



Procedures and Guidelines

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Title: *Implementation of Flight Dynamics Ground Systems for Mission Support*

1 PURPOSE

This procedure establishes guidelines for the implementation of ground systems to provide flight dynamics support for spaceflight mission operations. It outlines the processes used by the Guidance, Navigation and Control Center (GNCC) to specify flight dynamics ground systems requirements, work with the Information Systems Center (ISC) to develop the systems, and certify that the systems are launch-ready.

2 REFERENCES

- 1) 572-PG-8700.2.2, *Analytical Design of Spacecraft Missions*.
- 2) 580-PG-8730.4.1, *Information Systems Center (ISC) Product Development Handbook*.

3 SCOPE

These guidelines apply to anyone providing flight dynamics ground support to projects supported by the GNCC and covered by the scope of the GSFC Quality Management System (QMS).

4 DEFINITIONS

System

The "system" consists of all hardware, software, and documentation that are required to provide flight dynamics support for spaceflight mission operations.

Team

The "team" consists of the GNCC and ISC personnel who are responsible for system requirements, design, development, and implementation.

5 AUTHORITIES & RESPONSIBILITIES

- 5.1 All GNCC employees will follow this procedure in all efforts covered by it.

- 5.2 Implementation guidelines may be modified or waived due to extenuating circumstances, such as limitation of time and/or resources, or customer request. These procedures may be waived in order to use existing contractor ISO 9000 procedures. Changes and waivers must be documented by the team and approved by the customer and the Chief of the GNCC or his designee.
- 5.3 The head of the Flight Dynamics Analysis Branch (FDAB) will be responsible for assigning project team members, approving budgets, arranging funding, and negotiating support from the ISC. At the discretion of the branch head, considering the scope of the effort and the number of team members involved, a team leader may be identified to serve as the external point of contact and/or to coordinate activities of the team.
- 5.4 The FDAB head will identify the team's customer. Typically, the customer is the flight project systems engineer, the project manager, or the mission operations manager. Others within and outside of the GNCC will interact freely with members of the team. However, only the team's customer has immediate authority regarding priorities and technical requirements that affect the team.
- 5.5 FDAB management has the authority, in consultation with the customer, for approving and modifying any programmatic items relating to the team's effort.
- 5.6 The FDAB will serve as the customer for the ISC and as the end user of the system. The FDAB and ISC will work as a team to ensure that the system meets the needs of the FDAB's customer (e.g., the flight project.)
- 5.7 Depending on the customer and the scope of GNCC support being provided, the team may be a standalone team, part of a larger project/customer development team or it may be part of a larger GNCC team providing full GNCC services to a project (for example, mission design, spacecraft control system development, and spacecraft ground/onboard navigation systems). The customer will usually dictate this with consultation from GNCC management.

6 IMPLEMENTATION

6.1 Define the Mission Requirements

- 6.1.1 The team works with the customer during the mission requirements definition phase. The flight project typically levies requirements in the form of the Detailed Mission Requirements (DMR), or similar document. The team performs analyses to ensure that mission requirements can be satisfied.
- 6.1.2 In practice, the customer also levies requirement changes during the subsequent stages of the project life cycle, and the same implementation guidelines apply, as applicable.

6.2 Initial Planning

- 6.2.1 The GNCC management verifies that the team is composed of individuals with the required technical skills. Assigned personnel will review the requirements, which will be modified if requirements changes are necessary to best meet the mission objectives.
- 6.2.2 Team members review the mission requirements to assess the usefulness of existing ground system components or commercially available components. Tools not already available will be procured or developed by ISC or GNCC with concurrence of the customer.
- 6.2.3 The team submits a budget that includes personnel costs, facilities and equipment costs, travel, training, and any other items considered necessary.
- 6.2.4 The team defines a flight dynamics ground systems architecture to be developed for mission operations support which will meet the DMR requirements. This information is formally presented at the Systems Design Review (SDR) or similar presentation.

6.3 Procurement

- 6.3.1 The team is responsible for procuring and installing all operational ground systems hardware and software, as needed.

6.4 Detailed Design

- 6.4.1 The team will be responsible for designing operational ground systems hardware and software, and internal and external interfaces, as needed. In general, and depending on the complexity of the ground system, ISC members of the team may have primary responsibility for this activity. GNCC management and/or the customer will negotiate this. Detailed development procedures are documented in Reference 2.
- 6.4.2 The team will be responsible for system maintenance and operation during the Prelaunch, Launch, and Early Mission operations phases. For continuing operations, these responsibilities are generally turned over to the customer.

6.5 Documentation

- 6.5.1 The team, with concurrence of the customer, will decide the appropriate level of configuration control for all documents.
- 6.5.2 System requirements are documented in the DMR.

- 6.5.3 The team will work with external entities to define all operational interfaces with the system. Each interface will be documented in an Interface Control Document (ICD), which defines data formats, transfer methods, and delivery schedules.
- 6.5.4 The team will produce Systems Description documentation that details the system design and information necessary for configuration and maintenance of the system.
- 6.5.5 The team will produce User's Guide documentation that provides information on how to execute the system. The team will use these documents to provide training to system users.
- 6.5.6 The team will produce Operations Procedures documentation that provides step-by-step procedures of how to operate the system under both nominal and contingency operations scenarios. These procedures will be exercised during prelaunch simulations.

6.6 Quality Records

- 6.6.1 During the system design phase, the team is responsible for documenting all mission analyses critical to ensuring that the ground system can meet mission performance and accuracy requirements levied in the DMR. This documentation will be provided to the customer.
- 6.6.2 During the system development phase, the team is responsible for acceptance testing to ensure that all DMR requirements are met. GNCC will produce an Acceptance Test Plan document that defines several operational test scenarios and the expected results from system execution. The final test results will be included in the Acceptance Test Plan document.
- 6.6.2 During the system development phase, the team is responsible for interface testing of the ground system, per the ICDs, to ensure that all external interfaces are functioning properly. Mission simulations will be executed to validate operations procedures. Problems encountered during testing and simulations will be tracked in a Project Discrepancy Report (DR) / Non Conformance Report (NCR) system.
- 6.6.3 The Mission Readiness Manager will produce an Interface Test Plan document that defines several mission simulations and tests each DMR requirement in one or more simulation. The final results will be documented and presented at the Flight Operations Review (FOR).
- 6.6.4 The team will maintain configuration management on all system documentation, hardware, and software.

6.7 Reviews

6.7.1 The team presents the following reviews. The audience includes GNCC management, ISC management, and the customer:

The System Requirements Review (SRR) addresses:

- the mission overview
- GNCC's role in the mission
- definition of system requirements

The Operations Concepts Review (OCR) addresses:

- the roles of the GNCC and ISC in support of the mission
- the flight dynamics ground systems concept
- flight dynamics products and interfaces
- operational scenarios
- schedule and staffing estimates

The Systems Design Review (SDR) addresses:

- operations facility hardware components and layout
- software components and system design
- detailed ground systems interfaces
- ground systems development and testing schedules
- applicable system documentation

The Operational Readiness Review (ORR) addresses:

- flight dynamics ground systems readiness
- prelaunch simulation activities
- operations training and readiness of the operations team

6.7.2 The team provides support to the following project reviews:

- Preliminary Design Review (PDR)
- Critical Design Review (CDR)
- Mission Operations Review (MOR)
- Flight Operations Review (FOR)

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	07/28/1999	Initial Release