may be “not applicable.”

EXIT CRITERIA FROM PRELIMINARY DESIGN PHASE

• Have all components that are candidates for reuse been analyzed? Have the trade-offs between reuse and new development been carefully investigated?

• Have developers evaluated alternative design approaches and chosen the optimum design?

• Have they been inspected?

• Have the key criteria been met? That is, has the PDR been successfully completed and all PDR action items been answered?

APPENDIX B1
Software Review Instructions
(continued)

Critical Design Review

This review occurs after the detailed design is complete and before implementation is begun. This is typically a bottom-up review of the detailed design that will be the blueprint for the delivered code. This does not mean that no coding can begin until after the CDR, prototyping of key components is a general practice.

Attendees should be familiar with the project background, requirements, and design. (757 TRF standing panels are selected to maintain this corporate knowledge and continuity)

Agenda - selective presentation of the detailed design of the system. Emphasis should be given to changes to the high-level design, system operations, development plan, etc. since PDR. Speakers should highlight these changes both on their slides and during their presentations, so that they become the focus of the review. The CDR also provides an opportunity for the development team to air issues that are of concern to management, the mission project office, quality assurance personnel and the CCB.

Materials Distribution
- Detailed design document or Project equivalent
- Applicable requirements documents
- CDR material is distributed two days in advance

Key Issues To Be Addressed
- Are the operational scenarios acceptable?
- Are all baseline diagrams complete to the subroutine level? (or OO equivalent)
- Are all interfaces - external and internal - completely specified at the subroutine level?
- Will an implementation of the detailed design provide all of the required functions? (Does the design satisfy all requirements and specifications?)
- Is the design robust? Is user input examined for potential errors before processing continues?
- Is the design testable?
- Does the build/release schedule provide for early testing of end-to-end system capabilities? Is the schedule reasonable and feasible for implementing the design?
- Have all design guidelines and standards been followed?

Suggested Outline and Contents

1. Introduction - background of project, purpose of the system, and an agenda outlining review materials to be presented
   a. Status of PDR action items

2. Design overview - major design changes since PDR (with justification)
   a. Design diagrams, showing products generated, interconnections among subsystems, external interfaces
   b. Mapping of external interfaces to ICDs and ICD status

3. Results of prototyping efforts

4. Changes to system operation since PDR
   a. Updated operations scenarios/scripts
   b. System performance considerations

5. Changes to major software components since PDR (with justifications)

APPENDIX B1
Software Review Instructions
(continued)

6. Requirements Traceability matrix mapping requirements to major components

7. Software reuse strategy
   a. Changes to the reuse proposal since PDR
   b. New/revised reuse tradeoff analyses
   c. Key points of the detailed reuse strategy, including software developed for reuse in future projects
   d. Summary of reusable software library use - what is used, what is not, reasons, statistics

8. Changes to testing strategy
   a. How test data are to be obtained
   b. Drivers/simulators to be built

9. Required Resources - hardware required, internal storage requirements, disk space, impact on current computer usage, impacts of compiler

10. Changes to the software development/management plan since PDR

11. Implementation of dependencies - the order in which components should be implemented to optimize unit/package testing

12. Updated software size estimate - revised from memory, bandwidth, cpu use numbers presented at PDR

13. Milestones and schedules including a well thought-out build plan

14. Issues, risks, problems, TBD items
   a. Review of TBDs from PDR
   b. Dates by which TBDs and other issues must be resolved
   c. Risk - technical, cost, schedule

Some of the above may be very short or not applicable (e.g. Ada topics, build plan for extremely small system, and reuse)

EXIT CRITERIA

• Are all design diagrams complete to the unit level? Have all interfaces - external and internal been completely specified?

• Have all unit designs been inspected?

• Have all TBD requirements been resolved? If not, how will the remaining TBDs impact the current system design? Are there critical requirements that must be determined before implementation can proceed?

• Have the key exit criteria for this phase been met? That is, has the detailed design document been completed (TRF equivalent?), has the CDR been successfully concluded, and have responses been provided to all CDR action items?

APPENDIX B1
Software Review Instructions
(continued)

2. Researcher-Provided Software
If the software system is complex, a PDR and CDR shall be required. Otherwise, a software review outlined below shall be used to prepare for the review presentation.

1.1 Requirements
- 1.1.1 Overview of experiment objectives
- 1.1.2 Interface requirements - summary of hardware and software interfaces
- 1.1.3 Performance requirements – summary of system processing speed, system response time, system failure recovery time, and output data availability
- 1.1.4 Environment considerations – special computing capabilities, e.g. graphics configuration, operating system configuration (e.g. type and version), operating system limitations, database constraints, and resource limitations
- 1.1.5 Operations concepts – high level diagrams of operating scenarios showing intended system behavior from the user viewpoint. Discussion of the system's modes of operation (e.g. normal, failure detection, and failure recovery modes)

1.2 Software Design and Architecture
- 1.2.1 Assumptions and constraints
- 1.2.2 Design diagrams showing products generated, interconnections among subsystems and external interfaces (e.g. SCRAMNet, Ethernet, ARINC, and/or serial communications)
- 1.2.3 Sample input screens and menus, sample output displays, reports, and plots
- 1.2.4 Performance Metrics, e.g. hardware required, memory/disk usage, processing time, software size
- 1.2.5 List of software components
- 1.2.6 Technical or programmatic concerns, issues, or risks (if any)
- 1.2.7 Schedule for milestones, e.g. design, test, and delivery completion

1.3 Software Testing Strategies
- 1.3.1 Standalone versus real-time test setup and procedures
- 1.3.2 Test data to be obtained
- 1.3.3 Test cases to be obtained
- 1.3.4 A test plan which includes requirements to be tested, test procedure, criteria for acceptance, test results, and date of test performed

1.4 Software Pre-flight Procedure – The test procedure for validation of software version and configuration as well as software operation before each flight

1.5 Software Start-up and Reset Procedures – The procedures for appropriate and repeatable startup and reset of software during setup or in case of failure

1.6 Software configuration management plan and/or procedure – Plan and procedure for appropriate control of software configuration items (CIs) after the initial delivery of these CIs to the ARIES for local checkout

APPENDIX B2
Software Delivery Instructions

1. Documentation Delivery
    - 1.1 Software descriptions
    - 1.2 Software file listing
    - 1.3 Software Test Plan
    - 1.4 Software Pre-flight Procedure
    - 1.5 Software Start-up and Reset Procedures
    - 1.6 Software Configuration Management Procedure

2. Code Delivery
    - 2.1 Use Langley Form (LF) 238 for software to be delivered to the ARIES or General Aviation Aircraft.
    - 2.2 Use a separate LF 238 for each set of software that resides on a separate platform or is provided by a specific vendor/research partner.
    - 2.3 For software to be hosted on the flight Onyx and PCs,
        - 2.3.1 Select your choice of delivery media, i.e. CD, disk, or tape
        - 2.3.2 Provide the LF 238 with
            - 2.3.2.1 Software title
            - 2.3.2.2 Software provider (name of company/university)
            - 2.3.2.3 Contract/grant/agreement type and number
            - 2.3.2.4 Version number
            - 2.3.2.5 Delivery date
            - 2.3.2.6 Number of CDs, disks, or tapes needed for the software to be delivered
        - 2.3.3 Provide two copies of software in the media of your choice
        - 2.3.4 Label each media copy with software title and version number
        - 2.3.5 Label each media copy with "QA" or "ARIES".
    - 2.4 For software that resides on an avionics box such as an UAT, a Mode-S Transponder, or a TCAS computer, provide the LF 238 with
        - 2.4.1 Software title
        - 2.4.2 Software provider (name of company/university)
        - 2.4.3 Contract/grant/agreement type and number
        - 2.4.4 Manufacturer part/identification number and/or version number
    - 2.5 At initial delivery of software, provide documentation according to Section 1. After initial delivery, provide documentation of software changes such as functionality descriptions, user instructions, file listing, and/or release notes.
    - 2.6 Sign and date as a "NASA LaRC Point of Contact" on the first signature line. This "NASA LaRC Point of Contact" is a person who receives software from the vendors/research partners, and is able to verify the software version received.
    - 2.7 Deliver the LF 238 and two copies of software media to Victoria Chung (phone: 757-864-6406) in Building 1268A, Room 2118B.
    - 2.8 For any software change after initial delivery, follow Section 2.1 to 2.7 for subsequent delivery of software.

APPENDIX B3
Software Field Change Instructions

The LMS-CP-0909 process officially describes how the change requests are to be processed. In this case the objective in the use of the LF 436 or ***Experimental Systems Work Request*** (ESWR) form is to track changes to the experimental systems software. The purpose is not to control or impede a principle investigators desire to modify software, only to help ensure that changes are implemented, tested and installed in manner consistent with common software quality practices and to officially document these activities.

After software is delivered to ARIES/GA aircraft for the first Instrument Check Flight, any change to the delivered software will require the process of filling out an ESWR form for managing a software change on ARIES/GA aircraft. Each software developer shall keep a documented log of software symptoms or bugs occurring during the flight. A software change may be requested due to either a requirement change or a deficiency. Submission of the ESWR may occur either before or after the implementation of the change depending on the ability of a software developer in knowing the involvement of the software change in advance. After the ESWR has been completed and signed off, the modified software may be submitted as a new version with the software delivery form 238. The EWSR number(s) should be referenced on the software delivery form in the “title” field. Once software is delivered, it may then be installed on the subsystem.

The following is an example of the order in filling out the ESWR form.

ESWR Submission by the software provider with the following fields completed:

- System or Aircraft Designation – name of experiment (e.g. SV/SVDC,
- Subsystem – Title found on software delivery form (e.g. SVS software, Radar Data Recording)
- Requested By – PI of experiment
- Description of work to be done should include the following
    1. Identification of requirement change or software deficiency
    2. Proposed or actual software modification
    3. Affected software and associated hardware systems (provide affected files)

After the Software Manager receives the ESWR with the above sections completed, the form will be processed by discussing the changes with a Flight Experiment Operation Panel (FEOP) follows by obtaining approvals from the panel to proceed with the changes.

APPENDIX C

Roles and Responsibilities of Key Personnel and Organizations Involved in the Conduct of SASA Experiments

Note: See LMS-OUP-0900, "*Flight Research Services Competency Organizational Unit Plan*," for general information about organizational roles and responsibilities

Title or Organizational Unit	Roles & Responsibilities
Flight Research Services Competency (FRSC) Office	▪ Manages the Simulation and Aircraft Service Activity (SASA) ▪ Reviews and approves SASA Work Request, Langley Form (LF) 444, and PRD(s) for formulation ▪ Authorizes formulation of implementation team ▪ Chairs System Requirements Reviews (SRR's) ▪ Commits FRSC to schedule and to begin implementation planning ▪ Chairs the Change Control Board for SASA facilities and the associated requirements documents ▪ Guides and supports implementation teams in following LMS-CP-0960 ▪ Facilitates Systems Requirements Review, design reviews, and Experiment Integration Review ▪ Approves aircraft deployment travel plans and schedules ▪ Serves as research community's focal point for research systems upgrade of baseline hardware and software for all SASA facilities
Chief of Research Operations	▪ Ensures that operations of and modifications to aircraft and the associated equipment are conducted in accordance with the Center's Aviation Safety Program (ref. NPR 7900.3) and the Flight Test Operations and Safety Reports (FTOSR's) approved by the Center's Airworthiness and Safety Review Board (ASRB) ▪ Resolves implementation team conflicts regarding access to the Center's aircraft ▪ Provides members to the implementation team, including pilots, operations engineers, maintenance and quality assurance personnel ▪ Reviews and approves Flight Operations Requests, LF 437, and flight manifests
Aviation Safety Officer	▪ Works with the Chief of Research Operations to ensure that operations of aircraft and the associated equipment are conducted in accordance with the Center's Aviation Safety Program (ref. NPR 7900.3) ▪ Participates in ASRB meetings and approves FTOSR's and hazard analyses/risk assessments.
Aircraft Services Branch, FRSC	▪ Provides member(s) of implementation team ▪ Maintains/modifies the interfaces to the research systems in the Center's aircraft ▪ Provides/coordinates aircraft ground and flight service maintenance and modification logistics for Center aircraft. ▪ Conducts Flight Readiness Reviews for all Center aircraft (see Chapter 5.4 of Langley Task Description LMS-TD-0940)
Airworthiness Engineers, FRSC	▪ Provides airworthiness reviews and approvals for all hardware and software designs for the Center's aircraft ▪ Facilitates development of hazards analyses for flight experiments

APPENDIX C

Roles and Responsibilities of Key Personnel and Organizations Involved in the Conduct of SASA Experiments

(continued)

Note: See LMS-OUP-0900, "*Flight Research Services Competency Organizational Unit Plan*," for general information about organizational roles and responsibilities

Airworthiness & Safety Review Board (ASRB) (CID 1150.2)	▪ Conducts safety reviews for all Center-conducted or managed flight and drop-model test operations ▪ Evaluates hazard analyses and risk assessments ▪ Reviews and approves FTOSR's (required before research flights can begin)
Flight Operations Branch, FRSC	▪ Provides operations engineer for implementation team ▪ Provides test director for research flights on the B-757 ARIES ▪ Provides test director, as requested, for all other of the Center's aircraft ▪ Provides operational and ground logistics (including hotel reservations) and coordination for research missions involving the Center's aircraft ▪ Responsible for preparing flight cards that meet both research and operational requirements ▪ Presents flight operations concepts at Test Operations Review with project pilot ▪ Leads the implementation team in operations planning and implementation ▪ Aids in the development of those sections of the FTOSR pertaining to flight operations ▪ Prepares daily timelines related to flight operations, conducts pre and post flight briefings, prepares manifests, maintains flight logs, and provides ATC coordination ▪ Provides research pilots for both flight and simulation experiments ▪ Provides project pilot to the implementation team ▪ Presents flight operations concepts at Test Operations Review with operations engineer ▪ Reviews and approves Flight Requests and flight manifests
Quality Assurance Office, FRSC	▪ Provides flight quality assurance specialist for implementation team ▪ Inspects and verifies that the research systems and their interfaces on each aircraft owned, leased, or controlled by the Center are in accordance with the Center's Aviation Safety Program (ref. NPR 7900.3) and the FTOSR's approved by the ASRB ▪ Performs instrument calibrations, material, parts, component and fastener certifications
Research Branch Heads, Research Competencies	▪ Assess researcher/PI readiness to commence requirements negotiations with core "implementing organization" members of the Implementation Team (typically FSSB and/or AEB and Operations Engineers) ▪ Sponsor/conduct Experiment Reviews ▪ Approve Requirements Documents ▪ Assign research personnel ▪ Review and approve research reports

APPENDIX C

Roles and Responsibilities of Key Personnel and Organizations Involved in the Conduct of SASA Experiments in the Flight Research Services Competency (FRSC) (continued)

Note: See LMS-OUP-0900, "*Flight Research Services Competency Organizational Unit Plan*," for general information about organizational roles and responsibilities

Researchers	▪ Serve as Principal Investigator (PI), i.e., senior/lead researcher for an experiment with the final authority for the research requirements ▪ Negotiates the formulation of the Requirements Documentation with consensus with other members of the implementation team ▪ Prepare LF 444 ▪ Prepare or identify PRD(s) ▪ Present experimental plans at experiment reviews ▪ Prepare Requirements Documentation with assistance of implementation team ▪ Participate in preparation of hazards analysis and approve same ▪ Lead overall preparation of FTOSR ▪ Lead overall presentations to the ASRB ▪ Serve on design review panels ▪ Serve on Test Operations Review panel ▪ Serve as Contracting Officer's Technical Representative (COTR) for development of hardware and software provided by research vendors ▪ Participate in planning and conduct of integrated system(s) checkout ▪ Provide flight card inputs/information to Operations Engineers ▪ Provide inputs to Flight Requests and flight manifests ▪ Conduct experiments and report results
Flight Simulation and Software and Aircraft Engineering Branches	▪ Provides engineers and technicians to the implementation team ▪ Designs, develops, tests, installs, maintains, integrates and operates SASA flight research systems ▪ Maintains and operates SASA simulators and integration labs ▪ Responsible for software development for SASA simulators, integration labs, and flight research systems ▪ Insures that researcher-provided software design and test strategies are appropriately reviewed. Insures that all software integrates with the Transport Research System (TRS). Manages external software revision process sufficient to insure safety of flight and TRS integrity. ▪ Presents hardware and software designs at appropriate design reviews ▪ Develops implementation schedules for flight and simulation experiments ▪ Provides and maintains templates and "good practice" recommendations for Requirements Documents. Works with the PI's on implementation teams to define/refine requirements ▪ Supports the PI's in preparation for ASRB presentations

APPENDIX D

The table shows the Flight Test Operations and Safety Report outline and sections of the Requirements Document that may be copied directly into the FTOSR. Sections marked N/A need additional information than what is found in the requirements document.

FTOSR Outline	Requirements Document (Sections which may be copied directly into FTOSR)
1.0 Program Overview	
1.1 Program Objectives and general description	3.1 General description 3.2 Goals & Objectives
1.2 Program Management	3.3 Program Hierarchy
1.3 Selected Aircraft	3.4.1 Aircraft
1.4 Proposed A/C modifications & Design Criteria	N/A
1.5 Instrumentation hardware &/or sw & flight test data requirements	N/A
1.6 Contractual requirements	N/A
1.7 Other involved agencies	N/A
1.8 Summary of supporting research and tests	N/A
1.9 Proposed schedule milestones	3.6 Milestones 3.7 Proposed Schedule
2.0 Flight Test Operations	
2.1 Location	7.2 Location
2.2 Planned start of flight tests	N/A
2.3 Planned number of flights	N/A
2.4 Flight test procedures	N/A
2.5 Planned flight test envelope	7.6 Planned Flight Test Envelope
3.0 Support Requirements	
3.1 Support organizations & their responsibilities	N/A
3.2 Transportation to test location	N/A
3.3 Chase requirements	7.12 Chase Requirements
3.4 Photo &/or TV coverage	7.11 Photographic requirements
3.5 Tracking requirements	7.13.4 Tracking
3.6 Telemetry requirements	7.13.3 Telemetry
3.7 Communications requirements	7.13.2 Communications
3.8 Meteorological requirements	7.13.1 Meteorological Support
3.9 Data Requirements	7.13.5 Data
3.10 Other special requirements	7.13.6 Other
4.0 Safety	N/A
4.1 System safety program	N/A
4.1.1 Hazards Analysis	N/A
4.1.2 Risk Assessments	N/A
4.2 General Operational Restrictions & Conditions	N/A
4.2.1 Weather	N/A
4.2.2 Personal Equipment	N/A
4.2.3 Minimum on-board equipment	N/A
4.3 Abort procedures	N/A
4.4 Emergency plans and procedures	N/A
4.5 Configuration control responsibilities	N/A
4.6 Other	N/A

APPENDIX E

Acronym List

AEB	Aircraft Engineering Branch
ASB	Aircraft Services Branch
ASRB	Airworthiness and Safety Review Board
ATC	Air Traffic Control
AWO	Aircraft Work Order
BA	Boarding Authorization
CDR	Critical Design Review
CM	Configuration Management
CR	Change Request
ESWR	Experimental Systems Work Request
FCF	Functional Check Flight
FOB	Flight Operations Branch
FRR	Flight Readiness Review
FRPO	Flight Research Projects Office
FRSC	Flight Research Services Competency
FSSB	Flight Simulation and Software Branch
FSIL	Flight Systems Integration Lab
FSR	Flight Safety Release
FTOSR	Flight Test Operations and Safety Report
ICF	Instrument Check Flight
IRB	Institutional Review Board
LAPG	Langley Policies and Guidelines
LaRC	Langley Research Center
LMS	Langley Management System
MAO	Mission Assurance Office
OTR	Operations Test Review
PDR	Preliminary Design Review
PI	Principal Investigator
PRD	Program/Project Requirements Document
PT	Plan of Test
QA	Quality Assurance
QAO	Quality Assurance Office
RSIL	Research Systems Integration Lab
SASA	Simulation and Aircraft Service Activity
SEC	Systems Engineering Competency
SMR	Simulation Modification Request
SRR	Systems Requirements Review

APPENDIX F

Flight Research Services Competency Assets

Simulators

Asset	Written Request	Form	Controlling Process
Differential Maneuvering Simulator	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
Generic Flight Deck Simulator	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
Integration Flight Deck Simulator	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
Research Flight Deck Simulator	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
Research System Integration Lab	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
Visual Motion Simulator	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
General Aviation Simulator	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960

Aircraft

Asset	Written Request	Form	Controlling Process
B-757 Aircraft	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
GA-LANCAIR C-300	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
GA-CESSNA C-206	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
GA-Cirrus SR 22	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
BE-200 Aircraft	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
OV-10A Aircraft	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
T-38A Aircraft	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960
UH-1H Aircraft	Yes	Simulator and Aircraft Service Activity Work Request, LF 444	LMS-CP-0960