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GCS CONFIGURATION MANAGEMENT PLAN

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GCS CONFIGURATION MANAGEMENT PLAN

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Preface

The GCS Configuration Management Plan is document # 5A in a series of documents which fulfill the Radio Technical Commission for Aeronautics RTCA/DO-178A guidelines, "Software Considerations in Airborne Systems and Equipment Certification". These documents were prepared under contract with NASA-Langley Research Center.

This project consists of two complementary goals. First, to develop software for use in the Research Triangle Institute (RTI) software error studies research program sponsored by NASA-Langley Research Center [1]. Second, to use and assess the RTCA/DO-178A guidelines for the Federal Aviation Administration (FAA). The two goals are complementary in that the use of the structured DO-178A guidelines in the development of the software will ensure that the test specimens of software have been developed according to the best standards for critical software. The error studies research analyses will then be conducted using high quality software specimens. The implementations will be subjected to two different software testing environments: verification of each implementation according to RTCA/DO-178A guidelines and replicated random testing in an n-version configuration. This research effort involves the gathering of product and process data from every phase of software development for later analysis. More information on the goals of the Guidance and Control Software (GCS) project are available in the GCS Plan for Software Aspects of Certification (document #14).

The series consists of the following documents:

- GCS Configuration Index *Document no. 1*
GCS Development Specification *Document no. 2*
- GCS Design Descriptions *One for each software implementation. Document no. 3*
- GCS Programmer's Manual *Document no. 4, includes Software Design Standards, document no. 12.*
- GCS Configuration Management Plan *Document no. 5A*
- Software Quality Assurance Plan for GCS *Document no. 5B*

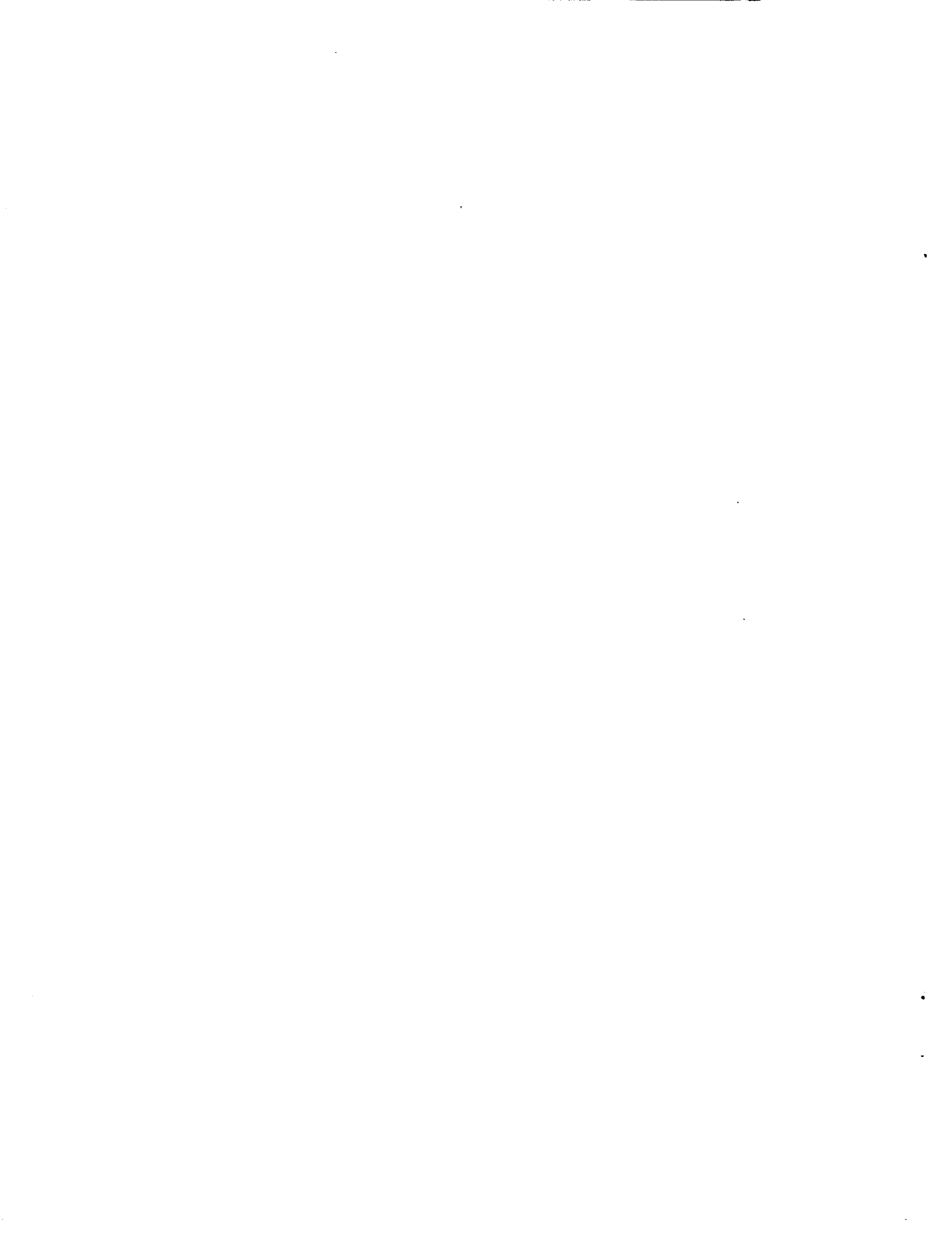
- GCS Source Listings *One for each software implementation. Document no. 6*
- GCS Source Code *One for each software implementation. Not available on hardcopy. Document no. 7*
- GCS Executable Object Code *One for each software implementation. Not available on hardcopy. Document no. 8*
- GCS Support/Development System Configuration *Document no. 9*
- GCS Accomplishment Summary *Document no. 10*
- Software Verification Plan for GCS *Document no. 11*
- Software Requirements Review Description for GCS *Document no. 11A*
- GCS System Requirements *Document no. 13*
- GCS Plan for Software Aspects of Certification *Document no. 14*

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1 Management Methods

This report describes the methods and tools used for the configuration management of the Guidance and Control Software experiment (GCS) project-related documents. The use of configuration management techniques is intended to reduce confusion over multiple versions of the documents and to increase traceability of changes throughout the lifetime of the various documents. Configuration management for this project will consist of defining and using an orderly, structured method of storing, recalling, and modifying any document (including software) that is produced. By using a configuration management scheme, compliance with the requirements outlined in the RTCA document DO-178A is insured. Configuration management also has the advantage of encouraging a uniform method of access to all documents.

To reduce the time, effort, and cost of setting up and using a configuration management scheme, tools that are already available at RTI and AIRLAB will be used. Also, the number of people with direct access to these documents will be kept to a minimum and the procedure for updating documents will be kept as simple as possible.

The most important configuration tool will be the Code Management System (CMS) provided by Digital Equipment Corporation (DEC). CMS provides a method of tracking and retrieving versions of documents. CMS uses "libraries" that contain all versions of the documents. The operations allowed within CMS are as follows:

Fetch A copy of the file is placed in the current directory, but no changes to the file within the library are made.

Reserve A copy of the file is placed in the current directory. The file is marked within the library so that no else may make changes to it during this time. The file will later be returned to the library and any changes will be made to the library copy.

Replace A file that has been reserved may be replaced and in doing so, any changes to the file are put into the library for later use.

Unreserve If a file has been reserved, but no changes were made, the file may be unreserved. This will simply remove the restriction on that

file within the library, so the original operation becomes very similar to a fetch.

There will be six CMS libraries to hold the documents. There will be one library for documents produced by the management team (Doc Library) and controlled by the on-site Software Quality Assurance representative (SQA Rep.) and the Configuration Manager (Cfg. Mgr.). There will be one library for the GCS specification (Spec Library) and its formal modifications that will be controlled by the SQA Rep. There will be three libraries for the application programmers (Prog Libraries 1-3). Each of these libraries will contain all documents produced or modified by the programmers including their source code. The programmer libraries will be controlled by the SQA Rep. and Cfg. Mgr. Last, there will be a library (Test Library) that will contain files of test cases used and test logs generated during the Verification procedure.¹ This library will be controlled by the on-site SQA representative. Programmers should have private libraries to keep their code in during development and module testing. This will allow old versions/fixes to be restored if necessary.

Because of the form of documentation used for some documents, (e.g. the design description will be in *teamwork*² format and the problem reports are filled out by hand on paper), these documents will be configured using hard copies only. Other documents such as the object code can be reproduced from the source code, thus do not need to be placed under configuration management directly.

2 Documents Under Configuration Management

Table 1 below contains a list of the documents under configuration management, which libraries contain them, a list of people authorized to request copies of the documents, and a list of people authorized to update the library.

¹This explanation may be expanded and more libraries may be added depending on the type of tools used for verification.

²*Teamwork* is a registered trademark of Cadre Technologies Inc.

Table 1: Organization and Authorization for Managed Documents

Document	Library	Authorized Requesters	Authorized Controllers
Configuration Index (Doc #1)	Doc	Mgmt. Team	SQA Rep.
GCS Specification (Doc. #2)	Spec	Mgmt. Team	SQA Rep.
Specification Modifications (part of Doc. #2)	Spec	Mgmt. Team	SQA Rep.
Design Description (Doc. #3)	Hard Copy	Testers	SQA Rep. Cfg. Mgr.
Programmers' Manual (Doc. #4)	Doc	Mgmt. Team	SQA Rep. Cfg. Mgr.
Programmer Instructions (part of Doc. #4)	Doc	Mgmt. Team	SQA Rep. Cfg. Mgr.
Configuration Management. Plan (Doc. #5A)	Doc	Mgmt. Team	SQA Rep. Cfg. Mgr.
SQA Plan (Doc. #5B)	Doc	SQA Rep.	Cfg. Mgr.
Programmers' Source Listing/Code (Doc. #6 and #7)	Prog (1, 2, or 3)	Testers	SQA Rep. Cfg. Mgr.
Object Code (Doc. #8)	Reproduced from Doc. #7	Testers	SQA Rep.
Support/Development System Configuration (Doc. #9)	Doc	Mgmt. Team	SQA Rep.
Accomplishment Summary (Doc. #10)	Doc	Mgmt. Team	SQA Rep.

Table 1: Organization and Authorization for Managed Documents (cont.)

Document	Library	Authorized Requesters	Authorized Controllers
Verification/ Validation Plan (Doc. #11)	Doc	Mgmt. Team Testers	NASA Rep. Cfg. Mgr.
Test Cases/Runs (part of Doc. #11)	Test	Testers	NASA Rep. Cfg. Mgr.
Design Standards (Doc. #12, included in Doc. #4)	Doc	Mgmt. Team	SQA Rep.
System Requirements (Doc. #13)	Doc	Mgmt. Team	SQA Rep.
Certification Document (Doc. #14)	Doc	Mgmt. Team	SQA Rep. Cfg. Mgr.
Problem Reports	Hard Copy	Testers	SQA Rep.

3 Configuration Procedures

All documents under configuration control will be located in their libraries, or in binders held by the controller, and after they are put under control, only the authorized controllers may update the library by reserving, replacing, adding, or deleting elements within the library. **EXTREME PRUDENCE** should be used when deleting elements from libraries. All authorized requesters should be made aware of the locations of the libraries, and will be allowed to fetch files from these libraries. By fetching files, no changes are made to the library, thus the integrity of the experiment is maintained. VMS access control allows CMS libraries to be set up so that some people may fetch files from a given library without being able to reserve, replace, add, or delete files. In addition, backups are made every twelve hours of files that have been modified or changed, and once each month, all files are backed up onto tape media.

Anyone desiring access to files under configuration control should ask one of the authorized requesters for the files they need. If no changes are anticipated, the requester may fetch the files. If changes are anticipated, the requester should send an electronic request to the controller who will then reserve the files and send them to the person asking for them.

It is the job of the requester and the controller to insure that all transactions in the CMS library are documented using the built-in commenting ability of CMS. The requester and the controller have the right to refuse access to files or to require further documented justification for file access. If the controller sees fit to do so, each document request may be placed into the libraries for later reference.

4 Version Numbering Scheme

When each document is placed under configuration management, it will be considered version 1.0 of that document. After that time, any modifications to the document will increment the counter to 1.1, 1.2, ... For documents, such as the design description, which require hard copy output, only the sheets that have been modified should be printed and configured. At major milestones, the version number will be incremented to 2.0, 3.0, ... and hard

copy documents will be completely re-printed. Each version of a document will be organized as a CMS "class" for ease in later retrieval of versions. For documents that require separate versions for each programmer (e.g. design documents, source code, etc.) the programmer's identification name will be added to the beginning of the version number. For example, the first revision of Jupiter's design document would be: **Jupiter1.1**. Following is a list of documents under configuration management and a milestone that will determine when they are put under configuration control:

Configuration Index (Doc #1) After SQA approval.

GCS Specification (Doc #2) When Venus and Jupiter start Prototypes.

Specification Modifications After SQA approval.

Design Description (Doc #3) After Design Review.

Programmers' Manual (Doc #4) After SQA approval.

Programmer Instructions After SQA approval.

Configuration Management Plan (Doc #5A) After SQA approval.

Software Quality Assurance Plan (Doc #5B) After Mgmt. Team approval.

Programmers' Source Listing/Code (Doc #6/#7) At first clean compile.

Object Code (Doc #8) At first clean compile.

System Configuration (Doc #9) After SQA approval.

Accomplishment Summary (Doc #10) End of project after SQA approval.

Verification / Validation Plan (Doc #11) After SQA approval.

Test Cases / Runs As test case is generated.

Design Standards (Doc #12) After SQA approval.

System Requirements (Doc #13) After SQA approval.

Certification Document (Doc #14) After SQA approval.

Problem Reports When a problem is first reported, a problem report will be completed according to the procedures listed in the SQA Plan.

For example, the major milestones for changing version numbers of the code will be:

- Clean compile (1.0),
- Code review (2.0),
- End of Module Testing (3.0),
- End of White Box Sub-Frame Testing (W3.x),
- End of Black Box Sub-Frame Testing (B3.x),
- End of Sub-Frame Testing (4.0),
- End of Frame Testing (5.0), and
- End of System Testing (6.0).

A Representatives

Following are the abbreviations used in this document along with the people they represent:

Cfg. Mgr. Configuration Manager - B. Edward Withers

Doc. DO-178A Document

Mgmt. Team Management Team - Leslie Dent, Stephen Duncan, Janet Dunham, Douglas S. Lowman, Anita Shagnea, and B. Edward Withers.

NASA Rep. NASA Representative - Kelly Hayhurst.

SQA Rep. On-site Software Quality Assurance Representative - Stephen Duncan

Testers GCS Testers - Leslie Dent, Anita Shagnea, and Charlotte Scheper

User GCS User - B. Edward Withers

Requester Individual responsible for documenting any changes made to documents and who may fetch a copy for working purposes or request that a copy be reserved for updating.

Controller Individual responsible for assuring that all changes have been documented, and who has the power to reserve and replace documents. This individual may refuse to allow changes to propagate to the official versions until appropriate documentation has been completed.

References

- [1] George B. Finelli. Results of software error-data experiments. In *AIAA/AHS/ASEE Aircraft Design, Systems and Operations Conference*, Atlanta, GA, September 1988.



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16. Abstract <p>This document describes the tools and methods used for the configuration management of the artifacts (including software and documentation) associated with the Guidance and Control Software (GCS) project. The GCS project is part of a software error studies research program conducted by the Research Triangle Institute and the NASA Langley Research Center. For this project, three implementations of GCS are being produced according to the Radio Technical Commission for Aeronautics RTCA/DO-178A guidelines, "Software Considerations in Airborne Systems and Equipment Certification" in order to study the fundamental characteristics of the software failure process. The Code Management System (CMS) provided by Digital Equipment Corporation is used to track and retrieve versions of the documentation and software. This document describes the application of the CMS for this project and delineates the numbering scheme for the versions of the project artifacts. This document fulfills the requirements for document #5B in the RTCA/DO-178A guidelines.</p>			
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