Appendix F: Support Documentation Change Reports for the Guidance and Control Software Project

This document was produced as part of Guidance and Control Software (GCS) Project conducted at NASA Langley Research Center. Although some of the requirements for the Guidance and Control Software application were derived from the NASA Viking Mission to Mars, this document does not contain data from an actual NASA mission.

Support Documentation Change Report

1. Configuration Item Verification Plan	2. Date 7/27/93	3. Formal Modification #: 1

4. Part of Configuration Item Affected: Appendix Design Review Checklist

5. Reason for Modification: It was discovered during a Design Review the following modification was needed to identify cases where input/output variables may be used in a process, but are not defined by the process where they are used.

6. Modification: In the Data Usage section, add item number 7.

7. Are all the input/output variables of a process defined in the INPUT/OUTPUT section of the design P-SPEC for that process?

7. SQA Signature & Date: Original Signed by Carlos Liceaga 7/27/93

Support Documentation Change Report

1. Configuration Item Verification Plan	2. Date 7/29/93	3. Formal Modification #: 2

4. Part of Configuration Item Affected: Appendix Design Review Checklist, Date Usage section, item #3

5. Reason for Modification: In order to comply with the Software Development Standards change to Design Documentation section, subsection II. Design Structure, paragraph e) Data Dictionary regarding additional variables in the design.

6. Modification: Data Usage

3. If the design includes variables in addition to the global data store variables defined in the GCS specification, and these variables represent flows between processes, are they included in the design data dicitonary?

7. SQA Signature & Date: Original Signed by Carlos Liceaga 7/29/93

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
VERIFICATION PLAN	8/6/93	3

4. Part of Configuration Item Affected:

DESIGN REVIEW OVERVIEW AND DESIGN REVIEW PROCEDURES

5. Reason for Modification:

change in moderator duties + person who is the moderator will change.

6. Modification:

1. "Change moderator to project leader
2. Remove SQA duties from moderator duties
3. Correct typo's

Corrected pages are attached with the corrections marked.

New corrected pages 3, 5 & 6 are included with this report

7. SQA Signature & Date: Original Signed by Carlos Liceaga 8/13/93

Original Signed by George Finelli 8/6/93

Support Documentation Change Report page 1 of 2

1. Configuration Item:	2. Date:	3.Formal Modification #: 4
Software Verification Plan	09/09/93	

4. Part of Configuration Item Affected:

Design Review Procedures

5. Reason for Modification:

Change in SQA role in Design Review Procedures

6. Modification:

Corrections were made to the Review Team members, removing the SQA from the team. The SQA was also removed from the Inspector section of the document.

7. SQA Signature and Date: Original Signed by George Finelli 9/21/93

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #: 5
Software Verification Plan	12/28/93	

4. Part of Configuration Item Affected:

Code Review Sections

5. Reason for Modification:

Insert the documentation for Code Review Overview, Code Review Procedures and Code Review Checklist.

Correction to the Inspection Log in order to distinguish between the different Inspections, Design and Code.

6. Modification:

Added the documentation for Code Review Overview, Code Review Procedures and Code Review Checklist. (see attached sheets)
Correction to the Inspection Log in order to distinguish between the different Inspections, Design and Code. (see attached sheet)

7. SQA Signature & Date: Original Signed by George Finelli 3/14/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #: 6
Software Verification Plan	3/17/94	

4. Part of Configuration Item Affected:

The Design Review Procedures and Code Review Procedures will be modified into one section called the Review Procedures. The Test Phase documentation will be added.

5. Reason for Modification:

There was too much repetitious information in the Design Review Procedures and the Code Review Procedures. so a new combined section , The Review Procedures, will be added. The Testing Plan will be added as well as a copy of the Problem Report. The font and page formatting were changed to make the document more readable. The copy of the PR document will be added later, due to formatting problems.

6. Modification:

A new version of the Software Verification Plan has been created. This new version of the Review Procedures replace the Design Review Procedures and the Code Review Procedures, eliminating the redundancies in these documents. The Testing Plan, ~~PR form~~ were added. Modification to the Traceability Matrix added the Test Case column. General clean up was also performed, including formatting and font changes. Corrections attached.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst — 5/2/94

Support Documentation Change Report

1. Configuration Item: Software Verification Plan	2. Date: 5/31/94	3. Formal Modification #: 7

4. Part of Configuration Item Affected:

A table of content will be added into the document and all the text rearranged to conform with the table of contents.

5. Reason for Modification:

The current plan does not contain all topics and considerations required by DO-178B. The Test Overview section will be reorganized into Testing Activities. The Transition Criteria section and Reverification Guidelines section will be added. This modification will make the plan more accurately reflect the requirements listed in DO-178B for a verification plan.

6. Modification:

A table of contents has been added. Portions of the document have been reorganized to correspond with the table of contents and to address the issues required by DO-178B. Specifically, The Verification Methods section has replaced the Review and Analysis Overview and the Test Overview Sections.

References are cited for verification tool descriptions and accordingly added to the reference listing.

The Traceability Matrix has been updated.

7. SQA Signature & Date:

Original Signed by
Kelly Hayhurst

8/8/94

Support Documentation Change Report

1. Configuration Item: Software Verification Plan	2. Date: 12/6/94	3. Formal Modification #: 8

4. Part of Configuration Item Affected:

1. Testing Activities section of the document
2. Traceability Matrix
3. Table of contents

5. Reason for Modification:

1. Make the Testing section of this document consistant with The Software Cases and Procedures document.
2. Traceability Matrix
3. Add a useful table of contents

6. Modification:

References to the Software Verification Cases and Procedures document were added, because this document did not exist when the Software Verification Plan document was created. The Traceability Matrix has been updated and expanded. The old copy in the existing Software Verification Plan was replaced. All references to Appendix F & G were removed as these are now covered in the Software Verification Cases and Procedures documents. A new improved table of contents was added.

7. SQA Signature & Date:

Original Signed by
Kelly Hayhurst

12/8/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases and Procedures Document	12-21-94	2

4. Part of Configuration Item Affected:

Test case development procedure and test case execution procedure.

5. Reason for Modification:

DO-178B requires test cases and procedures for high-level requirements. Test case development and execution procedures will be clarified. Trajectory testing needs to be added.

6. Modification:

1) The test case development procedure has been modified to include step by step procedure for regenerating test-input and expected results files.

2) The trajectory test development procedure has been added

3) Tables listing all the files involved in the testing process has been added.

4) Filenames used in the procedure have been checked for consistency with CMS.

7. SQA Signature & Date:

Original Signed by
Kelly Hayhurst

9/13/95

Support Documentation Change Report

1. Configuration Item: Software Verification Plan	2. Date: 4/19/95	3. Formal Modification #: 9

4. Part of Configuration Item Affected:
1. Test Coverage Overview
2. Appendix A
3. Table of contents

5. Reason for Modification:
The Verification Plan should be modified so that it contains test coverage issues and no procedural descriptions. Trajectory testing should be addressed in the document. The Table of Content must be updated to reflect this change. The list of authors need to be updated.

6. Modification:
The verification plan has been modified to address coverage issues. All procedural information has been moved to the Verification Cases document. The table of contents has been changed accordingly. The author list has been updated.

7. SQA Signature & Date:
Original Signed by
Kelly Hayhurst
9/13/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Configuration Management Plan	8/31/93	1

4. Part of Configuration Item Affected:

Table 8: Configuration Identification for the DO178-B Life Cycle Data

5. Reason for Modification:

Clarification of configuration items.

6. Modification:

The Design Description has been broken into two configuration items for configuration managemenet purposes; they will be maintained in the same CMS library under different element names. Also, since the Spec had formal mods written before the SDCR form was in place, the CM Plan needs to reflect this.

Old Text:

Design Description*	Design Description	11.10
Problem and Action Reports* Support Document Change Forms	Problem Reports	11.17

Modified text:

Team*work* Model* Design Overview*	Design Description	11.10
Problem and Action Reports* Support Document Change Forms Formal Modifications to the Specification**	Problem Reports	11.17

** Formal modifications 2.2-1 through 2.2-26 of the GCS Specification were not recorded on a Support Documentation Change Report (SDCR) form. All remaining modifications to the GCS Spec will be recorded on a SDCR form.

7. SQA Signature & Date: Original Signed by Carlos Liceaga 9/1/93

Support Documentation Change Report

1. Configuration Item: Configuration Management Plan	2. Date: 5/18/94	3. Formal Modification #: 2

4. Part of Configuration Item Affected:

Entire document

5. Reason for Modification:

Need to change number of implementations from three to two and remove any references to Earth implementation.

6. Modification:

OLD (section "The Role of SCM in the GCS Project"):

The GCS project involves independent production of three implementations of a guidance and control application where the development process for each implementation follows the DO-178B guidelines. The three GCS implementations are referred to by planetary names: Mercury, Earth, and Pluto. When there is a need to distinguish multiple implementations, the word *planet* will be used to refer to Mercury, Earth, or Pluto. For this project, the configuration environment and activities must provide for the management of the life cycle data for one development process and must also provide a mechanism to preserve the independence of the life cycle data for the multiple implementations. This plan will address the configuration management process for life cycle data from all three GCS implementations.

NEW:

The GCS project involves independent production of two implementations of a guidance and control application where the development process for each implementation follows the DO-178B guidelines. The two GCS implementations are referred to by planetary names: Mercury and Pluto. When there is a need to distinguish multiple implementations, the word *planet* will be used to refer to Mercury or Pluto. For this project, the configuration environment and activities must provide for the management of the life cycle data for one development process and must also provide a mechanism to preserve the independence of the life cycle data for the multiple implementations. This plan will address the configuration management process for life cycle data from both GCS implementations.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/18/94

Support Documentation Change Report Continuation

a. Report #: FM 2 for CM Plan

b. Notes/Explanation (Please reference appropriate section number):

OLD (section "SCM Environment"):

Since three GCS implementations are being independently developed, there will be data from each of the three implementations in some cases. For example, each implementation will have its own source code (e.g., Mercury Source Code, Earth Source Code, and Pluto Source Code).

NEW:

Since two GCS implementations are being independently developed, there will be data from each of the implementations in some cases. For example, each implementation will have its own source code (e.g., Mercury Source Code and Pluto Source Code).

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Configuration Management Plan	5/18/94	3

4. Part of Configuration Item Affected:

Entire document

5. Reason for Modification:

The source code phase is no longer transitional; therefore, need to remove references to transitional source code phase and modify text appropriately.

6. Modification:

Modification 1: Deleted the term "transitional" from the phrases "transitional coding" and "transitional software coding" in 4 occurrences: twice in section The Role of SCM in the GCS Project of the Introduction and twice in section Baselines and Traceability of the SCM Activities.

Modification 2: Deleted reference to Post-Code Review version of code in 6 occurrences: once in section Procedures for Using CMS of the SCM Environment, three times in section Baselines and Traceability of the SCM Activities, and twice in Transition Criteria.

Modification 3: The transitional software design process is complete when the design has been verified and approved by the SQA. The coding phase is complete when the code has been verified and approved by the SQA (in section The Role of SCM in the GCS Project of the Introduction).

Modification 4: The source code libraries and the executable object code libraries will start after the design phase is completed instead of being created from the Post-Code Review version received from RTI (in section CMS Libraries of the SCM Environment).

Modification 5: Removed RTI Post-Code Review and Original Transition Code milestones from the source code baselining schedule (in section Baselines and Traceability of the SCM Activities).

Modification 6: Changed source code and executable object code transition criterion from Post-Code Review version received from RTI to Design Phase Completion in Table 9.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/19/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Configuration Management Plan	5/19/94	4

4. Part of Configuration Item Affected:

Entire document

5. Reason for Modification:

1. Remove references to concurrent/noconcurrent qualifier in CMS libraries. The Configuration Manager now uses DECwindows interface with CMS which works differently than the CMS subsystem command level which was previously used.

2. Change the information the GCS participants must supply the CM.

3. Change Configuration Manager's room number.

4. Remove reference to current GCS specification version (otherwise, the CM Plan would have to be updated with each new Spec version).

5. Miscellaneous mods: grammatical errors, spacing in tables, etc.

6. Modification:

Modification 1. Removed references to the concurrent/noconcurrent qualifier.

A) Removed the following statements :

- All elements in the CMS libraries will have the concurrent qualifier disabled; this will ensure that two project participants are not working on the same element at the same time and making separate changes to the element (from section CMS Description).
- The element is marked within the CMS library that it is reserved so that no other concurrent reservations may be made during this time (from section CMS Description).
- As elements are created, they will have the "noconcurrent" qualifier enabled. This means that only one reservation of an element may exist at one time; this will ensure that two project participants are not working on the same element at the same time and making separate changes to the element (from section Procedures for Using CMS).

B) Removed the noconcurrent qualifier from CMS example in section Procedures for Using CMS.

Modification 2. Removed "CMS library name" from information provided to the Configuration Manager when requesting a reservation in 3 occurrences: once in the section Procedures for Using CMS, once in the section Change control, and once in the section Change Review.

Modification 3. Now refer to "Configuration Manager's office" instead of specific room number. Changed once in the section Other SCM Tools and twice in the section Configuration Status Accounting.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst — 5/20/94

Support Documentation Change Report Continuation

a. Report #: 4, for the Configuration Management Plan

b. Notes/Explanation (Please reference appropriate section number):

Modification 4. Removed reference to current GCS specification in the following paragraph:

> In some cases, a new baseline may be established for a support document if numerous modifications have been made (since no predefined milestone exists). For example, when the GCS specification was first developed, Version 1.0 was created. There were a few interim versions of the GCS specification (Version 1.1, 1.2, etc.) created before it was classified as Version 2.0. After verification of the GCS specification, it was updated to Version 2.0. After a significant number of specification modifications, the GCS specification was updated to Version 2.1. **Now that the GCS project has been transferred to NASA, numerous modifications have been made to the GCS specification and it is now at Version 2.2.** (in the section Baselines and Traceability)
>
> Replaced the bolded sentence with: **Upon transfer to NASA, a number of significant modifications were made to the GCS specification, and Version 2.2 was released at the end of the transitional software requirements development phase.**

Modification 5. Miscellaneous mods.

- Removed "CC1" from the titles of Table 3 and Table 4.
- Changed the sentence "In case of an unusual occurrence, a red "*" will be entered in the log with a number associated with it; an explanation of this occurrence will be on a separate page in the binder." to "In case of an unusual occurrence, a "*" will be entered in the log with an explanation of the occurrence." in the section Configuration Status Accounting because the status logs are also available via Excel spreadsheets.
- grammatical errors corrected
- realigned some tables

The following paragraph should have been modified with SDCR #3 for the Configuration Management Plan:

OLD:
The support documents enter CMS when the initial draft of the document has been approved by the SQA representative, with the exception of the GCS specification. The development products enter configuration management process at the Post-Code Review version received from RTI (see the chapter "SCM Environment" in this document for a list of the support documentation). Table 9 shows the transition criterion for entering the configuration management process for the project data.

NEW:
The support documents enter CMS when the initial draft of the document has been approved by the SQA representative, with the exception of the GCS specification. The design descriptions enter the configuration management process at the Post-Code Review version received from RTI. The source code and executable object code are generated and then enter the configuration management process after the design phase has been completed. Table 9 shows the transition criterion for entering the configuration management process for the project data.

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Configuration Management Plan	12/19/94	5

4. Part of Configuration Item Affected:
Problem and Change Reporting section

5. Reason for Modification:
There have been a number of changes in the procedures that are followed for problem reporting. This needs to be reflected in the document.

6. Modification:

The following section and figures were modified to show that the project leader has control of the assignment of PR's.

- Instructions for Problem and Action Reports
- Figures 3: Flow of Problem Reporting Process for the Development Products
- Problem Reporting for Support Documentation
- Figure 5: Flow of Change Reporting Process for the Support Documentation
- Completing the Problem Report Form
- Completing the Action Report Form
- Completing the Support Documentation Change Report Form

(See the attached text for the updated changes.)

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/22/94

Support Documentation Change Report

1. Configuration Item: CM Plan	2. Date: 1/25/95	3. Formal Modification #: 6

4. Part of Configuration Item Affected:

Entire document

5. Reason for Modification:

1. remove reference to SQA having access to CMS libraries
2. reflect the fact that the "replace" command is executed after SQA signs PR
3. update library names to reflect current naming
4. need to clarify that verification cases library is not planet specific
5. status log sheet has been modified
6. change SQA to project leader in a few cases
7. cosmetic changes
8. adding references on how to fetch, reserve, and replace an element using CMS

6. Modification:

1. Remove reference to SQA having access to CMS libraries in the sections "CMS Description" and "Procedures for Using CMS"
2. New Text for Replace command in section "CMS Description": As in the example where the programmer has reserved an element to make a change in response to a Problem Report, **the element will be replaced after the SQA representative has signed the PR indicating all necessary changes have been made.**
3. In the section "CMS Libraries", Table 7 removed reference to the Software Verification Cases and the Software Verification Procedures being planet specific from the library names.
4. The following text was added to the footnote at the end of Table 7 in the section "CMS Libraries": * These project data are implementation specific. **The Verification Cases library only has a few elements that are implementation specific; therefore, there will be a naming convention to distinguish between the two implementations.** In the section "Configuration Identification", the following was added for clarification: For implementation specific data, some elements in the libraries may have the same names. Since each implementations' elements are **mainly** kept in separate libraries there will be no confusion as to which elements are being referenced; **however, for the verification cases, some elements are distinguished be preceding the element name with the first letter of the planet name followed by an underscore. For example, the guidance processing test case for Mercury would be named m_test_gp.for.**
5. In the section "Configuration Status Accounting", updated the description and illustration of the status log sheet to reflect the one that is currently being used.
6. In the section "Change Control", removed text referring to SQA in the following: (a)Approval of the procedure by the **(SQA representative and)** project leader is required prior to implementing the procedure; (b) Because this tool directly affects the output from the testing, any change to the simulator would require regression testing and approval by **(the SQA representative and)** the project leader. In the section "Transition Criteria", changed SQA to project leader in the following: (a) The software life cycle data that requires approval by **the project leader** will enter the configuration management process after approval has been received and (b) The support documents enter CMS when the initial draft of the document has been approved by **the project leader**, with the exception of the GCS specification
7. minor wording in various sections

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 2/24/95

Support Documentation Change Report Continuation

a. Report #: 6

b. Notes/Explanation (Please reference appropriate section number):

8. Deleted the old contents of the section "Procedures for Using CMS", and added new text explaining how to fetch, reserve, and replace elements. The new section follows:

Procedures for Using CMS

The configuration manager will use CMS libraries to manage project data. CMS can be invoked from the DCL command level, from the CMS subsystem command level, or from the DECwindows user interface.

In order to fetch, reserve or replace an element using CMS, it is easiest to have the directory set to the specific directory in which the element will be placed or retrieved. The fetch command is issued when a copy of the element is needed for examination purposes only; no changes may be made to this copy of the element. For example, after issuing the fetch command, the element name is entered in the appropriate place. If this transaction needs to be recorded in the history log, a remark must be entered before the command is executed; otherwise, no transaction will be recorded. Once the fetch command has been issued, the element will reside in the VMS default directory that was set prior to issuing the command. The reserve and replace commands work in a similar manner, except these transactions are always recorded in the history log, even if no remark is entered along with the command. The reserve command places a working copy of the element in the directory; the latest version of the element is reserved unless otherwise specified. If the noconcurrent qualifier was issued at the time of reservation, no other reservations of that element are allowed until after the element has been replaced. Once the reserve command has been issued, the element name is entered, along with a remark, and then the reservation is executed. The replace command can only be executed if a reservation exists. The replace command, along with the element name and remark, are entered and executed. If there is more than one version of a file in the default directory, the replace command will use the highest version number for the replacement of an element.

The wildcard character, "*", may be used for multiple reservations, replacements, or fetches if the elements are similar in name. The * may be used in place of one or more characters.

The following section describes the tool team*work*, which will be used by the programmers for the development of their detailed designs in addition to CMS.

DEV_STAND

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #: 1
Software Development Standards	7/27/93	

4. Part of Configuration Item Affected:

Chapter: Software Design Standards, Section: Design Documentation, II e)

5. Reason for Modification:

Need to clarify the wording regarding the contents of the Data Dictionary.

Propose that the Data Dictionary should contain all entries from the Data Dictionary in the GCS specification and any additional variables contained in the design that represent data flows between processes.

6. Modification:

Action: Replace the following text with the modified text.

e) **Data Dictionary**
This subsection should contain a complete data dictionary, including both specified and non-specified variables. This subsection may also contain all the information pertaining to resource limitations, such as memory and timing constraints.

Modified Text:

e) **Data Dictionary**
This subsection should contain the data dictionary for the team*work* design. This data dictionary should include all of the data dictionary entries in the GCS specification and any additional variables contained in the design that represent flows between processes. This subsection may also contain all the information pertaining to resource limitations, such as memory and timing constraints.

7. SQA Signature & Date: Original Signed by (Carlos Liceaga 7/28/93

Support Documentation Change Report

Configuration Item: Software Development Standards	2. Date: 8/30/93	3. Formal Modification #: 2

4. Part of Configuration Item Affected:
Chapter: Problem and Change Reporting
Section: Instructions for Problem and Action Reports, first paragraph

5. Reason for Modification:
Need to make explicit the concept that during verification activities where a Moderator is present, the Moderator will have the authority to make the final determination as to whether issuing a Problem Report is appropriate; that is, during such verification activities, it will not be the case that any project participant can initiate a Problem Report.

6. Modification:
Action: Modified the sentence below to clarify who has the authority to initiate Problem Reports

Original Text: During the development cycle, any participant in the project (programmer, verification analyst, SQA representative, or system analyst) who identifies or observes something that may need to be changed in some way in a development product is responsible for initiating a Problem Report.

Modified Text: In general, a project participant who identifies, in the course of their prescribed activities, something in a development product that may be regarded as a problem (such as a violation of a software requirement or project standard) is responsible for initiating a Problem Report. However, during those verification activities where a Moderator is present, the Moderator will have the authority to determine whether issuing a Problem Report is appropriate.

7. SQA Signature & Date:

Original Signed by
George Finelli 8/30/93

Support Documentation Change Report

Configuration Item:	2. Date:	3. Formal Modification #:
Software Development Standards	8/30/93	3

4. Part of Configuration Item Affected:
Chapter: Problem and Change Reporting
Section: Instructions for Problem and Action Reports, item 1.

5. Reason for Modification:

Need to clarify that during verification activities where a Recorder is present, the Recorder will be the actual initiator of the Problem Reports.

Decided a different modification was more important. Had the configuration manager "unreserve" this configuration item.

6. Modification:

7. SQA Signature & Date:

Original Signed by
George Finelli 8/31/93

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Software Development Standards	1/3/94	3

4. Part of Configuration Item Affected:

Chapter: Problem and Change Reporting

Sections: Instructions for Problem and Action Reports, Completing the Problem Report Form, Completing the Action Report Form, Problem Reporting for Support Documentation, Completing the Support Documentation Change Report, Figure 6, and Figure 8

5. Reason for Modification:

The GCS project leader has assumed some of the responsibilities associated with the Problem and Action reporting that had been delegated to the SQA representative. The project leader will now be the first point of contact for Problem and Action Reports and Support Documentation Change Reports. The project leader will give the initial approval to make the change, assign report numbers, and distribute forms to the appropriate persons. Need to change the problem reporting procedures to reflect this change.

6. Modification:

To show that several of the problem and action reporting responsibilities that had belonged to the SQA representative now belong to the project leader, the term "SQA representative" was replaced with "project leader" in the appropriate parts in the chapter, "Problem and Action Reporting", along with a few minor wording changes to clarify the process. Those changes have been highlighted and are attached to this form.

7. SQA Signature & Date: Original Signed by George Finelli 1/5/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Software Development Standards	5/6/94	4

4. Part of Configuration Item Affected:

The following chapters are affected: section The Software Development Process for the GCS Project of the Introduction , Instructions for Programmers Regarding the Transitional Design Phase, Software Code Standards, Instructions to Programmers Regarding the Transitional Coding Phase

5. Reason for Modification:

Change in project plan: now going to have the programmers generate their own source code for the implementation instead of modifying existing code for the implementation developed at the Research Triangle Institute. The instructions to the programmers during the design and coding phases will change along with the code standards.

6. Modification:

Modification 1: Deleted the term "transitional" from the phrases "transitional coding" and "transitional software coding" in 3 occurrences: once in section The Software Development Process for the GCS Project of the Introduction and twice in Instructions to Programmers Regarding the Transitional Coding Phase

Modification 2: Removed the statement "5. modification of the existing code (developed at RTI) to bring it up to the newly revised design" from the Introduction (The Software Development Process for the GCS Project)

Modification 3: Deleted the following section from Instructions for Programmers Regarding the Transitional Design Phase:

While waiting for their design reviews, the programmers should (given that there is time to do so):

1. Reserve their original Post Code Review version of their coded implementation out of the CMS library after submitting the design to the SQA representative. An element or class of elements can be fetched or reserved from the CMS library by contacting the configuration manager. When requesting an element, be specific about which element is needed, why that element is needed, and whether to reserve or fetch that element. VAX Notes should be used to request elements from CMS. Note that the configuration manager will not release the Post Code Review version of the code until the design description has been submitted for configuration management.
2. After reserving the Post Code Review version of the implementation, the programmer should remove (delete) the revision history, all code that was commented out due to changes from previous RTI-generated Problem Reports, and comments associated with those Problem Reports from this version of code. When finished, the code should still have the original descriptive comments in place. No executable code should be deleted or modified at this time. This new version of code will be referred to as the original transition code. To assure that no executable code has been deleted, it is suggested that the programmer use the DIFFERENCES command in VAX/VMS to compare the original Post Code Review version to the original transition code version. The only differences reported as a result of using the DIFFERENCES command should be comments.
3. Replace the original transition version of the code back into the appropriate CMS library for the code (by consulting with the configuration manager using VAX Notes) prior to making any other modifications to the code. The elements of the original transition version of code will be put in a baseline for that implementation.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/12/94

Support Documentation Change Report Continuation

a. Report #: 4, for the Software Development Standards

b. Notes/Explanation (Please reference appropriate section number):

Section 6. Modification (continued):

Modification 4. Modified the entire section Code Presentation and Documentation in chapter Software Code Standards to the following:

Code Presentation and Documentation

For this GCS project, the programmers are required to follow a few simple guidelines with respect to the presentation and documentation of the source code. With respect to presentation standards (line length, indentation, blank lines, etc.), programmers are only required to make the source code easily readable to aid in verification and future modification. Programmers are encouraged to make generous use of indentation and blank lines, but no specific constraints are imposed. With respect to documentation, each programmer should add descriptive comments to the source code wherever appropriate. The comments should provide sufficient information to allow changes to be made completely, consistently, and correctly while retaining the structure. The following items also are required for the documentation of the source code: module header blocks, a revision history (starting after the first Code Review), and a system for denoting modifications. Below is a brief description of these items.

Module Header Block -- Header blocks should be used at the beginning of each module to provide an overall summary of that module. Figure 3 shows a general format for the module header. Each programmer may choose the exact style of the header block; that is, the style does not have to conform precisely to the style presented in Figure 3, but all of the information should be included.

Revision History -- All modifications made to each module should be summarized in a section called revision history located directly under the header block for that module. Each modification to a module should be labeled with a version number, v#. For example, the first modification to a module would be labeled v1 and the second modification would be v2. The revision history also should contain the Action Report (AR) number associated with each change made to the module, the date the change is made, the name of the person implementing the change, and a description of the change.

Notation of Modifications -- Once the source code is submitted for code review, no code that is to be modified in response to a Problem Report may be deleted. The source code that is to be modified should be commented out (instead of deleted) and the new code added. The beginning of all areas of changes should be noted clearly with a comment line, as shown below, containing the following:

```
!-
! v# Begin changes for AR#<action report number>. <short description of change>
!-
```

The end of change areas should be similarly marked by an "End Change" comment line.

Support Documentation Change Report Continuation

a. Report #: 4, for the Software Development Standards

b. Notes/Explanation (Please reference appropriate section number):

Modification 4. continued

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
!      MODULE NAME:
!      PURPOSE:
!      ARGUMENTS:
!      NOTES:
!      AUTHOR:
!      IMPLEMENTATION NAME:
!      DATE FIRST SUBMITTED FOR CONFIGURATION MANAGEMENT:
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
!                              REVISION HISTORY
!      v# , <date>, <author name>, <description, including AR#>
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

Figure 3. Module Header Block and Revision History

Naming conventions for subprograms, variables, and constants should be understandable (to aid traceability and verification) and conform to requirements in the GCS specification. The specification states specific requirements regarding the labeling of global data stores. The specification also places a constraint on the use of variables in addition to the global data store variables (see the GCS specification for further information). In addition to these constraints, no special coding tools should be used to generate the code. Beyond those stated here, no further constraints have been imposed on the coding process.

Modification 5: Modified the first instruction under Instructions to Programmers Regarding the Transitional Coding Phase from

1. Modify the original transition version of code such that the source code implements the detailed design description and conforms to the Software Coding Standards defined above. Each programmer can reserve the original transition version of code by consulting the configuration manager using VAX Notes. Programmers can start the modification of the original transition version of their code prior to the completion of the Design Reviews. However, the code should not be replaced in CMS or submitted for Code Review before the completion of the Design Review phase (since the Design Reviews can initiate changes to the design description).

to

1. Generate source code that implements the detailed design description and conforms to the Software Coding Standards defined above.

Modification 6: Made minor wording changes in instructions 3 and 4 in Instructions to Programmers Regarding the Transitional Coding Phase. Replaced the word "Replace" with "Submit" in instruction 3; replaced the phrase "to inform him that" to "when" in instruction 4; and deleted the phrase "will determine dates and times for the Code Reviews" from instruction 4.

Support Documentation Change Report

1. Configuration Item: Software Development Standards	2. Date: 5/16/94	3. Formal Modification #: 5

4. Part of Configuration Item Affected:

The following chapters are affected: Introduction, Software Requirements Standards, Software Code Standards, Collecting Effort Data, Communication Protocol, and the Appendix

5. Reason for Modification:

Change in project plan: now only have 2 implementations of the GCS application as opposed to 3 implementations. Need to change all references to 3 implementations and delete references to the Earth implementation (which is the implementation that was dropped).

6. Modification:

Modification 1: Changed the reference to three implementations to multiple implementations in several occurrences:

(a) in section The Software Development Process for the GCS Project of the Introduction
"The GCS project involves the development of three separate implementations ... " was changed to:
"The current GCS project involves the development of separate implementations ... "; and
added the phrase "and only develop two of the implementations" to the end of the sentence:
Due to the transitioning of the project from RTI to NASA along with new focus on the DO-178B guidelines, the decision was made to revisit some of the original development activities.

(b) in section Review of the Software Requirements in Software Requirements Standards:
"In fact, the three implementations ..." was changed to "In fact, the implementations ..."

(c) in section Programming Language in Software Code Standards:
"... the three GCS implementations ..." was changed to "... the GCS implementations..."

(d) in Collecting Effort Data:
"... for the three GCS implementations ..." was changed to "...for the GCS implementations..."

(e) in Instructions to the SQA Representative for Recording Effort in the Appendix,:
"... the three GCS implementations ..." was changed to "...the GCS implementations..." in 4 places, and
"... the three implementations ..." was changed to "...the implementations..." in 1 place.

(f) in Instructions to the System Analyst for Recording Effort in the Appendix,:
"... the three GCS implementations ..." was changed to "...the GCS implementations..." in 2 places,

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/23/94

Support Documentation Change Report Continuation

a. Report #: 5, for the Software Development Standards

b. Notes/Explanation (Please reference appropriate section number):

Section 6. Modification (continued):

Modification 1: (continued)

(g) in Instructions to the Configuration Manager for Recording Effort in the Appendix,:
"... the three GCS implementations ..." was changed to "...the GCS implementations..." in 2 places
"... all three implementations ..." was changed to "...all implementations..." in 1 place.

Modification 2: Deleted references to the Earth implementation

(a) in section Conventions for Communication between Programmers and System Analyst in Communication Protocol, deleted:
SA-Earth-Programmer: contains all communication between the system analyst and the Earth Programmer

(b) in the table labeled Effort Hours for Software Quality Assurance Activities in the Appendix, deleted the entire section referring to the Earth implementation

(c) in the section Instructions to the Configuration Manager for Recording Effort Data in the Appendix, changed the phrase "Mercury, Earth, and Pluto" to "Mercury and Pluto"; and, in the table labeled Effort Hours for Configuration Management Activities, deleted the references to the Earth Programmer and Earth Verification Analyst

(d) in the table labeled Effort Hours for System Analyst Activities in the Appendix, deleted the references to the Consulting for the Earth implementation and Participating in Reviews for the Earth implementation

Modification 3: The forms shown in the Appendix for collecting effort data were originally developed using the MacDraft tool. Replaced the forms done in MacDraft with Word tables. Consequently, there are some minor cosmetic changes to the forms shown, but the content should be the same with the inclusion of the changes described above.

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Software Development Standards	5/23/94	6

4. Part of Configuration Item Affected:

The following chapters are affected: Software Requirements Standards, Software Design Standards, Problem and Change Reporting, Instructions for Using CMS, Communication Protocol, and the Appendix

5. Reason for Modification:

Originally in the project, any changes to the GCS specification were referred to as "formal modifications". Later in the project, we instituted a system of Support Documentation Change Reports to handle change requests for much of the project documentation, including the GCS specification. The Support Documentation Change Report system was documented in the standards, but many of the references to "formal modifications" were not changed. Need to change the references to the old formal modifications to make them consistent with the Support Documentation Change Report system.

6. Modification:

Modification 1: in section Derived Requirements and Modification in the Software Requirements Standards, changed the first paragraph from:

"In general, changes to the GCS specification are made through a system of "formal modifications"*. All questions raised by any member of the development team regarding the GCS specification are brought to the system analyst. The system analyst reviews all questions and determines if changes to the specification are required. When changes are deemed necessary, the system analyst submits a description of the necessary modification to the SQA representative and project leader for review. Figure 2 shows information that is included in the description of the modifications. The chapter "Problem and Change Reporting" gives a more detailed description of the procedures and forms used for tracking, reviewing and approving changes to the GCS specification."

* Formal modifications were not issued for the changes made to the GCS specification during the transitional requirements development phase, since a significant number of changes were made during one period. All changes, however, were reviewed and the revised text was denoted in version 2.2 as described in the previous section. All other changes to the GCS specification will be made using the system of formal modifications.

to:

"According to DO-178B, the GCS specification is classified under control category 1 -- which means that the project must provide a formal system of problem reporting, change control, and change review for that data. All changes to the GCS specification, along with the other project support documentation, are made through a system of Support Documentation Change Reports. All questions raised by any member of the development team regarding the GCS specification are brought to the system analyst. The system analyst reviews all questions and determines if changes to the specification are required. When changes are deemed necessary, the system analyst submits a description of the necessary modification to the SQA representative and project leader for review. The chapter "Problem and Change Reporting" gives a more detailed description of the procedures and forms used for tracking, reviewing and approving changes to the GCS specification."

Modification 2: Deleted Figure 2. Formal Modifications to the Requirements; and renumbered the figures accordingly

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/24/94

Support Documentation Change Report Continuation

a. Report #: 6, Software Development Standards

b. Notes/Explanation (Please reference appropriate section number):

Section 6: (continued)

Modification 3: Changed the term "formal modification" to "modification" in the following places:
(a) 2 occurrences in section Derived Requirements and Modification in the Software Requirements Standards
(b) 3 occurrences in section Problem Reporting for Support Documentation in Problem and Change Reporting (including changing the Support Documentation Change Report Form)
(c) 1 occurrence in section Completing the Support Documentation Change Report in Problem and Change Reporting
(d) 2 occurrences in section General Rules Regarding Topics and Replies in Communication Protocol

Modification 4: Deleted the following sentence from section Design Documentation in Software Design Standards
"If changes, additions, or deletions are made in response to a formal modification, the formal modification number should be referenced."

Modification 5: Deleted the label "Formal Modification for Specification" from Table 2. Configuration Identification for the DO-178B Life Cycle Data.

Modification 6: Changed the following paragraph in section General Rules Regarding Topics and Replies in Communication Protocol from:

"The Topic Source is either the name of the section(s) in the specification or the name of a Formal Modification to the specification, to which the question applies. The specification section names are predefined and appear in Table 7 below. The programmer must use at least the first four characters of the section name if the section name has four or more characters, but may use more if so desired. If the actual section name has less than four characters, then the full section name should be used. In those cases where the first four characters are not unique, substitutions are given in the table below, and those substitutions must be used instead of the actual section name. In each case, the required part of the section name is bolded. If the source of the question is a Formal Modification, then the Topic Source should be "Modx.y-z", where x.y-z is the number of the Formal Modification. If, for some reason, none of the predefined section names nor a Formal Modification number is appropriate, then one should use the substitute name "other" and describe the source in the text part of the topic. In the case where the question applies to more than one source, list all the applicable sources separated by commas."

to:

"The Topic Source is either the name of the section(s) in the specification or the name of a modification to the specification, to which the question applies. The specification section names are predefined and appear in Table 7 below. The programmer must use at least the first four characters of the section name if the section name has four or more characters, but may use more if so desired. If the actual section name has less than four characters, then the full section name should be used. In those cases where the first four characters are not unique, substitutions are given in the table below, and those substitutions must be used instead of the actual section name. In each case, the required part of the section name is bolded. If the source of the question is a Support Documentation Change Report, then the Topic Source should be "Modx.y-z", where x.y-z is the number of the modification. If, for some reason, none of the predefined section names nor a modification number is appropriate, then one should use the substitute name "other" and describe the source in the text part of the topic. In the case where the question applies to more than one source, list all the applicable sources separated by commas."

Support Documentation Change Report Continuation

1. Report #: 6, Software Development Standards

b. Notes/Explanation (Please reference appropriate section number):

Section 6: (continued)

Modification 7: Changed the term "Formal Modification" to "Support Documentation Change Report" in 2 occurrences in Figure 9. Example of Conversation Between the Programmer (PG) and System Analyst (SA) and in 1 occurrence in Figure 10. Directory of All Notes in the Conversation Example.

Modification 8: In Instructions to the Programmers for Recording Effort in the Appendix, the following changes were made:

(a) deleted the phrase: "except when a change is made during this time in response to a Formal Modification to the specification." from instruction 2.

(b) changed the term "formal modification" to "modification" in instruction 3.

(c) changed instruction 6 from

6. Responding to Formal Modifications: record time spent reading and understanding the formal modification to the GCS specification and making changes to the design or code due to the formal modifications. Effort should be recorded in this category only after the first Design Review.

to:

6. Responding to Modifications to the Requirements: record time spent reading and understanding the Support Documentation Change Reports for the GCS specification and making changes to the design or code due to modifications to the GCS specification. Effort should be recorded in this category only after the first Design Review.

(d) Changed part 6. to Responding to Modifications to the Requirements in Figure 11. Form for Recording Effort Data for Programmers

Modification 9: In Instructions to the Verification Analysts for Recording Effort in the Appendix, the following changes were made:

(a) changed the title of instruction 3 from "**Responding to Formal Modifications:**" to "**Responding to Modifications to the Requirements:** " and made the corresponding change in Figure 12. Form for Recording Effort Data from Verification Analysts

(b) changed the term "formal modification" to "Support Documentation Change Report" in 2 occurrences in instruction 3.

(c) changed the term "formal modification" to "modification" in the last occurrence in instruction 3.

Modification 10: In Instructions to the SQA Representative for Recording Effort in the Appendix, the following changes were made:

(a) changed the term "formal modification" to "Support Documentation Change Report" in the first paragraph and in instructions 2 and 3.

(b) changed the title of instruction 5 from "**Reviewing Formal Modifications:**" to "**Reviewing Modifications to the Requirements:** " and made the corresponding change in Figure 13. Form for Recording Effort Data from the SQA Representative

Modification 11: In Instructions to the System Analyst for Recording Effort in the Appendix, changed the term "formal modification" to "Support Documentation Change Report" in instructions 1 and 3

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Software Development Standards	5/25/94	7

4. Part of Configuration Item Affected:
Software Design Standards and Instructions to Programmers Regarding the Transitional Design Phase

5. Reason for Modification:

Need to revise the Software Design Standards to eliminate some items not specified by the DO-178B guidelines and not needed as part of the project -- in particular, the requirements to give a call structure, transition history, and revision history as part of the design. Also need to revise the Instructions to the Programmers Regarding the Transitional Design Phase in response to the changes that have been made.

6. Modification:

Modification 1: in the section Design Documentation of the Software Design Standards, deleted the sentence "It is important to note that the design documentation should reference the *planetary name* of the implementation, but not directly reference the name of the programmer."

Modification 2: in the section Design Documentation of the Software Design Standards, deleted section II a) Description of Call Structure. Renumbered the sections accordingly.

Modification 3: in the section Design Documentation of the Software Design Standards, added the following sentence to the start of section II c) Module Description:
"This section should provide the software architecture and low-level requirements, developed using the team*work* tool, that satisfy the requirements given in the GCS specification."

Modification 4: in the section Design Documentation of the Software Design Standards, deleted section III. Transition History.

Modification 5 in the section Design Documentation of the Software Design Standards, deleted section IV. Revision History.

Modification 6 in the section Design Documentation of the Software Design Standards, changed the section number for References from V to III.

Modification 7: in the section Design Documentation of the Software Design Standards, deleted section VI. Appendix.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/25/94

Support Documentation Change Report Continuation

1. Report #: 7, Software Development Standards

b. Notes/Explanation (Please reference appropriate section number):

Section 6: (continued)

Modification 8: in the Instruction to Programmers Regarding the Transitional Design Phase, changed:

> "Within this transitional phase, special instructions, such as including a section describing the Transition History in the design documentation standards, and modifying an existing design, have been included to provide guidance to the project programmers due to the special circumstances of this period."
>
> to:
>
> "Within this transitional phase, special instructions for modifying the existing design have been included to provide guidance to the project programmers due to the special circumstances of this period."

Modification 9: in the Instructions to Programmers Regarding the Transitional Design Phase, changed:

> "1. Modifying the original design of their implementation (developed at RTI) so that the new detailed design meets the requirements of version 2.2 of the GCS specification and the standards set forth in this document in the chapter "Software Design Standards". As described in the design standards, the CASE tool, team*work* should be used to update the design to reflect the functionality in version 2.2 of the specification prior to making modifications to the code."
>
> to:
>
> "1. Modifying the original design of their implementation (developed at RTI) so that the new detailed design meets the requirements of the most current version of the GCS specification and the standards set forth in this document in the chapter "Software Design Standards". As described in the design standards, the CASE tool, team*work*, should be used to update the design."

Modification 10: in item 4. of the Instructions to Programmers Regarding the Transitional Design Phase, changed the references to the SQA representative to the project leader.

Modification 11: in item 4. of the Instructions to Programmers Regarding the Transitional Design Phase, changed the phrase:

> "will determine dates and times for the Design Reviews and contact the participants in the review to schedule the review sessions."
>
> to:
>
> "will contact the participants in the review to schedule the review sessions."

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Software Development Standards	5/25/94	8

4. Part of Configuration Item Affected:
Software Requirements Standards

5. Reason for Modification:

The paragraph at the end of the section Review of the Software Requirements discusses the bolding used to highlight changes when we went to version 2.2 of the specification. Since we have since revised the specification and removed the bolding, this paragraph is no longer appropriate.

6. Modification

Deleted the following paragraph from the end of the section Review of the Software Requirements in the Software Requirements Standards:

Version 2.2 of the GCS specification contains a number of modifications to version 2.1 of the specification document. To help identify changes made during the enhancement of the specification, the text that was modified from version 2.1 was bolded in version 2.2. Some existing text was moved to another place in the document, and some text was deleted. There is no demarcation in version 2.2 to indicate where text was moved or deleted. The modifications that are significant (may impact the coding of an implementation) are marked with a footnote number. Where there were a number of significant modifications within a processing step (in Level 3 of the specification), a footnote number was placed just at the top of the processing step (as opposed to marking each individual change within the processing step). There was also a significant new addition to the specification: requirements for exception handling. New additions to the text were also bolded.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/25/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Software Development Standards	5/25/94	9

4. Part of Configuration Item Affected:
Instructions for Using CMS and the Appendix

5. Reason for Modification:

In SDCR #4, changed the project plan to have the programmers generate their own source code for the implementation instead of modifying existing code for the implementation developed at the Research Triangle Institute. However, some text in the Instructions for Using CMS and the Appendix still contains language about using the old code from RTI and needs to be corrected.

6. Modification

Modification 1: Deleted the last paragraph, shown below, in the section Basic CMS Commands in the chapter Instructions for Using CMS:

> Prior to the first code review, a programmer can reserve a copy of the original transition version of code and make changes so that the source code implements the design description and conforms to the Software Coding Standards. While the specific element generations making up the original transition code are reserved, the programmers are allowed to make as many changes as needed without replacing the element after each change. However, once the code has been submitted for Code Review, changes to the code can be made only in response to a Problem Report. In addition, the source code element should be reserved and replaced with each individual change. The Action report for each change should be noted in the comment for that reservation.

Modification 2: Added the sentence below to the new last paragraph in the section Basic CMS Commands in the chapter Instructions for Using CMS

"The report number for each change should be noted in the comment for that reservation."

Modification 3: in the Instructions to the Programmers for Recording Effort in the Appendix, changed instruction 2 from:

> "**2. Changing Code during Transitional Coding Phase**: record time spent updating the existing software code to match the detailed design description. This will include all time spent modifying the code until the time of the first Code Review. "
>
> to
>
> "**2. Developing Source Code**: record time spent developing source code to meet the detailed design description. This will include all time spent generating the source code until the time of the first Code Review."

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/25/94

Support Documentation Change Report Continuation

a. Report #: 9, for the Software Development Standards

6. Modification

Section 6: (continued)

Modification 4. in the Instructions to the Programmers for Recording Effort in the Appendix, changed the label for instruction 2 in Figure 11. Form for Recording Effort Data from Programmers to "2. Developing Source Code"

Modification 5: in the Instructions to the Verification Analysts for Recording Effort Data in the Appendix, changed the phrase "Transitional Coding Phase" to "Coding Phase" in 3 occurrences in Figure 12. Form for Recording Effort Data from Verification Analysts

Software Requirements GCS Development Specification

Formal Modification # 2.2-1

Date: December 30, 1992

Part of Specification Affected:

Chapter 5
AECLP
Page 38
Section labeled "PROCESSING WHEN AXIAL ENGINES ARE ON"
Last sentence of the first paragraph

Reason for Modification:

The statement pertaining to the initialization of PE_INTEGRAL, YE_INTEGRAL, and TE_INTEGRAL needs to be corrected. If the trajectory begins with FRAME_COUNTER set to one, then these variables will be initialized to zero; however, if the FRAME_COUNTER begins at a value other than one, these variables may be initialized to a value other than zero.

Modification:

Original Text:

"The variables PE_INTEGRAL, YE_INTEGRAL, AND TE_INTEGRAL will be initialized to the value zero **by INIT_GCS."**

Action:

- Delete the text "to the value zero"

Modified Text:

"The variables PE_INTEGRAL, YE_INTEGRAL, AND TE_INTEGRAL will be initialized by INIT_GCS."

Formal Modification # 2.2-2

Date: December 30, 1992

Part of Specification Affected:
Chapter 5
RECLP
Page 65
Section labeled "DETERMINE PULSE INTENSITY AND DIRECTION"
Third sentence from the end of the paragraph

Reason for Modification:
The statement pertaining to the initialization of the variable THETA needs to be corrected. The variable THETA will be initialized to the initial roll angle which is not necessarily zero.

Modification:

Original Text:
"The variable THETA will be initialized to the value zero **by INIT_GCS."**

Action:
- Delete the text "to the value zero"

Modified Text:
"The variable THETA will be initialized by INIT_GCS."

Formal Modification # 2.2-3

Date: December 30, 1992

Part of Specification Affected:
Chapter 5
AECLP
Page 41
Section labeled "COMPUTE AXIAL ENGINE VALVE SETTINGS"
Last sentence in the section

Reason for Modification:
The wording "to the nearest integer" needs more specificity.

Modification:

Original Text:
"with INTERNAL_CMD between 0 and 1.0 being converted *linearly* **(to the nearest integer)[27]** to a value of AE_CMD between 0 and 127."

Actions:
- Delete the text " **(to the nearest integer)[27]** "
- Add new text which will then become the last sentence in the section. The new sentence is shown below under "Text to be Added".

Text to be Added:
"Each value for AE_CMD is to be rounded to the nearest integer, where rounding is defined as follows:[27]
Let x represent the real value that is to be rounded
Then, AE_CMD = the integer part of (x + 0.5)"

Modified Text:
"with INTERNAL_CMD between 0 and 1.0 being converted *linearly* to a value of AE_CMD between 0 and 127. **Each value for AE_CMD is to be rounded to the nearest integer, where rounding is defined as follows:[27]**
Let x represent the real value that is to be rounded
Then, AE_CMD = the integer part of (x + 0.5)"

Software Requirements GCS Development Specification

Formal Modification # 2.2-4

Date: February 8, 1993

Part of Specification Affected:
Chapter 5
GP
Page 60
Table 5.10
First line of the table (GP_PHASE = 1), under the column labeled "EVENT"

Reason for Modification:

The phrase **"and engines were not turned off in prior frame"** is unecessary because when the lander is in Phase 1, the engines will not yet have been turned off.

Modification:

Original Text:
"Altitude for turning engines on is sensed **and engines were not turned off in prior frame"**

Action:
- Delete the text **"and engines were not turned off in prior frame"**

Modified Text:
"Altitude for turning engines on is sensed"

Software Requirements GCS Development Specification

Formal Modification # 2.2-5

Date: February 24, 1993

Part of Specification Affected:
Chapter 5
ARSP
Page 43
INPUT (list of variables that are inputs to this processing module)

Reason for Modification:

The variable FRAME_COUNTER was omitted from the list of inputs.

Modification:

Original Text:

INPUT

AR_ALTITUDE AR_FREQUENCY K_ALT	AR_COUNTER AR_STATUS

Action:
- Add the variable FRAME_COUNTER to the list of inputs.

Modified Text:

INPUT

AR_ALTITUDE AR_FREQUENCY FRAME_COUNTER	AR_COUNTER AR_STATUS K_ALT

Software Requirements GCS Development Specification

Formal Modification # 2.2-6

Date: March 10, 1993

Part of Specification Affected:
Chapter 6, **Data Requirements Dictionary**
PART I. DATA ELEMENT DESCRIPTIONS
Page 89 (GVE)
Page 91 (PE_MAX and PE_MIN)
Page 94 (TE_MAX and TE_MIN)
Page 95 (YE_MAX and YE_MIN)

Reason for Modification:
The DATA TYPE for GVE should be "real*8" instead of "array(1..2) of real*8".
The DATA TYPE for PE_MAX, PE_MIN, TE_MAX, TE_MIN, YE_MAX, and YE_MIN should be "array(1..2) of real*8" rather than "real*8"

Modification for GVE:

Original Text:

DATA TYPE: array(1..2) of real*8

Action:
- Delete "array(1..2) of" before "real*8"

Modified Text:
DATA TYPE: real*8

Modification for PE_MAX, PE_MIN, TE_MAX, TE_MIN, YE_MAX and YE_MIN:

Original Text:

DATA TYPE: real*8

Action:
- Insert "array(1..2) of" before "real*8"

Modified Text:

DATA TYPE: array(1..2) of real*8

Software Requirements GCS Development Specification

Formal Modification # 2.2-7

Date: March 10, 1993

Part of Specification Affected:

Chapter 5
AECLP
Page 38, Section labeled "COMPUTE LIMITING ERRORS FOR PITCH"
Page 39, Section labeled "COMPUTE LIMITING ERRORS FOR YAW"
Page 39, Section labeled "COMPUTE LIMITING ERRORS FOR THRUST"

Reason for Modifications:

The variable GVE is a scalar, and thus references to it should not be subscripted.

Each of the variables PE_MIN, PE_MAX, TE_MIN, TE_MAX, YE_MIN, and YE_MAX is an array with two elements, and thus references to individual elements mus be subscripted.

Modification:

Original Text:

COMPUTE LIMITING ERRORS FOR PITCH

- **If P_e^L < PE_MIN then set P_e^L to PE_MIN.**
- **If P_e^L > PE_MAX then set P_e^L to PE_MAX.**

COMPUTE LIMITING ERRORS FOR YAW

- **If Y_e^L < YE_MIN then set Y_e^L to YE_MIN.**
- **If Y_e^L > YE_MAX then set Y_e^L to YE_MAX.**

COMPUTE LIMITING ERRORS FOR THRUST

GVE(CL)•VELOCITY_ERROR + GVEI(CL)•TE_INTEGRAL

- **If TE_LIMIT < TE_MIN then set TE_LIMIT to TE_MIN.**
- **If TE_LIMIT > TE_MAX then set TE_LIMIT to TE_MAX.**

Actions

- Replace occurrence of GVE(CL) with GVE.
- Replace occurrences of PE_MIN, PE_MAX, TE_MIN, TE_MAX, YE_MIN, YE_MAX with PE_MIN(CL), PE_MAX(CL), TE_MIN(CL), TE_MAX(CL), YE_MIN(CL), YE_MAX(CL), respectively.

Modified Text:

COMPUTE LIMITING ERRORS FOR PITCH

- If P_e^L < PE_MIN(CL) then set P_e^L to PE_MIN(CL).
- If P_e^L > PE_MAX(CL) then set P_e^L to PE_MAX(CL).

COMPUTE LIMITING ERRORS FOR YAW

- If Y_e^L < YE_MIN(CL) then set Y_e^L to YE_MIN(CL).
- If Y_e^L > YE_MAX(CL) then set Y_e^L to YE_MAX(CL).

COMPUTE LIMITING ERRORS FOR THRUST

GVE·VELOCITY_ERROR + GVEI(CL)·TE_INTEGRAL

- If TE_LIMIT < TE_MIN(CL) then set TE_LIMIT to TE_MIN(CL).
- If TE_LIMIT > TE_MAX(CL) then set TE_LIMIT to TE_MAX(CL).

Software Requirements GCS Development Specification

Formal Modification # 2.2-8

Date: March 10, 1993

Part of Specification Affected:

Chapter 5
GP
Page 61, Section labeled "DETERMINE WHICH SET OF CONTROL LAW PARAMETERS TO USE"

Reason for Modifications:

The subset of variables listed in the first paragraph should not contain the variable GVE and is missing the variables PE_MIN, PE_MAX, TE_MIN, TE_MAX, YE_MIN, and YE_MAX.

Modification:

Original Text:

...This subset consists of the following eight variables: GVE, GVEI, GV, GVI, GR, GW, GWI, and GQ. Note that each one of these variables is an array of two elements. The eight elements with a subscript of one will be referred to as the "first" set of Control Law Parameters, while the eight elements with...

Actions

- Remove the variable GVE from the list
- Add the variables PE_MIN, PE_MAX, TE_MIN, TE_MAX, YE_MIN, and YE_MAX to the list.
- Remove all references to "eight" variables

Modified Test:

...This subset consists of the following variables: GVEI, GV, GVI, GR, GW, GWI, GQ, PE_MIN, PE_MAX, TE_MIN, TE_MAX, YE_MIN, and YE_MAX. Note that each one of these variables is an array of two elements. The elements with a subscript of one will be referred to as the "first" set of Control Law Parameters, while the elements with ...

Software Requirements GCS Development Specification

Formal Modification #2.2-9

Date: May 20, 1993

Part of Specification Affected:
INTRODUCTION

2.2-9

Location:
Page 13, section labeled DEFINITIONS, immediately before the definition for **Global Data Store Variable".**

Reason for Modification:
To define the use in this specification of the term "data store".

Action:
Insert definition for "data store"

New Text:

Data Store

The definition for a data or control store given in Hatley[13] is "A data or control store is simply a data or control flow frozen in time. The data or control information it contains may be used any time after that information is stored and in any order." In this specification, all stores contain data, while some also contain data conditions. For the purposes of this specification, the term "data store" will be used to refer to any store which contains some combination of data and data conditions. Thus, all four stores listed in the Data Requirements Dictionary part II will be referred to as "data stores".

Software Requirements GCS Development Specification

Formal Modification # 2.2-10

Date: May 27, 1993

Parts of Specification Affected:
Chapter 2, **LEVEL 0 SPECIFICATION**
Chapter 3, **LEVEL 1 SPECIFICATION**

2.2-10.1
Location:
Page 19
Reason for Modification:
In order to accurately reflect the new contents of Chapter 2.
Action:
Change the title.
Original Text
2. LEVEL 0 SPECIFICATION
Modified Text
2. LEVELS 0 and 1 SPECIFICATION

2.2-10.2
Location:
Page 21, second sentence
Reason for Modification:
To improve the wording.
Action:
Change the text "impact upon landing" to "touch down".
Original Text:
The purpose of the GCS is to keep the vehicle descending along the predetermined velocity-altitude contour which has been chosen to conserve enough fuel to effect a safe attitude and impact upon landing.
Modified Text:
The purpose of the GCS is to keep the vehicle descending along the predetermined velocity-altitude contour which has been chosen to conserve enough fuel to effect a safe attitude and touch down.

2.2-10.3
Location:
Page 21, last sentence in next-to-last paragraph.
Reason for Modification:
An explanation regarding the structured analysis diagrams has been added as the last paragraph in this section, and is not needed here.
Action:
Delete the entire sentence.
Original Text:
The figures in Chapters 2-4 follow the Structured Analysis/Structured Design notation (see Appendix A).
Modified Text:
(none)

2.2-10.4
Location
Page 21, immediately before last sentence in last paragraph
Reason for Modification:
A sentence was omitted.
Action:

Insert a new sentence "In addition, FORTRAN Intrinsic Functions may be used." between the two sentences in the original text.

Original Text:

"...in Appendix B. Other system services..."

Modified Text:

"...in Appendix B. In addition, FORTRAN Intrinsic Functions may be used. Other system services..."

2.2-10.5

Location:

Page 21, following last paragraph, and all of page 22.

Reason for Modification:

An explanation is required for the differences between the structured analysis diagrams in this specification and those in Hatley[13].

Action:

Insert new text after the last paragraph. Because the additional text does not all fit on page 21, the overflow has replaced page 22, and the new Figure 2.1 appears on page 23.

Original Text:

Other system services and library routines are explicitly excluded from use by the programmer.

Modified Text:

Other system services and library routines are explicitly excluded from use by the programmer.

Figures 2.2 through 2.5, 3.1, 3.2, and 4.1 through 4.4, and Tables 2.1, 3.1, 4.1, and 4.2 follow Hatley's extension to Structured Analysis (see Appendix A), with the following exceptions and assumptions.

Exceptions:

1. Any data store may appear at more than one level because the processes specified do not communicate directly but only through data stores.
2. Any unlabeled flow between a process and a data store may not necessarily carry all the information in the data store (the actual flow content is defined by the process specification and the Data Requirements Dictionary Part II).

Assumptions:

1. The initial value for control signals is assumed to be "FALSE".
2. In a process activation table (PAT), an empty process cell indicates the process is deactivated.
3. In a PAT, an empty output cell indicates the control signal value remains unchanged.
4. In a PAT, output control signals receive values before any processes are activated and therefore may delay the activation of processes by deactivating their parent process.

An example of assumption 4 is Table 3.1 where setting RENDEZVOUS to "TRUE" delays the activation of the processes of which RUN_GCS is composed until GCS_SIM sets RENDEZVOUS to "FALSE".

2.2-10.6

Location:

Page 23, entire page

Reason for Modification:

An additional figure showing the structure of the GCS specification is needed.

Action:

The old Figure 2.2 was replaced with an entirely new Figure 2.1.

2.2-10.7

Location:

Page 24, entire page

Reason for Modification:

The old structured analysis diagrams are being replaced by new ones.

Action:
A blank page was replaced with an entirely new structured analysis Figure 2.2.

2.2-10.8
Location:
Page 25, entire page
Reason for Modification:
The old structured analysis diagrams are being replaced by new ones.
Action:
The old Chapter 3 title was replaced with an entirely new structured analysis Figure 2.3.

2.2-10.9
Location:
Page 26, entire page
Reason for Modification:
The old structured analysis diagrams are being replaced by new ones.
Action:
A blank page was replaced with a Chapter 3 subtitle and an entirely new structured analysis Figure 2.4.

2.2-10.10
Location:
Page 27
Reason for Modification:
The old structured analysis diagrams are being replaced by new ones.
Action:
The old Figure 3.1 and the chapter subtitle were replaced with an entirely new structured analysis Figure 2.5.

2.2-10.11
Location:
Page 28
Reason for Modification:
The old structured analysis diagrams are being replaced by new ones.
Action:
The old Figure 3.2 and Table 3.1 were replaced with an entirely new structured analysis Table 2.1.

Software Requirements GCS Development Specification

Formal Modification # 2.2-11

Date: June 2, 1993

Parts of Specification Affected:
Chapter 4, **LEVEL 2 SPECIFICATION**

Modification 2.2-11.1
Location:
Page 29, chapter number
Reason for Modification:
The old Chapter 4 now becomes the new Chapter 3.
Action:
Change the chapter number.
Original Text
4. LEVEL 2 SPECIFICATION
Modified Text
3. LEVEL 2 SPECIFICATION

Modification 2.2-11.2
Location:
Page 31, section title on second line
Reason for Modification:
In order to reflect the new structured analysis diagrams.
Action:
Replace the section title.
Original Text:
PROCESS 1. INIT_GCS[18]
Modified Text:
PROCESS SPECIFICATION (P-Spec) 1: INIT_GCS[18]

Modification 2.2-11.3
Location:
Page 31, **INPUT** and **OUTPUT** sections
Reason for Modification:
The input is incorrect, and the output can be stated directly rather than using a reference to a table.
Action:
Replace both the **INPUT** and **OUTPUT** sections.
Original Text:
INPUT

None

OUTPUT

See Table 6.7

Modified Text:
INPUT

INITIALIZATION_DATA

OUTPUT

INITIALIZATION_DATA

Modification 2.2-11.4

Location:

Page 31, Subsection labeled **"PROCESS"**, beginning with the first paragraph, last sentence, and continuing through to the end of the page.

Reason for Modification:

A new variable SUBFRAME_COUNTER is being added to the EXTERNAL data store for use by the functional unit CP. Also, the fact that FRAME_COUNTER and SUBFRAME_COUNTER are actually included in INITIALIZATION_DATA needs clarification.

Action:

Text has been reworded and reorganized to explain the initialization process and to specifically explain the initialization of the two variables FRAME_COUNTER and SUBFRAME_COUNTER.

Original Text:

The first call to GCS_SIM_RENDEZVOUS will cause INIT_GCS to automatically be executed, which will result in the loading of all necessary initial values and the initialization of the frame counter (FRAME_COUNTER) as follows:

LOAD INITIAL VALUES

- **Load initial values for all variables listed in part III of the Data Requirements Dictionary, namely Table 6.7, *Initialization Data.***

SET FRAME COUNTER

- **FRAME_COUNTER** will be initialized to some number representing the next frame to be executed. This allows the option of starting execution at some point beyond the first frame of a trajectory.

Modified Text:

The first call to GCS_SIM_RENDEZVOUS will cause INIT_GCS to automatically be executed. INIT_GCS will initialize all variables in the group flow INITIALIZATION_DATA, which is defined in Table 6.7 in the Data Requirements Dictionary Part III. Since the variables FRAME_COUNTER and SUBFRAME_COUNTER are part of INITIALIZATION_DATA, they will be initialized at this time. FRAME_COUNTER will be initialized to a value representing the next frame to be executed, while SUBFRAME_COUNTER will always be initialized to the value one, which implies that the first subframe of the first frame to be executed will always be the sensor processing subframe. Although a terminal descent trajectory begins with FRAME_COUNTER initialized to the value one, the option exists for starting execution at some point other than at the beginning of the trajectory, i.e., FRAME_COUNTER may be initialized to a value greater than one.

Modification 2.2-11.5

Location:

Between pages 31 and 32

Reason for Modification:

Additional structured analysis figures and tables and one new chapter heading page were needed.

Action:

New pages 31.1 through and including page 31.9 have been added containing additional structured analysis diagrams (Figures 3.1, 3.2, 4.1, 4.2, 4.3, and Tables 3.1, 4.1) as well as one new chapter heading for Chapter 4 (page 31.4).

Modification 2.2-11.6

Location:

Page 32, entire page

Reason for Modification:

The old structured analysis diagrams are being replaced by new ones.

Action:

The old Figure 4.1 was replaced with an entirely new structured analysis Figure 4.4.

Modification 2.2-11.7
Location:
Page 33, entire page
Reason for Modification:
The old structured analysis diagrams are being replaced by new ones.
Action:
The old Figure 4.2 was replaced with an entirely new structured analysis Table 4.2.

Modification 2.2-11.8
Location:
Page 34, Section labeled "SCHEDULING", sixth sentence
Reason for Modification:
Clarification.
Action:
Add the text " (frame number 1)"
Original Text:
Also note that execution of the GCS may begin at any frame number and should operate as if it had been running from the beginning of the trajectory.
Modified Text:
Also note that execution of the GCS may begin at any frame number and should operate as if it had been running from the beginning of the trajectory (frame number 1).

Modification 2.2-11.9
Location:
Page 34, Section labeled "SCHEDULING, third sentence from end of paragraph.
Reason for Modification:
A new variable SUBFRAME_COUNTER is being added, and thus text describing the initialization and updating of the value of SUBFRAME_COUNTER needs to be included.
Action:
Add the text " and SUBFRAME_COUNTER".
Original Text:
On the first, and subsequent, calls to GCS_SIM_RENDEZVOUS, FRAME_COUNTER will be returned to the **Implementation** containing the correct value for operation.
Modified Text:
On the first, and subsequent, calls to GCS_SIM_RENDEZVOUS, FRAME_COUNTER and SUBFRAME_COUNTER will be returned to the **Implementation** containing the correct values for operation.

Modification 2.2-11.10
Location:
Page 34, Section labeled "SCHEDULING", second and next-to-last sentences
Reason for Modification:
Table 4.1 was renumbered to 4.3 because new tables were added before it.
Action:
Change the number of the table from 4.1 to 4.3.
Original Text:
"...Table 4.1..."
Action:
Change the number of the table.
Modified Text:
"...Table 4.3..."

Modification 2.2-11.11
Location:
Page 34, heading for table
Reason for Modification:

Table 4.1 was renumbered to 4.3 because new tables were added before it.

Action:

Change the number of the table.

Original Text:

Table 4.1: FUNCTIONAL UNIT SCHEDULING[21]

Modified Text:

Table 4.3: FUNCTIONAL UNIT SCHEDULING[21]

Modification 2.2-11.12

Location:

Page 34, footnote at bottom of page

Reason for Modification:

Chapter 5 now contains functional unit descriptions for both levels 3 and 4, rather than just level 3.

Action:

Delete reference to levels, and merely refer to the chapter.

Original Text:

"...In the Level 3 Specification, Chapter 5."

Modified Text:

"...In Chapter 5."

Modification 2.2-11.13

Location:

Between pages 34 and 35

Reasons for Modification:

The specification needs clarification regarding the requirement to execute sequential frames. Also, the criteria and procedures for terminating GCS had been given in the functional unit GP, but are more appropriate in the scheduling section.

Action:

Insert new page, namely page 34.1, with new text to describe the sequential execution of frames and also the reworded termination criteria and procedures for GCS.

New Text:

The GCS software must meet all the requirements for a particular frame for any specific value of the variable FRAME_COUNTER. The software must be capable of executing continuously one frame after another until specified termination conditions are met, at which time it must terminate itself according to specified termination procedures.

The termination conditions and procedures are: GCS should check whether to terminate itself in each frame immediately after executing the Guidance Processing functional unit. At that time if the value of the variable GP_PHASE is equal to 5, then GCS should terminate itself gracefully (without any exception conditions). In this case, the implementation should terminate at the end of the present subframe, i.e., it should execute the functional unit Communications Processing and then terminate without calling GCS_SIM_RENDEZVOUS.

Software Requirements GCS Development Specification

Formal Modification # 2.2-12

Date: June 2, 1993

Parts of Specification Affected
FOREWORD
Contents
List of Figures
List of Tables
Chapter 1, INTRODUCTION
Chapter 5, LEVEL 3 SPECIFICATION

General Reason for Modifications:
To bring the specification into agreement with the new structured analysis diagrams.

2.2-12.1
Location:
Page iii, second paragraph, sixth sentence
Reason for Modification:
The P-Specs for the functional units are now at both level 3 and level 4.
Action:
Change the reference.
Original Text:
"...(in level 3 of the specification)..."
Modified Text:
"...(in Chapter 5 of the specification)..."

2.2-12.2
Location:
Page vi
Reasons for Modifications:
The old structured analysis diagrams are being replaced by new ones in which an additional level was added to the structured diagrams, namely that for specifying the three subframes.

Actions:
The old Chapters 2 and 3 have now both been incorporated into Chapter 2 which now contains the specifications for levels 0 and 1 instead of just level 0.

The old Chapter 4 has become the new Chapter 3 which now contains the level 2 specification instead of the level 1 specification.

A new Chapter 4 has been included which now contains the level 3 flow diagrams and C-Specs instead of the level 2 specification.

The names for Chapters 2, 3, 4, and 5 were changed, and section headings were added for Chapters 2 and 3 and changed for Chapter 5.

The names for the section headings in Chapter 5 were changed.

Chapter 5 now contains the levels 3 and 4 P-Specs instead of just the level 3 specification.

The title for Chapter 6, Part III was changed in order to be a more accurate representation of the contents.

The title for Appendix A was changed to include the new level.

2.2-12.3

Location:

Page vii

The titles for Figures 2.1, 2.2, 3.1, 3.2, 4.1, and 4.2 were changed, and entries for Figures 2.3, 2.4, 2.5, 4.3, and 4.4 were added in order to incorporate the new structured analysis diagrams.

2.2-12.4

Location:

Page ix

The titles for Tables 3.1 and 4.1 were changed. Entries for Tables 2.1, 4.2, 4.3 and Tables 6.8 through 6.12 were added in order to incorporate the new structured analysis diagrams.

2.2-12.5

Location:

Page 12, Subsection labeled **"Functional Unit"**, first sentence

Reason for Modification:

The P-Specs for the functional units are now at both levels 3 and level 4.

Action:

Change the reference.

Original Text

"Chapter 5 (LEVEL 3 SPECIFICATION) is divided..."

Modified Text

"Chapter 5 is divided..."

2.2-12.6

Location:

Page 14, Subsection labeled **"Order of Processing"**, first sentence

Reason for Modification:

The P-Specs for the functional units are now at both levels 3 and level 4.

Action:

Change the reference.

Original Text

"...in the Level 3 specification,..."

Modified Text

"...in Chapter 5,..."

2.2-12.7

Location:

Page 15, Subsection labeled **"Rotation of History Variables"**, first sentence.

Reason for Modification:

The P-Specs for the functional units are now at both levels 3 and level 4.

Action:

Change the reference.

Original Text

"In the LEVEL 3 SPECIFICATION,..."

Modified Text

"In Chapter 5,..."

2.2-12.8

Location:

Page 35

Reason for Modification:

The P-Specs for the functional units are now at both level 3 and level 4.

Action:

Replace the chapter title.

Original Text:

5. LEVEL 3 SPECIFICATION

Modified Text:

5. P-Specs FOR LEVELS 3 AND 4

Software Requirements GCS Development Specification

Formal Modification # 2.2-13

Date: June 2, 1993

Part of Specification Affected:
Chapter 5
AECLP

2.2-13.1
Location:
Page 37, title for P-Spec.
Reason for Modification:
In order to reflect the numbering in the new structured analysis charts.
Action:
Replace the title.
Original Text:
2.1 AECLP - Axial Engine Control Law Processing
Modified Text:
AECLP - Axial Engine Control Law Processing (P-Spec 2.3.1)

2.2-13.2
Location:
Page 37, INPUT (list of variables that are inputs to this functional unit)
Reasons for Modification:
The variables GP_ATTITUDE and GRAVITY were omitted from the list of inputs.
The variable AE_STATUS should not have been included in the list of inputs.
The input variables are not listed in ascii sequence.
Actions:
Add the variables GP_ATTITUDE and GRAVITY to the list of inputs.
Delete the variable AE_STATUS from the list of inputs.
Rearrange the modified list of inputs in ascii sequence.

Original Text:
INPUT

A_ACCELERATION	AE_STATUS
AE_SWITCH	AE_TEMP
CHUTE_RELEASED	CL
DELTA_T	FRAME_COUNTER
FRAME_ENGINES_IGNITED	FULL_UP_TIME
CONTOUR_CROSSED	ENGINES_ON_ALTITUDE
GA	GAX
GP_ALTITUDE	GP_ROTATION
GP_VELOCITY	GP1
GP2	GPY
GQ	GR
GV	GVE
GVEI	GVI
GW	GWI
OMEGA	PE_INTEGRAL
PE_MAX	PE_MIN
TE_INTEGRAL	TE_INIT
TE_LIMIT	TE_MAX
TE_MIN	TE_DROP
VELOCITY_ERROR	YE_INTEGRAL
YE_MAX	YE_MIN

Modified Text:
INPUT

AE_SWITCH	AE_TEMP
A_ACCELERATION	CHUTE_RELEASED
CL	CONTOUR_CROSSED
DELTA_T	ENGINES_ON_ALTITUDE
FRAME_COUNTER	FRAME_ENGINES_IGNITED
FULL_UP_TIME	GA
GAX	GP1
GP2	GPY
GP_ALTITUDE	GP_ATTITUDE
GP_ROTATION	GP_VELOCITY
GQ	GR
GRAVITY	GV
GVE	GVEI
GVI	GW
GWI	OMEGA
PE_INTEGRAL	PE_MAX
PE_MIN	TE_DROP
TE_INIT	TE_INTEGRAL
TE_LIMIT	TE_MAX
TE_MIN	VELOCITY_ERROR
YE_INTEGRAL	YE_MAX
YE_MIN	

Formal Modification # 2.2-14

Date: June 2, 1993

Part of Specification Affected:
Chapter 5
GSP

2.2-14.1
Location:
Page 63, title for P-Spec.
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.7 GSP - Gyroscope Sensor Processing
Modified Text:
GSP - Gyroscope Sensor Processing (P-Spec 2.1.4)

2.2-14.2
Location:
Page 63, INPUT (list of variables that are inputs to this functional unit)
Reason for Modification:
The variable G_STATUS should not have been included in the list of inputs.
Action:
Delete the variable G_STATUS from the list of inputs.
Original Text:
INPUT

ATMOSPHERIC_TEMP	G3
G4	G_COUNTER
G_GAIN_0	G_OFFSET
G_ROTATION	G_STATUS

Modified Text:
INPUT

ATMOSPHERIC_TEMP	G3
G4	G_COUNTER
G_GAIN_0	G_OFFSET
G_ROTATION	

Software Requirements GCS Development Specification

Formal Modification # 2.2-15

Date: June 2, 1993

Part of Specification Affected:
Chapter 5
RECLP

2.2-15.1
Location:
Page 65 (with mod 2.2-2), title for P-Spec.
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.8 RECLP - Roll Engine Control Law Processing
Modified Text:
RECLP - Roll Engine Control Law Processing (P-Spec 2.3.2)

2.2-15.2
Location:
Page 65, INPUT (list of variables that are inputs to this functional unit)
Reason for Modification:
The variable RE_STATUS should not have been included in the list of inputs.
Action:
Delete the variable RE_STATUS from the list of inputs.

Original Text:
INPUT

DELTA_T	G_ROTATION
P1	P2
P3	P4
RE_STATUS	RE_SWITCH
THETA	THETA1
THETA2	

Modified Text:
INPUT

DELTA_T	G_ROTATION
P1	P2
P3	P4
RE_SWITCH	THETA
THETA1	THETA2

Software Requirements GCS Development Specification

Formal Modification # 2.2-16

Date: June 2, 1993

Part of Specification Affected:
Chapter 5
TDLRSP

2.2-16.1
Location:
Page 67, title for P-Spec.
Reason for 2.2-16.:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.9 TDLRSP - Touch Down Landing Radar Sensor Processing
Modified Text:
TDLRSP - Touch Down Landing Radar Sensor Processing (P-Spec 2.1.3)

2.2-16.2:
Location:
Page 67, INPUT (list of variables that are inputs to this functional unit)
Reason for 2.2-16.:
The variable TDLR_STATUS should not have included in the list of inputs.
Action:
Delete the variable TDLR_STATUS from the list of inputs.
Original Text:
INPUT

DELTA_T	FRAME_BEAM_UNLOCKED
FRAME_COUNTER	K_MATRIX
TDLR_ANGLES	TDLR_COUNTER
TDLR_GAIN	TDLR_LOCK_TIME
TDLR_OFFSET	TDLR_STATE
TDLR_STATUS	TDLR_VELOCITY

Modified Text:
INPUT

DELTA_T	FRAME_BEAM_UNLOCKED
FRAME_COUNTER	K_MATRIX
TDLR_ANGLES	TDLR_COUNTER
TDLR_GAIN	TDLR_LOCK_TIME
TDLR_OFFSET	TDLR_STATE
TDLR_VELOCITY	

Software Requirements GCS Development Specification

Formal Modification # 2.2-17

Date: June 3, 1993

Part of Specification Affected:
Chapter 5
TSP

2.2-17.1
Location:
Page 75, title for P-Spec.
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.11 TSP - Temperature Sensor Processing
Modified Text:
TSP - Temperature Sensor Processing (P-Spec 2.1.5)

2.2-17.2
Location:
Page 75, INPUT (list of variables that are inputs to this functional unit)
Reason for Modification:
The variable TS_STATUS should not have been included in the list of inputs.
Action:
Delete the variable TS_STATUS from the list of inputs.

Original Text:
INPUT

M1	M2
M3	M4
SS_TEMP	T1
T2	T3
T4	THERMO_TEMP
TS_STATUS	

Modified Text:
INPUT

M1	M2
M3	M4
SS_TEMP	T1
T2	T3
T4	THERMO_TEMP

Software Requirements GCS Development Specification

Formal Modification # 2.2-18

Date: June 3, 1993

Part of Specification Affected:
Chapter 5
ARSP, ASP, CRCP, and TDSP

2.2-18.1
Location:
ARSP, page 43 (with mod 2.2-5), title for P-Spec
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.2 ARSP - Altimeter Radar Sensor Processing
Modified Text:
ARSP - Altimeter Radar Sensor Processing (P-Spec 2.1.2)

2.2-18.2
Location:
ASP, page 45, title for P-Spec
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.3 ASP - Accelerometer Sensor Processing
Modified Text:
ASP - Accelerometer Sensor Processing (P-Spec 2.1.1)

2.2-18.3
Location:
CRCP, page 53, title for P-Spec
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.5 CRCP - Chute Release Control Processing
Modified Text:
CRCP - Chute Release Control Processing (P-Spec 2.3.3)

2.2-18.4
Location:
TDSP, page 73, title for P-Spec
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.10 TDSP - Touch Down Sensor Processing
Modified Text:
TDSP - Touch Down Sensor Processing (P-Spec 2.1.6)

Software Requirements GCS Development Specification

Formal Modification # 2.2-19

Date: June 3, 1993

Part of Specification Affected:
BIBLIOGRAPHY

2.2-19

Location:
Page 119, following reference [18]

Reason for Modification:
team*work* was used for developing structured analysis charts.

Action:
Add reference for team*work*

New Text:
[19] team*work*/SA team*work*/RT User's Guide, Cadre Technologies, Inc., Providence, Rhode Island, Release 4.0, 1990.

Software Requirements GCS Development Specification

Formal Modification # 2.2-20

Date: June 3, 1993

Part of Specification Affected:
Chapter 5
GP

2.2-20.1
Location:
Page 55, title for P-Spec.
Reason for Modification:
In order to reflect the numbering in the new structured analysis figures.
Action:
Replace the title.
Original Text:
2.6 GP - Guidance Processing
Modified Text:
GP - Guidance Processing (P-Spec 2.2)

2.2-20.2
Location:
Page 60, step labeled "PHASE 1:"
Reason for Modification:
The phrase **"and the engines were not turned off in prior frame"** is unnecessary because when the lander is in Phase 1, the engines will not yet have been turned off.
Action:
Delete the text **"and the engines were not turned off in prior frame"**
Original Text:
PHASE 1: If the altitude provided by the guidance processor is less than or equal to the ENGINES_ON_ALTITUDE **and the engines were not turned off in prior frame,** set GP_PHASE = 2.[48]
Modified Text:
PHASE 1: If the altitude provided by the guidance processor is less than or equal to the ENGINES_ON_ALTITUDE, set GP_PHASE = 2.[48]

2.2-20.3
Location:
Page 61 (with mod 2.2-8), step labeled "PHASE 4", second paragraph.
Reasons for Modification:
The termination of GCS is not necessarily a requirement for the functional unit GP, but is actually a scheduling requirement; therefore, the conditions and procedures for termination of GCS would be more appropriate in the scheduling section. The text describing termination needs clarification. The control signal "END_GCS" is not used in the new structured analysis charts.
Action:
Delete the paragraph from the functional unit GP and include a modified version of it in the scheduling section (see Formal Modification 2.2-11.13).
Original Text:
It should be noted that under certain conditions, the next phase is **5 which means "END_GCS".** This means that the implementation should stop itself at the end of the present subframe. Thus, in all cases, **a GCS implementation should stop** just after Communications Processing during the Guidance subframe, but before calling rendezvous.
Modified Text:
(none)

Software Requirements GCS Development Specification

Formal Modification # 2.2-21

Date: June 4, 1993

Parts of Specification Affected:
Chapter 5
CP

2.2-21.1
Location:
Page 49, title for P-Spec.
Reason for Modification:
In order to reflect the numbering in the new structured analysis diagrams.
Action:
Replace the title.
Original Text:
2.4 CP - Communications Processing
Modified Text:
CP - Communications Processing (P-Spec 2.4)

2.2-21.2
Location:
Page 49, INPUT, (list of variables that are inputs to this functional unit)
Reasons for Modification:
Some of the variables in the Data Store GUIDANCE_STATE are not inputs to this processing unit. The variable SUBFRAME_COUNTER should be included as an input. The variable C_STATUS should not be included as an input (see Formal Modification 2.2-21.9). The inputs are not listed in ascii sequence.
Actions:
The data store names GUIDANCE_STATE and SENSOR_OUTPUT have been replaced by the individual names of variables in those stores which are inputs to this functional unit. The variable SUBFRAME_COUNTER has been added to the input list. The variable C_STATUS has been deleted from the input list. The modified list of inputs has been arranged in ascii sequence.

Original Text:

INPUT

AE_CMD	C_STATUS
COMM_SYNC_PATTERN	FRAME_COUNTER
GUIDANCE_STATE	RE_CMD
SENSOR_OUTPUT	

Modified Text:

INPUT

AE_CMD	AE_STATUS
AE_TEMP	AR_ALTITUDE
AR_STATUS	ATMOSPHERIC_TEMP
A_ACCELERATION	A_STATUS
CHUTE_RELEASED	COMM_SYNC_PATTERN
CONTOUR_CROSSED	FRAME_COUNTER
GP_ALTITUDE	GP_ATTITUDE
GP_PHASE	GP_ROTATION
GP_VELOCITY	G_ROTATION
G_STATUS	K_ALT
K_MATRIX	PE_INTEGRAL
RE_CMD	RE_STATUS
SUBFRAME_COUNTER	TDLR_STATE
TDLR_STATUS	TDLR_VELOCITY
TDS_STATUS	TD_SENSED
TE_INTEGRAL	TS_STATUS
VELOCITY_ERROR	YE_INTEGRAL

2.2-21.3

Location:
Page 49, Subsection labeled "PROCESS", first sentence

Reason for Modification:
The order given for the items in the data packet does not agree with the correct order given in Table 5.7.

Action:
Move "checksum information" to the end of the list.

Original Text:
The data packet (PACKET) prepared for transmission is organized to sequentially contain a synchronization pattern, a sequence number, checksum information, new sample mask, and the data itself.

Modified Text:
The data packet (PACKET) prepared for transmission is organized to sequentially contain a synchronization pattern, a sequence number, new sample mask, the data itself, and the checksum information.

2.2-21.4

Location:
Page 49, Subsection labeled "DETERMINE SEQUENCE NUMBER", last sentence.

Reason for Modification:
The sentence was not explicit about the fact that the sequence number increases by one each subframe, and also the number 255 was incorrect.

Action:
Insert the phrase "increase by one every subframe, except that they" and change the text "255th" to "256th".

Original Text:
Sequence numbers repeat after the 255th packet, and can be calculated based on the FRAME_COUNTER and the subframe where the present call to CP was made.

Modified Text:

Sequence numbers increase by one every subframe, except that the values repeat after the 256th packet. The sequence number can be calculated based on the values of the variables FRAME_COUNTER and SUBFRAME_COUNTER.

2.2-21.5

Location:

Page 49, Subsection labeled "PREPARE SAMPLE MASK", between second and third sentences.

Reason for Modification:

An explicit statement is needed regarding the functional units ARSP and TDLRSP.

Action:

Insert the text "The output variables from the functional units ARSP and TDLRSP, however, should not be transmitted when the variable FRAME_COUNTER is an even number."

Original Text:

"...mask and transmitted. Values that have been..."

Modified Text:

"...mask and transmitted. The output variables from the functional units ARSP and TDLRSP, however, should not be transmitted when the variable FRAME_COUNTER is an even number. Values that have been..."

2.2-21.6

Location:

Pages 49-50, Subsection labeled "PREPARE SAMPLE MASK", the sentence which begins at the bottom of page 49 and continues at the top of page 50, and the second sentence on page 50.

Reason for Modification:

The first sentence is incorrect because some variables in GUIDANCE_STATE are never sent in the packet, and more clarity is needed in the second sentence regarding the correspondence between mask bits and variables to be sent.

Action:

Replace the two sentences.

Original Text:

A position should represent each variable contained in either GUIDANCE_STATE or SENSOR_OUTPUT in addition to AE_CMD and RE_CMD. These variables should be arranged as shown in table 5.5.

Modified Text:

Each bit position in the mask represents a particular variable listed in Table 5.5. The leftmost bit of the mask corresponds to AE_CMD, and moving across the mask from left to right, the next mask bit corresponds to the next variable in Table 5.5 (in row order).

2.2-21.7

Location:

Page 50, Subsection labeled "PREPARE DATA SECTION, between the second and third sentences.

Reason for Modification:

The text needs some clarification regarding the exact manner in which the variables to be transmitted should be packed into the data section.

Action:

Insert clarifying text between the second and third sentences.

Original Text:

"...do not have to be transmitted. The data are concatenated..."

Modified Text:

"...do not have to be transmitted. Once it has been determined which variables should be transmitted for this particular subframe, those variables should be packed into the data section. Although the length of the variable PACKET is fixed, the number of bytes of PACKET which contain actual variables to be transmitted will vary depending on the values of FRAME_COUNTER and SUBFRAME_COUNTER. The variables to be transmitted should be concatenated so that there are no unused bytes between the data to be transmitted. There may however be unused bytes following the checksum. The data are concatenated..."

2.2-21.8

Location:

Page 50, Subsection labeled "CALCULATE CHECKSUM", following the last sentence in the section.

Reason for Modification:

The text needs some clarification regarding exactly where the checksum should be placed in the packet.

Action:

Insert clarifying text at the end of the paragraph.

New Text:

The checksum should be placed in the two bytes immediately following the last byte of actual data to be transmitted for this subframe.

2.2-21.9

Location:

Page 50, Subsection labeled "SET COMMUNICATOR STATUS TO HEALTHY".

Reason for Modification:

The variable C_STATUS should be set before preparing the data section, so that the value transmitted in the packet will be the new value set in this subframe rather than the value that was set in the previous subframe.

Action:

Move the entire Subsection "SET COMMUNICATOR STATUS TO HEALTHY" so that it is before the Subsection "CONSTRUCT PACKET".

Software Requirements GCS Development Specification

Formal Modification # 2.2-22

Date: June 4, 1993

Part of Specification Affected:
Appendix A

2.2-22.1
Location:
Page 105, title for the appendix.
Reason for Modification:
In order to reflect the new structured analysis diagrams.
Action:
Replace the title.
Original Text:
A. FORMAT DESCRIPTION FOR LEVEL 0, 1, 2 SPECIFICATIONS
Modified Text:
A. NOTATION FOR LEVELS 0, 1, 2, AND 3 SPECIFICATION

2.2-22.2
Location:
Page 107, title for the appendix.
Reason for Modification:
In order to reflect the new structured analysis diagrams.
Action:
Replace the title.
Original Text:
A. FORMAT DESCRIPTION FOR LEVEL 0, 1, 2 SPECIFICATIONS
Modified Text:
A. NOTATION FOR LEVELS 0, 1, 2, AND 3 SPECIFICATION

2.2-22.3
Location:
Page 107, first sentence.
Reason for Modification:
Reference to sources for development using structured analysis methods was not complete, and "." should be "," in reference.
Action:
Add a second reference, and change "." to ","
Original Text:
"...advocated by Hatley [12.13]."
Modified Text:
"...advocated by Hatley [12,13] and Cadre's team*work* [19]."

2.2-22.4
Location:
Page 107, entire third paragraph and first two sentences of the fourth paragraph.
Reason for Modification:
Inaccuracies.

Action:
Replace the third paragraph and the first sentence of the fourth paragraph.
Original Text:
The data flow diagrams describe the processes, data flows, data stores, and data conditions. The data context diagram is the highest-level data flow diagram and represents the data flow for the entire system. Data conditions are represented by directed arcs with broken lines.
The control flow diagrams describe processes, control signal flows, and stores. The control signal flows are depicted using directed arcs with broken lines.
Modified Text:
The data flow diagrams describe the processes, data flows, and data stores. The data context diagram is the highest-level data flow diagram and represents the data flow for the entire system.
The control flow diagrams describe processes, control signal and data condition flows, control specifications, and data stores. The control signal and data condition flows are depicted using directed arcs with broken lines.

2.2-22.5
Location:
Page 107, fourth paragraph, next-to-last sentence.
Reason for Modification:
Statement is unclear and unnecessary.
Action:
Delete the entire sentence.
Original Text:
This duplication of processes is consistent with the approach of slaving the control flow to the data flow.
Modified Text:
(none)

2.2-22.6
Location:
Page 107, last sentence
Reason for Modification:
To reflect new structured analysis diagrams.
Action:
Change phrase at end of sentence.
Original Text:
The Data Requirements Dictionary contains definitions for both data and control signals.
Modified Text:
The Data Requirements Dictionary contains definitions for data, data conditions, control signals, and group flows.

2.2-22.7
Location:
Page 107, following the last sentence
Reason for Modification:
To reflect new structured analysis diagrams.
Action:
Add an additional paragraph to describe the meanings and definitions, etc. for the new structured analysis diagrams.
New Text:
Following is a list of definitions and explanations for the structured analysis diagrams:
1. The data and control flow names on the directed arcs in the structured analysis figures can be found in the Data Requirements Dictionary Part I, while the group flow names on the arcs can be found in the Data Requirements Dictionary Part III.
2. In the Process Activation Tables, the first column contains the inputs. The second set of columns (separated by two vertical lines) contains the cells which indicate whether a process is to be activated or deactivated. A blank cell indicates that the process is deactivated. An

integer indicates that the process is activated. A process whose cell contains the integer "n" must complete before the process with integer "n+1" is activated. All processes whose cells contain the same integer can be activated in any order. The third set of columns, if present, represents the output values for control signals.

3. The meanings for the symbols used in the expressions for inputs are:

=	equal
~=	not equal
~	logical NOT
&	logical AND
|	logical OR
()	grouping (expression inside parentheses is evaluated first)

2.2-22.8

Location:

Page 108, graphical symbols

Reason for Modification:

To reflect the new structured analysis diagrams.

Action:

In the title, the word "FLOW" has been changed to "STRUCTURED ANALYSIS".
The rectangular symbol for PROCESS MODULE has been replaced with a bubble.
The dashed rectangular symbol for SOURCE OR SINK has been replaced with a solid rectangle.
The solid lines which represent a DATA STORE have been moved closer to each other.

Software Requirements GCS Development Specification

Formal Modification # 2.2-23

Date: June 4, 1993

Part of Specification Affected:
Chapter 6
PART I. DATA ELEMENT DESCRIPTIONS

2.2-23.1
Location:
Pages 83 through and including page 95 (with mod 2.2-6), all entries
Reason for Modification:
P-Spec numbers for functional units are unnecessary.
Action:
P-Spec numbers for functional units were deleted wherever they occurred.

2.2-23.2
Location:
Page 83, A_ACCELERATION, "USED IN" field
Reason for Modification:
Functional unit CP was omitted.
Action:
Functional unit CP was added.
Original Text:
NAME: A_ACCELERATION
USED IN: 2 .1 AECLP, 2.3 ASP, 2.6 GP
Modified Text:
NAME: A_ACCELERATION
USED IN: AECLP, ASP, CP, GP

2.2-23.3
Location:
Page 83, AE_STATUS, "ATTRIBUTE" field
Reason for Modification:
Attribute is incorrect.
Action:
Attribute was changed from "data condition" to "data".
Original Text:
NAME: AE_STATUS
ATTRIBUTE: data condition
Modified Text:
NAME: AE_STATUS
ATTRIBUTE: data

2.2-23.4
Location:
Page 85, following entry for CL
Reason for Modification:
New structured analysis charts use new control signal, CLP_DONE.
Action:
New entry for CLP_DONE was added.

New Text:
NAME: CLP_DONE
DESCRIPTION: Control signal which indicates whether or not Control Law Processing function has completed.
USED IN: 2. RUN_GCS
UNITS: none
RANGE: [FALSE: running of Control Law Processing function incomplete;
TRUE: running of Control Law Processing function complete]
DATA TYPE: logical*1
ATTRIBUTE: control
DATA STORE LOCATION: none
ACCURACY: N/A

2.2-23.5

Location:
Page 86, ENGINES_ON_ALTITUDE, "ATTRIBUTE" field

Reason for Modification:
Attribute is incorrect.

Action:
Attribute was changed from "data condition" to "data".

Original Text:
NAME: ENGINES_ON_ALTITUDE
ATTRIBUTE: data condition

Modified Text:
NAME: ENGINES_ON_ALTITUDE
ATTRIBUTE: data

2.2-23.6

Location:
Page 86, FRAME_COUNTER, "USED IN" field

Reason for Modification:
Functional unit ARSP was omitted.

Action:
Functional unit ARSP was added.

Original Text:
NAME: FRAME_COUNTER
USED IN: 2.1 AECLP, 2.4 CP, 2.6 GP, 2.9 TDLRSP

Modified Text:
NAME: FRAME_COUNTER
USED IN: AECLP, ARSP, CP, GP, TDLRSP

2.2-23.7

Location:
Page 86, FRAME_COUNTER, "ACCURACY" field

Reason for Modification:
This variable is not an output from GCS.

Action:
ACCURACY was changed from "TBD" to "N/A".

Original Text:
NAME: FRAME_COUNTER
ACCURACY: TBD

Modified Text:
NAME: FRAME_COUNTER
ACCURACY: N/A

2.2-23.8

Location:
Page 88, GP_ATTITUDE, "DESCRIPTION" field

Reason for Modification:
The description is inaccurate.

Action:
The description was replaced.

Original Text:
NAME: GP_ATTITUDE
DESCRIPTION: attitude as seen by guidance processor

Modified Text:
NAME: GP_ATTITUDE
DESCRIPTION: direction cosine matrix

2.2-23.9

Location:
Page 88, GP_ATTITUDE, "USED IN" field

Reason for Modification:
Functional unit AECLP was omitted.

Action:
Functional unit AECLP was added.

Original Text:
NAME: GP_ATTITUDE
USED IN: 2.4 CP, 2.6 GP

Modified Text:
NAME: GP_ATTITUDE
USED IN: AECLP, CP, GP

2.2-23.10

Location:
Page 88, GP_PHASE, "ATTRIBUTE" field

Reason for Modification:
The attribute should be "data condition"

Action:
The attribute was changed from "data" to "data condition".

Original Text:
NAME: GP_PHASE
ATTRIBUTE: data

Modified Text:
NAME: GP_PHASE
ATTRIBUTE: data condition

2.2-23.11

Location:
Page 88, GRAVITY, "USED IN" field

Reason for Modification:
Functional unit AECLP was omitted.

Action:
Functional unit AECLP was added.

Original Text:
NAME: GRAVITY
USED IN: 2.6 GP

Modified Text:
NAME: GRAVITY
USED IN: AECLP, GP

2.2-23.12

Location:
Page 89, GSP_DONE, "UNITS" field

Reason for Modification:
Units are incorrect

Action:
Change units.

Original Text:
NAME: GSP_DONE
UNITS: Binary

Modified Text:
NAME: GSP_DONE
UNITS: none

2.2-23.13

Location:
Page 89, GUIDANCE_STATE, entire entry

Reason for Modification:
The data stores are listed in Data Requirements Dictionary Part II.

Action:
The entire entry for GUIDANCE_STATE was deleted.

Original Text:
NAME: GUIDANCE_STATE
DESCRIPTION: Data store containing all the status, state, and sensed variables in alphabetical order.
USED IN: 2.1 AECLP, 2.2 ARSP, 2.3 ASP, 2.4 CP, 2.5 CRCP, 2.7 GSP, 2.6 GP, 2.8 RECLP, 2.9 TDLRSP, 2.10 TDSP, 2.11 TSP
UNITS: N/A
RANGE: N/A
DATA TYPE: common
ATTRIBUTE: data store
DATA STORE LOCATION: GUIDANCE_STATE
ACCURACY: N/A

Modified Text:
(no entry)

2.2-23.14

Location:
Page 91 (with mod 2.2-6), RE_SWITCH, "USED IN" field

Reason for Modification:
Functional unit RECLP was omitted.

Action:
Functional unit RECLP was added.

Original Text:
NAME: RE_SWITCH
USED IN: 2.6 GP

Modified Text:
NAME: RE_SWITCH
USED IN: GP, RECLP

2.2-23.15

Location:
Page 91 (with mod 2.2-6), following entry for RECLP_DONE

Reason for Modification:
New structured analysis charts use new control signal, RENDEZVOUS.

Action:
Add entry for RENDEZVOUS.

New Text:
NAME: RENDEZVOUS
DESCRIPTION: Control signal which indicates whether or not GCS_SIM_RENDEZVOUS is to be activated.
USED IN: 2. RUN_GCS
UNITS: none
RANGE: [FALSE: GCS_SIM_RENDEZVOUS is not to be activated, TRUE: GCS_SIM_RENDEZVOUS is to be activated]
DATA TYPE: logical*1
ATTRIBUTE: control
DATA STORE LOCATION: none
ACCURACY: N/A

2.2-23.16

Location:
Page 92, RUN_PARAMETERS, entire entry

Reason for Modification:
The data stores are listed in Data Requirements Dictionary Part II.

Action:
The entire entry for RUN_PARAMETERS was deleted.

Original Text:
NAME: RUN_PARAMETERS
DESCRIPTION: Data store containing all the run parameters in alphabetical order.
USED IN: 2.1 AECLP, 2.2 ARSP, 2.3 ASP, 2.4 CP, 2.6 GP, 2.7 GSP, 2.8 RECLP, 2.9 TDLRSP, 2.10 TDSP, 2.11 TSP
UNITS: N/A
RANGE: N/A
DATA TYPE: common
ATTRIBUTE: data store
DATA STORE LOCATION: RUN_PARAMETERS
ACCURACY: N/A

Modified Text:
(no entry)

2.2-23.17

Location:
Page 92, SENSOR_OUTPUT, entire entry

Reason for Modification:
The data stores are listed in Data Requirements Dictionary Part II.

Action:
The entire entry for SENSOR_OUTPUT was deleted.

Original Text:
NAME: SENSOR_OUTPUT
DESCRIPTION: Data store containing all the sensor output in alphabetical order.
USED IN: 2.1 AECLP, 2.2 ARSP, 2.3 ASP, 2.4 CP, 2.6 GP, 2.7 GSP, 2.8 RECLP, 2.9 TDLRSP, 2.10 TDSP, 2.11 TSP
UNITS: N/A
RANGE: N/A
DATA TYPE: common
ATTRIBUTE: data store
DATA STORE LOCATION: SENSOR_OUTPUT
ACCURACY: N/A

Modified Text:
(no entry)

2.2-23.18

Location:
Page 92, before entry for SS_TEMP

Reason for Modification:
New structured analysis charts use new control signal, SP_DONE.

Action:
Add entry for SP_DONE

New Text:
NAME: SP_DONE
DESCRIPTION: Control signal which indicates whether or not Sensor Processing function has completed.
USED IN: 2. RUN_GCS
UNITS: none
RANGE: [FALSE: running of Sensor Processing function incomplete; TRUE: running of Sensor Processing function complete]
DATA TYPE: logical*1
ATTRIBUTE: control
DATA STORE LOCATION: none
ACCURACY: N/A

2.2-23.19

Location:
Page 92, following entry for SS_TEMP

Reason for Modification
New variable SUBFRAME_COUNTER is needed.

Action:
New entry for SUBFRAME_COUNTER was added.

New Text:
NAME: SUBFRAME_COUNTER
DESCRIPTION: Counter containing the number of the present subframe.
USED IN: CP
UNITS: none
RANGE: [1, 3]
DATA TYPE: Integer*2
ATTRIBUTE: data
DATA STORE LOCATION: EXTERNAL
ACCURACY: N/A

2.2-23.20

Location:
Page 93, TDLRSP_DONE, "RANGE" field

Reason for Modification:
"TDSP" is incorrect.

Action:
"TDSP" was replaced by "TDLRSP".

Original Text:
NAME: TDLRSP_DONE
RANGE: [0: running of task 2.11 TDLRSP incomplete, 1: running of task 2.10 TDSP complete]

Modified Text:
NAME: TDLRSP_DONE
RANGE: [0: running of task TDLRSP incomplete, 1: running of task TDLRSP complete]

2.2-23.21

Location:
Page 93, TDLRSP_SWITCH, entire entry

Reason for Modification:
The variable TDLRSP_SWITCH is not needed.

Action:
The entire entry for TDLRSP_SWITCH was deleted.

Original Text:
NAME: TDLRSP_SWITCH
DESCRIPTION: Flag indicating whether or not the touch down landing radar sensor processor is turned on.
USED IN: 1. INIT_GCS
UNITS: none
RANGE: [0: processor is off, 1: process is on.]
DATA TYPE: logical*1
ATTRIBUTE: data condition
DATA STORE LOCATION: GUIDANCE_STATE
ACCURACY: N/A

Modified Text:
(no entry)

2.2-23.22

Location:
Page 94, TDSP_SWITCH, entire entry

Reason for Modification:
The variable TDSP_SWITCH is not needed.

Action:
The entire entry for TDSP_SWITCH was deleted.

Original Text:
NAME: TDSP_SWITCH
DESCRIPTION: Flag indicating whether or not the touch down sensor is turned on.
USED IN: 0.GCS
UNITS: none
RANGE: [0: touch down sensor is off, 1: touch down sensor is on.]
DATA TYPE: logical*1
ATTRIBUTE: data condition
DATA STORE LOCATION: GUIDANCE_STATE
ACCURACY: N/A

Modified Text:
(no entry)

2.2-23.23

Location:
Page 94, TE_INTEGRAL, "USED IN" field

Reason for Modification:
Functional unit GP was omitted.

Action:
Functional unit GP was added.

Original Text:
NAME: TE_INTEGRAL
USED IN: 2.1 AECLP, 2.4 CP

Modified Text:
NAME: TE_INTEGRAL
USED IN: AECLP, CP, GP

2.2-23.24

Locations:

Page 83, AECLP_DONE, "RANGE" field
Page 84, ARSP_DONE, "RANGE" field
Page 84, ASP_DONE, "RANGE" field
Page 85, CP_DONE, "RANGE" field
Page 85, CRCP_DONE, "RANGE" field
Page 88, GP_DONE, "RANGE" field
Page 89, GSP_DONE, "RANGE" field
Page 89, INIT_DONE, "RANGE" field
Page 91, RECLP_DONE, "RANGE" field
Page 92, RUN_DONE, "RANGE" field
Page 93, TDLRSP_DONE, "RANGE" field
Page 94, TDSP_DONE, "RANGE" field
Page 95, TSP_DONE, "RANGE" field

Reason for Modification:

To reflect values used in new structured analysis diagrams

Action:

The value "0" was replaced by "FALSE", and the value "1" was replaced by "TRUE".

Original Text:

"RANGE: [0: " ... " incomplete, 1: " ... " complete]"

Modified Text:

"RANGE: [FALSE: " ... " incomplete, TRUE: " ... " complete]"

Software Requirements GCS Development Specification

Formal Modification # 2.2-24

Date: June 7, 1993

Part of Specification Affected:
Chapter 6
PART II. CONTENTS OF DATA STORES

2.2-24.1
Location:
Pages 97 through and including page 100, "USED BY" Column for all entries.
Reason for Modification:
P-Spec numbers for functional units are unnecessary.
Action:
P-Spec numbers for functional units were removed.

2.2-24.2
Location:
Page 97, Table 6.1, GP_ATTITUDE, "USED BY" Column
Reason for Modification:
Functional unit AECLP was omitted.
Action:
Functional unit AECLP was added.
Original Text:

GP_ATTITUDE	2.4 CP, 2.6 GP

Modified Text:

GP_ATTITUDE	AECLP, CP, GP

2.2-24.3
Location:
Page 97, Table 6.1, RE_SWITCH, "USED BY" Column
Reason for Modification:
For consistency, INIT_GCS should not be included.
Action:
INIT_GCS was deleted.
Original Text:

RE_SWITCH	INIT_GCS, 2.6 GP, 2.8 RECLP

Modified Text:

RE_SWITCH	GP, RECLP

2.2-24.4
Location:
Page 97, Table 6.1, TDLR_STATE, "USED BY" Column
Reason for Modification:
Functional unit GP should not be included.
Action:
Functional unit GP was deleted.
Original Text:

TDLR_STATE	2.4 CP, 2.6 GP, 2.9 TDLRSP

Modified Text:

TDLR_STATE	CP, TDLRSP

2.2-24.5

Location:
Page 97, Table 6.1, TDLRSP_SWITCH

Reason for Modification:
The variable TDLRSP_SWITCH is not needed.

Action:
Entire entry for TDLRSP_SWITCH was deleted.

Original Text:

TDLRSP_SWITCH	INIT_GCS

Modified Text:
(no entry)

2.2-24.6

Location:
Page 97, Table 6.1, TDSP_SWITCH

Reason for Modification:
The variable TDSP_SWITCH is not needed.

Action:
Entire entry for TDSP_SWITCH was deleted.

Original Text:

TDSP_SWITCH	0.GCS

Modified Text:
(no entry)

2.2-24.7

Location:
Page 97, Table 6.1, TE_INTEGRAL, "USED BY" Column

Reason for Modification:
Functional unit GP was omitted.

Action:
Functional unit GP was added.

Original Text:

TE_INTEGRAL	2.1 AECLP, 2.4 CP

Modified Text:

TE_INTEGRAL	AECLP, CP, GP

2.2-24.8

Location:
Page 98, Table 6.2, FRAME_COUNTER, "USED BY" Column

Reason for Modification:
Functional unit ARSP was omitted.

Action:
Functional unit ARSP was added.

Original Text:

FRAME_COUNTER	2.1 AECLP, 2.4 CP, 2.6 GP, 2.9 TDLRSP

Modified Text:

FRAME_COUNTER	AECLP, ARSP, CP, GP, TDLRSP

2.2-24.9

Location:
Page 98, Table 6.2, between entries for SS_TEMP and TD_COUNTER

Reason for Modification:
New variable SUBFRAME_COUNTER is in the EXTERNAL data store.

Action:
SUBFRAME_COUNTER was added.

Original Text:

SS_TEMP	2.11 TSP
TD_COUNTER	2.10 TDSP

Modified Text:

SS_TEMP	TSP
SUBFRAME_COUNTER	CP
TD_COUNTER	TDSP

2.2-24.10

Location:
Page 99, Table 6.4, DELTA_T, "USED BY" Column

Reason for Modification:
Functional unit AECLP was omitted.

Action:
Functional unit AECLP was added.

Original Text:

DELTA_T	2.6 GP, 2.8 RECLP, 2.9 TDLRSP

Modified Text:

DELTA_T	AECLP, GP, RECLP, TDLRSP

2.2-24.11

Location:
Page 99, Table 6.4, GRAVITY, "USED BY" Column

Reason for Modification:
Functional unit AECLP was omitted.

Action:
Functional unit AECLP was added.

Original Text:

GRAVITY	2.6 GP

Modified Text:

GRAVITY	AECLP, GP

Software Requirements GCS Development Specification

Formal Modification # 2.2-25

Date: June 7, 1993

Part of Specification Affected:
Chapter 6
PART III. CONTROL VARIABLES, DATA CONDITIONS, AND INITIALIZATION DATA

2.2-25.1
Location:
Pages 101 through and including page 103, "USED BY" Column
Reason for Modification:
P-Spec numbers for functional units are unnecessary.
Action:
P-Spec numbers for functional units were removed.

2.2-25.2
Location:
Page 101, Part III title
Reason for Modification:
Title improvement
Action:
Replace title.
Original Text:
PART III. CONTROL VARIABLES, DATA CONDITIONS, AND INITIALIZATION DATA
Modified Text:
PART III. CONTROL SIGNALS, DATA CONDITIONS, AND GROUP FLOWS.

2.2-25.3
Location:
Page 101, Table 6.5, title and contents
Reason for Modification:
Title improvement
The control variable INIT_DONE was omitted.
Three additional control variables, namely CLP_DONE, RENDEZVOUS, and SP_DONE are used in the new structured analysis diagrams.
Actions:
The title was changed.
The control variables INIT_DONE, CLP_DONE, RENDEZVOUS, and SP_DONE were added.
Original text:

Table 6.5: CONTROL VARIABLES (OPTIONAL USAGE)

CONTROL VARIABLE NAME
AECLP_DONE
ARSP_DONE
ASP_DONE
CP_DONE[114]
CRCP_DONE
GP_DONE
GSP_DONE
RECLP_DONE[115]
RUN_DONE[116]
TDLRSP_DONE
TDSP_DONE
TSP_DONE

Modified text:

Table 6.5: CONTROL SIGNALS (OPTIONAL USAGE)

CONTROL SIGNAL NAME
AECLP_DONE
ARSP_DONE
ASP_DONE
CLP_DONE
CP_DONE[114]
CRCP_DONE
GP_DONE
GSP_DONE
INIT_DONE
RECLP_DONE[115]
RENDEZVOUS
RUN_DONE[116]
SP_DONE
TDLRSP_DONE
TDSP_DONE
TSP_DONE

2.2-25.4

Location:

Page 101, Table 6.6, contents

Reason for Modification:

The variables AE_SWITCH, CONTOUR_CROSSED, RE_SWITCH and GP_PHASE were omitted.

Action:

The variables AE_SWITCH, CONTOUR_CROSSED, RE_SWITCH, and GP_PHASE were added.

Original text:

Table 6.6: DATA CONDITIONS (REQUIRED USAGE)

DATA CONDITION VARIABLE NAME
AE_TEMP
CHUTE_RELEASED
TD_SENSED
TDLR_STATE

Modified text:

Table 6.6: DATA CONDITIONS (REQUIRED USAGE)

DATA CONDITION VARIABLE NAME
AE_SWITCH
AE_TEMP
CHUTE_RELEASED
CONTOUR_CROSSED
GP_PHASE
RE_SWITCH
TD_SENSED
TDLR_STATE

2.2-25.5

Location:
Page 102, Table 6.7, DELTA_T, "USED BY" Column

Reason for Modification:
Functional units AECLP, RECLP, and TDLRSP were omitted.

Action:
Functional units AECLP, RECLP, and TDLRSP were added.

Original text:

DELTA_T	2.6 GP

Modified text:

DELTA_T	AECLP, GP, RECLP, TDLRSP

2.2-25.6

Location:
Page 102, Table 6.7, FRAME_COUNTER, "USED BY" Column

Reason for Modification:
Functional unit ARSP was omitted.

Action:
Functional unit ARSP was added.

Original text:

FRAME_COUNTER	2.1 AECLP, 2.4 CP, 2.6 GP, 2.9 TDLRSP

Modified text:

FRAME_COUNTER	AECLP, ARSP, CP, GP, TDLRSP

2.2-25.7

Location:
Page 102, Table 6.7, GP_ALTITUDE, "USED BY" Column

Reason for Modification:
Functional unit CP was omitted, and the order of units is incorrect.

Action:
Functional unit CP was added, and the order was corrected.
Original text:
GP_ALTITUDE 2.6 GP, 2.1 AECLP
Modified text:
GP_ALTITUDE AECLP, CP, GP

2.2-25.8
Location:
Page 102, Table 6.7, GP_ATTITUDE, "USED BY" Column
Reason for Modification:
Functional units AECLP and CP were omitted.
Action:
Functional units AECLP and CP were added.
Original text:
GP_ATTITUDE 2.6 GP
Modified text:
GP_ATTITUDE AECLP, CP, GP

2.2-25.9
Location:
Page 102, Table 6.7, GP_ROTATION, "USED BY" Column
Reason for Modification:
Functional units AECLP and CP were omitted, and RECLP should not have been included.
Action:
Functional units AECLP and CP were added, and RECLP was deleted.
Original text:
GP_ROTATION 2.6 GP, 2.8 RECLP
Modified text:
GP_ROTATION AECLP, CP, GP

2.2-25.10
Location:
Page 102, Table 6.7, GP_VELOCITY, "USED BY" Column
Reason for Modification:
Functional units AECLP and CP were omitted.
Action:
Functional units AECLP and CP were added.
Original text:
GP_VELOCITY 2.6 GP
Modified text:
GP_VELOCITY AECLP, CP, GP

2.2-25.11
Location:
Page 102, Table 6.7, GRAVITY, "USED BY" Column
Reason for Modification:
Functional unit AECLP was omitted.
Action:
Functional unit AECLP was added.
Original text:
GRAVITY 2.6 GP
Modified text:
GRAVITY AECLP, GP

2.2-25.12

Location:

Page 103, Table 6.7, RE_SWITCH,"USED BY" Column

Reason for Modification:

INIT_GCS should not have been included.

Action:

INIT_GCS was deleted.

Original text:

RE_SWITCH	INIT_GCS, 2.6 GP, 2.8 RECLP

Modified text:

RE_SWITCH	GP, RECLP

2.2-25.13

Location:

Page 103, Table 6.7, between SS_TEMP and T1

Reason for Modification:

New variable SUBFRAME_COUNTER is initialized.

Action:

Variable SUBFRAME_COUNTER was added

Original text:

SS_TEMP	2.11 TSP
T1	2.11 TSP

Modified text:

SS_TEMP	TSP
SUBFRAME_COUNTER	CP
T1	TSP

2.2-25.14

Location:

Page 103, Table 6.7, between T4 and TD_SENSED

Reason for Modification:

The variable TD_COUNTER was omitted from the table.

Action:

Variable TD_COUNTER was added.

Original text:

T4	2.11 TSP
TD_SENSED	2.4 CP, 2.6 GP, 2.10 TDSP

Modified text:

T4	TSP
TD_COUNTER	TDSP
TD_SENSED	CP, GP, TDSP

2.2-25.15

Location:

Page 103, Table 6.7, TDLR_COUNTER,"USED BY" Column

Reason for Modification:

Functional unit TDSP is incorrect.

Action:

Functional unit TDSP was replaced by TDLRSP.

Original text:

TDLR_COUNTER	2.10 TDSP

Modified text:

TDLR_COUNTER	TDLRSP

2.2-25.16

Location:
Page 103, Table 6.7, TDLR_STATE,"USED BY" Column

Reason for Modification:
Functional unit GP should not have been included

Action:
Functional unit GP was deleted.

Original text:

TDLR_STATE	2.4 CP, 2.6 GP, 2.9 TDLRSP

Modified text:

TDLR_STATE	CP, TDLRSP

2.2-25.17

Location:
Page 103, Table 6.7, TDLRSP_SWITCH

Reason for Modification:
The variable TDLRSP_SWITCH is not needed.

Action:
Entire entry for TDLRSP_SWITCH was deleted.

Original text:

TDLRSP_SWITCH	INIT_GCS

Modified text:
(no entry)

2.2-25.18

Location:
Page 103, Table 6.7, TDSP_SWITCH

Reason for Modification:
The variable TDSP_SWITCH is not needed.

Action:
Entire entry for TDSP_SWITCH was deleted.

Original text:

TDSP_SWITCH	0.GCS

Modified text:
(no entry)

2.2-25.19

Location:
Page 103, Table 6.7,TE_INTEGRAL,"USED BY" Column

Reason for Modification:
The functional unit GP was omitted.

Action:
Functional unit GP was added.

Original text:

TE_INTEGRAL	AECLP, 2.4 CP

Modified text:

TE_INTEGRAL	AECLP, CP, GP

2.2-25.20

Location:
Page 104

Reason for Modification:
Additional group flows were used in the new structured analysis charts.

Action:
Add Tables 6.8, 6.9, 6.10, 6.11, and 6.12.

Table 6.8: TEMP_DATA

VARIABLE NAME
SS_TEMP
THERMO_TEMP

Table 6.9: SENSOR_DATA

VARIABLE NAME
A_COUNTER
AR_COUNTER
TDLR_COUNTER
G_COUNTER
TEMP_DATA
TD_COUNTER

Table 6.10: OUTPUT_DATA

VARIABLE NAME
AE_CMD
RE_CMD
PACKET

Table 6.11: OUTPUT_CONTROL

VARIABLE NAME
AE_SWITCH
RE_SWITCH
CHUTE_RELEASED

Table 6.12: FRAME_DATA

VARIABLE NAME
FRAME_COUNTER
SUBFRAME_COUNTER

Software Requirements GCS Development Specification

Formal Modification # 2.2-26

Date: June 7, 1993

Part of Specification Affected:
INTRODUCTION
EXCEPTION HANDLING

2.2-26

Location:
Page16, paragraph labeled "UPPER OR LOWER LIMIT EXCEEDED"

Reason for Modification:
The fact that the RUN_PARAMETERS and EXTERNAL data stores need not be checked for limits was omitted. Also, the fact that it is not necessary for the functional unit CP to make any checks for limits was omitted.

Action:
Change text to include the additional information.

Original Text:
The current value for a data element exceeds its upper or lower limit as specified in the range section in the DATA DICTIONARY.

Modified Text:
The current value for a data element in the GUIDANCE_STATE or SENSOR_OUTPUT data store exceeds its upper or lower limit as specified in the range section in the Data Requirements Dictionary Part I. The data elements in the RUN_PARAMETERS and EXTERNAL data stores need not be checked for limit exceeded. In addition, it is not necessary for the functional unit CP to check any data elements for limit exceeded.

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.2	December 23, 1993	2.2 - 27

4. Part of Configuration Item Affected:

APPENDIX C. NUMERICAL INTEGRATION INSTRUCTIONS
Page 118, immediately following the last paragraph.
Table of Contents

5. Reason for Modification:

Clarification is needed in the adaptation of the Runge-Kutte fourth-order method to the GCS software for the Guidance Processing functional unit.

6. Modification:

Action: Add new text containing the clarification to the end of Appendix C.

New Text:

ADAPTATION OF RUNGE-KUTTE FOURTH-ORDER METHOD FOR SIMULTANEOUS EQUATIONS TO THE GCS SOFTWARE

In the case where the Runge-Kutte method has been selected for integration in the Guidance Processing functional unit, the following gives information on how it is to be applied to GCS. The notation and formulas presented here are merely one representation of the Runge-Kutte method and its adaptation to GCS. The software designer/implementer may vary the notation and/or the form of the equations as long as the algorithm used is equivalent to the one presented here.

The Runge-Kutte fourth-order method (for one dependent variable only) can be summarized as follows:

Given:

Let $dy/dx = f(x,y)$

Let h represent the interval between equidistant values of x

Let the initial values for x and y be x0 and y0 respectively

Let $x1 = x0 + h$

The problem is to estimate y1

The solution is:

$y1 = y0 + k$

$k = 1/6 \times (k1 + 2 \times (k2 + k3) + k4)$

where:

$k_1 = h \times f(x0, y0)$

$k2 = h \times f(x0 + h/2, y0 + k1/2)$

$k3 = h \times f(x0 + h/2, y0 + k2/2)$

$k4 = h \times f(x0 + h, y0 + k3)$

7. SQA Signature & Date: Original Signed by George Finelli 1/13/94

Support Documentation Change Report Continuation

a. Report #: 2.2-27

b. Notes/Explanation (Please reference appropriate section number)

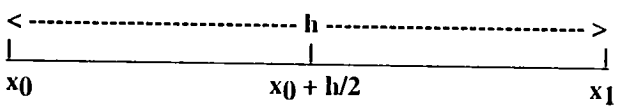
The GCS problem to be solved is as follows:

Simultaneously calculate current values for the variables GP_ATTITUDE, GP_VELOCITY, and GP_ALTITUDE, using the equations for the corresponding derivatives given in GUIDANCE PROCESSING (P-Spec 2.2), Table 5.8.

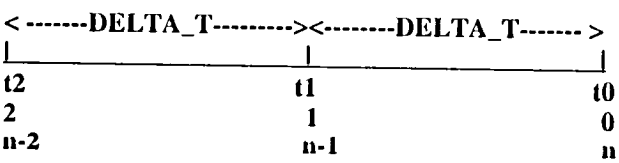
Adaptation to GCS of the Runge-Kutte fourth-order method for simultaneous equations

In the discussion that follows, let the "dependent" variables refer to GP_ATTITUDE, GP_VELOCITY, and GP_ALTITUDE, and let the "sensor" variables refer to G_ROTATION, A_ACCELERATION, K_MATRIX, TDLR_VELOCITY, K_ALT, and AR_ALTITUDE. In the Runge-Kutte method, it is assumed that the derivative for y can be obtained as a function of the dependent and independent variables. In GCS, the derivative for each of the dependent variables is a function of some subset of the dependent variables and some subset of the sensor variables. The values for the sensor variables are only available to GCS at discrete values of time, namely at any time which is an integer multiple of the value of DELTA_T. It is therefore not possible to calculate derivatives at the midpoint between two frames. The mapping of the Runge-Kutte independent variable to the GCS time interval is shown below. This mapping should be used, as it will ensure that derivatives can be calculated as required.

Runge-Kutte



GCS



where:
h = 2 x DELTA_T

t0 = present time (time for the current frame)
t1 = t0 - DELTA_T (time one frame ago)
t2 = t0 - (2 x DELTA_T) (time two frames ago)

The Algorithm

The following is intended to be a conceptual representation of the Runge-Kutte algorithm as applied to GCS. It is not intended to be pseudocode or actual code. In this discussion, the subscripts for arrays have been omitted except for the history subscript which appears as "(j)" where j is 0, 1, or 2. This has been done here in order to present the concepts involved concisely, but without low-level details. The previously calculated values of the dependent variables at t1, although available, are not to be used. Also note that the history values of the dependent and sensor variables with subscripts of 3 and 4 are not used in this adaptation of Runge-Kutte to GCS.

Support Documentation Change Report Continuation

a. Report #: 2.2-27

b. Notes/Explanation (Please reference appropriate section number)

Notation

Let k1, k2, k3, k4 each represent a 3 x 3 array to hold estimate for change in attitude.
Let l1, l2, l3, l4 each represent a vector of size 3 to hold estimate for change in velocity.
Let m1, m2, m3, m4 each represent a scalar to hold estimate for change in altitude.

Let SENS_ATT(j) represent the G_ROTATION array with time history subscript j, where j is 0,1, or 2.
Let SENS_VEL(j) represent the G_ROTATION, A_ACCELERATION, K_MATRIX, and TDLR_VELOCITY arrays with time history subscript (j), where j = 0, 1, or 2.
Let SENS_ALT(j) represent the K_ALT and AR_ALTITUDE arrays with time history subscript j, where j = 0,1, or 2.

Let f_att represent the function for derivative of attitude with respect to time.
Let f_vel represent the function for derivative of velocity with respect to time.
Let f_alt represent the function for derivative of altitude with respect to time.

Algorithm

Do first estimates of changes using derivatives calculated at t2:

k1 = h x f_att (GP_ATTITUDE(2), SENS_ATT(2))
l1 = h x f_vel (GP_ATTITUDE(2), GP_VELOCITY(2), SENS_VEL(2))
m1 = h x f_alt (GP_ATTITUDE(2), GP_VELOCITY(2), GP_ALTITUDE(2), SENS_ALT(2))

Do second estimates of changes using derivatives calculated at t1:

k2 = h x f_att (GP_ATTITUDE(2) + k1/2, SENS_ATT(1))
l2 = h x f_vel (GP_ATTITUDE(2) + k1/2, GP_VELOCITY(2) + l1/2, SENS_VEL(1))
m2 = h x f_alt (GP_ATTITUDE(2) + k1/2, GP_VELOCITY(2) + l1/2, GP_ALTITUDE(2) + m1/2, SENS_ALT(1))

Do third estimates of changes using derivatives calculated at t1:

k3 = h x f_att (GP_ATTITUDE(2) + k2/2, SENS_ATT(1))
l3 = h x f_vel (GP_ATTITUDE(2) + k2/2, GP_VELOCITY(2) + l2/2, SENS_VEL(1))
m3 = h x f_alt (GP_ATTITUDE(2) + k2/2, GP_VELOCITY(2) + l2/2, GP_ALTITUDE(2) + m2/2, SENS_ALT(1))

Do fourth estimates of changes using derivatives calculated at t0:

k4 = h x f_att (GP_ATTITUDE(2) + k3, SENS_ATT(0))
l4 = h x f_vel (GP_ATTITUDE(2) + k3, GP_VELOCITY(2) + l3, SENS_VEL(0))
m4 = h x f_alt (GP_ATTITUDE(2) + k3, GP_VELOCITY(2) + l3, GP_ALTITUDE(2) + m3, SENS_ALT(0))

Add weighted average of four change estimates to previous value of dependent variable to get current dependent variable:

GP_ATTITUDE(0) = GP_ATTITUDE(2) + 1/6 x (k1 + 2 x (k2 + k3) + k4)
GP_VELOCITY(0) = GP_VELOCITY(2) + 1/6 x (l1 + 2 x (l2 + l3) + l4)
GP_ALTITUDE(0) = GP_ALTITUDE(2) + 1/6 x (m1 + 2 x (m2 + m3) + m4)

Action: Change Table of Contents (page vii) to reflect change in page number for the Bibliography, from page 119 to page 123

Modified Text: BIBLIOGRAPHY 123

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.2	January 19, 1994	2.2 - 28

4. Part of Configuration Item Affected:

INTRODUCTION, Subsection Exception Conditions, UPPER OR LOWER LIMIT EXCEEDED
Table of Contents

5. Reason for Modification:

In the requirements for checking for upper or lower limit exceeded, specificity is needed regarding the data types of the elements to be checked, the context in which the checks should be made, and when the checks should be performed.

6. Modification:

Action: Replace the entire paragraph under the heading "UPPER OR LOWER LIMIT EXCEEDED" with the new text.

New Text:

The current value for a data element exceeds its upper or lower limit as specified in the range section in the Data Requirements Dictionary Part I.

Only certain data elements under certain conditions are to be checked for limits exceeded. The criteria for which elements are to be checked, in what context they are to be checked, and when they must be checked is as follows:

Which data elements:

A particular data element is to be checked for limits exceeded only if it is of data type REAL*8, and is in either of the two global data stores GUIDANCE_STATE or SENSOR_OUTPUT.

Context for check:

A data element is to be checked only when it is being used as an input. If the data element is a vector or array, then each element in the vector or array that is being used as input must be checked, including history values. It is not necessary for the functional unit CP to check any of its input data elements for limit exceeded.

When data element must be checked:

When an input data element is to be used or processed in a given subframe, then it must be checked sometime within that same subframe before it is used. If the data element is also being updated or changed in the same subframe before it is being used as an input, then it must be checked sometime between the time it is updated and the time it is used.

7. SQA Signature & Date:

Original Signed by
George Finelli

2/15/94

Support Documentation Change Report Continuation

a. Report #: 2.2-28

b. Notes/Explanation (Please reference appropriate section number)

Action: Change Table of Contents (page vi) to reflect change in page number for the section Output to be Generated for Each Exception Condition, from page 16 to page 17

Modified Text:

Output to be Generated for Each Exception Condition 17

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.2	March 15, 1994	2.2 - 29

4. Part of Configuration Item Affected:

Many miscellaneous parts are affected.

(Each individual modification below lists the part affected by that modification)

5. Reason for Modifications:

Miscellaneous corrections, clarifications, and revisions

(Each individual modification below lists the reason for that modification)

6. Modifications

Modification: 2.2-29.1:

Part of Configuration Item Affected: Preface, first paragraph, last sentence

Reason for Modification: Definition of "RTCA" has changed, and Guidelines DO-178B have replaced DO-178A

Action: Change "Radio Technical Commission for Aeronautics RTCA/DO-178A " to "Requirements and Technical Concepts for Aviation RTCA/DO-178B"

Modification: 2.2-29.2:

Part of Configuration Item Affected: Preface, second paragraph, first and second sentences and last paragraph, second sentence

Reason for Modification: Guidelines DO-178B have replaced DO-178A

Action: Change "DO-178A" to "DO-178B"

Modification: 2.2-29.3:

Part of Configuration Item Affected: BIBLIOGRAPHY, item [1]

Reason for Modification: Definition of "RTCA" has changed, and Guidelines DO-178B have replaced DO-178A

Action: Replace the current item with the new text below:

New Text:

[1] Special Committee 167 of Requirements and Technical Concepts for Aviation Inc. (RTCA, Inc.). Software Considerations in Airborne Systems and Equipment Certification, DOCUMENT NO. RTCA/DO-178B. RTCA Inc., Washington, D. C., 1992.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst (SQA) 3/16/94

a. Report #: Support Documentation Change Report 2.2-29

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.2-29.4:

Part of Configuration Item Affected: FOREWORD, first paragraph, second and third sentences
Reason for Modification: Redundant information (see Appendix A)
Action: Delete entire second sentence and change first two words of third sentence from "This specification" to "It"

Modification: 2.2-29.5:

Part of Configuration Item Affected: INTRODUCTION, second paragraph, third sentence
Reason for Modification: The roll engines are on at the beginning of the trajectory.
Action: Change "The axial and roll engines are ignited;" to "The axial engines are ignited;"

Modification: 2.2-29.6:

Part of Configuration Item Affected: INTRODUCTION, NOTATION, Matrices and Arrays, last sentence
Reason for Modification: Clarification needed
Action: Change the word "indices" to "index for the time history"

Modification: 2.2-29.7

Part of Configuration Item Affected: INTRODUCTION, REQUIREMENTS, Use of Tables , between second and third sentences
Reason for Modification: Clarification needed
Action: Insert a new sentence between these two sentences
New Text: If the actions in one line of the table are performed, then none of the actions in any other line of the table should be performed in the same subframe.

Modification: 2.2-29.8:

Part of Configuration Item Affected: AECLP, P-Spec 2.3.1, COMPUTE LIMITING ERRORS FOR PITCH
Reason for Modification: Clarification needed
Action: Replace the sentence **"where t_0 is the beginning of the time step and t is the end of the time step."** with the new text
New Text: where t_0 is the time at the beginning of this frame and t is the time at the end of this frame.

Modification: 2.2-29.9:

Part of Configuration Item Affected: AECLP, P-Spec 2.3.1, COMPUTE LIMITING ERRORS FOR YAW
Reason for Modification: Clarification needed
Action: Replace the sentence **"where t_0 is the beginning of the time step and t is the end of the time step."** with the new text
New Text: where t_0 is the time at the beginning of this frame and t is the time at the end of this frame.

a. Report #: Support Documentation Change Report 2.2-29

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.2-29.10:

Part of Configuration Item Affected: AECLP, P-Spec 2.3.1, COMPUTE LIMITING ERRORS FOR THRUST, between the equation for TE_INTEGRAL and the sentence "Solve the following equation..."

Reason for Modification: Clarification needed

Action: Insert the new text

New Text: where t_0 is the time at the beginning of this frame and t is the time at the end of this frame.

Modification: 2.2-29.11:

Part of Configuration Item Affected: AECLP, P-Spec 2.3.1, Table 5.2

Reason for Modification: Clarification needed

Action: Insert the headings "**CURRENT STATE**" and "**ACTIONS**"

Modification: 2.2-29.12:

Part of Configuration Item Affected: AECLP, P-Spec 2.3.1, Table 5.3

Reason for Modification: Clarification needed

Action: Insert the headings "**CURRENT STATE**" and "**ACTIONS**"

Modification: 2.2-29.13:

Part of Configuration Item Affected: ASP, P-Spec 2.1.1, first paragraph, third sentence

Reason for Modification: The part of the sentence following the comma is not necessary, and is confusing.

Action: Delete the part of the sentence following the comma, and change the comma to a period. The new sentence is shown below:

New Text: The sign of the counter will always be positive, but the offset given in A_BIAS will be negative or zero.

Modification 2.2-29.14:

Part of Configuration Item Affected: GP, P-Spec 2.2, subsection labeled DETERMINE IF ENGINES SHOULD BE ON OR OFF, first sentence

Reason for Modification: FRAME_ENGINES_IGNITED could be initialized to some value other than zero if the initial FRAME_COUNTER is not initialized to the value one.

Action: Delete the words "**to zero**"

Modification 2.2-29.15:

Part of Configuration Item Affected: GP, P-Spec 2.2, Table 5.9

Reason for Modification: Clarification

Action: In the heading over the fourth column, change "a prior frame?" to "any prior frame?"

a. Report #: Support Documentation Change Report 2.2-29

b. Notes/Explanation (Please reference appropriate section number)

Modification 2.2-29.16:

Part of Configuration Item Affected: GP, P-Spec 2.2, subsection labeled DETERMINE GUIDANCE PHASE, second paragraph, third sentence.

Reason for Modification: Inaccurate wording, and second double quote is in the wrong place

Action: Change **"PRESENT STATE" DESCRIPTION** to **"CURRENT STATE DESCRIPTION"**

Modification 2.2-29.17:

Part of Configuration Item Affected: GSP, P-Spec 2.1.4, subsection labeled PROCESS, table showing the map of G_COUNTER

Reason for Modification: Numbering of the bit positions is not consistent with numbering in the VAX FORTRAN Language Reference Manual.

Action: Change the numbering of the bits from 1 through 16 to 0 through 15.

Modification 2.2-29.18:

Part of Configuration Item Affected: RECLP, P-Spec 2.3.2, subsection labeled DETERMINE PULSE INTENSITY AND DIRECTION, sixth sentence

Reason for Modification: The word "step" has not been defined

Action: Change the word "step" to the word "frame"

Modification 2.2-29.19:

Part of Configuration Item Affected: RECLP, subsection labeled DETERMINE ROLL ENGINE COMMAND, table showing the layout of pulse intensity and direction in the roll engine command

Reason for Modification: The numbering of the bit positions is not consistent with the numbering in the VAX FORTRAN Language Reference Manual. In addition, the format of the table is not consistent with the table in GSP, P-Spec 2.1.4

Action: Change the numbering of the bits from 1 through 16 to 0 through 15, and move the bit positions to the top line and the layout to the bottom line.

Modification: 2.2-29.20:

Part of Configuration Item Affected: TDLRSP, P-Spec 2.1.3, Table 5.12

Reason for Modification: Clarification needed

Action: Insert the headings "**CURRENT STATE**" and "**ACTIONS**"

Modification: 2.2-29.21:

Part of Configuration Item Affected: DATA REQUIREMENTS DICTIONARY, PART I, element COMM_SYNC_PATTERN, subsection RANGE

Reason for Modification: Clarification needed

Action: Add the text "(binary)"

___ Report Continuation

a. Report #: Support Documentation Change Report 2.2-29

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.2-29.22:

Part of Configuration Item Affected: DATA REQUIREMENTS DICTIONARY, PART I, element RE_SWITCH, subsection DATA STORE LOCATION
Reason for Modification: Typographical Error
Action: Change "GUIDANCE" to "GUIDANCE_STATE"

Modification: 2.2-29.23:

Part of Configuration Item Affected: DATA REQUIREMENTS DICTIONARY, PART I, element THETA, subsection DATA STORE LOCATION
Reason for Modification: Typographical Error
Action: Change "GUIDANCE" to "GUIDANCE_STATE"

Modification: 2.2-29.24:

Part of Configuration Item Affected: DATA REQUIREMENTS DICTIONARY, PART III, Table 6.6
Reason for Modification: Typographical Error
Action: Change "RE_SWTICH" to "RE_SWITCH"

Modification: 2.2-29.25:

Part of Configuration Item Affected: RECLP, P-Spec 2.3.2, Figure 5.2
Reason for Modification: Ambiguity
Action: Add the new text at the bottom of the figure.
New Text: Note: $P_1 < P_2 < P_3 < P_4$ and $\theta_1 < \theta_2$

Modification: 2.2-29.26:

Part of Configuration Item Affected: TSP, P-Spec 2.1.5, Figure 5.4
Reason for Modification: Ambiguity regarding M3, M4, T3, and T4, and also the parabolas need to be redrawn
Action: Add new text at the bottom of the figure concerning M3, M4, T3, and T4, and also redraw the parabolas
New Text: Note: $M_3 < M_4$ and $T_3 < T_4$

Modification: 2.2-29.27:

Part of Configuration Item Affected: APPENDIX C. NUMERICAL INTEGRATION INSTRUCTIONS, ADAPTATION OF RUNGE-KUTTE FOURTH-ORDER METHOD FOR SIMULTANEOUS EQUATIONS TO THE GCS SOFTWARE
Reason for Modification: Typographical errors
Action: Change the following terms (everywhere they appear):

from: x0, x1, y0, y1, t0, t1, t2, k1, k2, k3, k4, l1, l2, l3, l4, m1, m2, m3, m4
to: x_0, x_1, y_0, y_1, t_0, t_1, t_2, k_1, k_2, k_3, l_1, l_2, l_3 l_4 m_1, m_2, m_3 m_4
respectively.

a. Report #: Support Documentation Change Report 2.2-29

Modification: 2.2-29.28:

Part of Configuration Item Affected: Title Page

Reasons for Modification: Version number of document needs to be updated. The RTCA document number and the names of the authors were missing.

Actions: Change the version number of the document from 2.2 to 2.3. Add the RTCA Document number and the names of the authors.

Modification: 2.2-29.29:

Part of Configuration Item Affected: Page immediately following the title page

Reason for Modification: Acknowledgement page was missing

Action: Insert acknowledgement page after the title page

Modification: 2.2-29.30:

Part of Configuration Item Affected: Appendix B, INTERFACE, PROCESS section, first paragraph, last sentence, and GCS Initialization section, first sentence

Reasons for Modifications:

- The term "time step" has not been defined, and timing requirements have been removed
- The initial value for SUBFRAME_COUNTER was omitted

Actions:

- In the PROCESS section, change the text "time step" to "subframe", and delete the text "or have run out of time"
- In the GCS Initialization section, at the end of the first sentence, add the text ", and the subframe counter (SUBFRAME_COUNTER) will be initialized to the value one"

Modification: 2.2-29.31:

Part of Configuration Item Affected: INTRODUCTION, PURPOSE OF THE GUIDANCE AND CONTROL SOFTWARE, first sentence, and also the BIBLIOGRAPHY

Reason for Modifications: Reference to the Viking '75 Spacecraft paper was omitted

Actions: Insert a reference to the Viking paper in the INTRODUCTION, and insert an entry for the paper in the BIBLIOGRAPHY

Modification: 2.2-29.32:

Part of Configuration Item Affected: INTRODUCTION, GENERAL INFORMATION, NOTATION, Operators, Multiplication sign

Reason for Modifications: The terms i, j, and n are not defined

Actions: Define the range for i and j, and change the range for k.

Modification: 2.2-29.33:

Part of Configuration Item Affected: Chapter 5, ARSP (P-Spec 2.1.2), Table 5.4

Reason for Modifications: Heading in "Actions" columns is not consistent with other tables

Action: Change "ACTIONS TO BE TAKEN" to "ACTIONS"

a. Report #: Support Documentation Change Report 2.2-29

Modification: 2.2-29.34:

Part of Configuration Item Affected: Chapter 5, CP (P-Spec 2.4), Table 5.5
Reason for Modifications: Since the table is to be read crosswise, the internal lines should be horizontal rather than vertical
Actions: Replace the internal vertical lines, with horizontal lines

Modification: 2.2-29.35:

Part of Configuration Item Affected: APPENDIX A, NOTATION FOR LEVELS 0, 1, AND 3 SPECIFICATION
Reason for Modifications: Clarification , more accurate wording, and additional text is needed
Actions:

- In the first paragraph, last sentence, change the text "functional modules" to "processes"
- In the second paragraph, first sentence, change the semicolons to commas, and change the word "descriptions" to "specifications"
- In the third paragraph, last sentence, change the text "for the entire system" to "between the system and the external entities"
- In the fourth paragraph, third sentence, change the text ";or," to ",or "
- In the fourth paragraph, replace the fourth sentence with the text "The flow diagrams show what the process structure must do under all conditions."
- In the fourth paragraph, next-to-last sentence, change the last word from "diagram" to "diagrams"
- In the fifth paragraph, last sentence, change the word "when" to "under which", and add the text ", and in some cases also contain output values for control signals" to the end of the sentence

Modification: 2.2-29.36:

Part of Configuration Item Affected: Entire specification
Reason for Modification: Version 2.2 is to be replaced by Version 2.3
Actions:

- Renumber the pages in the entire document
- Remove the notes "with mod 2.2-.." at the bottoms of the revised pages
- Remove the bolding and the footnote numbers that had previously been added as a result of changing from Version 2.1 to Version 2.2
- Remove the entire second paragraph of the FOREWORD, which expained the differences between Version 2.1 and Version 2.2 of this specification.
- Update the Table of Contents, List of Figures, and List of Tables to reflect the new page numbers

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.3	May 12, 1994	2.3 - 1

4. Part of Configuration Item Affected:

Miscellaneous parts are affected.

(Each individual modification below lists the part affected by that modification)

5. Reason for Modifications:

Miscellaneous clarifications and revisions.

(Each individual modification below lists the reason for that modification)

6. Modifications

Modification: 2.3-1.1:

Part of Configuration Item Affected: Chapter 1, INTRODUCTION, REQUIREMENTS, Calls to GCS_SIM_RENDEZVOUS

Reason for Modification: Clarification.

Action: Add new text at the end of the sentence

New Text: See Chapter 2 and Appendix B for discussions regarding GCS_SIM_RENDEZVOUS.

Modification: 2.3-1.2:

Part of Configuration Item Affected: Chapter 1, INTRODUCTION, REQUIREMENTS, EXCEPTION HANDLING, Output to be Generated for Each Exception Condition, *Lower Limit Exceeded* and *Upper Limit Exceeded*

Reason for Modification: The only variables now being checked for limits exceeded are of type real.

Action: Delete the text "for type real elements, and use FORMAT (x,a32,i12) for integer or logical data elements."

Modification: 2.3-1.3:

Part of Configuration Item Affected: Title Page

Reason for Modification: Formal Modification Numbers are needed in addition to Version Number.

Action: Add the Formal Modification Number 2.3-1 following the Version Number.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/13/94

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.3	May 18 1994	2.3 - 2

4. Part of Configuration Item Affected:

Miscellaneous parts are affected.

(Each individual modification below lists the part affected by that modification)

5. Reason for Modifications:

The scheduling of the GCS functional units and the termination conditions are being modified.

6. Modifications

Modification: 2.3-2.1:

Part of Configuration Item Affected: Chapter 4, SCHEDULING

Reason for Modification: The scheduling of the functional units is being modified. The two major changes are that each functional unit will be executed every frame, and the check for termination will be made at the end of the third subframe instead of at the end of the second subframe.

Action: Replace the entire section labeled SCHEDULING.

Note: Even though this particular modification directly affects only the SCHEDULING section of Chapter 4, the changes made to this section do have an impact on the functional unit CP (P-Spec 2.4). This is due to the fact that each functional unit will now be scheduled every frame, and therefore the data which must be sent by CP in some subframes will be different from what it was when not every functional unit was being scheduled every frame.

Modification: 2.3-2.2:

Part of Configuration Item Affected: Chapter 5, ARSP -- Altimeter Radar Sensor Processing (P-Spec 2.1.2), Section labeled "PERFORM ALTERNATE PROCESSING IF THIS IS AN EVEN-NUMBERED FRAME"

Reason for Modification: The actual calculations for this functional unit are to be performed each frame.

Action: Delete the entire section.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 5/19/94

Support Documentation Change Report Continuation

a. Report #: Support Documentation Change Report 2.3-2

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-2.3:

Part of Configuration Item Affected: Chapter 5, TDLRSP --Touch Down Landing Radar Sensor Processing (P-Spec 2.1.3), Section labeled "PERFORM ALTERNATE PROCESSING IF THIS IS AN EVEN-NUMBERED FRAME"

Reason for Modification: The actual calculations for this functional unit are to be performed each frame.

Action: Delete the entire section.

Modification: 2.3-2.4:

Part of Configuration Item Affected: Chapter 5, CP -- Communications Processing (P-Spec 2.4), section labeled PREPARE SAMPLE MASK, third sentence.

Reason for Modification: The scheduling changes in Formal Modifications 2.3-2.2, and 2.3-2.3 require that the calculations for functional units ARSP and TDLRSP be performed every frame, and since the outputs may change every frame, they should be sent every frame.

Action: Delete the third sentence which states "The output variables from the functional units ARSP and TDLRSP, however, should not be transmitted when the variable FRAME_COUNTER is an even number."

Modification: 2.3-2.5:

Part of Configuration Item Affected: Title Page

Reason for Modification: Formal Modification Numbers are needed in addition to Version Number.

Action: Add the Formal Modification Number 2.3-2 following the Version Number.

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.3	June 8, 1994	2.3 - 3

4. Part of Configuration Item Affected:

Several miscellaneous parts are affected.

(Each individual modification below lists the part affected by that modification)

5. Reasons for Modifications

Miscellaneous corrections and clarifications.

(Each individual modification below lists the reason for that modification)

6. Modifications

Modification: 2.3-3.1

Part of Configuration Item Affected: INTRODUCTION, EXCEPTION HANDLING, Exception Conditions, UPPER OR LOWER LIMIT EXCEEDED, Context for Check

Reason for Modification: A clarification is required for the context in which a limit check should be made.

Action: Insert new text between the first and second sentences.

New Text: Rotation of a data element is not considered to be a use as an input for the purposes of limit checking.

Modification: 2.3-3.2

Part of Configuration Item Affected: Chapter 5, AECLP, P-Spec 2.3.1, INPUT Table.

Reason for Modification: Any variable which must be accessed in order to perform the functions of a functional unit should be listed in the INPUT Table for that functional unit, but the variable INTERNAL_CMD is not listed in the INPUT Table.

Action: Add the variable INTERNAL_CMD to the INPUT Table.

Modification: 2.3-3.3

Part of Configuration Item Affected: Chapter 5, ARSP, P-Spec 2.1.2, PROCESS section, first paragraph.

Reason for Modification: This paragraph should have been deleted by Formal Modification 2.3-2, in which it was stated that this functional unit should be executed every frame.

Action: Delete the entire paragraph.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 6/9/94

Support Documentation Change Report Continuation

a. Report #: Support Documentation Change Report 2.3-3

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-3.4

Part of Configuration Item Affected: Chapter 5, TDLRSP, P-Spec 2.1.3, PROCESS section, first paragraph.

Reason for Modification: This paragraph should have been deleted by Formal Modification 2.3-2, in which it was stated that this functional unit should be executed every frame.

Action: Delete the entire paragraph.

Modification: 2.3-3.5

Part of Configuration Item Affected: Chapter 5, CP, P-Spec 2.4, INPUT Table.

Reason for Modification: Any variable which must be accessed in order to perform the functions of a functional unit should be listed in the INPUT Table for that functional unit, but the variable C_STATUS is not listed in the INPUT Table.

Action: Add the variable C_STATUS to the INPUT Table.

Modification: 2.3-3.6

Part of Configuration Item Affected: Chapter 5, CP, P-Spec 2.4, PREPARE SAMPLE MASK, second and third sentences, and PREPARE DATA, second sentence.

Reason for Modification: In PREPARE SAMPLE MASK, an exception needs to be added to the second sentence, the third sentence needs more clarity, and the fourth sentence is unecessary. In PREPARE DATA, the second sentence is redundant.

Action: In PREPARE SAMPLE MASK, replace the second and third sentences with the new text and delete the fourth sentence. In PREPARE DATA, delete the second sentence.

New Text: Any variables listed in Table 5.5 that may have changed during the present subframe should be marked in the mask and transmitted, with one exception. The variable TE_INTEGRAL may be changed by GP in the second subframe and by AECLP in the third subframe; however, TE_INTEGRAL should be trasmitted by CP only during the third subframe, and not during the second subframe. In the case of any "history variable", that is, one which contains a time dimension, only the object (scalar, vector, or array) with a time subscript of zero should be transmitted.

Modification: 2.3-3.7

Part of Configuration Item Affected: Title Page

Reason for Modification: Formal Modification Numbers are needed in addition to Version Number.

Action: Add the Formal Modification Number 2.3-3 following the Version Number.

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.3	August 23, 1994	2.3 - 4

4. Part of Configuration Item Affected:

Miscellaneous parts are affected.

(Each individual modification below lists the part affected by that modification)

5. Reason for Modifications:

Miscellaneous corrections and clarifications.

(Each individual modification below lists the reason for the modification)

6. Modifications

Modification: 2.3-4.1

Part of Configuration Item Affected: TABLE OF CONTENTS and INTRODUCTION, REQUIREMENTS

Reason for Modification: There is no explicit statement regarding the required precision for floating point calculations.

Action: In the INTRODUCTION, add a subsection containing an explicit precision requirement for floating point calculations, and add this subsection name to the TABLE OF CONTENTS.

Modification: 2.3-4.2

Part of Configuration Item Affected: Chapter 5, ASP (P-Spec 2.1.1), section labeled "DETERMINE ACCELERATIONS AND ACCELEROMETER STATUS"

Reason for Modification: The form of the equation given for the standard deviation, if implemented exactly as shown, may result in a negative argument for the square root due to roundoff.

Action: Change the form of the equation for the standard deviation to one which, if implemented exactly as shown, cannot lead to a negative argument for the square root.

Modification: 2.3-4.3

Part of Configuration Item Affected: Chapter 6, PART I, DATA ELEMENT DESCRIPTIONS, element AE_TEMP

Reason for Modification: AE_TEMP has three valid values, and thus a data type of integer*2 would be more appropriate than one of logical*1.

Action: Change the data type of AE_TEMP from logical*1 to integer*2.

Note: Even though this change is being made directly only to the Data Dictionary, it does have an impact on the packing of data for the third subframe into the PACKET array.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 8/24/94

Support Documentation Change Report Continuation

a. Report #: Support Documentation Change Report 2.3-4

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-4.4

Part of Configuration Item Affected: Chapter 6: PART I, DATA ELEMENT DESCRIPTIONS, element CHUTE_RELEASED; PART II, CONTENTS OF DATA STORES, Table 6.1 and Table 6.2

Reason for Modification: CHUTE_RELEASED is in the GUIDANCE_STATE store, but its value is transmitted to the external world, and thus it should be in the EXTERNAL store.

Action: In PART I, under CHUTE_RELEASED, change the DATA STORE LOCATION from GUIDANCE_STATE to EXTERNAL. In PART II, delete CHUTE_RELEASED from Table 6.1, and add CHUTE_RELEASED to Table 6.2.

Modification: 2.3-3.5

Part of Configuration Item Affected: Title Page

Reason for Modification: Formal Modification Numbers are needed in addition to Version Number.

Action: Add the Formal Modification Number 2.3-4 following the Version Number.

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.3	September 28, 1994	2.3 - 5

4. Part of Configuration Item Affected:

Miscellaneous parts are affected.

(Each individual modification below lists the part affected by that modification)

5. Reason for Modifications:

Miscellaneous corrections and clarifications.

(Each individual modification below lists the reason for the modification)

6. Modifications

Modification: 2.3-5.1

Part of Configuration Item Affected: INTRODUCTION, Figures 1.1, 1.2, and 1.3

Reason for Modification: The vehicle axes should form a right-handed coordinate system, but are not shown as such.

Action: In Figure 1.1, change the direction of the positive Y axis. In Figure 1.2, change the direction of the positive Y and the positive Z axes, and enhance the phase descriptions. In Figure 1.3: in the "Bottom View", reverse the direction of the positive Y axis and of the positive roll; in the "Side View" on the left-hand bottom of the page, reverse the direction of the positive Y axis and of the positive yaw; in the "Side View" on the right-hand bottom of the page, change the note to show that the positive Y axis comes out of the page.

Modification: 2.3-5.2

Part of Configuration Item Affected: Chapter 5, ARSP (P-Spec 2.1.2), input table.

Reason for Modification: The variable FRAME_COUNTER is not an input to this functional unit.

Action: Delete the variable FRAME_COUNTER from the input table.

Modification: 2.3-5.3:

Part of Configuration Item Affected: Chapter 5, ASP (P-Spec 2.1.1), input table

Reason for Modification: The variables are not listed in ASCII order.

Action: Arrange the variables in the input table in ascending ASCII sequence.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 9/23/94

Support Documentation Change Report Continuation

a. Report #: Support Documentation Change Report 2.3-5

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-5.4:

Part of Configuration Item Affected: Chapter 5, GP (P-Spec 2.2), input table
Reason for Modification: The variables are not listed in ASCII order.
Action: Arrange the variables in the input table in ascending ASCII sequence.

Modification: 2.3-5.5:

Part of Configuration Item Affected: Chapter 5, GP (P-Spec 2.2), section labeled "CALCULATE NEW VALUES OF ATTITUDE, VELOCITY, AND ALTITUDE", and Table 5.8
Reason for Modification: The equations for rate of change of attitude, velocity, and altitude need clarification.
Action: Replace Table 5.8 and most of the text in this section.

Modification: 2.3-5.6:

Part of Configuration Item Affected: Chapter 5, GP (P-Spec 2.2), section labeled "DETERMINE VELOCITY ERROR", and Figure 5.1.
Reason for Modification: Some of the wording in this section needs improvement, and in addition, it has not been made clear that the velocity being considered is the x component of the velocity.
Action: In the section DETERMINE VELOCITY ERROR, replace most of the text, and also add a statement concerning the minimum numher of non-zero elements in CONTOUR_ALTITUDE. In Figure 5.1, change the label on the x-axis and on the trajectories, add a label for the constant-velocity part of the contour, and change the curves to make them distinguishable from each other.

Modification: 2.3-5.7:

Part of Configuration Item Affected: Chapter 5, GP (P-Spec 2.2), section heading "DETERMINE GUIDANCE PHASE"
Reason for Modification: All section headings should be in bold print.
Action: Change the heading to bold print.

Modification: 2.3-5.8:

Part of Configuration Item Affected: Chapter 5, GP (P-Spec 2.2), section labeled "DETERMINE WHICH SET OF CONTROL LAW PARAMETERS TO USE", second paragraph, seventh sentence, beginning with "The constant-velocity part of the contour..."
Reason for Modification: The explanation for the constant-velocity part of the contour needs clarification.
Action: Change the wording of this sentence.

Modification: 2.3-5.9:

Part of Configuration Item Affected: Chapter 5, GSP (P-Spec 2.1.4), section labeled "PURPOSE", first sentence.
Reason for Modification: The sentence states "as shown", but there is no figure.
Action: Delete the text "as shown".

Support Documentation Change Report Continuation

a. Report #: Support Documentation Change Report 2.3-5

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-5.10:

Part of Configuration Item Affected: Chapter 5, RECLP (P-Spec 2.3.2), FIGURE 5.2
Reason for Modification: There is no statement regarding the viewing reference for the roll thrust direction.
Action: Add a note at the bottom of Figure 5.2 regarding the viewing reference for the roll thrust direction.

Modification: 2.3-5.11

Part of Configuration Item Affected: Chapter 5, TDLRSP (P-Spec 2.1.3), section labeled "SET VALUES IN K_MATRIX"
Reason for Modification: Clarification is needed regarding the off-diagonal elements of K_MATRIX.
Action: Add a clarifying sentence as the last sentence in this section.

Modification: 2.3-5.12

Part of Configuration Item Affected: Chapter 5, TDSP (P-Spec 2.1.6), input and output tables
Reason for Modification: The variables are not listed in ASCII order.
Action: Arrange the variables in the input and output tables in ascending ASCII sequence.

Modification: 2.3-5.13

Part of Configuration Item Affected: Chapter 6, PART I, DATA ELEMENT DESCRIPTIONS, element ATMOSPHERIC_TEMP, section DATA STORE LOCATION.
Reason for Modification: "," does not belong at the end of the DATA STORE LOCATION.
Action: Remove the "," at the end of the DATA STORE LOCATION.

Modification: 2.3-5.14

Part of Configuration Item Affected: Chapter 6, PART I, DATA ELEMENT DESCRIPTIONS, element FRAME_ENGINES_IGNITED, section DATA STORE LOCATION.
Reason for Modification: The DATA STORE LOCATION is not correct.
Action: Change the DATA STORE LOCATION from GUIDANCE to GUIDANCE_STATE.

Modification: 2.3-5.15

Part of Configuration Item Affected: Chapter 6, PART I, DATA ELEMENT DESCRIPTIONS, element GP_ROTATION, section DATA STORE LOCATION.
Reason for Modification: "," does not belong at the end of the DATA STORE LOCATION.
Action: Remove the "," at the end of the DATA STORE LOCATION.

Modification: 2.3-5.16

Part of Configuration Item Affected: Chapter 6, PART I, DATA ELEMENT DESCRIPTIONS, element RE_CMD, section RANGE.
Reason for Modification: The values for the RANGE needs clarification.
Action: Replace the RANGE section.

___ Report Continuation

a. Report #: Support Documentation Change Report 2.3-5

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-5.17

Part of Configuration Item Affected: Chapter 6, PART I, DATA ELEMENT DESCRIPTIONS, element TE_LIMIT, ATTRIBUTE section.
Reason for Modification: Consistency of notation.
Action: Change "Data" to "data".

Modification: 2.3-5.18

Part of Configuration Item Affected: Title Page
Reason for Modification: Formal Modification Numbers are needed in addition to Version Number.
Action: Add the Formal Modification Number 2.3-5 following the Version Number.

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.3	December 21, 1994	2.3 - 6

4. Part of Configuration Item Affected:

Miscellaneous parts are affected.

(Each individual modification below lists the part affected by that modification)

5. Reason for Modifications:

The Preface needs to be updated, and the calculation of the checksum in the communications functional unit needs additional requirements.

6. Modifications

Modification: 2.3-6.1

Part of Configuration Item Affected: TABLE OF CONTENTS
Reason for Modification: A new appendix , namely Appendix D, is needed.
Action: Add Appendix D to the TABLE OF CONTENTS.

Modification: 2.3-6.2

Part of Configuration Item Affected: LIST OF TABLES
Reason for Modification: TABLE 5.7 was renamed.
Action: Change name of TABLE 5.7 in LIST OF TABLES.

Modification: 2.3-6.3

Part of Configuration Item Affected: CP, Section labeled "PROCESS"
Reason for Modification: The term "message" needs to be defined.
Action: Replace the first sentence of this section.

Modification: 2.3-6.4

Part of Configuration Item Affected: CP, Section labeled "CALCULATE CHECKSUM"
Reason for Modification: Clarification is needed, and a reference is needed to point to the new Appendix D.
Actions: Replace the first paragraph of this section, rename and replace TABLE 5.7 with a table that includes the byte allocations for each subframe, and delete the first part of the note under TABLE 5.7.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/21/94

Support Documentation Change Report Continuation

a. Report #: Support Documentation Change Report 2.3-5

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-6.5

Part of Configuration Item Affected: Between Appendix C and the Bibliography.
Reason for Modification: Appendix D is needed.
Action: Add Appendix D.

Modification: 2.3-6.6

Part of Configuration Item Affected: Title Page
Reason for Modification: Formal Modification Numbers are needed in addition to Version Number, and line with "RTCA DO-178B Document Number 2" is not needed.
Action: Add the Formal Modification Number 2.3-6 following the Version Number, and delete the line "RTCA DO-178B Document Number 2".

Modification: 2.3-6.7

Part of Configuration Item Affected: Preface
Reason for Modification: The preface needs to be updated to be consistent with RTCA/DO-178B.
Action: Replace the entire preface.

Modification: 2.3-6.8

Part of Configuration Item Affected: Bibliography
Reason for Modification: The first two items in the bibliography are not consistent with the references in the new preface.
Action: Reverse the positions of the first two items in the bibliography.

Support Documentation Change Report

1. Configuration Item	2. Date	3. Formal Modification #:
Software Requirements GCS Development Specification Version 2.2	March 14, 1995	2.3-7

4. Part of Configuration Item Affected:

Chapter 5, ASP (P-Spec 2.1.1); Chapter 5, GP (P-Spec 2.2); Title Page

5. Reason for Modifications:

Each individual modification below lists the reason for that modification

6. Modifications

Modification: 2.3-7.1:

Part of Configuration Item Affected: Chapter 5, ASP (P-Spec 2.1.1), section labeled "DETERMINE ACCELERATIONS AND ACCELEROMETER STATUS"

Reason for Modification: When all three previous values of A_STATUS are healthy and all three previous values of A_ACCELERATION are equal to each other, it is not necessary to check for extreme values of acceleration.

Action: Under the sentence "the following steps are described for the x axis but should be performed for each axis:", a new condition was added as the second condition and the last condition was modified.

Modification: 2.3-7.2:

Part of Configuration Item Affected: Chapter 5, GP (P-Spec 2.2), Table 5.9

Reason for Modification: In the heading of the third column under "CURRENT STATE", eliminate the possibility of the argument of the square root function being negative, and eliminate any ambiguity from the fact that parentheses are not used.

Action: Instead of using GP_ALTITUDE as the argument for the square root, the maximum of the two values, namely GP_ALTITUDE and zero, is to be used. Parentheses were also added. It was also necessary to add a footnote below the table because the new square root argument no longer fits in the table cell.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 3/15/95

___ Report Continuation

a. Report #: Support Documentation Change Report 2.3-7

b. Notes/Explanation (Please reference appropriate section number)

Modification: 2.3-7.3:

Part of Configuration Item Affected: Chapter 5, GP (P-Spec 2.2), the section labeled "DETERMINE GUIDANCE PHASE", under "PHASE 3", and also Table 5.10.

Reason for Modification: In both places, eliminate the possibility of the argument of the square root function being negative.

Action: In Table 5.10 in the "EVENT" column, in the first line where the column GP_PHASE under "CURRENT STATE" contains "3" (fourth row of table), in order to avoid the possibility of the argument of the square root function being negative, the maximum of the two values, namely GP_ALTITUDE and zero, is to be used. It was necessary to add a footnote below the table because the square root argument would no longer fit in the table. It was also necessary to make the same change to the same expression under the bullet labeled "PHASE 3".

Modification: 2.3-7.4

Part of Configuration Item Affected: Title Page

Reason for Modification: Formal Modification Numbers are needed in addition to the Version Number, and the date needs to be updated.

Action: Add the Formal Modification Number 2.3-7 following the Version Number, and update the date.

VER_CASES

Support Documentation Change Report

1. Configuration Item: Software Verification Cases	2. Date: 8/25/94	3. Formal Modification #: 1

4. Part of Configuration Item Affected:
All AECLP Expected Values files (AECLP*.EX), The RUN_PARAMETERS namelist

5. Reason for Modification:
Creating new expected results files which will be able to compare all of the namelists, including the RUN_PARAMETERS.

6. Modification:
Creating new expected results files which will be able to compare all of the namelists, including the RUN_PARAMETERS.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 8/30/94

Support Documentation Change Report

1. Configuration Item: Software Verification Cases	2. Date: 8/25/94	3. Formal Modification #: 2

4. Part of Configuration Item Affected:
All CRCP Expected Values files (CRCP*.EX), The RUN_PARAMETERS namelist

5. Reason for Modification:
Creating new expected results files which will be able to compare all of the namelists, including the RUN_PARAMETERS.

6. Modification:
Creating new expected results files which will be able to compare all of the namelists, including the RUN_PARAMETERS.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 8/30/94

Support Documentation Change Report

1. Configuration Item: Software Verification Cases	2. Date: 9/7/94	3. Formal Modification #: 3

4. Part of Configuration Item Affected:
All GP Testcases and Expected Values files

5. Reason for Modification:
The value for FRAME_ENGINES_IGNITED was set incorrectly in the input files.

6. Modification:
Put in the correct value for FRAME_ENGINES_IGNITED for all test cases, reran the *Mathematica* model and replaced all the test cases and expected results files associated with GP.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 9/15/94

Support Documentation Change Report

1. Configuration Item: Software Verification Cases	2. Date: 9/19/94	3. Formal Modification #: 4

4. Part of Configuration Item Affected:
All GP Testcases and Expected Values Files

5. Reason for Modification:
Due to Spec Mod 2.3-4.4 all test cases must be recreated in order to put CHUTE_RELEASED into the correct data store (EXTERNAL) and remove it from GUIDANCE_STATE.

6. Modification:
CHUTE_RELEASED was placed in the correct data store namelist in all test cases.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/2/94

Support Documentation Change Report

1. Configuration Item: Software Verification Cases	2. Date: 9/19/94	3. Formal Modification #:5

4. Part of Configuration Item Affected:
All AECLP Testcases and Expected Values files

5. Reason for Modification:
Due to Spec Mod 2.3-4.4 all test cases must be recreated in order to put CHUTE_RELEASED into the correct data store (EXTERNAL) and remove it from GUIDANCE_STATE.
.

6. Modification:
CHUTE_RELEASED was placed in the correct data store namelist in all testcases.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/12/94

Support Documentation Change Report

1. Configuration Item: Software Verification Cases	2. Date: 9/19/94	3. Formal Modification #:6

4. Part of Configuration Item Affected:
All RECLP Testcases and Expected Values files

5. Reason for Modification:
Due to Spec Mod 2.3-4.4 all test cases must be recreated in order to put CHUTE_RELEASED into the correct data store (EXTERNAL) and remove it from GUIDANCE_STATE.

.

6. Modification:
CHUTE_RELEASED was placed in the correct data store namelist in all testcases.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/2/94

Support Documentation Change Report

1. Configuration Item: Software Verification Cases	2. Date: 9/19/94	3. Formal Modification #:7

4. Part of Configuration Item Affected:
All CRCP Testcases and Expected Values files

5. Reason for Modification:
Due to Spec Mod 2.3-4.4 all test cases must be recreated in order to put CHUTE_RELEASED into the correct data store (EXTERNAL) and remove it from GUIDANCE_STATE.
.

6. Modification:
CHUTE_RELEASED was placed in the correct data store namelist in all testcases.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/2/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
CP Test Cases	12- 21-94	8

4. Part of Configuration Item Affected:
Expected values files for CP test cases and CP model.

5. Reason for Modification:
The Packet processing for CP has been updated in the GCS Specification. The CP model must now be updated to match the Spec. The expected results must also be regenerated using the updated model.

6. Modification:
The model of CP has been updated so that the bit checksum bytes do not switch positions before being stored into the packet. The expected values files have been regenerated using the updated model.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/27/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
ASP Test Cases	12- 28-94	9

4. Part of Configuration Item Affected:
ASP test cases and expected values files.

5. Reason for Modification:
The ASP Requirements based test cases test the wrong status variable. This directly effects 6 ASP test cases but should be corrected in all ASP test cases.

6. Modification:
All ASP test cases have been corrected to test the A_STATUS variable instead of AR_STATUS variable. The updated test cases have been re-executed with the VENUS prototype and no ".ANA" files were generated indicating that all expected values files match the prototype results.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/29/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
CP Model & CP Test Cases Expected Values Files	1-9-95	10

4. Part of Configuration Item Affected:

Expected values files for CP test cases and CP model.

5. Reason for Modification:

An error has been found in the CP test case expected values files. This error can be traced to modifications for SDCR-8 during which the CP model was modified and verified against the VENUS prototype. During that verification, necessary VENUS switches were not set causing no CRC checksum to be generated. The checksum needs to be added back to the PACKET variable in the expected values files

6. Modification:

The model of CP has been updated so that the bit checksum bytes are being stored into the packet. The expected values files have been regenerated using the updated model.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 1/12/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Test Drivers	2-6-95	11

4. Part of Configuration Item Affected:

Subframe and frame test drivers calculate the expected value of the PACKET data element. The subroutine that performs this calculation is P_EX_CP.FOR for the Pluto and Mercury implementation respectively.

5. Reason for Modification:

The subroutine for generating expected values for subframe and frame test cases use a duplicate of the CP model. This part was not updated when the Specification for CP was updated in formal mod # 2.3-6. The subroutines need to be modified so that the bit checksum is no longer flipped.

6. Modification:

In the file P_EX_CP.FOR the three instances of code which reverses the CRC byte has been commented out. The CRC byte is no longer flipped for any subframe packet.

7. SQA Signature & Date:

Original Signed by
Kelly Hayhurst

2/8/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Subframe Test Cases	2-7-95	12

4. Part of Configuration Item Affected:
GPSF_001 to 008.TC, GPSF_001 to 008.EX, and CLP_011.TC, and CLP_011.EX

5. Reason for Modification:
The subframe counter value in the above test cases does not agree with the subframe being tested. This effects the generation of values for the PACKET data element during CP processing at the end of the subframe.

6. Modification:
The test case input and expected values files were edited instead of regenerated because only one item was changed and no calculations were involved. The subframe counter has been updated to 3 in the CLP_011.TC. The CLP_011.EX had the correct value for subframe counter so no editing was required. The subframe counter has been set to 2 for GP subframe test cases GPSF_001 to 008.TC and GPSF_001 to 008.EX.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 2/10/95

Support Documentation Change Report

2/11/95 KJH

1. Configuration Item: Verification Cases (Frame and Subframe Command files)	2. Date: 2/8/95	3. Formal Modification #: 13

4. Part of Configuration Item Affected:

Frame and Subframe Command file

5. Reason for Modification:

The command files were not set up properly to run the frame and subframe test cases for Mercury.

6. Modification:

The following new command files were created: M_SP_DRIVER.COM, M_GPSF_DRIVER.COM, M_CLP_DRIVER.COM, M_LNKGPSF.COM, M_LNKFRAME_COM and M_LNKSP.COM.

Path information was corrected from [cquach.gcs.test_cases.xx] to [dbt.test_cases.xx]

Link command files were changed to reflect the differences between the Pluto and Mercury FORTRAN files.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 2/14/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Frame Test Cases	2-15-95	14

4. Part of Configuration Item Affected:

FRAME_001-009.TC and FRAME_001-009.EX. Also affected are test drivers for each implementations. These are P_TEST_FRAME.FOR and M_TEST_FRAME.FOR

5. Reason for Modification:

Local variable names in the frame model were miss-matched for GP_ALTITUDE. This caused the expected value of the GP_ALTITUDE history index to be incorrect.

6. Modification:

Test case FRAME001 to FRAME_008 were regenerated with the model of GP fetched from CMS. No changes were made to the GP model. The drivers were corrected so that the functional units are not called when GP_PHASE is 5.

7. SQA Signature & Date:

Original Signed by
Kelly Hayhurst

2/16/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Models	2-23-95	15

4. Part of Configuration Item Affected:

The model for generating expected values for GP test cases and all test cases that use the model. This includes the test GP functional unit test cases, the GP subframe test cases, the Frame test cases.

5. Reason for Modification:

The model for GP test cases does not transition from phase 4 to phase 5 correctly for when TDS_STATUS is FAILED and TD_SENSED is TOUCH_DOWN_NOT_SENSED.

6. Modification:

The model for GP has been corrected by removing the extra conditions in the statements the perform the GP_PHASE transition. All the GP related test cases have been regenerated.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 3/24/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Models	2-24-95	16

4. Part of Configuration Item Affected:
The GP strucutral test cases for Mercury, the expected values and the mathematica driver files.

5. Reason for Modification:
The model for GP test cases did not transition from phase 4 to phase 5 correctly for when TDS_STATUS is FAILED and TD_SENSED is TOUCH_DOWN_NOT_SENSED -- and was corrected as per SDCR #15. The corresponding corrections need to be made for the Mercury structural test cases. The driver files need to be replaced to reflect changes in names of the mathematica files.

6. Modification:

The test cases and expected values were recreated due to a change in the mathematica code (see SDCR 15). The driver files changed the actual code name of GP.TC.CODE to GP.M to reflect the names of the code saved in CMS.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 2/24/95

Support Documentation Change Report

Configuration Item:	2. Date:	3. Formal Modification #:
rification Cases -Mathematica Drivers	2-24-95	17

4. Part of Configuration Item Affected:
The Mathematica drivers for the structural test cases for AECLP and RECLP (M_RUN_AECLP_ST.*, M_RUN_RECLP_ST.*)

5. Reason for Modification:
The driver files need to be replaced to reflect changes in names of the mathematica files.

6. Modification:
The driver files changed the actual code name of AECLP.TC.CODE to AECLP.M and RECLP.TC.CODE to RECLP.M to reflect the names of the code saved in CMS.

SQA Signature & Date: Original Signed by Kelly Hayhurst 2/21/95

Support Documentation Change Report

1. Configuration Item: Verification Cases (Frame and Subframe Command files	2. Date: 2/25/95	3. Formal Modification #: 18

4. Part of Configuration Item Affected: GP Functional unit Test Cases, GP Subframe Test cases, GP Structural Test Cases, NAMELIST_EX

5. Reason for Modification:

When these files were recreated (SDCR 15) an old version of the namelist code was used. This code causes a problem when the values of G_ROTATION are negative. This only affects a few test cases, but all test cases should be recreated and rerun. In a FORTRAN namelist file anything in the 1st column is ignored.

6. Modification:

The modification was made to the file NAMELIST_EX which creates the expected values files. Spaces were added before the data was written to the file. The test cases were then rerun.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 2/27/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	3/1/95	19

4. Part of Configuration Item Affected:
Structural test cases for GP for the Mercury implementation

5. Reason for Modification:
The structural test cases for GP should have been reserved and changed under SDCR 18; however, due to an oversight, those test cases were not reserved. Those test cases still need to modified as described in SDCR 18.

6. Modification:
The modification was made to the NAMELIST_EX which creates the expected value files. Spaces were added before the data was written to the file.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst — 3/1/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	3/1/95	20

4. Part of Configuration Item Affected:
The GP subframe expected values files and the GP subframe mathematica run files.

5. Reason for Modification:
The changes made in SDCR 18 were implemented incorrectly due to an error in the run files. The expected values data did not have the prefix EX_ in front of the variable names.

6. Modification:
Modification was made in the RUN_GSF.xx files replacing the last call to NAMELIST1 with NAMELIST_EX.

7. SQA Signature & Date:
Original Signed by
Kelly Hayhurst

3/2/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	3-1-95	21

4. Part of Configuration Item Affected:
GP_PST_001-021.TC & EX

5. Reason for Modification:
The model for GP test cases has been updated and these test cases need to be regenerated using the new model.
(related to SDCR #15 : 15 changed the model, this SDCR is to change the actual test cases)

6. Modification:
All 21 Pluto structural test cases for GP have been regenerated with the new model.

7. SQA Signature & Date:
Original Signed by
Kelly Hayhurst
3/6/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Driver	3/7/95	22

4. Part of Configuration Item Affected:
The driver for the structural test cases for Mercury

5. Reason for Modification:
The driver file needs to be modified to use the correct test cases.

6. Modification:
The driver was modified to build the correct test case names.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 3/7/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Structural Test cases for TDLRSP for Mercury	3/10/95	23

4. Part of Configuration Item Affected:
The structural test cases, expected values and Mathematica driver files for Mercury

5. Reason for Modification:
The test cases and expected values files had errors from Mathematica because no initial conditions were input, so Mathematica did not know what to do with them.

6. Modification:
The Mathematica drivers were corrected by adding a call to the input file and replaced. The Test cases and expected values were re created.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 3/10/95

Support Documentation Change Report

.. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Models and test cases.	3-14-95	24

4. Part of Configuration Item Affected:
ASP.M, ASP_NR_xxx.TC & EX, and ASP_RO_xxx.TC & EX, GP.M, GP_NR_xxx.TC & EX, and GP_RO_xxx.TC & EX
SP.M, SP_001.TC & EX, GPSF_001-008.TC & EX,
FRAME.M, FRAME_001-009.TC & EX

5. Reason for Modification:
Models must be updated to reflect new Spec Mod.2.3-7.

6. Modification:

1) The ASP.M model has been updated to calculate the mean and standard deviation only if all status are healthy and previous accelerations are not identical. The test input and expected values files (ASP_NR_xxx.TC & EX and ASP_RO_xxx.TC & EX) have been regenerated.

2) The GP.M model has been updated to include the MAX function on the RHS of the MAX_NORMAL_VELOCITY comparison in table 5.9 and 5.10. The test input and expected values files (GP_NR_xxx.TC & EX and GP_RO_xxx.TC & EX) have been regenerated.

3) The SP.M model has been replaced by SP_001.M. The new file contains the test data as well as the calls to the functional unit models without directory references for the calls. The test input and expected values files (SP_001.TC & EX and SP_001.TC & EX) have been regenerated because the ASP.M model has been changed.

4) The test input and expected values files (GPSF_xxx.TC & EX and GPSF_xxx.TC & EX) have been regenerated because the GP.M model has been changed.

5) The FRAME.M model has been updated by removing directory references from calls to individual functional unit models. The test input and expected values files (FRAME_xxx.TC & EX and FRAME_xxx.TC & EX) have been regenerated because the ASP.M and GP.M models have been changed.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 3/23/95

Support Documentation Change Report

1. Configuration Item: Structural Test Cases for ASP and GP VERIFICATION CASES	2. Date: 3/14/95	3. Formal Modification #:25

4. Part of Configuration Item Affected: Structural Test Cases for ASP and GP – for MERCURY

5. Reason for Modification:

Structural test cases and the expected results have to be regenerated using the new *Mathermatica* model due to Spec Mod 2.3.7.

-model was changed in SDCR #24

6. Modification:

The *Mathematica* code for ASP and GP was corrected in accordance to Spec. Mod 2.3.7 and the structural test cases were recreated.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/3/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Structural test cases for Pluto.	3-14-95	26

4. Part of Configuration Item Affected:
ASP_PST_xxx.TC & EX, GP_PST_xxx.TC & EX

5. Reason for Modification:
Structural test case inputs and expected results must be regenerated with the new model. Model changed under SDCR #24

6. Modification:
Input and expected-values files have been regenerated for Pluto's GP and ASP functional units. (structural test cases)

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/5/95

Support Documentation Change Report

1. Configuration Item: RECLP test case # 68 Verification CASES - MERCURY *	2. Date: 3/14/95	3. Formal Modification #:27

4. Part of Configuration Item Affected: RECLP_NR_068.TC and RECLP_NR_068.EX

5. Reason for Modification:

An error was detected in the value to THETA while doing MC/DC testing. THETA had the wrong initial value so that the expected value was calculated wrong.

6. Modification:

The correct initial value of Theta was put into test case 68

* The error in these test cases was ~~discovered~~ discovered while developing structural test cases for MERCURY

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 3/16/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - model for TDLRSP .	3-30-95	28

4. Part of Configuration Item Affected:
TDLRSP.M, TDLRSP_NR_xxx.TC & EX,TDLRSP_RO_xxx.TC & EX, SP_001.TC & EX, FRAME_xxx.TC & EX

5. Reason for Modification:
The TDLRSP model needs to be corrected to properly assign the value of K_MATRIX for cases not specified in table 5.11 and where no beams are in lock.
All TDLRSP requirements based test cases need to be regenerated based on the new TDLRSP model.
The SP and all FRAME test cases need to be regenerated based on the new TDLRSP model.

6. Modification:
The TDLRSP model now assigns K_MATRIX values properly. Debug print statements have been added to help future debugging efforts.
The TDLRSP requirements based test cases have been regenerated.
The SP test case has been regenerated.
The FRAME test cases have been regenerated.

No changes were actually made to TDLRSP model with respect to K_MATRIX (the values in the original model were correctly assigned). The only modification was the addition of debugging statements KJH 4/5/95

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/5/95

Support Documentation Change Report

1. Configuration Item: MERCURY Structural Test Cases for TDLRSP VERIFICATION CASES	2. Date: 4/3/95	3. Formal Modification # 29

4. Part of Configuration Item Affected: MERCURY Structural Test Cases for TDLRSP.

5. Reason for Modification:

Structural test cases and the expected results have to be regenerated using the new *Mathematica* model (SDCR 28) due to an error discovered in the TDLRSP *Mathematica* code by the MERCURY tester.

6. Modification:

MERCURY Structural test cases for TDLRSP were recreated using the *Mathematica* code corrected in SCDR 28.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/6/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	4-2-95	30

4. Part of Configuration Item Affected:
TDLRSP_PST_xxx.TC & EX

5. Reason for Modification:
The expected results files need to be regenerated based on the new TDLRSP.M model.

6. Modification:
Pluto structural test cases for TDLRSP are no longer needed. Test cases from the TDLRSP requirements based suite have been found to provide the same test coverage. The following replacements have been made:

TDLRSP_PST_001.TC & EX	replaced by	TDLRSP_RO_006.TC & EX
TDLRSP_PST_002.TC & EX	replaced by	TDLRSP_RO_026.TC & EX
TDLRSP_PST_003.TC & EX	replaced by	TDLRSP_RO_002.TC & EX
TDLRSP_PST_004.TC & EX	replaced by	TDLRSP_RO_026.TC & EX
TDLRSP_PST_005.TC & EX	replaced by	TDLRSP_NR_021.TC & EX
TDLRSP_PST_006.TC & EX	replaced by	TDLRSP_NR_004.TC & EX
TDLRSP_PST_007.TC & EX	replaced by	TDLRSP_NR_003.TC & EX

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/5/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases - Trajectory Group	4-2-95	31

4. Part of Configuration Item Affected:
RUN_TRAJ.COM - support file to run simulator test cases.

5. Reason for Modification:
The directory specific references should be removed from the RUN_TRAJ.COM file so that the user will not need to correct the directory reference before running trajectory test cases.

6. Modification:
The absolute directory reference has been replaced with a relative reference.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/3/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	4-7-95	32

4. Part of Configuration Item Affected:
P_LNK*.COM -- files for linking test support files

5. Reason for Modification:
The files listed below have the "/DEBUG" option in the link statement and is very inconvient to use. The "/DEBUG' option should be removed because it is unnnecessary.

P_LNKRECLP.COM
P_LNKCRCP.COM
P_LNKCP.COM

6. Modification:
The "/DEBUG" options have been removed from the files

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/7/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	4-7-95	33

4. Part of Configuration Item Affected:
P_*_DRIVER.COM -- files for subframe test cases

5. Reason for Modification:
The files listed below have Mercury directory references and should be corrected to run pluto files
P_GPSF_DRIVER.COM
P_CLP_DRIVER.COM

6. Modification:
The Mercury references have been replaced by Pluto directory references.

7. SQA Signature & Date:
Original Signed by
Kelly Hayhurst
4/7/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases -- Mercury Structural test cases	4-10-95	34

4. Part of Configuration Item Affected:
m_asp_st_004-006.tc, ex

5. Reason for Modification:

Wrong model used in generating test cases.

6. Modification:
Used correct model from CMS to recreate these test cases.

7. SQA Signature & Date:

Original Signed by
Kelly Hayhurst

4/10/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	4-7-95	35

4. Part of Configuration Item Affected:
M_RUN_TRAJ.COM

5. Reason for Modification:
Due to a change in directory structure the M_RUN_TRAJ.COM file must be corrected to reflect this change.

6. Modification:
The directory structure was changed from [DBT.TEST_CASES.TRAJ] to [DBT.TRAJ] in M_RUN_TRAJ.COM..

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/10/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	4-10-95	36

4. Part of Configuration Item Affected:
AP_PST_002.TC * EX

5. Reason for Modification:

This test case has to be updated to account for the new structure of ASP after PR-27 modifications. Since the structure of ASP has changed, the path to reach the decision being tested by the test case is slightly different.

6. Modification:
The A_ACCELERATION variable for X axis has been changed so that its 3 history values are different and require the standard deviation computation. This leads to the check for extreme values.

7. SQA Signature & Date:

Original Signed by
Kelly Hayhurst

4/10/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	4-10-95	37

4. Part of Configuration Item Affected:
GP_NR_053.EX1,
TDLRSP_NR_006.TC & EX
TDLRSP_PST_*.TC * EX

5. Reason for Modification:

The following is a list of files in CMS no longer used in the testing procedure for the given reasons:

GP_NR_053.EX1	This file has never been part of the GP suite
TDLRSP_NR_006.TC & EX	This test case has been renamed TDLRSP_RO_006.TC & EX
TDLRSP_PST_*.TC & EX	During a review TDLRSP test cases for SDCR-28 & SDCR 30, it is discovered that there are requirements based test cases that provide the same coverage. These structural test cases are no longer needed.

6. Modification:
Files should be removed from CMS

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/10/95

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Verification Cases	4-14-95	38

4. Part of Configuration Item Affected:
P_RUN_TRAJ.COM

5. Reason for Modification:

The call to TRAJ.COM in this file must be changed to P_TRAJ to accomodate for the name change of TRAJ.COM to P_TRAJ.COM.

6. Modification:
Calls to TRAJ.COM changed to P_TRAJ.COM

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/14/95

Support Documentation Change Report

1. Configuration Item: Verification Cases and Procedures Document	2. Date: 12-8-94	3. Formal Modification #: 1

4. Part of Configuration Item Affected:

Test procedures must be modified to be more specific. Details of the required test case directory structure must be added. Description of test case execution tracking needs to be added.

5. Reason for Modification:

DO-178B requires specific test case execution procedures. The tracking of test case execution needs to be added.

6. Modification:

A step by step test execution procedure has been added. Appendix D and E has been combined and the appendixes that follow have been renumbered. An example of a test log has been added as Appendix F. Titles have been added to the appendixes.

The original Test Procedure section has been renamed to Test Case Development Procedure.

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 12/13/94

Support Documentation Change Report

1. Configuration Item:	2. Date:	3. Formal Modification #:
Simulator source code	3-28-95	1

4. Part of Configuration Item Affected:
TRAJ_SIM.EXE

5. Reason for Modification:
Trajectory simulator prints out incorrect accuracy data in the ACC_LIM_OUTPUT.DAT file.

6. Modification:
Corrected the bug which was producing incorrect data in the file:
ACC_LIM_OUTPUT.DAT
when the following occurs

1) multiple implementations are executed
2) the accuracy check is performed on an integer or logical
3) and thevalue of the driving implementation's variable is zero

7. SQA Signature & Date: Original Signed by Kelly Hayhurst 4/3/95