J Software Test Plan

FOR THE

GLOBAL ULTRAVIOLET IMAGER

-GUVI-

Data Processing

-DP-

PAYLOAD OPERATIONS CENTER

-POC-

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Revision B

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1. SCOPE

1.1 Identification

This Software Test Plan (STP) describes the Formal Qualification Test (FQT) activities and the environment in which those activities will take place for the Global Ultraviolet Imager (GUVI) Data Processing (DP) Payload Operations Center (POC) software, hereafter referred to as the "DP POC".

The DP POC is composed of the following three Computer Software Configuration Items (CSCIs):

1. Algorithms CSCI
2. User Interface CSCI
3. Webserver Capability CSCI

Reference 1 establishes the DP POC software requirements. Reference 2 documents the design of the CSCIs that comprise the software for the DP POC. Unit testing and integration testing will be performed during development on site at Johns Hopkins University Applied Physics Lab (JHU/APL) as defined in Reference 2. This document addresses the FQT activities that take place upon delivery of the software.

1.2 Overview

GUVI is a horizon-to-horizon scanning spectrographic imager operating in the far ultraviolet (FUV: 110 to 180nm). The GUVI spectrograph, with a Rowland Circle mount, uses a two-dimensional detector to record spatial and spectral information for each step position as it scans over 140°. To reduce the downlinked data rate, the GUVI data are processed onboard the TIMED spacecraft to produce five "colors" or monochromatic bands that are useful diagnostics of the dynamics and energetics of the thermosphere and ionosphere.

The GUVI DP POC will be located at the JHU/APL during the spacecraft integration and test phase before launch as well as during flight mission operations. The development of the DP POC will be a combined effort between JHU/APL and Computational Physics, Inc.

The Algorithms CSCI generates a set of GUVI data products, which include Level 1C, Level 2, graphical overlays and survey products. GUVI Level 2 data products are derived from the Level 1A data using scientific algorithms specific to the day, night and auroral regions. Level 3 and Level 4 data products will be generated as part of MO/DA functionality. Processing includes generation of new data products, regeneration of existing data products as well as data product access and retrieval. This is all scheduled with a CSC called Execution Control.

The User Interfaces CSCI provides the capability to display all of the routine GUVI data products. Various map projections are available for the display of Level 1C and Level 2 images. Additional information such as ground track, operation sites and geomagnetic grids may be overlaid upon user request.

The Webserver Capability CSCI provides the capability to obtain GUVI data products, obtain supporting data, provide access to planning tools, display GUVI survey and status products as well as providing access to the GUVI and the TIMED Mission Data Center (MDC) catalog. The Engineering POC generated planned and as flown timelines will also be available upon user request via the Webserver Capability CSCI.

1.3 Document Overview

The purpose of this document is to establish the requirements for the testing of the GUVI DP POC. The structure of this document and the strategy for testing has been adapted principally from MIL-STD-498 (Reference 4). It contains the following information:

Section 1 Identifies the GUVI DP POC CSCIs and contains a brief overview.

Section 2 Lists applicable documents.

Section 3 Specifies the test environment that will be used in testing of the GUVI DP POC CSCIs. It includes a description of the hardware, software and personnel resources needed for installation, testing and control.

Section 4 This section identifies the formal qualification tests.

Section 5 Gives an alphabetical listing of acronyms and abbreviations used in this document.

1.4 Relationship to Other Plans

This STP is required by the Software Development Plan defined in Reference 2.

2. REFERENCED DOCUMENTS

The following documents form a part of this specification. In the event of conflict between the referenced documents and the contents of this specification, the contents of this specification supersede. If no issue date is listed, the latest revision is applicable.

Reference [1] **Software Requirements Specification for the GUVI POC**, JHU/APL 7366-9200, Feb. 1998.

Reference [2] **TIMED GUVI Data Processing POC Software Development Plan**, JHU/APL 7366-9201, Feb. 1998.

Reference [3] **Space Department Software Quality Assurance Guidelines**, SDO-9989, Sep. 1992.

Reference [4] **MIL-STD-498, Military Standard Software Development and Documentation**, AMSC No. N7069, Dec. 1994.

Reference [5] **TIMED GUVI Data Processing POC Software Design Document,** JHU/APL 7366-9204, Mar. 1998.

3. REQUIREMENTS

3.1 Software & Data Items

The software & data items required to perform the formal qualification testing and their purpose are listed in Table 1. There are no security issues because the data and software are unclassified and are not mission impact.

Software & Data Items	Purpose	Reason
Algorithms CSCI source code	Execution Control CSC, Data Reformatter CSC, Data Manager CSC, Operator Interface CSC, Utility Services CSC, Calibration Services CSC and Science Algorithms CSC implementation code	Testable
User Interface CSCI source code	User Interface CSCI implementation code	Testable
Webserver Capability CSCI source code	Webserver Capability CSCI implementation code	Testable
• GUVI Level 0 data • TIMED Spacecraft housekeeping • Solar and Geomagnetic Indices file • Orbit Number file • Current Good Telemetry Status file • Current Bad Telemetry Status file • Actual Position, Velocity, Attitude and Time file • Spacecraft Telemetry Definitions file • Aurora Coefficients • Aurora Rectification • Calibration • Day Rectification • Decompression • DITF • Geomagnetic • Midlatitude Background • Q_{euv} • ROVCDN2VCD • Statistical Aurora	Test data for input to Data Reformatter CSC	Support
• Telemetry Status Change Notification file • Support Data Status Change Notification file	Test data for input to Execution Control CSC	Support
GUVI Data Products • Level 1A data • Level 1C files • Level 2B files • Overlay files • Survey Products • Planning Tools • Data Catalog • GUVI Support Data files	Verification for Execution Control CSC Test data for input to Science Algorithms CSC Test data for input to User Interface CSCI Test data for input to Webserver Capability CSCI	Support Support Support Support

User Preferences file	Test data for input to User Interface CSCI	Support
User Interface CSCI	Test data for input to Webserver Capability CSCI. The User Interface CSCI is downloadable from the Webserver Capability CSCI.	Support
Web Interface	WWW connection	Support
Web Browser	Java version 2.0.4 compatible browser	Support

Table 1. Software Items to Support FQT

3.2 Hardware and Firmware Items

The hardware items required to perform the formal qualification testing and their purpose are listed in Table 2.

Hardware Item	Purpose
HP 9000 K460 with 4 CPUs	Platform on which Algorithms CSCI and User Interface CSCI will be tested
HP 9000 K460 with 4 CPUs	Platform on which Webserver Capabilities CSCI will be tested
2 GBytes RAM	Provide memory to process 4 orbits simultaneously
150 MBytes of free disk storage	Provide storage for source code, executables, data tables and test data for FQT
CD Jukebox	Provide storage for test data for FQT
Ethernet	Provide network link
Postscript printer	Provide hardcopy device

Table 2. Hardware Items to Support FQT

3.3 Installation, Testing and Control

The GUVI team will hold a dry run on the GUVI Data Processing POC development system prior to delivery to validate the FQT procedure. GUVI Integration & Test (I&T) personnel will install the three CSCIs and create executable modules which will be tested by DP POC personnel in coordination with I&T personnel according to this STP. The GUVI I&T team is responsible for maintenance of the test environment.

4. FORMAL QUALIFICATION TEST IDENTIFICATION

4.1 ALGORITHMS CSCI

The following sections describe the scope of formal testing for the Algorithms CSCI. All problems uncovered will be reported on problem reports.

4.1.1 Test Levels

FQT of the Algorithms CSCI will be accomplished at the:

- System level to evaluate conformance to system performance requirements
- CSCI to CSCI level to evaluate conformance to CSCI requirements and to evaluate compliance with external interface requirements within the DP POC
- CSCI level to validate output

4.1.2 Test Classes

The following classes of tests will be performed during FQT for the Algorithms CSCI:

- Expected value testing: values from the expected classes of the input domain will be used to test nominal performance
- Simulated data: simulated data for nominal and extreme geophysical conditions will be used to support error detection, recovery and reporting
- Erroneous input: sample values known to be erroneous will be used to test error detection, recovery and reporting
- Stress testing: maximum capacity of the input domain, including concurrent execution of multiple processes will be used to test external interfaces, error handling and size and execution time
- Timing testing: wall clock time, CPU time and I/O time will be recorded
- Desk check testing: both code and output will be manually inspected and analyzed

4.1.3 General Test Requirements

The following general requirements apply to the formal qualification tests of Algorithms CSCI:

- External interfaces will be validated
- Error detection, error recovery and error reporting will be tested
- Testing will be performed using nominal, extreme and erroneous data
- Size and execution time will be measured

4.1.4 General Test Conditions

The following subparagraphs identify and describe each formal qualification test to be conducted on the Algorithms CSCI. Test personnel must have dedicated use of the HP 9000 K460 workstation during performance of these tests. In addition, test personnel must have limited access to the TIMED Mission Data Center.

4.1.4.1 External Interfaces Test

The purpose of this test is to ensure that the requirements for handling external interfaces by the Algorithms CSCI are satisfied and that these interfaces function as designed.

a) Special Requirements: None

b) Test Level: System level and CSCI to CSCI level

c) Test Class: Expected value, simulated data, erroneous input, data validation

d) Qualification Method: Demonstration, inspection

e) SRS Reference: 3.2.3, 3.2.4, 3.3.1, 3.3.3, 3.3.5, 3.4.1

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of comparisons of output files with the baseline.

4.1.4.2 Error Handling Test

The purpose of this test is to ensure that the requirements for error handling and reporting are satisfied.

a) Special Requirements: None

b) Test Level: System level, CSCI level and CSU level

c) Test Class: Expected value, simulated data, erroneous input, stress, data validation and desk check

d) Qualification Method: Demonstration, inspection

e) SRS Reference: 3.2.3, 3.2.4

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output logs and code.

4.1.4.3 Execution Time Test

The purpose of this test is to ensure that the requirements for timing are satisfied.

a) Special Requirements: None

b) Test Level: System level and CSCI level

c) Test Class: Stress, timing

d) Qualification Method: Demonstration, inspection

e) SRS Reference: 3.2.3, 3.2.4, 3.3.1

f) Type of Data Recorded: Observed behavior during demonstration, inspection of output logs containing verification of wall clock times and completion status.

4.1.4.4 Sizing Test

The purpose of this test is to ensure that the requirements for executable processes and output are satisfied.

a) Special Requirements: None

b) Test Level: System level, CSCI level and CSU level

c) Test Class: Stress

d) Qualification Method: Demonstration, inspection

e) SRS Reference: 3.2.3, 3.2.4

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output logs and code.

4.2 USER INTERFACE CSCI

The following sections describe the scope of testing for the User Interface CSCI.

4.2.1 Test Levels

FQT of the User Interface CSCI will be accomplished at the:

- System level to evaluate conformance to system performance requirements
- CSCI to CSCI level to evaluate conformance to CSCI requirements and to evaluate compliance with external interface requirements within the DP POC
- CSCI level to validate output

4.2.2 Test Classes

The following classes of tests will be performed during FQT for the User Interface CSCI:

- Expected value testing: values from the expected classes of the input domain will be used to test nominal performance
- Boundary value testing: values from the boundaries of the input domain and derived test cases from the output domain will be used to perform testing of extreme input and to support error detection, recovery and reporting
- Erroneous input: values known to be erroneous will be used to test error detection, recovery and reporting
- Stress testing: maximum capacity of the input domain will be used to test external interfaces, error handling and size and execution time
- Data validation testing: output data will be validated by comparison with a baseline and by acceptable results
- Desk check testing: both code and output will be manually inspected and analyzed

4.2.3 General Test Requirements

The following general requirements apply to the formal qualification tests of the User Interface CSCI:

- External interfaces will be validated
- Error detection, error recovery and error reporting will be tested
- Testing will be performed using nominal, extreme and erroneous data
- Testing will be performed on the human interface
- Size will be measured

4.2.4 General Test Conditions

The following subparagraphs identify and describe each formal qualification test to be conducted on the User Interface CSCI. Test personnel must have the dedicated use of a computer installed with a Java enabled browser supporting Java 2.0.4 and access to the Internet during the performance of these tests.

4.2.4.1 External Interfaces Test

The purpose of this test is to ensure that the requirements for handling external interfaces by the User Interface CSCI are satisfied and that these interfaces function as designed.

a) Special Requirements: None

b) Test Level: System level and CSCI to CSCI level

c) Test Class: Expected value, erroneous input, stress, output validation and desk check

d) Qualification Method: Demonstration, inspection

e) SRS Reference: 3.2.4, 3.3.3

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output

4.2.4.2 Error Handling Test

The purpose of this test is to ensure that the requirements for error handling and reporting are satisfied.

a) Special Requirements: None

b) Test Level: System level and CSCI level

c) Test Class: Erroneous input, stress, data validation and desk check

d) Qualification Method: Demonstration, inspection

e) SRS Reference: 3.2.4, 3.3.3

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output

4.2.4.3 Human Interface Test

The purpose of this test is to ensure that the requirements for input from the user and output to the user are satisfied in the absence of error conditions.

a) Special Requirements: None

b) Test Level: System level, CSCI level and CSU level

c) Test Class: Expected value and desk check

d) Qualification Method: Demonstration, inspection, output validation

e) SRS Reference: 3.2.4, 3.3.3

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output

4.2.4.4 Sizing Test

The purpose of this test is to ensure that the requirements for executable processes and output are satisfied.

a) Special Requirements: None

b) Test Level: System level, CSCI level and CSU level

c) Test Class: Stress

d) Qualification Method: Demonstration, inspection

e) SRS Reference: 3.2.4, 3.3.3

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output logs and code.

4.3 WEBSERVER CAPABILITY CSCI

The following sections describe the scope of testing for the Webserver Capability CSCI.

4.3.1 Test Levels

FQT of the Webserver Capability CSCI will be accomplished at the:

- System level to evaluate conformance to system performance requirements
- CSCI to CSCI level to evaluate conformance to CSCI requirements and to evaluate compliance with external interface requirements within the DP POC
- CSCI level to validate output

4.3.2 Test Classes

The following classes of tests will be performed during FQT for the Webserver Capability CSCI:

- Expected value testing: values from the expected classes of the input domain will be used to test nominal performance

4.3.3 General Test Requirements

The following general requirements apply to the formal qualification tests of the Webserver Capability CSCI:

- External interfaces will be validated
- Testing will be performed on the human interface
- Size will be measured

4.3.4 General Test Conditions

The following subparagraphs identify and describe each formal qualification test to be conducted on the Webserver Capability CSCI. Test personnel must have the dedicated use of a computer with a WWW connection, a Java capable browser supporting Java 2.0.4 and access to the Internet during the performance of these tests.

4.3.4.1 External Interfaces Test

The purpose of this test is to ensure that the requirements for handling external interfaces by the User Interface CSCI are satisfied and that these interfaces function as designed.

a)	Special Requirements:	None
b)	Test Level:	System level and CSCI to CSCI level
c)	Test Class:	Expected value, erroneous input, stress, output validation and desk check
d)	Qualification Method:	Demonstration, inspection
e)	SRS Reference:	3.2.4, 3.3.3
f)	Type of Data Recorded:	Observed behavior during demonstration and results of inspection of output

4.3.4.2 Error Handling Test

The purpose of this test is to ensure that the requirements for error handling and reporting are satisfied.

a)	Special Requirements:	None
b)	Test Level:	System level and CSCI level
c)	Test Class:	Erroneous input, stress, data validation and desk check
d)	Qualification Method:	Demonstration, inspection
e)	SRS Reference:	3.2.4, 3.3.3

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output

4.3.4.3 Human Interface Test

The purpose of this test is to ensure that the requirements for input from the user and output to the user are satisfied in the absence of error conditions.

a) Special Requirements: None

b) Test Level: System level, CSCI level and CSU level

c) Test Class: Expected value and desk check

d) Qualification Method: Demonstration, inspection, output validation

e) SRS Reference: 3.2.4, 3.3.3

f) Type of Data Recorded: Observed behavior during demonstration and results of inspection of output

5. NOTES

5.1 ACRONYMS AND ABBREVIATIONS

CDR	Critical Design Review
CPI	Computational Physics, Inc.
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CSR	Consent to Ship Review
CSU	Computer Software Unit
DID	Data Item Description
DITF	(Dayside) Discrete Inverse Theory Function
DP	Data Processing
EDP	Electron Density Profile
EDPP	EDP Parameters (i.e. TEC)
EUV	Extreme Ultraviolet
FQT	Formal Qualification Test
FUV	Far Ultraviolet
GSE	Ground Support Equipment
GUVI	Global Ultraviolet Imager
I&T	Integration & Test
I/O	Input/Output
JHU/APL	Johns Hopkins University/Applied Physics Lab
K-12	Kindergarten through Secondary Education
MDC	(TIMED) Mission Data Center
MOC	(TIMED) Mission Operations Center
MO/DA	Mission Operations/Data Acquisition
PDR	Preliminary Design Review
POC	Payload Operations Center
ROVCDN2VCD	Ratio of O vertical column density to N_2 vertical column density
SDD	Software Design Document
SDP	Software Development Plan
SPDR	Software PDR
SRS	Software Requirements Specification
SSUSI	Special Sensor Ultraviolet Spectrographic Imager
STP	Software Test Plan
TBD	To Be Determined
TIMED	Thermosphere, Ionosphere, and Mesosphere Energetics and Dynamics
URL	Uniform Resource Locator
V&V	Verification and Validation
WWW	World Wide Web

END OF GUVI STP