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EOSDIS Core System Project

Audit Reports for the ECS Project

March 1996

Hughes Information Technology Systems
Upper Marlboro, Maryland

Audit Reports for the ECS Project

March 1996

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Preface

This document is a contract deliverable with an approval code of 3. This document is delivered to NASA for information only, but is subject to approval as meeting contractual requirements.

Any questions should be addressed to:

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Abstract

This Audit Reports document contains the summary results of audits conducted by the Quality Assurance department of the ECS Contractor during the previous six months. The period of this report is from September 1995 through March 1996. Quality Assurance audits of project activities are conducted in accordance with the Description of Contractor and Subcontractor Audit Programs for the ECS Project (DID 505/PA3) in order to gauge the level of adherence to command media, and identify opportunities for improvement.

Keywords: QO, QA, Quality Office, Quality Assurance, Audit Reports

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1. Introduction

1.1 Identification

This Audit Reports Document, Contract Data Requirements List (CDRL) Item 081, whose requirements are specified in Data Item Description (DID) 506/PA3, is a required deliverable under the Earth Observing System (EOS) Data and Information System (EOSDIS) Core System (ECS) Contract (NAS5-600000).

1.2 Scope

This document describes the Adult Reports from the previous six months for the ECS Project.

1.3 Purpose and Objectives

The purpose of this document is to report on and summarize audits conducted by the Quality Office (QO) during the previous six months. The objective of this document is to inform ECS and NASA management of audit findings, recommendations, and corrective actions.

1.4 Status and Schedule

This version of the Audit Reports document is submitted to the Government in March 1996. This document will be submitted semiannually and will be maintained by the Quality Office and controlled by the ECS Data Management Office (DMO).

1.5 Organization

Section 1 describes the identification and scope of the document, the purpose and objectives, and the status and schedule.

Section 2 describes parent, applicable, and information documents that are useful in understanding the details of subjects discussed in this document.

Section 3 describes the overview and actual audit findings of the audits conducted during the period of this report.

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2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content are derived.

420-05-03	Goddard Space Flight Center, Earth Observing System (EOS) Performance Assurance Requirements for the EOSDIS Core System
423-41-01	Goddard Space Flight Center, EOSDIS Core System Statement of Work
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data Information System (EOSDIS) Core System
423-41-03	Goddard Space Flight Center, EOSDIS Core System Contract Data Requirements Document

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, this document shall take precedence.

501-CD-001-004	Performance Assurance Implementation Plan for the ECS Project
194-505-PA3-001	Description of Contractor and Subcontractor Audit Programs for the ECS Project

2.3 Information Documents

The following documents, although not directly applicable, amplify or clarify the information presented in this document, but are not binding on the content herein.

SMAP-GB-A201	NASA Software Assurance Guidebook, SMAP Working Group
SMAP-GB-A301	NASA Software Quality Assurance Audits Guidebook

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3. Audit Reports

3.1 Overview

During the period covered by this report, twelve separate audits were conducted by various Quality Office groups and individuals. These audits were completed at various times during the audit period. Upon completion of these audit reports, the conclusions were formally or informally published and forwarded to GSFC code 300 and are available for review. The results contained in this document are a summary of the results of these individual audits.

3.2 FOS/Loral Audit Reports

Six audit reports were conducted during the last six months. The results of these audits are reported in summary fashion below. Complete copies of all audits are available for review.

3.2.1 Ingest Subsystem Development Files Follow-up Audit Report

Date Conducted: October 16, 1995

The Ingest Subsystem team is in compliance with the development processes defined in the SDP. All Ingest CSC SDF information is available. The inconsistency between the established SDFs and the CSC list in the Design Specification Document could cause confusion and/or problems. Additional potential problems could exist when the government audits the ECS program because of this same inconsistency. But overall, there is a dramatic improvement for the Ingest Subsystem in this follow-up audit.

3.2.2 Ingest and Data Server Subsystems Loral Statement of Work Code Unit Test Phase Compliance Audit Report

Date Conducted: December 8, 1995

The Ingest and Data Server Subsystems generally satisfied the requirements identified in the Loral SOW. Most of the SOW requirements identified under Program Management, Segment/Element Development, Segment/Element Reviews, Test and Evaluation, Performance Assurance, and M&O were being satisfied or were included in planning for future Code and Unit Test Phase activities.

3.2.3 Data Server Subsystem Software Development Files Follow-up Audit Report

Date Conducted: January 15, 1996

All Data Server Subsystem SDFs had been created. Schedules were available for all CSCs being developed for Release A Phase 1. Requirements were included in all Phase 1 developed software

CSC SDFs and in some of the CSC SDFs planned for development in phase(s) 2 and/or 3. Inclusion of design data in the SDFs had increased eighty percent from the previous audits. Thirty-three percent more of the SDFs contained or referenced some form of inspection notes. And finally, all Phase 1 developed software had completed test plans included in their respective SDFs. Unit tests had been performed on seventy eight percent of the Phase 1 software at the time of this audit. Overall, this audit indicated a tremendous improvement for the Data Server Subsystem SDFs.

3.2.4 FOS Detailed Design SDF Audit Report

Date Conducted: March, 1995 through October, 1995

The FOS Detailed Design SDF Audit Report summarizes the results of the informal SDF audits conducted during the FOS Detailed Design Phase. A matrix is included in the report which identifies each SDF, its responsible engineer(s), and the last date that a specific SDF was audited or reaudited. Specific SDF audit checklists can be found in each SDF or in Loral QA's FOS SDF Audit Log. All SDFs audited for the detailed design phase were noted as generally compliant with the ECS SDF Project Instruction (PI).

3.2.5 FOS Loral SOW Compliance Audit

Date Conducted: January 15, 1996

The FOS Loral SOW Compliance Audit was conducted to determine if the Flight Operations System (FOS) program was complying with the current draft version of the Loral Statement of Work (SOW) dated September 20, 1995. This version contains updates to the SOW based on Change Order 2. The objective for the audit was to assure that Loral/FOS has adequately planned the coding and unit testing activities within FOS to accomplish the tasks identified in the Loral SOW.

FOS is generally satisfying the requirements identified in the Loral SOW for the code and unit test phase. Most of the SOW requirements identified and audited under Program Management, Segment/Element Development, Test and Evaluation, Performance Assurance, and Maintenance and Operations are being satisfied or plan to be satisfied.

3.2.6 FOS Code and Unit Test Phase In-Process Audit

Date Conducted: January 22, 1996

The FOS Code and Unit Test Phase In-Process Audit was conducted to determine what process(es) FOS was following in developing and reviewing its code and unit tests and to identify deficiencies in these processes. The FOS Release and Development Plan (DID 307/DV2 and 329/DV2)and the ECS Software Development Plan (SDP) (DID 308/DV2) dated July 1995 and its associated Project Instructions (PIs) were referenced during this audit.

FOS uses a disciplined software development approach that is a tailored version of the ECS approved software development process. Where processes have not been sufficiently defined, FOS has supplemented the ECS process documentation with additional, more detailed process

documentation and distributed it to the FOS developers. FOS submitted an enhanced version of the FOS C++ Coding Standards PI (SD-1-010) to the ECS Software Engineering Process Group (SEPG) for evaluation in February, 1996.

SDFs are updated prior to the code and unit test inspection and after the unit test is conducted. Prior to the code inspection, the developer is required to update the associated SDF and document this on the associated code inspection pre checklist. QA reviews this checklist to ensure that the SDF is updated prior to the code inspection. After the unit test for a component has been conducted, the component's SDF is audited by Loral QA against the format specified in the Software Development File PI (SD-1-005). This audit is conducted to ensure that the SDF has been updated to contain all associated code and unit test documentation, to ensure that previously developed documentation has been updated based on code and unit test phase decisions. Milestone dependent QA reviews and audits of the SDFs (vs. periodic audits) help to ensure that the SDFs are habitually updated and are used by the developers.

3.3 Release A Audits

3.3.1 Release A Software Development Files (SDFs) In-Process Baseline Audit Internal Audit Report (IAR)

Date Conducted: October 30, 1995 through December 7, 1995.

The audit results consist of the completed SDF Audit Checklist with discrepancies noted. The checklist was developed using the DRAFT PI SD-1-005, Software Development Files, dated June 30, 1995. In general, all SDFs were established for the four subsystems. A total of thirty-four SDFs were audited. An index listing of all Configuration Software Units (CSUs) which make up the CSC should be included in the front of the binder. The majority of the pertinent information was found within the binders, some was found on-line, and a few provided references to other documentation.

Of the thirty-four SDFs established, thirty-one were used as statistics for this audit. Two SDFs (DB Generic Tools – PDPS and CSS Thread Tool – CSS) were established to support generic tools developed by the subsystems for reuse among the subsystem. The third SDF, Universal References, was established to document pertinent information for this common tool to be used by the ECS. Below is a brief summary of the results of the SDF audit by subsystem and QO recommendations for improvements.

MSS – Total SDFs: 10

CSS – Total SDFs: 8

PDPS – Total SDFs: 10

CIDM – Total SDFs: 3

Conclusions:

While planned schedules were in place, no actual schedules were supplied. All SDFs included functional and/or operational requirements. Approximately half the note books contained L4 requirements and 75% contained mappings to RBRs. All but four of the notebooks contained appropriate design data and 70% contained results of inspections. All of the notebooks contained the source code listings. Only one notebook was deficient in the Test Plan and Procedures area and 80% of those that should have included problem reports, did so.

Recommendations for this audit for all subsystems are to:

a. Developers should become very familiar with PI SD-1-005, Software Development Files. In some cases, the information was found in the SDF but was not filed in the appropriate section.

b. Maximize the use of RTM. For 71% of the SDFs, RTM was not used by the subsystems to capture the requirements.

c. Review the roles and responsibilities defined in PI SD-1-004, Software Inspections Process. As stated in the PI (see verification section on the Inspection Meeting Form (IMF)), the IMFs must be signed and verified by the inspection leader to ensure that all errors and/or action items were corrected/resolved.

d. For the CSCs that supported Evaluation Packages (EPs), provide reference to the appropriate EP documentation in the Design Support Data section of the SDF.

A series of follow-up audits will be conducted to verify the implementation of the corrections of the discrepancies documented as a result of this audit. The SDFs will be re-audited for verification. These audits will begin March 1, 1996.

3.3.2 RTM In-Process Follow-up Audit

Date conducted: December 22, 1995

A formal in-process follow-up audit of the RTM was conducted December 22, 1995. This audit is in response to the RTM In-process Audit of June 1995. The intent of the audit was to verify completion of updated corrective action plans. The verification of the completed corrective action plans was conducted from January 10, 1995 through February 22, 1996.

In summary, 9/11 (81%) actions were verified and closed by ECS QA. The remaining two open actions are: RTM population and documenting of RTM training provided by the project. Verification and Validation records consist of: RTM Database Standards and Procedures Project Instruction (PI) SE-1-004, dated 20 December 1995; RTM Database Standards and Procedures Project Instruction (PI) SE-1-004, dated 1 February 1996; ECS Data Handling System (EDHS), RTM tool – January 26, 1996 Baseline; and various RTM CCRs.

The recommendations for this follow-up audit are to: write CCRs to correct the discrepancies found, check for orphans monthly until all requirements are mapped and appear to be stable in RTM, and document the RTM Training provided by the project in the RTM Project Instruction (PI) or the appropriate PI.

A series of follow-up audits will be conducted to verify the implementation of the corrective action plans generated as a result of this audit. Verification will consist of but not limited to: orphan requirements mapped to RBRs, L4s, and system and acceptance tests and population of the NASA Science Internet (NSI) IRD requirements. These audits will verify that all changes to RTM are made via the CCR process. Verification of the test classes population and linkage will be scheduled once the test classes are placed under configuration control.

3.4 Ir1 Audits

3.4.1 Ir1 Software Development Notebook Audit

Date Conducted: February 22, 1996

The formal post development audit of the Ir1 Software Development Notebooks (SDNs) was conducted in the following Ir1 development subsystems: PDPS, Toolkit, Ingest, and CSS. The audit focused on verifying: (1) the establishment of the SDNs, and (2) that the contents of the SDNs were in compliance with Appendix A of ECS PI CM-1-025 (Software Development Handbook). The actual audit time was approximately thirty hours, which includes checklist completion, analysis/follow-up, and documenting the final results.

Specific results are summarized by Subsystem:

PDPS Toolkit: – Total SDNs: 12

Requirements: Only six of the twelve notebooks audited had L4 requirements mapping to RBRs/objects. Those included were obtained from DIDs 304 and 305. Eight out of twelve had acceptable Functional requirements.

Design Data: Most of the SDNs audited (8 of 12) included contained Design presentation data.

Code Inspection Notes: Twelve of twelve SDNs had Code Inspection data. All of these did have copies of the actual inspection form which were used, including defect list and attendees. However, only one IMF was signed off by the inspection leader verifying that all errors and/or action items were corrected/resolved.

Test Information: Test data provided was sporadic. Sometimes (5 of 12) test plans/procedures were included. Seven of the twelve did include Unit test results or Defect Reports.

CSS: – Total SDNs: 3

Requirements: L4 requirements mapping to RBRs/objects was included in al three SDNs.

Design Data: One of the SDNs provided contained little or no design data. The other two contained standard Design Inspection slides.

Code Inspection Notes: Code inspection information was provided in only one of the SDNs. The one SDN which did have inspection data did not have the forms; only copies of the code which was reviewed, with edits/notes written on the copies.

Test Information: One of the SDNs audited contain no test information; procedures, plans, or results. The other two contained Unit Test procedures, plans, and results.

Ingest: – Total SDNs: 1

Requirements: L4 requirements mapping to RBRs/objects was included.

Design Data: Very sufficient design data was found, including an object model.

Code Inspection Notes: Code inspection information was provided, including found defects and action items. Indications as t whether each item was completed was also provided.

Test Information: Test procedures and a test plan were found. Logs and (data used) of the conducted tests were also provided.

None of the Notebooks audited contained schedule information. The inclusion of L4 Requirements mappings was found to be inconsistent. The inclusion of Design data (in this case Design Review presentations) was found to be inconsistent. The inclusion of Code Inspection documents was found to be spotty, at best. Source code was found in each SDN. Test documents were generally found; although the desired Unit Test plans, procedures, and results were not always found.

In summary, recommendations for this audit for all subsystems are to:

a. Increase familiarization with Appendix A of ECS PI CM-1-025 (Software Development Handbook). In some cases, the information was found in the SDN but was complete as described within the PI. (See individual checklists for specifics.)

b. Dispense the SDN Audit checklist which was used here to each development lead for their use in monitoring the contents of the SDNs used by their respective developers. Each lead additionally provide the Checklist to the developers so that the developers could have it for their own guidance regarding the SDN contents.

c. Require Data Dictionary information. Standard procedures regarding coding using OO Design stress the importance of a Data Dictionary. Although the inclusion of a Data Dictionary is not indicated within the PI, it is recommended that it is used by each developer working on OO code, and placed in each SDN. The changes to the PI will be recommended through the appropriate channels.

d. Direct each developer to obtain a development schedule regarding his code. Each developer should be provided with 4a development schedule.

3.5 Ir1 Site Audits

Three DAAC site audits were conducted at: Goddard Space Flight Center DAAC system installed in Room S131A, Building 32; Ir1 Eros Data Center DAAC system installed in the Mundt Federal Building, Sioux Falls, South Dakota; and, LaRC DAAC system, Room 2215, Building 1268, NASA Langley, Hampton, Virginia. These were essentially Physical Configuration Audits where the installed equipment and the installed COTS software were audited against the Ir1 Installation Plan for the ECS Project (800-TP-001-001) and the updated inventory list. The developed software was audited against the master tar file listing maintained by configuration management and the Interim Release One (Ir1) Installation and Build Procedures for the ECS Project (xxx-RD-004-001). Developed software was installed on the Ir1 servers using the 16 tar files supplied by Configuration Management. The size, and date and time of creation of these tar files were verified against the master tar files maintained by CM. Then for each DAAC server, the existence of the required directories created during the untaring process and specified in the Installation and Build Procedures and the CM Master File List documents was verified. The builds were verified in the following order: SSIT, PDPS, MSS, Ingest, Toolkit, DSS/CSS/Gateway. For completeness, the entire file listing of 466 files from one tar file (HDF3.3r4.tar.Z) was verified against the CM Master List. Additionally, COTS software printouts were obtained from HTSC personnel for each terminal, and these printouts were used to provide information on what COTS software had been placed on each machine. (*Note: the configuration at each DAAC varied, therefore not every tar file was supplied at each site) Verification of authentic CM-supplied software being installed at a particular site required ensuring that the specific tar files which were installed at a specific site were obtained from CM. This was done by verifying tar file sizes, creation dates, and randomly verifying a sample of the contents of selected files.

3.5.1 A Goddard Space Flight Center DAAC Configuration Audit

Date Conducted: January 16-17, 1996

The configuration of the DAAC hardware and software conformed to the specifications details in the above referenced documents except as noted below.

a. The serial numbers for the monitor on ICL1, was found to be slightly different than indicated than indicated. 2140093 was indicated, while 2440093 was found. This discrepancy will be forwarded to HTSC.

b. The serial numbers for one of the RAID Enclosures, SPR1SGIGSFC, was found to be slightly different than indicated than indicated. 9620692 was indicated, while 9620696 was found. This discrepancy will be forwarded to HTSC.

c. Media was found for the Microsoft products with Ir1, but documentation for those products was not found. This discrepancy will be forwarded to HTSC.

3.5.2 Eros Data Center DAAC Configuration Audit

Date Conducted: January 24-25, 1996

The configuration of the DAAC hardware and software conformed to the specifications details in the above referenced documents except as noted below.

a. A laser printer, MSS3, was not found, although it is indicated on the spreadsheet audited against. This discrepancy will be forwarded to HTSC.

b. The serial number for the terminal for the Power Challenge, SPR1SGIEDCS, was found to be slightly different than indicated than indicated. 701c15103856 was indicated, while 01c151038658 was found. This discrepancy will be forwarded to HTSC.

c. The serial number for the same terminal's Tape Stacker was also different. 110c3403 was indicated, while 11003403 was found. This discrepancy will be forwarded to HTSC.

d. Media was found for the Microsoft products with Ir1, but documentation for those products was not found. A NCR was entered for replacement documentation.

3.5.3 Largely DAAC Configuration Audit

Date Conducted: January 18-19, 1996

The configuration of the DAAC hardware and software conformed to the specifications details in the above referenced documents except as noted below.

a. There is a slight variance in the floor layout of the equipment from floor plan specified in Figure B.5-1 of the Ir1 Installation Plan for the ECS Project. This is due to the fact that the room designated for the final DAAC hardware installation is under construction and was not ready. The equipment is temporarily set up in an alternative location in building 1268.

b. The inventory list indicated that Sun SPARC workstation, ser. # 524F04E6 should have 128 Megabytes of RAM installed. Only 96 Megabytes of RAM was actually installed. Upon investigation it was determined that the error was in the inventory list. That server is scheduled to be upgraded at Release A with an additional 32 Megabytes of RAM memory.

3.6 ECS CM In-Process Audit

Date Conducted: February 12-29, 1996

A Configuration Management in-process follow-up audit was conducted to follow-up on the findings of the baseline audit which was conducted on October 24, 1994. It was conducted to ensure compliance with the CM procedures, serve as a way to identify opportunities for process improvements and to identify areas where failures can be corrected before it impacts the system and/or the customer. Observations and Recommendations from this audit are:

a. The CM Plan has been updated; 11/95.

b. The CCRs are stored in a file cabinet numerically and locked every night. The CCB minutes are easily assessable and complete.

c. CM personnel have identified additional PIs that are needed; currently in Draft form.

d. The CM procedures should be updated, specifically Project Instructions (PIs).

e. Concern was expressed that there are activities being done that are not publicized to the project community. Recommend a way of disseminating this information.

f. The attendance at the CCB meetings by some organizations/offices is lacking.

g. Some CCB meetings seem to be more of a technical discussion rather than an approval/disapproval meeting increasing the duration of the meeting. This issue has improved recently.

h. The review time for some CCRs is inadequate, but is improving overall.

i. The procedures document and PI 1-CM-009 state that there will be "CM self-audits." These audits have not been performed to date but the CM organization is aware of the requirement and plan to schedule an audit in the near future.

j. Continue to monitor attendance at the start and end of each CCB meeting.

k. Rejuvenate the internal CM Working Group meetings with Release A, Release B, FOS, and EDF.

Conclusion

The in-process audit was successful and provided an opportunity to:

a. Measure actual progress.

b. Establish implementation action plans to ensure continuous quality improvements.

c. Make employees accountable for their specific quality responsibilities.

d. Prepare for future.

Quality Assurance Follow-up Activities

At the Debrief meeting, it was recommended that the Quality Office (QO) conduct the following audits:

a. EDF, Release B, FOS, Release A CCBs

b. Post Ir1 delivery

The Quality Office will schedule the above audits in conjunction with the overall audit plan.

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Abbreviations and Acronyms

CCB	Change Control Board
CCR	commitment, concurrency, and recovery (protocol) configuration change request
CDR	Critical Design Review
CDRD	Contract Data Requirements Document
CDRL	Contract Data Requirements List
CM	configuration management
CSC	computer software component
DAAC	distributed active archive center
DADS	data archive and distribution system
DID	data item description
DMO	data management organization
ECS	EOSDIS Core System
EDF	ECS development facility
EDHS	ECS Data Handling System
EOSDIS	Earth Observing System Data and Information System
FOS	Flight Operations Segment (ECS)
GSFC	Goddard Space Flight Center
IAR	Independent Architecture Review
IMF	Inspection Meeting Form
IRD	interface requirements document
L4	Level 4
M&O	maintenance and operations
NASA	National Aeronautics and Space Administration
PI	project instruction
QA	quality assurance
QO	quality office

RAID	redundant array of inexpensive disks
RTM	Requirements and Traceability Management
RBRs	Requirements by Release
SDF	Software Development Files
SDN	Software Developmnent Notebooks
SDPS	Science Data Processing Segment (ECS)
SEPG	Software Engineering Process Group
SOW	statement of work
TRMM	Tropical Rainfall Measuring Mission (joint US-Japan)
WBS	work breakdown structure