AD NUMBER

ADB010434

LIMITATION CHANGES

TO:

Approved for public release; distribution is unlimited.

FROM:

Distribution authorized to U.S. Gov't. agencies only; Test and Evaluation; 17 MAR 1976. Other requests shall be referred to Air Force Air Weather Service, CSE, Scott AFB, IL 62225.

AUTHORITY

aws, usaf ltr dtd 8 jul 1976

(18) SAMSO-TR-76-91 (19)

DC-TM-(L)-5613/008/01

(6) AIR FORCE GLOBAL WEATHER CENTRAL SYSTEM ARCHITECTURE STUDY.

FINAL SYSTEM/SUBSYSTEM SUMMARY REPORT.

VOLUME 8 ✓

SYSTEM SPECIFICATION.

SYSTEM DEVELOPMENT CORPORATION ✓
2500 Colorado Avenue
Santa Monica, California 90406

(11) 1 Mar[redacted]76 (12) 196p.

(9) Final Report. [redacted] 1 Feb[redacted]75 — 1 Mar[redacted]76.

Distribution Statement

Distribution limited to U.S. Government Agencies only. Other requests for this document must be referred to Air Weather Service/CSE, Scott Air Force Base, Illinois, 62225.

T&E 17 MAR 1976

(15) F04701-75-C-0114

Prepared for:

DEPUTY FOR DEFENSE METEOROLOGICAL SATELLITE PROGRAM OFFICE
H.Q. SPACE & MISSILE SYSTEMS ORGANIZATION
AIR FORCE SYSTEMS COMMAND
LOS ANGELES, CALIFORNIA 90009

339 900

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: TM-(L)-5613/008/01

2. GOVT ACCESSION NO.:

3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): AIR FORCE GLOBAL WEATHER CENTRAL SYSTEM ARCHITECTURE STUDY, FINAL SYSTEM/SUBSYSTEM SUMMARY REPORT, VOLUME 8 - System Specification

5. TYPE OF REPORT & PERIOD COVERED: Final Report for Period 1 Feb 1975 - 1 Mar 1976

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s):

8. CONTRACT OR GRANT NUMBER(s): F04701-75-C-0114 ✓

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
SYSTEM DEVELOPMENT CORPORATION
2500 Colorado Avenue
Santa Monica, California 90406

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: PE351670F

11. CONTROLLING OFFICE NAME AND ADDRESS:
DEPUTY FOR DEFENSE METEOROLOGICAL SATELLITE PROGRAM OFFICE
HQ SPACE & MISSILE SYSTEMS ORGANIZATION/YDA
LOS ANGELES, CALIFORNIA 90009

12. REPORT DATE: 1 March 1976

13. NUMBER OF PAGES: 193 (this volume)

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)
Distribution limited to U.S. Government Agencies only. Other requests for this document must be referred to Air Weather Service/CSE, Scott Air Force Base, Illinois, 62225.

T&E 17 MAR 1976

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
data system
computer system
computer architecture
weather data processing
Air Force Global Weather Central
meteorological data processing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This document has been prepared in partial fulfillment of CDRL line item A004 of System Development Corporation's Air Force Global Weather Central System Architecture Study contract. Efforts for this report were expended under Task 6, "Conceptual Design and Development Plan", performed under contract F04701-75-C-0114 for SAMSO, under the direction of Col. R. J. Fox, YDA.

The purpose of this study has been to optimize the entire AFGWC data process-

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ing system from the vantage point of current and future support requirements, addressing the AFGWC data processing system over the 1977 through 1982 time frame. This study was performed under a unique plan which allows complete traceability between user requirements, Air Force Global Weather Central operational functions, requirements levied upon the data system, a proposed component configuration which meets the data system requirements, and a system specification designed to acquire a system which meets these requirements.

The resultant system described has a number of unique features, including total hardware authentication separation of security levels, load leveling accomplished by assigning main processors in accordance with a dynamic priority queue of tasks, and a system-wide network control capability. Other key features include a central data base processor to fill requests for data from other processors, computer operations centers, the use of array processors for accomplishing difficult numerical problems, and sophisticated forecaster console support. These elements have been designed to provide 99.5% reliability in meeting user requirements.

The proposed system architecture consists of five dual processors each of which is about 3.5 times as powerful as an existing AFGWC processor (a Univac 1108). Each dual processor has an array processor which will be capable of very high performance on vector arithmetic. The array processors are used to assist on the difficult numerical problems, including the Advanced Prediction Model for the global atmosphere, as well as very fine grid cloud models and cloud probability models. Some of the new requirements that will be supported with this system are a one minute response to query interface, reentry support for Minuteman, and limited processing of high resolution (0.3 nautical mile) meteorological satellite data. In addition, cloud cover prediction for tactical weapon systems, ionospheric prediction for radio frequency management, and defense radar interference prediction will be supported by this system.

Volumes of this final System/Subsystem Summary Report are as follows:

Volume 1 - Executive Summary

Volume 2 - Requirements Compilation and Analysis (Parts 1, 2, and 3)

Volume 3 - Classified Requirements Topics (Secret)

Volume 4 - Systems Analysis and Trade Studies

Volume 5 - System Description

Volume 6 - Aerospace Ground Equipment Plan

Volume 7 - Implementation and Development Plans

Volume 8 - System Specification

System Development Corporation

AIR FORCE GLOBAL WEATHER CENTRAL

SYSTEM ARCHITECTURE STUDY

FINAL SYSTEM/SUBSYSTEM SUMMARY REPORT

VOLUME 8

SYSTEM SPECIFICATION

1 MARCH 1976

TM-(L)-5613/008/01

ABSTRACT

This document has been prepared in partial fulfillment of CDRL line item A004 of System Development Corporation's Air Force Global Weather Central System Architecture Study contract. Efforts for this report were expended under Task 6, "Conceptual Design and Development Plan", performed under contract F04701-75-C-0114 for SAMSO, under the direction of Col. R. J. Fox, YDA.

The purpose of this study has been to optimize the entire AFGWC data processing system from the vantage point of current and future support requirements, addressing the AFGWC data processing system over the 1977 through 1982 time frame. This study was performed under a unique plan which allows complete traceability between user requirements, Air Force Global Weather Central operational functions, requirements levied upon the data system, a proposed component configuration which meets the data system requirements and a system specification designed to acquire a system which meets these requirements.

The resultant system described has a number of unique features, including total hardware authentication separation of security levels, load leveling accomplished by assigning main processors in accordance with a dynamic priority queue of tasks, and a system-wide network control capability. Other key features include a central data base processor to fill requests for data from other processors, computer operations centers, the use of array processors for accomplishing difficult numerical problems, and sophisticated forecaster console support. These elements have been designed to provide 99.5% reliability in meeting user requirements.

The proposed system architecture consists of five dual processors each of which is about 3.5 times as powerful as an existing AFGWC processor (a Univac 1108). Each dual processor has an array processor which will be capable of very high performance on vector arithmetic. The array processors are used to assist on the difficult numerical problems; including the Advanced Prediction Model for the

global atmosphere, as well as very fine grid cloud models and cloud probability models. Some of the new requirements that will be supported with this system are a one minute response to query interface, reentry support for Minuteman, and limited processing of high resolution (0.3 nautical mile) meteorological satellite data. In addition, cloud cover prediction for tactical weapon systems, ionospheric prediction for radio frequency management, and defense radar interference prediction will be supported by this system.

Volumes of this final System/Subsystem Summary Report are as follows:

Volume 1 - Executive Summary
Volume 2 - Requirements Compilation and Analysis (Parts 1, 2, and 3)
Volume 3 - Classified Requirements Topics (Secret)
Volume 4 - Systems Analysis and Trade Studies
Volume 5 - System Description
Volume 6 - Aerospace Ground Equipment Plan
Volume 7 - Implementation and Development Plans
Volume 8 - System Specification

This volume contains a total system specification compatible with MIL-STD-490 and also compatible with the architectural domain of the study for total study traceability. Procurement strategy and functions are obviously government responsibilities, but they are addressed through the architectural domain topics of Management and Personnel.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

RELATIONSHIP OF VOLUME STRUCTURE TO DOMAINS

This document has been structured according to the basic format guidelines for system specifications as outlined in MIL-STD-490, "Specification Practices." Within this overall format, direct traceability to the architecture and characteristic domains has been established.

Specifications relating to architectural domain categories A10, "Data Storage," through A60, "Data Input/Display," appear in Sections 3.7.1 through 3.7.6, respectively. Within the subsections of these sections, specifications are directly referenced to subcategories of the architectural domain by the appropriate domain number; e.g., the specifications in paragraph 3.7.1.1.1, "Support Disk," are numbered A111-1 through A111-5. Similarly, personnel specifications in Section 3.6 are numbered under the A70 series. Management-related specifications are found in Section 3.1.7.1 (which covers A81, "Control," and A82, "Operations") and Section 3.5 (which encompasses A83, "Logistics," through A86, "Maintenance"), with all of the included specifications indexed to the appropriate level of the architectural domain. In this same manner, facility-related specifications are keyed to the A90 category under Section 3.5.6.

Specifications pertaining to overall data system characteristics, such as growth, maintainability, etc., are found in Section 3.2., "Characteristics." The items listed in this section are keyed to the corresponding categories of the characteristics domain. General characteristics are prefixed with G00, and appear in Sections 3.2.1, "Performance Characteristics," and 3.2.2, "Physical Characteristics." More specific areas are prefixed with G10 ("Growth") through G80 ("Miscellaneous") in the remainder of Section 3.2.

APPLICABLE DOMAIN VS. PARAGRAPH VS. PAGE NUMBER

VOLUME/DOMAIN RELATIONSHIPS

SPECIFICATIONS	TRADE STUDY NUMBERS
A111-(1-9)	A10-1, A11-3, A52-3
A112-(1-9)	A10-1
A113-(1-5)	A10-1, A10-4, A11-5, A13-2, A44-5
A114-1	A10-1, A10-4, A10-5, A13-3
A115-(1-3)	A10-1, A10-4, A13-2, A13-4, A13-5, A13-6
A116-(1-7)	A10-4, A11-8
A117-(1-22)	A10-1, A10-2, A10-4, A11-6, A11-8
A118-(1-6)	A10-3
A121-(1-3)	A10-1, A30-5, A30-6, A30-9
A122-(1-3)	A10-1, A31-5
A123-(1-14)	A10-1, A30-5, A30-6, A30-9
A131-(1-9)	A11-1, A13-1, A13-6, A13-8, A13-9
A132-(1-24)	A10-6, A11-1, A13-1, A13-7, A13-8, A13-10, A13-11, A13-14, A13-15, A31-2, A81-4
A20-(1-8)	A20-1, A21-1, A22-1, A22-2, A22-3, A24-1, A50-1, A71-1
A211-(1-5)	A22-2, A22-3
A212-1	
A213-1	A22-1
A214-1	A21-1, A32-3
A215-1	A22-2, A22-3, A24-1
A216-1	
A22-(1-3)	A22-2, A22-3
A221-(1-7)	A22-2, A22-3
A222-1	
A223-(1-2)	A22-2, A22-3, A24-1
A224-1	
A225-1	A22-2, A22-3
A226-1	A21-1
A23-(1-2)	
A231-(1-2)	A10-1
A232-1	A10-1
A233-(1-3)	A10-1, A13-2

A234-(1-2)	A10-1, A13-3
A235-(1-2)	A10-1, A13-2
A236-(1-4)	
A241-(1-11)	A10-4, A11-8, A13-5, A21-1, A22-1, A22-2, A22-3
A242-(1-2)	
A251-1	A13-1, A13-8, A21-1, A32-3
A252-1	A21-1, A22-2, A22-3
A261-1	A11-4, A13-1, A13-8
A262-1	
A263-1	A11-4
A264-1	A10-1, A30-9, A31-1, A81-3
A27-(1-2)	A24-2, A24-3
A28-(1-2)	
A291-(1-7)	A21-1, A22-1, A29-1, A29-2
A292-(1-3)	A21-1, A29-2
A293-(1-2)	A21-1
A294-(1-2)	A29-2
A311-(1-17)	A30-1, A30-5, A30-6, A30-9, A31-1, A32-3, A81-3
A312-(1-39)	A10-1, A11-4, A30-1, A30-5, A30-6, A30-9, A31-3
A313-(1-17)	A13-3, A30-1, A31-5, A50-1
A321-(1-12)	A85-1, A86-1
A322-(1-2)	
A323-(1-2)	A85-1
A324-(1-2)	A85-1
A331-(1-18)	A32-1, A32-3, A70-2
A332-1	A13-7, A13-16
A341-(1-11)	A11-1, A11-2, A13-1, A13-6, A13-8, A31-2, A31-3
A342-(1-10)	A32-3
A343-1	A30-4, A31-6
A40-(1-10)	A11-5, A31-6, A40-4, A40-7
A41-(1-13)	A40-5, A44-1, A44-2, A44-4
A411-1	A40-6, A44-6
A412-1	
A413-1	

A414-1	
A421-(1-2)	
A422-(1-2)	A40-6
A423-1	
A424-1	
A425-1	A40-6
A426-1	
A427-1	
A428-1	
A43-1	A42-1
A441-(1-3)	A13-3
A442-1	A13-3
A443-1	A13-3
A444-1	A10-5, A43-2
A451-(1-22)	A10-2, A11-5, A31-6, A32-3, A40-3
A452-(1-5)	A13-3, A13-5, A29-2
A461-1	A13-11, A29-2, A45-1
A462-(1-2)	
A471-1	
A472-1	A46-1
A50-(1-8)	A50-1, A71-1
A51-1	
A511-(1-10)	A32-3, A50-1, A71-1
A512-(1-10)	A51-1, A71-1, A86-1
A513-(1-11)	A10-3, A32-3, A50-1, A71-1
A514-(1-12)	A40-7, A44-3, A50-1, A71-1
A515-(1-4)	A10-5, A313-3, A13-5, A43-2, A43-3, A50-1
A516-(1-4)	A71-1
A52-(1-21)	A32-3, A51-2, A52-1, A52-3, A71-1, A85-2
A521-(1-5)	
A522-(1-3)	
A523-(1-4)	
A524-(1-4)	A42-1
A525-(1-8)	A71-1

A526-(1-7)	A71-1
A527-(1-9)	A71-1, A81-7, A82-4
A528-(1-12)	A32-1, A32-2, A52-2, A70-1, A71-1, A85-2
A529-(1-11)	A71-1
A61-1	
A611-(1-5)	
A612-(1-5)	
A613-(1-4)	
A62-1	
A621-(1-5)	
A622-(1-5)	
A623-(1-3)	
A624-(1-2)	
A63-1	
A631-(1-7)	
A632-1	
A641-(1-4)	A32-3
A642-(1-2)	
A643-(1-2)	
A644-(1-2)	
A652-(1-4)	
A661-(1-6)	
A662-(1-4)	
A663-(1-3)	
A664-(1-3)	
A665-(1-5)	
A70-1	
A71-(1-6)	A32-3, A71-1
A72-(1-8)	A70-1, A70-2, A71-1
A73-1	A71-1
A811-(1-12)	A40-1, A40-2, A81-1
A812-(1-2)	
A813-(1-23)	A22-2, A22-3, A32-3, A71-1, A71-2, A81-4, A81-5, A81-6, A81-8, A82-1, A84-1, A84-2

A821-(1-21)	A21-1, A22-1, A22-2, A22-3, A42-1, A82-2, A82-3
A822-(1-5)	
A831-(1-12)	A81-7, A83-1
A832-(1-3)	
A841-(1-2)	
A842-(1-4)	
A843-1	
A85-1	
A851-(1-8)	
A852-(1-10)	
A86-1	
A861-(1-13)	
A862-(1-5)	
A863-(1-3)	
A90-1	A93-1
A911-1	A93-1
A912-1	A93-1
A921-1	A70-1
A922-(1-2)	
A93-1	A93-1
A931-(1-8)	A13-1, A93-1
A932-1	A93-1
A933-1	A93-1
A934-(1-2)	A93-1
G00-(1-6)	
G10-(1-11)	
G20-(1-2)	
G30-(1-22)	A10-1, A10-2, A11-6
G40-(1-3)	A22-2, A22-3
G50-(1-3)	
G60-(1-2)	
G70-(1-2)	
G80-(1-14)	

PREFACE

The purpose of the AFGWC study was to define a total system architecture. This includes recommendations for procurement as well as recommendations for changes to the AFGWC organization and operating procedures which relate to the data system. At the present time, we do not know precisely the procurement packages nor the timing on them. We do not know which tasks are to be assumed by the Air Force and which are to be contracted. Since the AFGWC environment is ever changing, we cannot currently specify the precise baselines which must be used as the basis for a procurement.

We have been directed to use the Air Force system specification format as a guide to the structure for this portion of the final report. Because of the things mentioned above there must be deviations from what will eventually be used as a final system specification for individual portions of the system. We have, however, structured it in such a way that for a given approach and a given procurement, the work in extracting applicable pieces of information from the individual sections will be minimized.

In place of precise baselines we have identified our best knowledge of planned baselines for the various times that procurements can be made, and the alternatives associated with each one. For this reason, sections such as "Interface Definition" pertain to several alternatives as opposed to a firm baseline interface.

The structure under which our study was carried out identified areas of the "architecture" beyond hardware components and software modules. It includes management, personnel, and other considerations. To be consistent with the System Specification format we have included those areas in the appropriate sections deviating from our architectural baseline but providing a matrix as a map to make the relationships. We realize, as you will in reading the specification, that what we have identified as pertaining to the architecture and being recommendations to the Air Force may not be the same as would be

included in a specification to a contractor. (For example, we identify specific recommendations for each operator position in terms of specific man level skill and training. In specifying this position to the contractor it may be more desirable to have assumed the human interface characteristic and not to identify the individual for fear of wrong assumptions being made.)

The system design arrived at by SDC in Tasks 2, 3 and 4 of the Architecture Study is a system which meets the design requirements. However, this is not the only system that can meet the design requirements. This design also may be compatible with the most economic impelentation by any given vendor. For this reason, compliance with this configuration is not required as it is with the design specifications.

This specification has been written precisely and definitively. It is recognized that due to oversights, or lack of knowledge of vendor capability, other approaches might be available which do not fit precisely the specifications in some areas, but are deemed as an overall advantage to the government. Contractors are therefore encouraged to submit with their proposals identification of these areas of purposeful noncompliance and rewrite the applicable specifications in such a way as to accommodate their proposed changes and provide rationale for the action. Optional approaches may also be proposed where the "best" approach is not totally defined by the information available.

1.0 SCOPE

This specification establishes the performance and design requirements for the Air Force Global Weather Central System Architecture.

2.0 APPLICABLE DOCUMENTS

SPECIFICATIONS

Federal (None)

Military

Mil-D-1000 1 Mar 65	Drawing, Engineering and Associated List
MIL-E-4158E 11 Jan 73	Electronic Equipment, Ground General Requirements for
MIL-P-009024H (USAF) 15 Oct 73	Packaging, Handling and Transportability in Systems/Equipment Acquisition
MIL-Q-9858A 16 Dec 63	Quality Program Requirements

STANDARDS

Federal

USA Standard X3.9-1966	FORTRAN

Military

MIL-STD-12C 15 Jun 68	Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents
MIL-STD-100A 1 Oct 67	Engineering Drawing Practices
MIL-STD-130D 5 Mar 71	Identification Marking of US Military Property
MIL-STD-454D 31 Aug 73	Standard General Requirements for Electronic Equipment

MIL-STD-470 21 Mar 66	Maintainability Program Requirements (For Systems and Equipment)
MIL-STD-483 31 Dec 70 C1 - 1 Jun 71	Configuration Management Practices for Systems, Equipment, Munitions and Computer Programs (with appendices)
MIL-STD-490 30 Oct 68 Notice 1 - 1 Feb 69 Notice 2 - 18 May 72	Specification Practices
MIL-STD-721B 25 Aug 66 Notice 1 - 10 Mar 70	Definition of Effectiveness Terms for Reliability, Maintainability, Human Factors and Safety
MIL-STD-785A 28 Mar 69	Reliability Program for Systems and Equipment Development and Production
MIL-STD-1472A 15 May 70	Human Engineering Design Criteria for Military Systems, Equipment and Facilities

OTHER PUBLICATIONS

Manuals

AFM 36-1	Officer Classification Manual
AFM 39-1	Airman Classification Manual
AFM 127-101 26 June 70	Industrial Safety Accident Prevention Handbook
AFSCM/AFLCM 375-7 31 Mar 71	System Management, Configuration Management for Systems, Equipment, Munitions and Computer Programs

Regulations

AFR 80-14 12 May 72	Test and Evaluation
AFSCR 310-1 11 Mar 74	Management of Contractor Data
AFLCR 375-4 6 Oct 70	Optimum Repair Level Analysis (ORLA)

Pamphlets

AFGWCP 105-1 3 Feb 75	Air Force Global Weather Central Products
AFGWCP 105-2 6 Mar 74	Air Force Global Weather Central

Handbooks

AFNAG 5A 31 Mar 69	Red and Black Engineering and Installation Criterions
AFSC Design Handbook 1-3 1 Jan 72	Personnel Subsystems
AFSC Design Handbook 1-6 20 Jul 74	System Safety Handbook

Plans

No. - TBD Date - TBD	AFGWC System Test Plan
SDC TM-(L)-5613/006/001 14 Dec 75	AGE Plan

3.0 REQUIREMENTS

3.1 SYSTEM DEFINITION

The Air Force Global Weather Central (AFGWC) System Architecture is a computer-based system which will provide AFGWC with the capability to receive weather reports from throughout the world via the Automated Weather Network and blend these data with information available from military and civilian meteorological satellites to construct an integrated environmental data base. From this data base products are constructed as required to satisfy the aerospace environmental requirements for conventional and space operations of the United States Air Force, the United States Army and other DOD and governmental agencies as directed by the USAF. The architecture itemized in this specification will meet the AFGWC user requirements occurring during the time frame from 1977 through 1982.

In developing this architecture, a number of key design assumptions governed the choice of the final configuration. These assumptions were based on the best possible definition of the 1977 baseline system and included the following:

a. The near term procurement of a Data Base Processor will yield a main processor and array processor consistent with the design requirements of this specification.

b. The Datanet 355 will be the terminal for AUTODIN II communications, and the software provided with this processor shall be modified to handle the line handler/decoder router functions.

c. The Interdata 50 will be used as interface with all facsimile circuits.

d. Capabilities will exist for the DMSP ground station to write satellite data directly to disk units.

e. The special access communications processor will perform the functions of the line handler/decoder router.

3.1.1 General Description

The AFGWC System Architecture is composed of nine segments: data storage, data transfer and routing, computation and software, terminal interface, consoles, data input/display, personnel, management, and facilities. The first six are functional areas and specified in paragraph 3.7. The remaining three are included in appropriate paragraphs as required by MIL-STD-490.

a. Data Storage (A10). The data storage function includes all storage elements of the system. These consist of storage devices, memory, and data base.

b. Data Transfer and Routing (A20). The data transfer and routing function consists of principle hardware linkages, controllers, interfaces, routing devices, switches, compatibility devices, merging devices, and data routing concepts.

c. Computation and Software (A30). The computation/software function is composed of the processors, software, purchased software and developed software.

d. Terminal Interface (A40). The terminal interface function is composed of the normal access (classified), normal access (unclassified), special access, satellite data routing, general concepts and miscellaneous communications.

e. Consoles (A50). This function includes several types of automated consoles used for mission support, which are comprised of network control, operations, security downgrade, communications, satellite imagery dissemination, and maintenance. Included also are several

mission operations centers, which are comprised of several types of forecaster consoles, SESS consoles, a quality assurance console, programmer consoles, and a special operations console.

f. Data Input/Display (A60). This function is comprised of several types of devices that will be used in various combinations to equip the automated work center consoles. Included are devices for data input/display, visual documentation, miscellaneous status, switch and panel selection, miscellaneous communications, and manual inputs.

g. Personnel (A70). This segment considers personnel requirements for mission support and mission operations and the necessary training to impelment the new system.

h. Management (A80). This segment establishes requirements for control operations, logistics, planning, development and maintenance.

i. Facilities (A90). This segment establishes requirements for data system and support facilities (such as maintenance), personnel work areas, and storage.

3.1.2 Mission

The mission to be supported by the AFGWC system architecture is to provide a capability to analyze environmental observations, formulate an approximation to the current state, accomplish predictions of future states and produce environmental data products for transmission to users in the proper format and with the required accuracy and time response. This involves ingesting a large quantity of data at different data rates, producing the products that will satisfy the users requrements, and transmitting (sending) products identity in a timely manner.

3.1.3 Threat

This section is not applicable to the architecture study, however, a final specification should include security practices.

3.1.4 System Diagrams

The top level function flow diagram for the AFGWC system architecture is shown in Figure 1. The overall system configuration and its total description has been provided in volumes 1 and 5 of this final report.

3.1.5 Interfaces

The purpose of this section is to describe the external interfaces being assumed in the AFGWC data system architecture. The detailed assumptions concerning those interfaces are documented within this design specification, as are the interfaces between system components.

a. In the satellite data interface, the extremities of the AFGWC data system are the specific support processors which receive satellite data at readout speed from any of the three types of vehicles in digital form. These support processors then take these data and write them onto disks for later gridding and mapping by the main processor system. In the event that the Air Force decides to adopt a configuration in the 1977 baseline whereby a minicomputer writes data on currently existing disks, then the probabilities are great that their choice of processors will remain in the final configuration and that it will not be cost effective to change mass storage type. It is assumed that archival storage capability will exist within the satellite data processing subsystem independent of this architecture.

b. The satellite imagery dissemination (SID) interface is specified as a minicomputer which interfaces with the SID data lines. A SID console and storage capability are included within the architecture. Again,

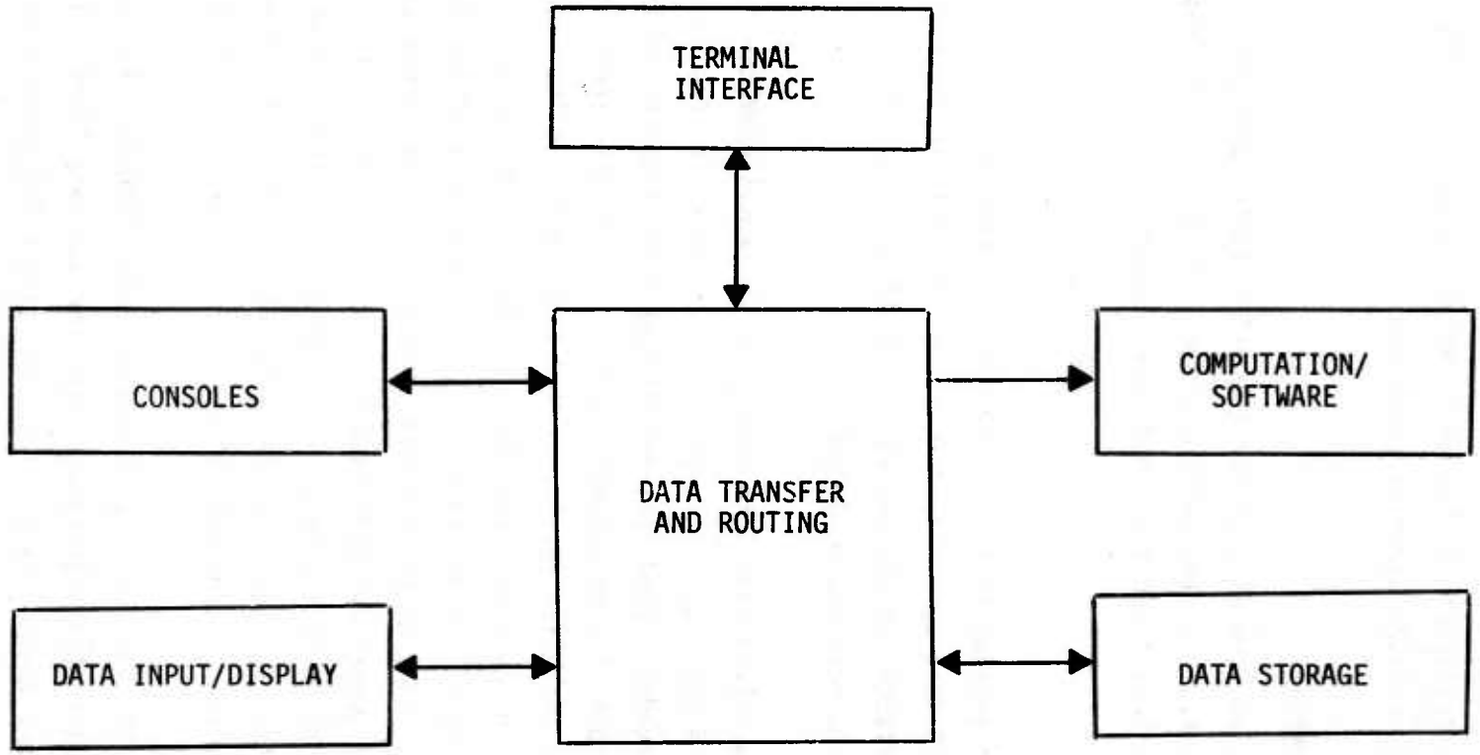

Figure 1. Relationships between AFGWC System Architecture Domain Subsystems

if the Air Force procures a minicomputer as part of the SID system then they must consider the fact that its functions may need to be expanded to be compatible with this architecture, but it will probably be feasible to include such a choice within the architecture as the designated support processor system.

c. Processors are specified which interface with all communications lines including the weather facsimile system. It is assumed that computers will exist prior to the new architecture in the special access, weather facsimile, and AUTODIN II (Datanet 355) areas. These have been identified to be the corresponding line handler/decoder routers. The assumption is made that the software may be modified to have the characteristics and capabilities called for in this specification. Other line handler/decoder routers, not prespecified, shall have the characteristics identified in this specification, i.e., the capability for line interface as well as routing by security level and interface with the communications console.

d. All operator functions have been automated within the AFGWC proper. The design defines the operator positions which must be filled and the effect of the data system on the AFGWC organization. It also deals with practices pertaining to operational readiness, maintenance, hardware augmentation, and software development as well as the specified facilities and environment implications of the new design.

3.1.6 Government Furnished Property List

The following items are potential government furnished property and equipment:

a. Facilities for the data system;
b. Vaulted facilities meeting security specifications;
c. Data system power and air conditioning;
d. Interconsole communications (e.g. telephones);

e. Maintenance area;

f. Datanet 355 for interface with AUTODIN II;

g. Interdate 50 for facsimile interfaces;

h. One dual processor system with an array processor as a result of the data base procurement;

i. Multiprocessor systems resulting from upgrades (e.g. 3 - 1110's (2 x 1), 2 - 1100/40's (2 x 1), and 1-Multiprocessor of the 1100/40 variety with an array processor;

j. Satellite data storage disk packs;

k. Satellite data support processor;

l. Special Access terminal acting as a line handler/decoder router,

m. Satellite imagery dissemination processor; and

n. Existing tape drives, printer, card punches and card readers.

3.1.7 Operational and Organizational Concepts

3.1.7.1 Management (A80)

3.1.7.1.1 Control (A81)

3.1.7.1.1.1 Organization (A811)

(A811-1) The AFGWC organization structure that will be employed to meet 1977-82 requirements is similar to the present organization. However, with the following exceptions:

a. Production Division Operations Staff (WPC). This organization will have the new responsibility to implement and validate new hardware and software;

b. Data Acquisition and Processing Branch (WPP). This group changes because of requirements to process greater amounts of satellite data of different types and because of

requirements to distribute this data through the Satellite Imagery Dissemination System;

c. Data Automation Branch (WPD). The change in this organization mainly due to a reoreintation of personnel to man automated consoles for computer operations (along with maintaining associated software), and to develop software to meet several new model and user requirements.

(A811-2) WPC should realize an expanded role as new data system components are acquired, integrated, and validated. Distinct responsibilities should be assigned within WPC for acquisition/integration and configuration control. Configuration Control Board Meetings should have at least one permanent attendee from the AFGWC Operations Staff, DO. The day-to-day functions of Production Division support should remain as responsibilities of WPC.

(A811-3) All in-house and contractor products shall be documented, produced, and maintained according to a consistent set of standards. The enforcement of these rules should be the responsibility of WPC. To enable this configuration control and contractor management, WPC will require a staff that is oriented towards the computer sciences and systems engineering so as to ensure the success of computer system implementation.

(A811-4) The Data Acquisition and Processing Branch shall continue to have Operations and Program Development sections for division of responsibility within the Branch. The Operations Section should be assigned specific operations responsibilities for satellite input processing support and satellite imagery dissemination. The Programming Section should similarly have specific software development units for input processing and satellite imagery

dissemination tasks. A more descriptive title that should be employed for this Branch is "Satellite Data Processing Branch".

(A811-5) The Machine Operations Section of the Automation Branch (WPD) will operate and support many of the automated consoles that will be used by machine operations personnel. Units should be established for Production Control, Mission Support, and Mission Operations. Mission support consoles supported by this section include those for network control, computer operations, communications, maintenance, and security monitoring/remote job entry. Applicable mission operations consoles are special operations and quality assurance.

(A811-6) The Computer Flight Plans Section of WPD will take on more importance with the influx of new CFP requirements in the 1977-82 time frame, but can retain its current structure.

(A811-7) The Mission Applications Section of WPD should be structured to emphasize some of the major new software development and maintenance efforts that will be required. Units should be established for new model software development, backup support software development, and request processing and special applications.

(A811-8) The Environmental Data Systems Section of WPD should be set up in part to emphasize the large development efforts that are anticipated in data base software and in executive program conversion, with designated units established for these development activities.

(A811-9) The Data Handling Section of WPD should be retitled from its former name of "Data Processing Section" to more accurately describe

its present and proposed functions. Its structure should allocate personnel to the coding, conversion, and maintenance of front-end decoders, to the development of software for new communcations processing functions, and to other development and maintenance of inter-computer communications software.

(A811-10) The Operations Support Section of WPD would be a new unit within this branch, oriented toward development and maintenance that will be required of AFGWC to accommodate the functions of the mission support and mission operations automated work center consoles. In the more distant fture, this section could develop software for other specialized operations, such as unique support for the Interactive Processing and Display System, to supplement contractor efforts.

(A811-11) The Aerospace Sciences Staff (ON) will report directly to the commander but work in close conjunction with the Studies and Analysis Branch. The Current Operations Branch (WPO) will closely monitor the production efficiency of the Division (especially the operations of the Global Environmental Applications Branch) by working with all line organizations. Both of these units would further serve to guarantee the success of the AFGWC mission through efficient advanced analyses and thorough quality control.

(A811-12) The areas of responsibility between AFGWC and Air Force Communications Service must be clearly defined. The appropriate Air Force Communications Service Agency should be responsible for the communications system and the line handler/decoder router. AFGWC should be responsible for the disk interface device, the disk, the main processor, and the communications console. The interface between the communications subsystem and AFGWC should be jointly

agreed upon and published by the Air Force Communications Service and AFGWC. Some of the types of information that should be specified in this document are: a) a method of data transfer with an acknowledgement/non-acknowledgement system; b) the sizes and formats of the data buffers to be exchanged; c) flags, routing bits and similar details. Thus, the Air Force Communications Service should have responsibility for equipment and circuit performance, as well as operating the communications system, while AFGWC should be responsible for data processing.

3.1.7.1.1.2 External Control (A812)

(A812-1) The philosophy pertaining to the control of the data system by sources external to AFGWC shall be such that there is no demand resource capability.

(A812-2) AFGWC shall act as a service organization which services data base queries and prepares responses under the control of network control.

3.1.7.1.1.3 Network Control (A813)

(A813-1) There shall be an automatic network control function which: a) schedules main processors (including the assignment of security level), b) schedules tasks, c) notifies requestors when tasks have been completed, d) maintains system status, e) initiates system level recovery from malfunction, and f) allows manual backup to automatic scheduling functions.

(A813-2) One computer assigned to the special access perimeter (highest security level) shall be designated as primary for network control at any point in time and shall be the sole active interface with the network control console.

(A813-3) The network control function shall be time-shared with other tasks so as to utilize a minimum of resource.

(A813-4) An independent processor operating under a separate execution shall be designated to provide backup to the network control function.

(A813-5) The network control function shall be continually monitored for malfunction by the backup processor. When a malfunction occurs the backup shall immediately take over the network control function.

(A813-6) There shall be a monitoring task associated with compiling statistics on task run characteristics and resource utilization in terms of time and frequencies.

(A813-7) Reflected in the allocation of resources shall be a loading prediction capability which accounts for a) current resource allocation, b) characteristic distributions of current task being run, c) potential new task demands as a function of time of day, and d) probability of critical assignments occurring.

(A813-8) To accommodate maintenance a capability shall exist to isolate components logically to the extent of non-interference with continuing operations and physically to the extent of not violating security restrictions.

(A813-9) The capability shall exist for programs to provide progress reports to network control when it is apparent that the tasks are deviating greatly from current run time statistics.

(A813-10) There shall be clocking of processor associated functions to provide statistics on system utilization.

(A813-11) In a multiprocessor environment (when configured as such) the network control function shall consider the multiprocessor as a unit, letting the multiprocessor executive perform more detailed scheduling.

(A813-12) Tasks shall be entered into a dynamic priority ordered queue where the priority may change as a function of time.

(A813-13) Network control shall only schedule main processors as a resource.

(A813-14) Main processors, support processors or a master system activity schedule shall be the sources of tasks.

(A813-15) If a network control failure of network control computers and its potential backups occurs, the system shall be configured to operate in a function-dedicated processor mode where manual switching accomplishes load leveling and assignment of functions.

(A813-16) Malfunctions below the level of network control specified requirements shall be met by the computer operations console.

(A813-17) Automatic functions critical to system operation within network control must be provided by fallback techniques, e.g., manual control and semiautomatic control.

(A813-18) The network controller shall be capable of obtaining status verbally from any other operator position within the system.

(A813-19) Any security violations/uncertainties shall be automatically reported to the network control console.

(A813-20) No one shall be able to interfere with, impede or take over control of any control/authority of the network control position.

(A813-21) The network control processor shall be capable of initiating the generation of a secure key in a special memory which contains the authenticate-key for encoding/decoding data from each uni- or dual-processor system (depending on the configuration) providing that clean lockout and unclassified lockout is not in effect with respect to that processor system.

(A813-22) The only functions which shall be processor dedicated (assigned until changed by network control or because of malfunction) in the main processors are network control, master data base processing, backup to these functions and programmer console support. These functions shall be dedicated until a malfunction occurs, preventive maintenance is required or the network controller elects to reallocate those functions.

(A813-23) The network controller shall have overall responsibility for the operation of the AFGWC data system.

3.1.7.1.2 Operations (A82)

3.1.7.1.2.1 Security (A821)

(A821-1) This system shall allow for a total physically secure environment for all computer systems and classified entities of the configuration. The configuration shall accommodate three special access levels along with Unclassified, Confidential, Secret, Top Secret and Top Secret SIOP.

(A821-2) The capability shall exist to switch into physically isolated and/or security protected (via authentication) subsets of the total

system designated to contain data at some maximum security level.

(A821-3) The netrok control computer shall be able to identify jobs to be run via a control-only data link which guarantees through minimum data availability techniques and extensive checking that no non-control (especially classified) data can be passed.

(A821-4) The capability shall exist to request data access by address from a higher security level processor to the unclassified master data base processor via the control-only link.

(A821-5) The capability shall exist to provide (on a limited basis) data from a higher security level configuration, allow certification/downgrading by manual means at a security control position and to reenter the same data into any lower level configuration.

(A821-6) Higher level security data shall be kept from inadvertent exposure to a lower level either physically or through the implementation of an encoder/decoder authentication chip using an algorithm such as the Data Encryption Standard specified by the Bureau of Standards.

(A821-7) Although hardware and special devices shall be used to ensure proper passage of data within the data system there shall also be an extensive software checking capability to ensure proper action by manually controlled functions and by the mixed mode security line handler/decoder routers.

(A821-8) Printer output shall be routed to printers according to classification categories defined in the data base.

(A821-9) Magnetic tapes used for storage of archival data shall be separated and manually assigned by classification level to the corresponding disk systems.

(A821-10) Logs and identification data sheets shall be automatically generated for each printer to correlate actual output with the unique classified jobs.

(A821-11) Normal access programming consoles, normal access unclassified forecaster consoles and studies and analysis consoles shall all be maintained at an unclassified level and connected only with unclassified data paths.

(A821-12) All components shall be TEMPEST certified if they are to contain classified data.

(A821-13) There shall be no capability to generate and execute code from external (outside of secured data system area) data links (consoles or communications lines) within a classified data path.

(A82 -14) An attempt shall be made and an approach described such that the system executive and network control programs are, through software and hardware means, totally inaccessible in terms of control or change from other than the single network control source.

(A821-15) The capability shall exist to manually initiate lower classification tasks from the special access perimeter but there shall be no electronic connection within that perimeter to this link.

(A821-16) An attempt shall be made throughout the system to maintain data at their lowest possible level of classification.

(A821-17) There shall be three security compartments within the special access perimeter; two which are separate but treated at the same hierarchical level and both subordinate to the highest level of classification within that perimeter.

(A821-18) The capability shall exist to manually switch any of the forecaster consoles within the special access perimeter to any one of the three different security level data bases which exist within that perimeter.

(A821-19) The security downgrade system shall consist of a low capacity storage write unit and a completely independent (no electronic connection) read unit which allows a) display on a CRT to a security monitor, b) hard copy and c) switchable manual routing to any classified level disk.

(A821-20) The programming consoles associated with the special access perimeter shall be at the highest level of classification.

(A821-21) The capability shall exist to send data from a low-security level component to a high-security component but where it is physically impossible to transmit data in the other direction.

3.1.7.1.2.2 Meteorological Quality Assurance (A822)

(A822-1) The data system design shall be consistent with and support the philosophy of pre-specified data integrity checking and total data verification.

(A822-2) The quality assurance console shall be the central operational position for administering and monitoring the quality assurance function.

(A822-3) The capability shall exist to continually collect statistics on forecast versus analysis data as a standard operational function.

(A822-4) The system shall have the capability to define in the data base threshold values, threshold functions, or threshold procedures for data validity checking of data values input to the system.

(A822-5) The capability shall exist to define levels at which data need to be subjected to manual checking procedures for correcting. These data shall be sent to the quality assurance console with appropriate identification for further action.

3.2 CHARACTERISTICS

3.2.1 Performance Characteristics (G00)

(G00-1) Under new loading magnitudes, timing distributions and demand distributions, the system shall be designed to meet a peak load that is two sigma above average.

(G00-2) Under expected load conditions, AFGWC data system shall have the capability to fulfill backup requirements for one agency (ETAC, DET-7, or NWS) while still supporting normal requirements.

(G00-3) There shall be inherent in the AFGWC data system design the ability for graceful degradation whereby requirements not satisfied shall be those of lowest priority, least impact, and highest probability for subsequent fulfillment even though specific time goals have not been met.

3.2.2 Physical Characteristics (G00 cont.)

(G00-4) The data system distribution of components shall be consistent with the distribution identified and physical space identified in the facilities specification (paragraph 3.5.6) and shall in addition provide for suitable environmental requirements of each component as well as required space requirements for cleaning, servicing and operations.

(G00-5) The contractor shall demonstrate consistency between the proposed component allocation weight distribution and the flooring specifications supplied by the Air Force.

(G00-6) Work areas shall afford adequate space for storage, observation and personnel collaboration on operational decisions based on console information.

3.2.3 Growth (G10)

(G10-1) Processor growth to support mathematical model computation shall be a potential for 20% growth per year beyond what exists at the beginning of any given year over five years.

(G10-2) Processor growth to support other computation shall be proportional to the growth considerations specified in the other computational areas.

(G10-3) The potential for main memory growth shall be proportional to the CPU throughput growth requirement.

(G10-4) The system shall accommodate a 10% growth in incoming communication channels over that specified in the design.

(G10-5) The system shall accommodate a 10% increase in data flow on existing channels.

(G10-6) Both the mass storage facility and the magnetic tape capabilities shall have a potential for 20% growth per year beyond what exists at the beginning of any given year over five years.

(G10-7) The Mass Storage Facility shall be expandable to:

a. A capacity of 350×10^9 characters.

b. Be within 60 seconds with a quiescent system.

c. Interface with 128 disk drives.

d. Provide a means of inhibiting writing on selected data sets for 50×10^9 of the total 350×10^9 characters.

d. Provide a means of inhibiting writing on selected data sets for 50×10^9 of the total 350×10^9 characters.

e. Transfer 8 data sets concurrently out to disk.

(G10-8) Data system potential growth from 1982 - 1987 shall require no more than a 10% increase in facilities.

(G10-9) The 1982 console design shall accommodate a potential 10% growth in number of devices and a 10% growth in traffic per work center between 1982 and 1987.

(G10-10) The Array processor shall have the capability for expansion as follows:

a. Control microstore shall be expandable in increments no larger than 8×10^3 words to at least 32×10^3 words.

b. A minimum of four arithmetic elements shall be capable of parallel operation on operand streams.

c. The trigonometric function generator shall be expandable to accept arguments in increments of 1 degree.

d. Local memory shall be expandable to a minimum of 10^6 characters in increments no larger than 256×10^3 characters.

(G10-11) The unclassified line handler/decoder router shall be capable of supporting potential growth of a Fleet Numerical Weather Control line rated at 50,000 bits per second.

3.2.4 Maintainability (G20)

(G20-1) The system shall be maintainable to the extent that the reliability requirement can be met.

(G20-2) When components of the system fail, the capability shall exist to recover full operational stature within 3 hours.

3.2.5 Reliability (G30)

(G30-1) The AFGWC system shall be reliable to the extent that there is a 99.5% probability that any user request is completely satisfied; where success is defined as the adequate (not necessarily best or nominal) response to user expectations in the time consistent with the overall time goal independent of external (to the AFGWC data system) influence (e.g., input sensor data, input quality, human interaction, and external communications).

(G30-2) The reliability requirements shall pertain to both hardware components and software.

(G30-3) Support disks shall have the following reliability characteristics:

a. Recoverable error rate of at most 1 in 10^8 bits,

b. Non-recoverable error rate of at most 1 in 10^{10} bits, and

c. Positioning error rate of at most 1 in 10^6 seeks.

(G30-4) Fixed head disks need not have removable storage devices but must then have sufficient spare tracks to meet reliability requirements associated with main processor systems.

(G30-5) Bulk and combination disks shall have the following reliability characteristics:

a. Recoverable error rate of at most 1 in 10^9 bits,

b. Non-recoverable error rate of at most 1 in 10^{11} bits, and

c. Positioning error rate of at most 1 in 10^6 seeks.

(G30-6) Backup requirements for consoles shall be based on a need to maintain a total system reliability of .995. (This translates to a reliability of .9988 for each console over its lifetime.)

(G30-7) The capabilities of the communication control console shall be consistent with the timing and reliability requirements identified within the system.

(G30-8) Bulk disk storage shall have a reliability of 99.99%; the reliability shall include the effect of redundant on-line data and the ability to restore data sets automatically from the mass storage facility.

(G30-9) Preventive maintenance on bulk disk storage shall not decrease the available storage below the previously specified limit of 1020×10^6 characters plus overhead, nor shall preventive maintenance degrade access time or throughput.

(G30-10) Redundant control units and drives shall be provided for maintenance and recovery as necessary to meet reliability requirements (see paragraph 3.2.5). Redundant units may be manually switched between security levels within a perimeter (after cleaning, if the switching is downgrade).

(G30-11) The Mass Storage Facility shall have no single point of failure.

(G30-12) The Mass Storage Facility shall be capable of recovering from a failure of a disk unit by reconfiguring.

(G30-13) The Mass Storage Facility shall be capable of being reconfigured on line so that disk units may be taken for preventive maintenance without interruption of standard operation.

(G30-14) There shall be no preventive maintenance of the Mass Storage Facility during which it cannot be operated on line; the Mass Storage Facility shall be capable of concurrent preventive maintenance and on-line operation.

(G30-15) The Mass Storage Facility shall have an undetected error rate not to exceed 1 bit in 10^{11}.

(G30-16) The Mass Storage Facility shall be capable of detecting and correcting double bit errors, i.e., two bits simultaneously, in error without degradation in access time or throughput.

(G30-17) The Mass Storage Facility shall be capable of automatically detecting excessive media degradation, i.e., bit errors which are correctable and ejecting the data cartridge after copying data over to a new cartridge.

(G30-18) The indices that contain the location of data sets on physical volumes within the Mass Storage Facility shall be kept on line redundantly.

(G30-19) The low capacity storage device shall last at least 1000 accesses without an unrecoverable input/output error.

(G30-20) The mean time between failure for the array processor shall exceed 1000 hours, and the mean time to restore the array processor shall be less than one half of an hour.

(G30-21) The individual reliability of a support processor shall exceed .995.

(G30-22) Support processors shall provide a power failure protection feature to insure CPU operations are brought to an orderly halt in an event of a drop in the primary power source. Upon return of power, the CPU shall be capable of automatically bootstrapping.

3.2.6 Integrity (G40)

(G40-1) Integrity of system data shall be consistent with the reliability requirement in particular in the areas associated with the interpretation of requests, the scheduling of tasks, the accomplishment of tasks, and the communication of results.

(G40-2) The integrity associated with the accomplishment of security objectives shall be the highest attainable where no fault due to software or hardware shall be known and not corrected.

(G40-3) It shall be the goal of the data system design to not degrade meteorological results through hardware component failure or software data computation and manipulation.

3.2.7 Testability (G50)

(G50-1) The system shall be specifically constructed so as to accommodate testing in hierarchically expansive technique, from each small module/component to consideration of it with its interface and finally with those as a group to be tested as an entity.

(G50-2) The testing shall be adequate to demonstrate the satisfaction of the reliability requirement taking into account reliability enhancement features such as backup and redundancy.

(G50-3) There shall be an emphasis on visibility into data flow and component operation to enhance the test program.

3.2.8 Adaptability (G60)

(G60-1) The system shall accommodate all aspects of the growth requirement with no major modifications to the data system required to accommodate the specific growth; a major modification is one costing more than $10,000, excluding the cost of the increased capability itself. For example, more data storage should not require software rewrites if the cost of the software will exceed $10,000.

(G60-2) There shall be an emphasis on modularity in all aspects of the data system.

3.2.9 Availability (G70)

(G70-1) It shall be demonstrated that the mean time to failure, the mean time to repair, and the recovery/redundancy features within system are consistent with the reliability previously specified.

(G70-2) The availability of a main processor system should be at least 99.95%, based on the following formula:

(1) $$\text{Availability} = \frac{\text{mean time between outage}}{\text{mean time between outage and mean time to restore}}$$

An outage shall be defined as non-functioning of the complete processor system, i.e., both halves of the system must be incapable of performing mission-oriented work. If preventive maintenance

requires the dedication of the processor system, the time shall be charged as outage.

"Degraded mode" of a main processor system is defined as an outage of any component that is essential for maximum performance (full capability) of the main processor system. The degraded mode availability of a main processor system shall be at least 99% based on formula (1). Preventive maintenance shall be charged as outage if the component being taken for preventive maintenance does not have a ready backup which can be switched in without system disruption; any system wait time due to switching shall be charged as outage.

3.2.10 Miscellaneous (G80)

(G80-1) System Effectiveness. That portion of the time that the hardware and software are operational with respect to the total time in use shall be consistent with the reliability requirement of paragraph 3.2.5.

(G80-2) Environmental Conditions. The hardware will be in operation only at the AFGWC and an environmental specification shall be prepared for each hardware component.

(G80-3) Transportability. The hardware shall be designed for transportation by common carrier including rail, ship and air freight. All configuration items shall also be designed so that loading, off-loading and placement shall not require special purpose equipment.

3.3 DESIGN AND CONSTRUCTION (G80 cont.)

(G80-4) Materials, Processes and Parts. The hardware shall conform to MIL-STD-454C, "Military Standard, Standard General Requirements for Electronic Equipment".

(G80-5) Electromagnetic Radiation. The hardware shall conform to the Electromagnetic Compatibility Requirements of MIL-E-6051D.

(G80-6) Nameplates and Product Markings. Identification markings shall be in accordance with MIL-STD-130D.

(G80-7) Workmanship. All equipment fabricated as part of the hardware design shall be in full compliance with reference military specifications and standards.

(G80-8) Interchangeability. As primary design objective, parts selection and subsystem selection shall be from standard industry inventory. Documentation for interchangeability shall be in accordance with MIL-D-1000. Engineering documentation shall be in accordance with MIL-D-1000, Form 2.

(G80-9) Safety. Work shall be accomplished in accordance with MIL-STD-790C and AFGWC DH 1-6.

(G80-10) Human Performance/Human Engineering. The contractor shall comply with the following:

a. The hardware shall conform to good human engineering standards in particular MIL-STD-1472.

b. Operator positions shall be simplified to the maximum extent practical for most efficient operation.

c. Consoles shall provide drawers and storage necessary for a complete work center.

d. Computation shall impose minimal duties on the operator.

e. Operator positions shall accommodate on-the-job training.

3.4 DOCUMENTATION (G80 cont.)

(G80-11) All documentation for the AFGWC System shall be in compliance with AFSCM/AFLCM 375-7.

(G80-12) Specifications. All specifications shall be in accordance with MIL-STD-490 and shall be maintained current throughout the design, development, and production phases.

(G80-13) This Type A-System Specification shall be maintained current during the contract period. This specification shall be the base for the development and production of the prime items and subsystems, the performance of such items being allocated from the system performance requirements.

(G80-14) Engineering Drawings. Engineering drawings shall be in accordance with MIL-D-1000, Form 2 and MIL-STD-100A.

3.5 LOGISTICS (A83)

3.5.1 Phaseover (A831)

(A831-1) The phase-in of the new AFGWC data system architecture shall be accomplished in several stages between early 1977 and mid-1979, as follows:

a. 1977 - Early 1978 - During this period, 3 major data bases (special access, classified, and satellite) shall be installed. The special access data base shall be connected to the current special access computer, as will new special access communications facilities. The classified data base shall be connected to a new processor system 3 (PS3), which shall replace one of the current 1110 computers employed for classified (but not special access) operations. The satellite data base shall communicate with the current satellite processor, while another new processor system shall be installed and connected to a simulated communications facility for simulated normal access communications and forecaster console support. This processor shall communicate with these communications and forecaster facilities through a temporary unclassified data base, and shall also communicate with an operations center. The main purpose of this latter processor system configuration shall be to gradually phase in and exercise these new concepts prior to actual implementation.

b. Early 1978 - In early 1978, processor system 4 (PS4) shall be formally initiated with the implementation of the processor system and communications facilities tested prior to this date. The unclassified data base shall thus now

be operational, along with upgraded appropriate normal access communications facilities. In addition, two operations centers (one each in the special access and normal access perimeters) shall be operational, and a new PS1 shall be implemented to process all special access functions.

c. Mid-1978 - Processor system 2 (PS2) shall now be phased in to function as the variable perimeter processing system. In addition, PS5 shall now be phased in, replacing the current satellite data processor, and communications facilities to new satellite ground terminals shall now be implemented.

d. Early 1979 - At this time, the upgrade data switches and control only switches shall be implemented, and an initial IPADS capability shall be installed for forecaster support. Also, the full network control capability shall be available by this date.

e. Mid-1979 - By this time, a full forecaster console capability shall be implemented, including forecaster consoles in the special access perimeter and several similar types of consoles in the normal access perimeter, including TAF-METWATCH, Military Weather Advisory, and synoptician consoles. Also, programmer support consoles in the special access and normal access perimeters shall be operational by this time.

(A831-2) DMSP satellite processing of primary and special data shall be performed with minimal change.

(A831-3) Certain communications processors (the Datanet 355 and the Interdata 50) shall remain.

(A831-4) The data base processor shall, if possible, be one of the main processor and array processor choices.

(A831-5) Satellite data disks and data base processor disks shall, if feasible, be retained.

(A831-6) FORTRAN shall be retained as the primary applications program language.

(A831-7) Current models and output processing software shall undergo minimal modification.

(A831-8) That portion of the phaseover process relating to data base shall be in accordance with the following sequential steps:

a. Implement data base interface software to allow old programs to operate with the new data base;

b. Build and implement master data base and management capability for the new software;

c. Build master data base and management capability;

d. Build request response and overlay software, including control only and upgrade characteristics (the new structure should already be transparent to programs, due to data base interface software);

e. Check space out and implement data base management on one computer at a time; and

f. Develop and implement backup and switch capability.

(A831-9) Pertinent ground rules for phase-in of the network control capability shall be as follows:

a. Initial processor operational capability shall interpret job requests, maintain a queue, and perform functions;

b. Initially, functions shall be dedicated, compatible with current system, including mixed mode (this capability shall serve as double error backup recourse);

c. Network control software, including job queueing, processor selection, key generation, job allocation, job response, and interrupt shall be checked out and implemented one system at a time.

(A831-10) Independent sets of existing code which must remain intact in the new environment shall be treated as entities within a structured software system. The rules that are laid down for new coding and for the structuring of the code shall then accept these entities under the constraints of the system, but internal to the entities there need not be compliance.

(A831-11) The first element of the structure applied against the programming task shall be a hierarchical structure of function where each step in the hierarchy outlines a more detailed representation of the tasks that shall be performed by the software. These functions shall be stated independent of the control that must be imposed

on the modules of the software system. These functions assume existence of data elements on the basis of need. They shall be developed along with a philosophy for its use. Through an iterative process, the data base references in the final level of the hierarchy shall be made to correspond to the data base structure description. The next item to be developed shall be a set of levels of abstractions which dictate responsibility in terms of resource control and task control. Once the levels of responsibility have been defined and the resources of the system identified with levels and the pecking order in terms of control are established, the executive control structure shall be designed and imposed on the lowest level of task as described in the hierarchical structure.

(A831-12) The design process shall include the documentation of the system standards to be imposed on each of the programming areas. There shall be sets of rules that the programmers must follow and the guidelines in terms of interface which are necessary in a structured environment. Two documents shall be developed on a system-wide basis. The first shall be a compendium of mathematical notation. The second document shall be a user interface document which describes the human engineering aspects of the design at each operator position. A philosophy of operation and a statement of task shall be developed which considers the interface before the code actually exists. These documents shall be updated as the design progresses and maintained current.

3.5.2 Spare Parts (A832)

(A832-1) Sufficient spare parts shall be inventoried locally or on-site such that any failed part can be replaced within 2 hours from the time that a fault is isolated to an individual part.

(A832-2) Spare parts inventories on-site shall be kept in an environment at least as protective as the environment in which the hardware is kept while in operation.

(A832-3) Spare parts shall be inventoried in relative measure with the number of units (containing the parts) that are present at AFGWC, i.e., the more units present, the more spares that are required.

3.5.3 Planning (A84)

3.5.3.1 Readiness (A841)

(A841-1) The system shall be designed to accommodate system readiness exercises of two types: a) preparation for support of a new activity, and b) preparation for support of peak load and abnormal conditions.

(A841-2) Major new activities shall be planned so as to operate under a simulated environment where interfaces outside of AFGWC are simulated.

3.5.3.2 System Simulation (A842)

(A842-1) The capability shall exist to introduce data into the data system as if it were being received over a predesignated communications link.

(A842-2) The capability shall exist to time phase the input of simulated communications data according to the user's specifications.

(A842-3) The capability shall exist to suppress output of communications data and to instead route these data to the printer system.

(A842-4) The capability shall exist to key scheduled activities as well as data base design simulation activity to a data base time base which can be reset in order to allow a break or gap in the processing in support of system readiness functions.

3.5.3.3 Long Term Scheduling (A843)

(A843-1) The capability shall exist to run the network control program in the simulate mode. This shall include a data base specified simulation of activities associated with each one of the major support areas. Requests shall automatically be interjected into the queue. Network control will be run but on a different time base (i.e., where nominal run times are some fraction, say .01 times the nominal specified time).

3.5.4 Development (A85)

(A85-1) Provision shall be made for further development of the AFGWC Data System in order that the data system maintains its capability to support the continually expanding data processing requirements.

3.5.4.1 Hardware Augmentation (A851)

(A851-1) The System shall be designed such that performance of the data system shall not be impaired during hardware augmentation.

(A851-2) The actions entailed in hardware augmentation (e.g., planning, system design, system simulation, system specification, hardware procurement, hardware installation, acceptance testing, and final integration of hardware in the system) shall be detailed as a well defined series of incremental steps each of which includes preliminary reviews.

(A851-3) Hardware components used to augment the AFGWC Data System shall be selected (designed) to insure that system reliability is not degraded.

(A851-4) Hardware components used to augment the AFGWC Data System shall be selected (designed) to insure that the integrity of data produced by the system or used by the system is not diminished (i.e., hardware components are not introduced which disallow data representation with sufficient significance for the computations to be performed).

(A851-5) Hardware components selected (designed) to augment the AFGWC Data System shall be capable of being tested individually and as a part of the AFGWC System.

(A851-6) Hardware selected (designed) for inclusion in the AFGWC Data System shall not degrade and shall contribute to system capabilities to adjust to peak loading requirements and unusual demands on the system.

(A851-7) Hardware selected (designed) for inclusion in the AFGWC Data System shall not be allowed to degrade system reliability due to its unavailability.

(A851-8) Backup hardware along with procedures for switching to such backup hardware shall be provided for any hardware components capable of degrading system reliability due to its unavailability.

3.5.4.2 Software Development (A852)

(A852-1) Augmentation of AFGWC Data System software shall not adversely perturb data system operation.

(A852-2) Software augmentation activities such as planning, system design, software design, software development (or procurement), software testing and software installation shall be planned such that they have no adverse effect of AFGWC Data System operation.

(A852-3) Software augmentations shall be planned as a well defined series of incremental steps which reflect the continuing data system requirements for reliability, integrity, testability, adaptability, and availability.

(A852-4) A set of well publicized and strictly enforced standards and procedures shall be imposed which provide guidance for all phases of the software cycle. These phases include but are not limited to: software requirements definition, software characteristics

description, software functional and detailed design, coding, test, integration, operation (user-maintenance-modification and software support), retirement, and disposal.

(A852-5) Composite design and structured programming disciplines shall be applied for AFGWC augmentations.

(A852-6) Most programs shall be written using three programming structures:

a. Simple Statements. Standard assignment statements and subroutine calls.

b. Comparative Statements. If--THEN ELSE statements.

c. Iterative Statements. DO WHILE statements.

(A852-7) Top down design techniques shall be followed.

(A852-8) Top level programs shall be coded and tested first. Bottom level routines are tested last. During early testing lower level routines shall be represented by dummy (or stub) programs.

(A852-9) A set of widely disseminated and strictly enforced standards and procedures shall be made for the testing and integration of software systems. Such procedures include: publication of a test plan early in the development cycle, parallel and, if possible, independent development of test cases, testing statements, test drivers or whatever testing devices are appropriate for the application; and publication of a test report after testing and integration have been completed.

(A852-10) Enforcement of software testing and integration shall be simplified by use of automated configuration management techniques such that libraries of the baseline software and updates of that software exist, are capble of being audited, and are capable of being retrieved.

3.5.5 Maintenance (A86)

(A86-1) Training shall be provided for USAF personnel to run diagnostics and replace failed parts for any hardware components that do not have local maintenance support.

3.5.5.1 Preventive (A861)

(A861-1) Main processor (CPU, I/O channels, memory, excluding array processors, unless they are supplied by the same vendor as the CPU) shall have on-site, 24-hour maintenance.

(A861-2) All hardware components other than main processors shall have standard commercial maintenance for three shifts (24 hr/day), 365 days/year.

(A861-3) Preventive maintenance shall be scheduled, and shall be coordinated with network control; no component shall be taken offline for maintenance without the permission of the network controller.

(A861-4) Components shall not be taken for maintenance until transition is accomplished to a backup unit.

(A861-5) Maintenance of all processors shall be without external communication links.

(A861-6) Main processor clusters (CPU, I/O channels, memory, array processor, local operator console, fixed head disks, and maintenance console) shall be isolated from the rest of the data system prior to any maintenance which requires dedication of a processor. Multiprocessors may be segmented and only a portion of the cluster dedicated to maintenance.

(A861-7) Support processors shall be isolated from the data base prior to all maintenance activity.

(A861-8) The upgrade and control-only systems shall not require preventive maintenance to meet their reliability goals.

(A861-9) Switches and authentication chips shall not require preventive maintenance to meet their reliability goals.

(A861-10) Authentication chips shall be capable of being bypassed or set to clear transmission for the purpose of running diagnostics.

(A861-11) When a disk drive string is of a higher classification than unclassified, and when the authentication chip that protects this string is set to clear for maintenance, the drives must be isolated from access by any CPU other than the diagnosing CPU. Disk drives shall be exercised from a CPU of equal security level.

(A861-12) It shall be possible to do all preventive maintenance on data base clusters without degrading normal, average throughput of the disk subsystem.

(A861-13) Diagnostics that are capable of isolating faults to the plug-replaceable level shall be provided for all hardware units.

3.5.5.2 Failure Response (A862)

(A862-1) Network control and central data base management shall have ready backups located on a separate computer from the primary, active software. These backups shall be capable of assuming the primary roles at all times, using tables stored on shared disk.

(A862-2) The backups shall sense the status of the primary at no longer than one-second intervals.

(A862-3) A single hardware failure shall not cause long-term inaccessibility of any segment of the data base. Spare control units and drives shall be available as backup units. Such backup units may be used during preventive maintenance, provided that all units are in working order.

(A862-4) Recovery from a disk failure shall normally be restoration of the information or a backup pack. Packs shall not be moved to spare drives without a directive from the network controller (due to time-critical requirements).

(A862-5) Unclassified data sets shall be backed up in the mass storage facility. Classified data sets shall be backed up on tape.

3.5.5.3 Graceful Degradation (A863)

(A863-1) Multiprocessor failure recovery shall be accomplished by operating in a uniprocessor mode, if necessary.

(A863-2) Total failure of a main processor cluster shall cause the variable perimeter to be switched into the appropriate classification level as a replacement.

(A863-3) Failure of network control software including the backup, shall be handled as follows:

a. Processors shall be dedicated to functions and security levels.

b. Processors shall be individually scheduled.

c. Processors shall poll the data base for job requests or communications messages.

3.5.6 Facilities (A90)

(A90-1) The new hardware configuration resulting from this specification shall be adaptable to the current facility space available as illustrated in Figures 2 and 3.

3.5.6.1 Support (A91)

3.5.6.1.1 Power (A911)

(A911-1) Commercial power supplied to AFGWC is used to continually recharge a large battery system (a power repository), which provides necessary support to the computer system. It is designed to minimize the effects of power fluctuations and outages external to AFGWC, and to allow for easy switching from primary to backup power sources. Use of this basic system shall be continued. Upgrading required to handle the new architecture will be dependent on the vendor or vendors chosen to supply the hardware. However, we feel that a representative estimate of the power requirement for the new configuration is 800 KW, small enough to be handled by the power resources available to AFGWC. The AFGWC power supply will continue to be housed in the room labeled "mechanical equipment" in figure 3.

3.5.6.1.2 Environment (A912)

(A912-1) The two main factors establishing the environment for machines and material are temperature and humidity. The material mentioned primarily includes computer punched cards, paper for alphanumeric terminal and high speed printers, magnetic tape, and photographic film. Both hardware and this supporting material shall be maintained in an environment between temperature and humidity ranges of 65°F to 73°F, and 30% to 60% respectively. The air conditioning equipment used to provide this environment is housed in the

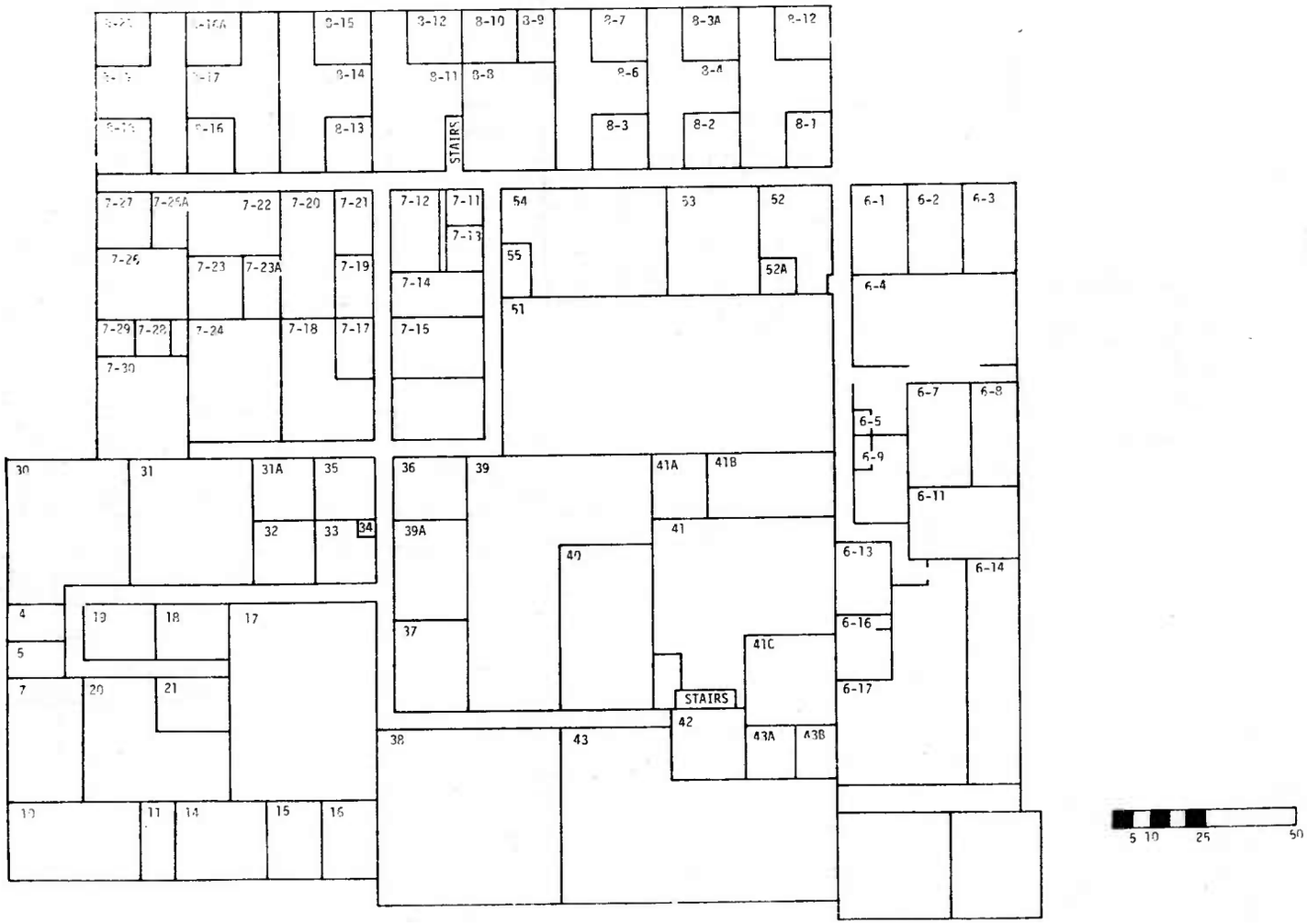

Figure 2. AFGWC Main Floor Facility

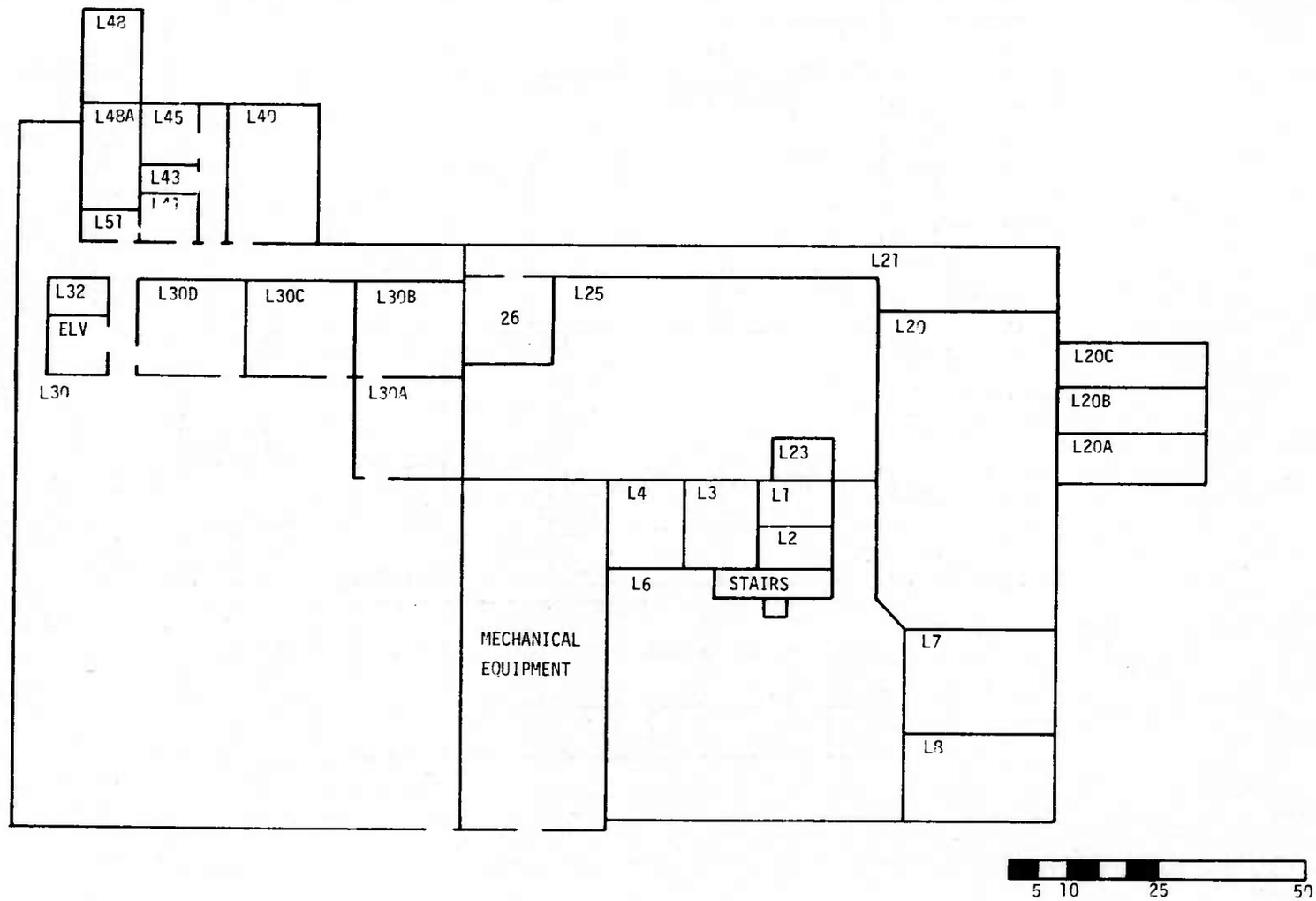

Figure 3. AFGWC Lower Floor Facility

room labeled "Mechanical Equipment" (as shown in Figure 4), the roof, and room 43. The exact amount of air conditioning required to handle the new architecture will be dependent on both the vendor or vendors chosen to supply the hardware and the exact placement on the equipment within the facility. However, we feel that a representative estimate of air conditioning required for the new configuration is 4,000,000 BTU's, well within AFGWC available air-conditioning resources.

3.5.6.2 Personnel Work Areas (A92)

3.5.6.2.1 Terminal-Human Interface (A921)

(A921-1) In the design of automated work centers or consoles, human engineering shall be considered to allow for optimum efficiency, ready use of all components, and easy interaction between individuals using the consoles.

3.5.6.2.2 Work Environment (A922)

(A922-1) There are five primary factors which have the most dramatic effect on the work environment of personnel:

a. Safety. System safety engineering principles shall be in accordance with the general requirements of MIL-HDBK-DHI-6, MIL-STD-1472A, and MIL-STD-454. These principles and standards shall be applied throughout the design/development, manufacture, test, installation, checkout, and operation of of the AFGWC equipment.

b. Radiation Hazards, Nuclear, Electromagnetic. Radiation hazard limits shall be in accordance with the requirement of MIL-R-9673.

c. Acoustic Levels. All technical equipment supplied to AFGWC shall be designed so that facility and equipment noise is controlled per MIL-STD-1472A. The noise level in console and work areas shall be not more than 15 db above audible threshold.

d. Temperature and Humidity Control. The relative humidity shall be not less than 30 percent nor more than 60 percent. The effective temperature shall range between 67°F and 69°F when heating or humidification is required, and between 69°F and 73°F when cooling or dehumidification is required. At least 15 cubic feet of fresh air per minute per person should be provided from an outside source.

e. Lighting. Lighting in work areas shall provide uniform brightness sufficient to do the task. This requires providing illumination of 2.5 candles per square inch, providing no glare and having an environment which limits brightness ratios by 3 to 1 between central visual area and immediate adjacent area with 10 to 1 otherwise.

(A922-2) The consoles shall be arranged so that traffic does not interfere with operations.

3.5.6.3 Storage and Support (A93)

(A93-1) This area considers the allocation of hardware and material within the facility area already defined. The impact of this hardware as well as security restraints and accessability shall be considered.

3.5.6.3.1 Floor Plan (A931)

(A931-1) The ultimate placement of equipment on the AFGWC premises shall be dictated by security requirements, cable instructions, human

factor considerations, and individual vendor requirements. Since the vendor or vendors who will eventually supply the equipment are unknown at this point it would be useless for us to specify the exact placement of architectural components. A sample analysis has been performed however, in Volume 4 of this document, trade study A93-1, to demonstrate that adequate facility space is available.

(A931-2) The variable access perimeter shall be physically contiguous with both the special access and normal access perimeters.

(A931-3) Normal access programmer, studies and analysis, and forecaster areas shall be outside of the normal access perimeter but in designated work areas.

(A931-4) The network control console shall be on the main floor of the AFGWC facility.

(A931-5) Hardware components of the new architecture shall be placed within the current building boundaries and no major reconstruction will be needed.

(A931-6) Noisy hardware components (e.g. printers) shall be isolated when necessary to comply with noise specifications (see A922-1).

(A931-7) Walking distance of console operators shall be minimized.

(A931-8) Hardware component connections will be arranged to minimize cost.

3.5.6.3.2 Structure (A932)

(A932-1) The data system shall require no major structural changes. The only structure changes required by proposed data system other than

those dictated by security requirements shall be identified and specified along with the component.

3.5.6.3.3 Access (A933)

(A933-1) Present access routes shall be maintained.

3.5.6.3.4 Security (A934)

(A934-1) The entire classified data system including all primary data base storage shall be in a vaulted area. If hardware components are arranged in a configuration comparable to that suggested by trade-study A93-1 the following security perimeters would result:

a. The normal access perimeter would include rooms 14, 15, 16, 17, 20, and L30 for hardware.

b. The variable access perimeter hardware would involve only room 38.

c. The special access perimter components would be situated in room 43.

(A934-2) Consoles utilizing classified information shall be placed behind screens or located so that classified information cannot be easily viewed by visitors.

3.6 PERSONNEL (A70)

(A70-1) Potential growth of the data system within the 1982-87 time frame shall require no increase in personnel.

3.6.1 Mission Support Positions (A71)

(A71-1) The network control console shall be manned by a senior officer well versed in computer networks, inter-computer communications, system scheduling, and the time and resource requirements of key AFGWC programs. He shall be assisted as required by one senior enlisted man to support him in the operation of network control console equipment.

(A71-2) The operations control consoles shall each be manned by a senior enlisted man trained in the specific operating characteristics of the selected processor systems and directly related components. He shall be assisted as required by a senior enlisted man to support him in the observation and operation of operations control console equipment.

(A71-3) The security control consoles shall each be manned by a senior officer who is thoroughly familiar with security classification aspects of applicable programs, communications, and personnel.

(A71-4) The communications consoles shall each be manned by a senior enlisted man who thoroughly understands internal and external system communications aspects, message protocols and priorities, and features of associated equipments. He shall be assisted as required by a senior enlisted man to support him in the observation and operation of communcations console equipment.

(A71-5) The SID console shall be manned by an officer who is oriented in the behavior of computer system components, such as support

processors and data base organization. He shall also be familiar with internal and external communications characteristics, satellite data user requirements, and the nature and features of digital data as received from meteorological satellites. He shall be assisted as required by a senior enlisted man to support him in the observation and operation of SID console equipments.

(A71-6) The maintenance consoles shall each be manned part time by an enlisted man who is thoroughly familiar with the features of the main processor, array processor, associated memories, and other directly related components. He shall function as an experienced computer operator who can assess processor subsystem behavior via available register and status displays, and take corrective action as required.

3.6.2 Mission Operations Positions (A72)

(A72-1) The TAF/METWATCH consoles and the military weather advisory console shall each be manned by two enlisted men of moderate experience in synoptic meteorology and in satellite data interpretation. These enlisted men shall generally have detailed experience in assigned geographical areas, but limited exposure to other areas.

(A72-2) The synoptician consoles shall each be manned by a junior officer and a senior enlisted man who have broad experience in synoptic meteorology, dynamic meteorology, and characteristics of larger geographical areas than those assigned to TAF/METWATCH and military weather advisory personnel.

(A72-3) The special access forecaster consoles shall each be manned by a senior enlisted man experienced in synoptic meteorology and satellite data interpretation. He shall also be experienced in dynamic meteorology and in all applicable facets of the computer system.

(A72-4) The special access SESS console shall be manned by an officer who is heavily experienced in geophysical forecasting and extraterrestrial phenomena, with a background in meteorology, ionospheric forecasting, and solar flux forecasting.

(A72-5) The normal access SESS console shall be manned by an enlisted man who shall function as a data base monitor and geophysical forecaster. He shall be thoroughly familiar with the construction and format of applicable input/output data, ranges of these data, and other appropriate data base aspects.

(A72-6) The quality assurance console shall be manned by a senior enlisted man or junior officer who shall be well versed in the interpretation of applicable statistical information regarding data base organization and usage.

(A72-7) The programmer consoles shall be manned by a variety of enlisted men and junior officers from the Automation Branch, SESS Branch, and Studies and Analysis Branch, who shall use these consoles in the development of new programs and in the maintenance of existing software.

(A72-8) The special operations forecaster console shall be manned by two senior enlisted men who have wide backgrounds in synoptic meteorology and satellite meteorology, and shall be well trained in a variety of key user requirements, such as computer flight plan processing, CFLOS/CLOS, etc.

3.6.3 Training (A73)

(A73-1) A training plan shall be prepared, and training programs shall be instituted and maintained to meet the personnel requirements indicated in sections 3.6.1 and 3.6.2 above. The numbers and sources of personnel to be so trained shall be in accordance with the information presented in Table 1.

TABLE 1. CONSOLE PERSONNEL ALLOCATIONS

CONSOLE WORK CENTER CATEGORY	FUNCTION	MAXIMUM PERSONNEL PER CONSOLE	PERSONNEL SLOTS PER SHIFT	TOTAL SLOTS	PRIMARY AFGWC ORG.
Mission Support	Network Controller	2[1]	2	10	WPD
	Operations Controller	2[1]	4	20	WPD
	Security Controller	1	2	10	WPD,WPJ
	Communications Controller	2[1]	4	20	WPD
	SID Controller	2[1]	2	10	WPP
	Maintenance	<1[2]	2[2]	10	WPD
Mission Operations	TAF/MET	2	30	150	WPF
	Military Wx. Adv.	2	2	10	WPF
	Synoptician	2	10	50	WPF
	Forecaster (SP Access)	1	3	15	WPJ
	SESS (SP Access)	1	1	5	WPE
	SESS (Nor Access)	2	2	10	WPE
	Quality Assurance	1	1	5	WPD
	Programmer	A S R E Q U I R E D			WPD,WPA,WPX
	SP POS Forecaster	2	2	10	WPF
			67[3]	335[3]	

[1]Maximum manning capability. Under normal conditions, 1 man operations are required.

[2]An average of 2 of 5 maintenance consoles are expected to be manned at a time.

[3]Plus use by Automation Branch, Studies and Analysis Branch, and Special Projects Branch personnel as required.

3.7 FUNCATIONAL AREA CHARACTERISTICS

3.7.1 Data Storage (A10)

3.7.1.1 Storage Devices (A11)

3.7.1.1.1 Support Disk (A111)

(A111-1) Disks that support the normal access forecaster consoles (TAF/METWATCH, Synoptician, and Military Weather Advisory consoles) shall be capable of storing at least 1.6×10^8 characters of user data.

(A111-2) Disks that support normal access printers shall be capable of storing at least 10^8 characters of user data.

(A111-3) Disks that support the special access forecaster consoles shall be capable of storing at least 1.6×10^8 characters of user data.

(A111-4) Disks that support the special access printers shall be capable of storing at least $.5 \times 10^8$ characters of user data.

(A111-5) Disks that support the Satellite Imagery Dissemination support processor shall be capable of storing at least $.4 \times 10^8$ characters of user data.

(A111-6) Normal and special access forecaster support disks shall be identical and disk packs shall be interchangeable between drives.

(A111-7) Normal and special access printer support disks shall be identical and disk packs shall be interchangeable between drives.

(A111-8) Satellite Imagery Dissemination support disks shall have interchangeable packs.

(A111-9) All support disks shall have the following characteristics:

Average head positioning (seek) time	- at most 40ms
Maximum head positioning (seek) time	- at most 70ms
Average rotational delay	- at most 15ms
Maximum rotational delay	- at most 30ms
Maximum access time to a single record	- at most 100ms
Startup/shutdown time to change packs	- at most 60 sec.
Transfer rate	- at least .5 x 10^6 char/sec

3.7.1.1.2 Fixed Head Disk (A112)

(A112-1) Each main processor system shall have locally attached high speed direct access storage.

(A112-2) The operating system, roll-in/roll-out areas, model scratch areas, and some data base areas shall reside on these fixed head disks.

(A112-3) The total storage capacity shall be at least 32 x 10^6 characters physically separable into two 16 x 10^6 character storage areas such that each half of a main processor system, a uniprocessor, has physically separate access paths to data in these areas, and data in each half is physically separate.

(A112-4) Each uniprocessor shall not be capable of accessing the other's data area (16 x 10^6 characters) when the main processor is segmented into separated mode by the multiprocessor switch.

(A112-5) It shall be possible to switch either half of the storage area to either of the uniprocessors at the time the multiprocessor is segmented.

(A112-6) When not operating in separated mode, each uniprocessor shall be capable of accessing the entire 32×10^6 character storage area.

(A112-7) The total 32×10^6 character storage area shall be cleanable within 30 seconds by writing random 1's and 0's three times over the total storage area.

(A112-8) The storage area shall be capable of two simultaneous transfers, one per uniprocessor when the main processor system is operated in separated mode.

(A112-9) The individual storage devices used to hold the 32×10^6 characters shall have the following characteristics:

Average rotational delay	- at most 10ms
Maximum rotational delay	- at most 20ms
Maximum access time to a single record	- at most 20ms
Transfer rate	- at least $.5 \times 10^6$ char/sec

3.7.1.1.3 Combination Disks (A113)

(A113-1) Combination disks shall consist of both a fixed head access area as well as a movable head access area under control of the same control unit.

(A113-2) Combination disks shall be separated onto control units according to classification levels, e.g., Top Secret disks shall have their own control units, and Secret disks shall have their own control units (see section 3.1.7.1.2.1 Security for the number of levels).

(A113-3) The combination disks shall have storage to accommodate data described in Table 2.

TABLE 2. Combination Disk Storage

CLASSIFICATION	STORAGE DESCRIPTION	VOLUME (in characters x 10^6) FIXED HEAD	MOVEABLE HEAD
Unclassified	Communications	3	57
	Job Parameters	3	27
	Consoler	-	120
	Scratch	-	330
	Program Absolutes	-	120
	Tape Spooling	-	120
Confidential	Communications	1.5	28.5
	Job Parameters	1	29
	Scratch	-	120
	Tape Spooling	-	120
Secret	Communications	1.5	28.5
	Job Parameters	1	28.5
	Overlay Data Base	-	120
	Scratch	-	120
	Tape Spooling	-	60
Top Secret	Communications	1.5	58.5
	Job Parameters	1	29
	Scratch	-	180
	Tape Handling	-	90
Top Secret SIOP	Job Parameters	2.5M	27.5
	Overlay Data Base	-	120
	Scratch	-	120
	Tape Spooling	-	60
Special Access-1	Communications	1	59
	Job Parameters	1	29
	Scratch	-	240
	Consoles	-	120
	Overlay Data Base	-	120
	Network Control	-	117
Special Access-2	Communications	1.5	58.5
	Job Parameters	1	29
	Scratch	-	120
	Tape Spooling	-	120
Special Access-3	Communications	1.5	58.5
	Job Parameters	1	29
	Scratch	-	120
	Tape Spooling	-	120

(A113-4) The combination disks shall have the following characteristics:

Average head seek positioning time	- at most 25ms
Maximum head seek positioning time	- at most 50ms
Average rotational delay	- at most 10ms
Maximum rotational delay	- at most 20ms
Maximum access time to a single record for fixed head area	- at most 20ms
Maximum access time for single record for movable head area	- at most 70ms
Startup/shutdown time to change packs	- at most 60 sec
Transfer rate	- at least $.8 \times 10^6$ char/sec

(A113-5) Combination disks shall have removable and interchangeable packs, at least for the movable head storage.

3.7.1.1.4 Satellite Disk (A114)

(A114-1) The satellite disks shall store the following volumes of raw data for each satellite type:

DMSP	smooth	96×10^6 characters
	fine	540×10^6
TIROS-N		96×10^6
GOES		372×10^6

3.7.1.1.5 Bulk Disk (A115)

(A115-1) Bulk disk shall be used to store the central meteorological data base of 1020×10^6 characters of meteorological data, plus any overhead or redundant data.

(A115-2) Data on bulk disk shall be backed up redundantly on line.

(A115-3) Additionally, data on bulk disks shall be backed up in the mass storage facility (see section 3.7.1.1.7).

3.7.1.1.6 Tape Units (A116)

(A116-1) There shall be separate tape subsystems for the normal and special access areas.

(A116-2) There shall be the capability in the normal access area to read and write data at the following densities and with the following technique:

7-track	200, 556, 800 BPI	NRZI (non-return to zero, IBM)
9-track	800 BPI	NRZI
	1600 BPI	PE (phase encoded)
	6250 BPI	GCR (group coded recording)

(A116-3) There shall be the capability in the special access areas to read and write data at the following densities and with the following techniques:

9-track	800 BPI	NRZI
9-track	800 BPI	PE
9-track	1600 BPI	GCR

(A116-4) Within a perimeter, tape drives shall be switchable between all control units; the switching mechanism shall be manual and security verifiable.

(A116-5) Tape drives shall have a visible indicator that shows the security level of the control unit (and hence the data base) to which the tape drive is attached. This indicator may be triggered automatically by the switching of a tape to a control unit, or may be set from network control.

(A116-6) There shall be a minimum of eight tape drives in the normal access area (plus spares for reliability); the majority of the tape drives shall be capable of recording data at 6250 BPI.

(A116-7) There shall be a minimum of six tape drives in the special access area (plus spares for reliability); the majority of the drives shall be capable of recording data at 1600 BPI.

3.7.1.1.7 Mass Storage Facility (A117)

(A117-1) The Mass Storage Facility shall be capable of storing a minimum of 35×10^9 characters of information of unclassified data.

(A117-2) The Mass Storage Facility shall have an access time of no greater than 60 seconds for a quiescent system.

(A117-3) The Mass Storage Facility shall be capable of transferring at least two data sets simultaneously to disk.

(A117-4) The Mass Storage Facility shall be capable of transferring data out at disk transfer rates.

(A117-5) The Mass Storage Facility shall provide a means of inhibiting writing on selected data sets; at a minimum, this capability shall exist for 5 billion of the 35 billion characters of data.

(A117-6) The Mass Storage Facility shall be under the control of the central data base manager.

(A117-7) Control of the Mass Storage Facility shall be switchable to the backup centralized data base manager.

(A117-8) The Mass Storage Facility shall be capable of switching to the backup central data base manager and recovering to full operation within 120 seconds.

(A117-9) The Mass Storage Facility shall be capable of presenting status to the central data base manager upon polling. Such data information should indicate whether or not the Mass Storage Facility is still active, and the condition of any failed units within the device.

(A117-10) The Mass Storage Facility shall stage data sets to and from disk on command from the central data base manager.

(A117-11) The Mass Storage Facility shall be capable of accepting pre-mount messages for prestaging of data sets (these may be routed through the central data base manager). These data sets shall remain on disk until the Mass Storage Facility is notified that the function which was using them has finished. At that time they shall be subject to destaging.

(A117-12) The Mass Storage Facility shall have an algorithm to optimize the use of disk space, e.g., destage data based on the least-recently-used algorithm.

(A117-13) Data sets which are destaged shall be available for immediate restaging to disk.

(A117-14) The Mass Storage Facility shall provide a positive means of eliminating any accidental staging or destaging of the wrong data set.

(A117-15) The Mass Storage Facility shall provide the capability to have certain data sets permanently resident on disk with backup copies created as follows: a) automatically at given time intervals, b) whenever the data set is modified. Each backup shall be kept on line for up to three generations, after which the oldest generation shall be ejected for archiving or optionally, written over.

(A117-16) The Mass Storage Facility shall be capable of directly interfacing with the central meteorological data base (bulk disk) but need not interface directly with any other unclassified disks.

(A117-17) Non-staging drives and staging drives shall be capable of being mixed on the same control unit. Non-staging drives are those which the Mass Storage Facility cannot use for staging and destaging of data sets.

(A117-18) The Mass Storage Facility shall require no manual, i.e., operator intervention for normal staging and destaging of data sets.

(A117-19) The Mass Storage Facility shall be capable of ejecting and accepting data cartridges.

(A117-20) The Mass Storage Facility shall provide an automatic means of identifying volumes which are ejected.

(A117-21) The Mass Storage Facility shall automatically verify the volume label(s) of any cartridges entered into the Mass Storage Facility.

(A117-22) The Mass Storage Facility shall be capable of being opened for manual retrieval of all data cartridges, if that becomes necessary.

3.7.1.1.8 Low Capacity Storage Device (A118)

(A118-1 The low capacity storage device shall have the capability to store at least 100,000 characters of information.

(A118-2) The low capacity storage device shall have a transfer rate of at least 100,000 bits/second.

(A118-3) It shall be possible to directly access any recorded message on the low capacity storage device without sequentially passing through all previously recorded messages; the average access time to a record shall be less than 10 seconds.

(A118-4) It shall be possible to remove the media from one low capacity storage device system and insert it into another within 10 seconds.

(A118-5) The media shall be protected from contamination during transfers between systems, without requiring operator action or handling to cover the media.

(A118-6) A pair of low capacity storage devices shall be associated with the support consoles as identified in section 3.7.5.1.

3.7.1.2 Memory (A12)

3.7.1.2.1 Main Processor Memory (A121)

(Additional memory considerations are listed in section 3.7.3.1.1 "Main Processor".)

(A121-1) Main Processor shall have sufficient main and auxiliary (extended) memory to support the functions outlined below:

Function Description	Memory Required (in charx10^6)
Average memory per processor required for 1982 normal access load based on peak load scenario and three 3.5RP multiprocessors	4.3
Round-up factor to protect against unbalanced memory usage	.7
Network Control Interface	.25
Array Processor work area in host memory	1.0
Data base management, software development support, or continuity of operators processing	.5
Forecaster jobs, support processor interface word, or communications processing	.5
Normal Access Total (per system)[1]	7.25
Special Access functions based on 1982 peak scenario	3.0
Network Control	.5
APM[2] and Array Processor Work Area	2.0
Forecaster support	.5
Communications processing	.5
Special Access Total[1]	6.5

[1] Less operating system areas.

[2] APM stands for "Advanced Prediction Model".

(A121-2) The variable perimeter shall have the larger of the two memory sizes between normal and special access.

(A121-3) Processor memory shall be sufficient to run the above requirements when the multiprocessor is segmented into uniprocessors, i.e., when there are two independent copies of the operating system.

3.7.1.2.2 Support Processor Memory (A122)

(A122-1) The support processors shall be provided sufficient memory to hold the operating system, real-time console support program, and console support buffers; additionally, at least 64×10^3 characters of unused memory shall be provided.

(A122-2) Memory for the support processors shall be field expandable to a minimum of 10^6 characters ($.5 \times 10^6$ characters for the operations center support processor) with no impact on software.

(A122-3) The memory element of the satellite data support processor computer(s) shall have the characteristics and features specified below.

a. Memory shall be structred such that concurrent access to memory by the CPU and I/O channels is allowed.

b. A minimum of one parity bit per word shall be stored in memory and checked by hardware upon readout. If parity is incorrect, an internal CPU interrupt shall be activated.

c. The initial configuration shall include memory of no less than 10^6 characters. At least $.5 \times 10^6$ characters of unused memory shall be available when loaded with the operating system and programs for real-time data ingestion.

3.7.1.2.3 Array Processor Memory (A123)

(A123-1) The dedicated array processor memory shall be sufficiently large to not degrade the processor in computation speed based on the individual characteristics of the array processor proposed.

(A123-2) The array processor instructions for high speed arithmetic shall be executed as microcode from a microstore.

(A123-3) The basic size of microstore shall be sufficient to execute a fast Fourier transform algorithm for 1024 complex points without paging of microstore contents.

(A123-4) The array processor shall be able to page instructions from local memory to microstore at local memory speed, or at the write speed of the microstore, whichever is the limiting factor.

(A123-5) The write cycle time of the microstore shall not exceed the read cycle time by more than a factor of 4.

(A123-6) The array processor shall contain a local (non-host) memory which is word addressable.

(A123-7) The word length of this memory shall be at least 32 bits.

(A123-8) The array processor shall be capable of detecting single bit parity errors in the local memory.

(A123-9) The array processor shall be reconfigurable to recover from a failure of a memory bank.

(A123-10) The array processor shall be capable of simultaneously loading operands from the host into one bank of local memory while

arithmetic elements are processing data from another, separate bank of local memory. (Alternatively, the bandwidth of local memory must be sufficient to insure simultaneous loading of operands from the host while arithmetic elements are fetching/storing operands from/to local memory without degradation of arithmetic element throughput.)

(A123-14) The bandwidth of the bus from local memory to arithmetic elements shall be sufficient to insure that all arithmetic elements can be kept busy simultaneously, i.e., transfer of operands and results shall be overlapped with computation.

3.7.1.2.4 Auxiliary Memory (A124)

(See pertinent specifications in paragraphs 3.7.1.2.1 "Main Processor Memory.")

3.7.1.3.1 Data Base Structure (A131)

(A131-1) Data base structure of the central meteorological data base shall be such as to support all requirements of internal users and external users of AFGWC, for example, forecaster and programmer support consoles, ETAC, Carswell, and WWMCCS requirements.

(A131-2) Data base structure shall accommodate classified overlays to the general unclassified meteorological data base, as described in section 3.7.1.3.2.

(A131-3) Classified processors shall have minimal data base capabilities such that they add classified overlays to any unclassified data sets transferred by the central data base manager and filter data.

(A131-4) The data base structure shall be such that it can be rapidly accessed for all meteorological parameters within a geographical area or within a time window.

(A131-5) Meteorological data shall be stored on a continuous time scale rather than a discrete time scale.

(A131-6) Linkage shall exist for the locating of satellite as well as conventional data by geographic area and time.

(A131-7) Classified processors shall request data over a much wider geographic area than they actually require in order to camouflage the request.

(A131-8) Classified processors shall then prefilter the data down to the necessary element for the requesting job.

(A131-9) The data base structure shall accommodate a hierarchy of resources that can be reserved on a shared or exclusive basis via keys.

3.7.1.3.2 Data Base Management (A132)

(A132-1) Data base management shall be centralized.

(A132-2) The central data base management software shall have a ready backup which shall be located on a separate main processor system from the active central data base manager.

(A132-3) The central data base management software shall maintain its status and all information necessary for recovery redundantly on disk units (attached to separate controllers) that are unclassified and can be shared with the backup data base manager.

(A132-4) Central data base manager shall have sole direct access to the central meteorological data base.

(A132-5) The central data base manager shall be responsible for control of the Mass Storage Facility.

(A132-6) Any Mass Storage Facility software shall reside on the central data base management processor.

(A132-7) The central data base manager shall accept requests for data via control-only data lines and shall return such data to the requestor.

(A132-8) Central data base manager shall accept requests for data from all main processor systems and from the forecaster consoles' support processor.

(A132-9) The central data base manager shall reside in the Normal Access perimeter.

(A132-10) The central data manger shall accept requests form the special access perimeter in the form of gridded systems, such as World Aeronautical Chart charts.

(A132-11) The central data base manager shall be able to prioritize requests for data according to tables supplied to the central data base manager by network control.

(A132-12) The central data base management shall maintain the meteorological data base redundantly on-line and shall update both copies at all times.

(A132-13) Selected subsets of stored data shall be fully recoverable in the event of system malfunctions. These data shall be those necessary to implement an alternate contingency configuration required to meet time dependent operational requirements.

(A132-14) The capability shall exist to filter or limit the data present in the data base under data base control.

(A132-15) The data base configuration shall be designed such that changes in system software and/or hardeware minimize changes in data storage operations.

(A132-16) There shall be a single unclassified data base with classified overlays contained in data bases associated with the classified processors.

(A132-17) Storage usage shall be optimized for computer program efficiency and data storage capacity.

(A132-18) Data base presentations shall be logical and designed with respect to storage efficiency as well as program efficiency.

(A132-19) The central data base manager shall make use of redundant copies in order to expedite requests for data.

(A132-20) Data base changes of a minor nature shall be allowed without recompiling computer programs except for the direct data base interface programs.

(A132-21) Operational data storage standards and conventions shall be defined and implemented to establish sets of uniform procedures for all AFGWC data storage users. The overall objectives of these data storage standards and conventions shall be to establish acceptable methods and techniques and practices that will maximize data storage operational efficiency and utilization.

(A132-22) Preprocessing and preformatting of data shall be accomplished where resources are available and the result is decrease of run time during potential peak load conditions and/or significant enhancement in the certainty of meeting the timing aspects of a requirements.

(A132-23) The data storage design shall include and/or accommodate a method for monitoring and accumulating data storage utilization data.

(A132-24) The capability shall exist on option to record access and usage statistics for all AFGWC data storage files.

3.7.2 Data Transfer and Routing (A20)

(A20-1) Each main processor subsystem shall have the following basic interfaces: a) the two-way control-only data link, b) a one-way parallel data upgrade link, c) a one-way input control-only link which loads the authentication memory, d) a one-way output link to the centralized computer operations subsystem, e) a two-way link to the computer operations keyboard, f) a two-way authentica- authentication-protected link with the appropriate storage subsystems. The standard tape link is a direct interface with the disk subsystems but if desired and justified the alternate tape configuration of the tape controllers will interface directly with the main processors, through appropriate authentication devices just like the disks.

(A20-2) The following data links shall exist, depending on the specific main processor subsystem: a) the network control shall interface with the network control console; b) the network control console shall have an output control-only data link to load the authentication memories, which is triggered by the network control processor; c) the potential backup network control and backup data base management processor systems shall interface with the programmer subsystem; and d) the number of connections between the master data base processor and the parallel upgrade data link shall be the maximum that can be afforded or the maximum which the master data base processor can logically accommodate simultaneously, whichever is smaller.

(A20-3) The design shall be structured such that there is a principal interface between the master data base processor with each main processor and each data base. Interface shall be accomplished using control-only requests and the upgrade data link.

(A20-4) The operations console input device shall be directly interfaced with the operations input support processor.

(A20-5) The operations console output devices shall be directly interfaced with the operations output support processor.

(A20-6) The following operator wait times (including computation and transfer) shall be goals in the AFGWC data system design:

Network controller	1 second
Operations controller	1 second
Communications Controller	1 second
Programmer, forecaster and SID controller	10 seconds average and 30 seconds maximum

(A20-7) The following system response times shall be goals (where system response does not include actual passing of data):

Network control and operations control consoles	100 milliseconds
Master data base transfer requests	1 millisecond
Master data base transfer response	1 second minimum 3 seconds average 10 seconds maximum
Time to upgrade the security level of a processor	1 second minimum 2 seconds average 30 seconds maximum
Time for network control to retrieve a job and place it in consideration with other jobs	100 milliseconds

Time for a processor to obtain a message to be processed	1 second
Time for external consoles to make resource requests	100 milliseconds
Time for remote support areas to interface with system data base	100 milliseconds

(A20-8) There shall be tape units and tape controllers in the architecture. Two vendor options are documented in the specification. In the "primary option" (the one which should be implemented if economically and technically feasible) the tapes interface with and transfer data directly to disks. In the "alternate option" tapes will interface directly with the main processors separated by encoding/decoding authentication devices in a manner exactly equivalent to the disks.

3.7.2.1 Hardware Linkages (A21)

3.7.2.1.1 Secured (A211)

(A211-1) There shall be secured links within the system specified at each of the system security levels over which no data at a higher level shall be allowed to pass.

(A211-2) Security integrity shall be protected via an authentication encoding technique where the data stream is encoded and non-recognition after decoding by the receiving device shall result in an assumption of non-validity. Once the data is deemed invalid and it is assured that this is the case, then data transmission is stopped and network control notified.

(A211-3) Authentication shall be accomplished by recognition of data header and structure which has undergone a transformation via an encoding chip.

(A211-4) The ability to encode or decode shall be determined by a key which is provided only from a key generator excepting input from the network control console or via the network control computer. (Even if a mistake is made the system is protected at the level it is assigned; no lower level has access to it and no higher level data can be accessed by it.)

(A211-5) Transfer resulting in routing shall make security violations physically impossible by means of hardware authentication and authentication encoding.

3.7.2.1.2 Unsecured (A212)

(A212-1) There shall be data lines in the system always assumed to be at a certain security level where sending and receiving devices are always at the same level and decoding is not required. These are called unsecured data lines.

3.7.2.1.3 One-Way (A213)

(A213-1) There shall be data lines either secured or unsecured in which data are allowed to travel only in one direction. Associated with these lines there may be a control-only data line where acknowledgment or nonacknowledgment of data receipt may be expressed.

3.7.2.1.4 Control-Only (A214)

(A214-1) A control-only data line shall exist in the system where only prespecified data may be transmitted in a predetermined manner. This is accomplished by a data delimiter device which also acts as a switch for data routing.

3.7.2.1.5 Upgrade (A215)

(A215-1) An upgrade data link is one in which data may travel to an equal or higher level security level but may never be downgraded.

3.7.2.1.6 Downgrade (A216)

(A216-1) A downgrade data link is one in which manual intervention by security controller certification and manual switching shall allow data to be transferred from a higher to a lower security level.

3.7.2.2 Security Separation (A22)

(A22-1) Network control only shall have the capability to change the key associated with the processors. It may be changed automatically by the network control processor or manually by the network controller.

(A22-2) A single key memory shall be associated with each uniprocessor or with each dual processor system when operating in that mode such that all authentication encoders and decoders will utilize the key from that single memory. Authentication shall not degrade channel speeds nor the ability of devices to establish and maintain communications.

(A22-3) There shall be authentication encoders associated with classified disk subsystems and with the upgrade data link. They shall, where possible, obtain the authentication key from a memory common to consistent classification levels. These keys shall be set manually from the network control console.

3.7.2.2.1 Authentication Encoder (A221)

(A221-1) The authentication encoder shall be a device which transforms data according to some algorithm; e.g., the Bureau of Standards data

encryption standard (DES) algorithm, where the transformation is unique and repeatable according to the same key.

(A221-2) Encoders which always have common security level may obtain the key from a common key memory.

(A221-3) Main processor key memories shall be loaded by a key generator under the control of the network control computer.

(A221-4) There shall be a key-change lockout capability for key memories associated with a processor system's I/O parts, thus disallowing the decoder to be downgraded until such time as it is ensured that the processor system has been cleaned and is available for downgrade.

(A221-5) The capability shall exist to be able to reconfigure the security level of all encoders associated with a given memory in approximately 10 milliseoncds, assuming that all lock out conditions are not in effect.

(A221-6) There shall exist, associated with data base systems, authentication encoders which do not have to be key changed by the network control computers but rather in which the key may be set manually by the network controller.

(A221-7) A key change in these devices shall take a minute or less to accomplish.

3.7.2.2.2 Authentication Decoder (A222)

(A222-1) There shall be authentication decoders which may or may not be the same unit as the authentication encoders but which operate off of the keying scheme with the same timing and lockout characteristics as the encoder.

3.7.2.2.3 Cascading Encoder/Decoder (A223)

(A223-1) There shall be a cascading encoder/decoder device which is part of the upgrade processor capability. This allows an independent hardware function through the upgrade-only device which allows upgrading from any level to any other level with certain exceptions: TS-SIOP cannot be upgraded to any of the special access areas, and the two lower special access levels (SA2 and DA3) cannot be upgraded to the other (SA1).

(A223-2) Upgrade shall be accomplished so as not to slow down the processing of data at channel speed.

3.7.2.2.4 Clean Lockout (A224)

(A224-1) There shall be a lockout device which is non-software that disallows downgrading of a processor from one level to the lower level until the entire processor system (including array processor, main processor, main memory, fixed head disks, and controllers), has been totally cleaned.

3.7.2.2.5 Unclassified Lockout (A225)

(A225-1) There shall be a lockout which disallows the loading of a classified key into a processor system key memory as long as the processor is hooked to an unclassified data connection.

3.7.2.2.6 Information Delimiter (A226)

(A226-1) There shall be a device used in the control-only data link which has the following capabilities:

a. Compares incoming data words against a prespecified set of acceptable words. If a comparison is not made, it asks for a retransmission of the data, and if the data still are not

valid, network control is notified of a control-only data violation.

b. Recognizes patterns and logical sequences of data coming over the control data line. If these patterns are disturbed or the sequence is broken network control is notified.

c. Checks the rate at which data are transmitted over this line to insure that it is compatible with normal line usage. If a violation results network control is notified.

3.7.2.3 Controllers (A23)

(A23-1) For the combination, satellite and bulk disk controllers the capability shall exist to handle multiple accesses from different processors on either a priority or "first come first served" basis.

(A23-2) To the greatest extent possible, all control units shall present a standardized hardware interface to processors. One suggested interface is the IBM plug compatible channel interface.

3.7.2.3.1 Support Disk Controller (A231)

(A231-1) A standard controller shall be used for interface between the support processors and the primary memory source, the support disks.

(A231-2) The disk control unit configuration that supports each of the following areas shall be capable of at least two simultaneous data accesses with transfer (per area):

a. Normal access forecaster consoles
b. Special access forecaster consoles
c. Normal access printers
d. Special access printers

3.7.2.3.2 Fixed Head Disk Controller (A232)

(A232-1) A standard controller shall be used as interface between the main processors and the fixed head disk systems.

3.7.2.3.3 Combination Disk Controllers (A233)

(A233-1) There shall be a standard controller to interface with the combination disk.

(A233-2) The disk control unit configuration that supports each of the following areas shall be capable of at least two simultaneous data accesses concurrent with two data transfers (per area):

a. Normal access unclassified
b. Normal access confidential
c. Normal access secret
d. Normal access top secret
e. Normal access top secret SIOP
f. Each of the three special access security levels

(A233-3) The controller shall be a standard controller in combination with a multiported switch or it shall have additional ports to handle up to 64 processor channels.

3.7.2.3.4 Satellite Disk Controller (A234)

(A234-1) There shall be a standard controller which interfaces with a satellite disk.

(A234-2) The satellite disks shall be capable of recording the following data simultaneously:

DMSP vehicle 1	smooth	6.36×10^4	(36 bit words/sec) for 10 minutes
	fine	$6.65 \times .0^4$	(36 bit words/sec) for 10 minutes
vehicle 2	smooth	6.36×10^4	(36 bit words/sec) for 2-5 minutes
	fine	6.65×10^4	(36 bit words/sec) for 10 minutes
TIROS-N vehicle 1	smooth	2.66×10^6	bits/sec for 10 minutes
vehicle 2	smooth	2.66×10^6	bits/sec for 10 minutes
GOES visible		1.747×10^6	bits/sec for 15 minutes
IR		$.524 \times 10^6$	bits/sec for 15 minutes

DMSP and TIROS-N storage shall be capable of simultaneous ingest and access for gridding and mapping.

3.7.2.3.5 Bulk Disk Controller (A235)

(A235-1) There shall be a standard controller to interface with the bulk disk.

(A235-2) The disk control unit configuration that supports the central meteorological data base (bulk disk) shall be capable of at least four simultaneous accesses to data; concurrent with the four data accesses, the disk control unit configuration shall be capable of supporting at least two simultaneous data transfers.

3.7.2.3.6 Tape Unit Controller (A236)

(A236-1) In the primary option for tape interface (see A20-8) a tape unit controller shall be a special controller with the properties similar to that of the Mass Storage Facility controller. It

shall have the ability to interface directly with the combination disk controller and to effect the writing of data onto the fixed head part of the combination disk. The data shall also be written in a cyclic manner so adequate time is allowed for data to be moved into the variable head portions of the disk or into the processor prior to overlap of data write.

(A236-2) In the primary option the capability shall exist under activation by the processor to move data from the combination disk directly onto tape in a format such that it can be later retrived as described above.

(A236-3) If the alternative tape configuration is selected then the tape controller shall be a standard controller allowing connection between the processor and the tape units with authentication decoders between the controllers and the processors.

(A236-4) There shall be tape control units (and their backups as necessary to meet reliability requirements) for each security level within the normal and special access perimeters (see A-821 section 3.1.7.1.2.1 Security for the number of levels).

3.7.2.4 Interface (A24)

3.7.2.4.1 Connection (A241)

(A241-1) Processor systems shall be linked to appropriate disk systems through dedicated switches. These shall be two way data links and shall contain authentication encoding/decoding capabilities. When communicating with a classified disk system the data are encoded by the processor then decoded by the disk system. In the case of the unclassified disk it is still encoded by the processor but there is no coding/decoding device associated with the

unclassified disk. If the processor is operating as unclassified then "encoding" actually has no effect on the data.

(A241-2) There shall be a link between each processor and the appropriate operations center, i.e., processor system 1 shall be hooked up with operation center 1, processor system 2 with either operation center depending on the state of the variable perimeter switch and all other processor systems shall be connected to operation center 2.

(A241-3) There shall be an upgrade data link which allows input of data from all external positions (except for the programmer console) and all main processors and has an output to each processor and each classification specific disk system. If classified sources, these connections shall have encoders/decoders at the appropriate level.

(A241-4) There shall be a control-only link from each of the support processors and each of the main processors with the control-only support processor.

(A241-5) There shall be a link between each of the line handler/decoder routers and the appropriate level disk controllers.

(A241-6) There shall be a link between the weather facsimile system and the unclassified disk system.

(A241-7) There shall be four support processor subsystems which support various activities as follows:

a. The special access perimeter subsystem consists of four processors, any one of which can support each of the following:

1. printer, disk spooling for printer support, low capacity storage device for security downgrade and operations center CRT output using data as input from either of the special access main processors;

2. link between the operations center alphanumeric keyboard with the main processor subsystems and the upgrade data link; and

3. support of the security downgrade and remote job entry subsystem including the output low capacity storage device, the alphanumeric keyboard, the display CRT and output to the switch which connects at any security level to the upgarde data link.

b. The normal access perimeter subsystem shall have five support processors each of which shall support:

1. special operations console and the switch which links it to the normal access disk systems;

2. printer, disk spooling, low capacity storage device in the security downgrade area, and the operations CRT using as input any of the normal access main processors;

3. interface between the operations center, alphanumeric keyboard and the normal access main processors; and

4. support of the security downgrade position including output, low capacity storage device, alphanumeric keyboard, CRT for display and output over the selector switch connected to the upgrade link at any security level.

c. Two support processors shall support the special access consoles including the forecaster consoles, quality assurance consoles and SESS consoles along with a disk subsystem to allow interface with the upgrade and control only data links.

d. The normal access console and satellite support area shall be supported by four support processors any one of which can do each of the following tasks:

1. support of the TAF/METWATCH, MWA, SESS, synoptician consoles as well as disk support interfacing with a control-only and upgrade data link;

2. interface with the satellite imagery dissemination console and disk subsystem interfacing with the switch input into the satellite to subsystem controllers as well as the upgrade and control only data link; and

3. interface with satellite inputs from the DMSP, TIROS or GOES subsystems inputing data through the upgrade and control-only data links, including the switch interfacing with the satellite disk controllers.

(A241-8) There shall be a link between the programmer consoles and the switch which links them to the current backup data base processor.

(A241-9) There shall be a link between the mass storage facility and the unclassified disk packs which operates at disk transfer rate to support mapped and gridded satellite data storage, master data base storage, and unclassified data storage.

(A241-10) There shall be a link between the network control console and all of the potential network control computers.

(A241-11) There shall be a link between the network control computer and the key memories associated with each of the main processor systems.

3.7.2.4.2 Input/Output Ports (A242)

(A242-1) The availability of extra ports or devices shall be employed for the purposes of load leveling in the channel-bound functions (e.g., data base management, job scheduling, and query/response).

(A242-2) If sufficient ports are unavailable on disk systems to accommodate linkages specified elsewhere then a switching device which allows port queuing (or some other equivalent alternative to proposed schemes) shall augment the configuration.

3.7.2.5 Routing (A25)

3.7.2.5.1 Control-Only (A251)

(A251-1) There shall be a control-only data link between all processors and all processor systems which in addition links to the upgrade device. This control-only link shall have the following characteristics:

a. The routing device shall be a small processor which recognizes an initial header message identifying message destination.

b. The total information content of a standard computer word shall be limited to a small subset of that possible by either table look-up and checking mechanism or through word truncation (and standard assignment of meanings).

c. The control-only router shall report as a violation transmissions which are not pre-established control words and shall disallow passage of information if violations from a single device exceed a data base specified threshold.

d. The control-only routers shall recognize the frequency of messages from a single source and shall report as a violation cases where the frequency exceeds a data base defined threshold.

e. The control-only router shall examine each control word and determine its legitimacy based on what is to be expected after the preceding control words and report violations as before.

3.7.2.5.2 Upgrade Data (A252)

(A252-1) There shall be an upgrade data link which is one-way to and from each processor and to each classification of disk system, as well as from all equipment which can initiate jobs and outputting only to the network control computer, with the following characteristics:

a. The routing of data shall be accomplished at channel speeds.

b. The switch for routing purposes shall be a small processor which has access via a control-only data line to the classification level of each processor at each instant of time. Routing directions shall be provided over the control-only data link from each processor to the upgrade data router.

c. The data are taken out of one level of authentication code as required and placed in another level if required via a cascading set of chips (independent of the data router) within which it is only possible that data be upgraded or sent at the same level but never downgraded.

d. The device shall be used simply for the serialization of messages coming from all the sources providing them to network control in an orderly manner.

e. If routing information specifies a downgrade of data, an error response will be sent to the sending processor as well as the network control computer over the control-only data line.

3.7.2.6 Switching (A26)

3.7.2.6.1 Manual (A261)

(A261-1) The following manual switching capability shall exist:

a. Configuration of main processors from a dual to a uniprocessor mode. The switching shall be totally secured.

b. Configuration of array processors to either uniprocessor as host.

c. Place the variable perimeter from the normal perimeter to the special access perimeter. (This switch shall be locked out by software until the clean function and verification have been run.)

d. Allocation of memory to processors.

e. Allocation of disks to controllers.

f. Allocation of tape drives to tape controllers.

g. Selects data routing in the data downgrade consoles, the operation console, the special operations console, and the communications console.

h. Puts processors in an independent mode separating them from the network control computers.

i. Selects support processors for performing support functions including an initial assignment switch and an array backup switch where single processors carry on multiple functions.

j. Identifies the network control computer and the backup for network control and also assigns programmer support processor to the backup.

k. Assigns master data base processor and also assigns programmer consoles to the backup processor.

l. Assigns each of the uniprocessors to the maintenance console and simultaneously disconnects it from the rest of the system.

m. Assigns line handler/decoder routers to appropriate circuits.

n. Switches input/output ports and therefore peripheral sets.

o. Separates fixed head disk units so that each processor has physically separate access paths to these devices, and that data for each half is kept on separate devices.

p. Remote the system partitioning unit switches and the initial executive bootstrap switch to the network control console.

3.7.2.6.2 Automatic (A262)

(A262-1) There shall be no automatic physical (electronic connect/disconnect) switching; the only automatic switching shall be logical (e.g., change of security levels) through the use of the authentication key system.

3.7.2.6.3 Gang (A263)

(A263-1) The gang switching capability shall pertain to the following switching functions: variable perimeter, network control assignment,

backup network control assignment, master data base processor assignment, and backup master data base processor assignment.

3.7.2.6.4 Multiprocessor Switch (A264)

(A264-1) There shall be a switch which is totally secure to separate two sides of a multiprocessor system into two uniprocessor systems which may operate at different security levels.

(A264-2) The array processor shall be switchable to either half of the main processor system.

(A264-3) Each main processor system shall be physically separable into two distinct processor subsystems, each capable of independent processing. This separator shall be verifiable and acceptable from a security standpoint.

(A264-4) The memory shall be partitionable asymmetrically; that is, on a bank-by-bank basis such that each half may have differing amounts of memory.

3.7.2.7 Compatibility (A27)

(A27-1) For non-standard linkages there shall be a compatibility interface which does not degrade effective data rates beyond the maximum of the slowest unit in the interface.

(A27-2) For the purposes of a design proposal, any given computer equipment manufacturer shall have the responsibility of providing compatible interfaces between his hardware unit and any interfacing unit.

3.7.2.8 Merging (A28)

(A28-1) Data shall be merged or multiplexed where it is shown to be cost effective and consistent with the line data rates required.

(A28-2) Multiple users per line shall be accommodated where possible to optimize data flow.

3.7.2.9 Conceptual (A29)

3.7.2.9.1 Protocol (A291)

(A291-1) A protocol standard shall be adopted for AFGWC, as a goal, realizing that retained components may not be able to comply completely.

(A291-2) Processors shall assume appropriate linkages are made when network control assigns them a job and a security level.

(A291-3) Disk control shall be processed on a first come, first served basis.

(A291-4) Consoles and external subsystems interfacing with the disks shall treat this system as a service bureau where they provide the data, notify network control, wait for a control-only data response to indicate that their request has been fulfilled.

(A291-5) Once data are sent to an upgrade data level, the sending system shall monitor a request for retransmission over the control-only data link. At least one minute's data shall be maintained for retransmission.

(A291-6) All data transfer and routing operations shall identify the security level of the data involved and the data transfer and routing

shall be made in a manner that makes physical violation of its security level impossible.

(A291-7) The network control computer shall use a channel polling technique to send requests.

3.7.2.9.2 Routing (A292)

(A292-1) The control-only data link shall automatically know the sender of data.

(A292-2) The upgrade data link shall, when it receives data, receive a corresponding control-only message which indicates where the data are to be routed.

(A292-3) Data streams shall always identify their sender.

3.7.2.9.3 Acknowledgment (A293)

(A293-1) Acknowledgment for data sent over the parallel upgrade data link shall be over the control-only data link. Acknowledgement from non-smart devices such as disks shall be over the return data link.

(A293-2) Acknowledgement shall be phased so as not to slow down the passage of data.

3.7.2.9.4 Data Integrity (A294)

(A294-1) Parity and checksum generation and checking shall be accomplished in all data transfers.

(A294-2) Data transfer shall be intelligent to the extent that no data can be lost.

3.7.3 Computation and Software (A30)

3.7.3.1 Processors (A31)

3.7.3.1.1 Main Processors (A311)

(A311-1) The main processor system shall have at least 3.5 times the throughput of a Univac 1108 with maximum main memory, FH432 drum units, and 8440 disks, as demonstrated by one of the following three methods:

a. Paper and Pencil Analysis. The processor system shall be shown to have an effective MIP rate on the instruction mix, shown in Table 4, that is 4.0* times the U1108. The instruction rate may be adjusted for factors such as the following:

(1) Executive assist in microcode;
(2) I/O degradation of the CPU, or lack thereof;
(3) Faster peripherals than the U1108;
(4) More main memory than the U1108; and
(5) Hierarchical memory systems.

Any adjustments should be justified in detail and may be challenged.

*"4.0" instead of "3.5" to account for the high probability of error in paper and pencil analyses. "4.0" should be about one sigma above the mean, which is centered at "3.5".

b. Benchmark with Common Algorithms. The processor system shall be shown to have a throughput rate 3.75* times the U1108 on the following two algorithms:

(1) Matrix Inverstion. Inversion of a non-singular matrix of random numbers in single precision floating point of order 10 x 10, 100 x 100, 1000 x 1000, and 10,000 x 10,000.

(2) Sort/Merge. The sorting into ascending order of a stream of word-length, fixed-point numbers generated at random for the following quantities: 1 million (1M) words, 10M, 100M. The sort must use movable head disks for scratch areas.

c. Benchmark with Actual Programs. The processor system shall be shown to have 3.5 times the average throughput of a Univac 1108 based on the list of jobs shown in Table 3. The throughput shall be measured as the time from start of job stream to end of job stream; this shall be $\frac{1}{3.5}$ times as long as it takes for a U1108. The programs and the data base on which they operate shall be frozen as of some mutually agreed date, and the program source and data base copied to tape for use in the benchmark. All programs are written in FORTRAN.

The benchmark shall consist of running a set of FORTRAN programs which are representative of the AFGWC production cycle. There will be three main groupings of functionally connected

*"3.75" instead of "3.5" to account for the inherently higher probability of error in this benchmark technique than in option (3), but lower than option (1).

Table 3. Instruction Mix

Instruction	Percent of Occurrence
Fixed Point	
Loop overhead (such as branch on count)	10
Load Register	15
Store Register	15
Add/Subtract*	10
Branch (unconditionally)	10
Branch (conditionally)**	10
Multiply*	2
Divide*	2
Compare*	6
Total fixed point	80%
Floating Point	
Load	5
Store	5
Add/Subtract*	3
Multiply*	3
Divide*	2
Compare*	2
Total floating point	20%

*Register to register/register to storage mix shall be 50/50%, if applicable.

**Branch/no branch mix shall be 50/50%.

analysis and forecasting routines and a set of miscellaneous, non-related operations. The functions making up this collection and their relationships are described in Table 4. Predecessor/successor relationships expressed in this table must be honored but where none exist programs can be run in any order or combination, e.g., the northern hemisphere whole mesh forecast can be run with a computer flight plan and/or the CONUS boundary layer model.

(A311-2) Each main processor system uniprocessor shall be capable of acting as host to an array processor.

(A311-3) The main processor system shall have at least 3.5 times the throughput of an 1108 (as described previously) in addition to any throughput required for hosting the array processor.

(A311-4) The host/array processor combination shall be capable of running an Advanced Global Atmospheric Prediction Model in two hours of wall time. This model shall produce gridded forecasts at 2° lat/lon intervals and 12 pressure levels for 2 hour intervals out to 36 hours, and at 6 hour intervals from 36 to 72 hours. This Advanced Global Atmospheric Prediction Model may use either a spectral or finite difference approach to solving the equations of motion of the atmosphere.

(A311-5) The array processor shall be switchable in accordance with section 3.7.2.6.4.

(A311-6) Each main processor system shall be physically separable into two distinct processor subsystems in accordance with section 3.7.2.6.4.

Table 4. Benchmark Software

FUNCTION	NUMBER	PREDECESSOR	SUCCESSOR
1) Northern Hemisphere whole mesh analysis	1	None	Northern Hemisphere whole mesh forecast
2) Northern Hemisphere whole mesh forecast	1	Northern Hemisphere whole mesh analysis	None
3) Satellite mapping and gridding (1/4 orbit, DMSP)	2	None	1/8 mesh cloud analysis
4) 1/8 mesh Northern Hemisphere cloud analysis	1	Satellite mapping & gridding	1/8 mesh cloud forecast
5) 1/2 mesh Northern Hemisphere cloud forecast	1	1/8 mesh cloud analysis	None
6) US 1/2 mesh analysis	1	None	US 1/2 mesh forecast
7) US 1/2 mesh forecast	1	US 1/2 mesh analysis	US boundary layer model
8) US boundary layer model	1	US 1/2 mesh forecast	None
9) Computer flight plan	25	None	None
10) Displays (high speed printer only)	10	None	None
11) FORTRAN compilation of functions 1-10	3	None	None

(A311-7) The memory shall be partitionable in accordance with section 3.7.2.6.4.

(A311-8) Each half of a main processor system shall have a clock or interval timer usable for determining task timing.

(A311-9) The initial executive bootstrap switch shall be remoteable to the network control console.

(A311-10) Each half of a main processor system shall be capable of receiving control-only information via control lines. These lines shall interrupt the processing unit when information is present.

(A311-11) The oeprator console of the main processor system shall be remoteable to a central location up to 200 cable feet from the mainframe of the processor system.

(A311-12) There shall be five main processor systems, one in special access, one in variable access, and three in normal access.

(A331-13) Main processor memory, registers, and microstore shall be cleanable by writing random ones and zeroes three times, within 30 seconds.

(A311-14) High data rate channels shall be capable of sustaining an average data rate of 10^6 characters per second.

(A311-15) Low data rate channels shall be capable of sustaining an average data rate of $.5 \times 10^6$ characters per second on an aggregate for all subchannels.

(A311-16) Channels shall not cycle-steal from the CPU's.

(A311-17) Total aggregate data rate for all channels shall exceed 20×10^6 characters per second in multiprocessor mode.

3.7.3.1.2 Array Processor (A312)

(A312-1) The array processor shall be a satellite to a general purpose host computer.

(A312-2) The array processor shall be closely coupled to the host, and behave very much as if it were another CPU in a multiprocessor system.

(A312-3) The array processor shall share memory with the host and be as autonomous as possible in its activities.

(A312-4) The computation performed by the array processor shall be controlled by a FORTRAN program in the host. The FORTRAN program shall use subroutine calls (to machine language routines, possibly) as its interface to the array processor.

(A312-5) Computation in the host and in the array processor shall be highly overlapped. Ideally, the host shall be refining and storing on disk results of the array processor's calculation while the array processor is working an another segment of the problem; simultaneously, the array processor shall be loading the next segment to be worked on and transferring the results of a previous segment to the host. In this way, all overhead shall be hidden behind the necessary calculation.

(A312-6) The array processor shall use the host as its interface to the remainder of the data system allowing the use of existing interfaces, e.g., host to disk, and the extensive software support already written for general purpose machines.

(A312-7) The array processor shall contain only enough logic to perform the requisite calculations and share memory with the host, minimizing its internal complexity and hence its cost.

(A312-8) The host shall also perform those calculations requiring longer precision than is present in the array processor, and shall perform data manipulation.

(A312-9) The host and array processor shall run asynchronously.

(A312-10) Control and coordination shall be attained in two ways: a) the host shall command (and sense the status of) the array processor via a normal I/O channel interface, b) the host can establish a queue (in host memory) of operations to be performed by the array processor.

(A312-11) The array processor shall be triggered via the channel interface to begin the operations listed in the queue. Upon exhaustion of the queue, the array processor shall be able to interrupt the host and notify it of completion of activities, again via the channel.

(A312-12) When interrupted by the host, the array processor shall be able to halt processing at some convenient point in such a manner that intermediate results can be saved and the activity restarted again later.

(A312-13) The host shall be able to quickly sense a failure of the array processor so that a job can be restarted and still meet deadlines.

(A312-14) The array processor shall have microcoded rather than hardwired control.

(A312-15) The array processor shall eliminate data path bottlenecks such as those occurring between the host and the array processor, or within the array processor.

(A312-16) The use of a local memory on the array processor shall minmize conflict problems arising from using the host memory and also minimize the overhead due to host/array processor communication.

(A312-17) The array processor shall be capable of directly addressing up to 16×10^6 characters of memory.

(A312-18) The array processor shall have expandability of local memory, control microstore, the number of processing elements, and trigonometric function generator as specified in section 3.2.3.

(A312-19) The array processor shall be capable of floating point add, subtract, multiply, divide, and square root. The accuracy of these computations shall be sufficient to guarantee no round-off error in 32-bit floating point results.

(A312-20) The array processor shall contain a trigonometric function generator. The trigonometric functions available directly shall be sine, cosine, and tangent.

(A312-21) The generator shall accept arguments in degrees at increments of 3 degrees. The results shall be presented in floating point format compatible with array processor interval arithmetic.

(A312-22) The array processor shall be capable of storing the results of operations for further processing.

(A312-23) The array processor shall be able to clean memory, microstore, and registers via the writing of random ones and zeroes, on command from the host within 30 seconds.

(A312-24) All conversion between host data formats and array processor internal formats shall be accomplished by array processor interface hardware during data transfer.

(A312-25) There shall be no degradation in transfer rate or array processor processing rate due to floating/fixed point conversion.

(A312-26) The host shall initiate/terminate processing in the array processor accomplished via interrupts and commands transferred over an interface other than the operand interface (memory port).

(A312-27) The array processor shall be capable of presenting status information to the host upon request without terminating processing. Upon completion of processing, the array processor shall notify the host via an interrupt and present the status of the processing (e.g., completed successfully, terminated abnormally, and overflow).

(A312-28) The host shall maintain a queue of operations in host memory to be performed by the array processor. The host shall notify the array processor of the location of the queue.

(A312-29) The array processor shall be capable of executing operations from the queue without host intervention until the queue is exhausted or the host interrupts the array processor.

(A312-30) The host shall initialize the array processor via a bootstrap procedure.

(A312-31) The array processor may transfer operands between the arithmetic elements and the host directly without going through local memory.

(A312-32) The array processor shall access operands in host memory through memory ports as would a central processing unit or an input/output access unit (channel).

(A312-33) It shall not be necessary for the host to schedule input/output in order for the array processor to access operands inside host memory.

(A312-34) The array processor shall interface to both primary and (extended) storage, if both exist on the host.

(A312-35) The array processor microcode programs shall be compiled on the host.

(A312-36) The host shall have a simulator capable of "executing" array processor microcode in non-realtime. This simulator shall be capable of detecting illegal array processor operations, and presenting appropriate diagnostic information for the programmer.

(A312-37) The array processor operations shall be invokeable via FORTRAN subroutine calls, i.e., the host program written in FORTRAN shall call subroutines which build parameter lists, control blocks, etc., and which initiate array processor operation on a queue of activities.

(A312-38) The array processor shall be capable of performing a 1024 point complex fast Fourier Transform in 10 milliseconds of time. The vendor shall propose any options capable of reducing this time to as low as possible.

(A312-39) The array processor shall be capable of presenting the normalized results of floating point multiply-adds at no greater than 160 nanosecond intervals.

3.7.3.1.3 Support Processors (A313)

(A313-1) The support processors shall provide the interface between the operational elements of AFGWC and the main processors. The support processors shall be dedicated to functions and are tailored to their needs.

(A313-2) At least four operations center support processors shall be provided for each operations center (normal and special access).

(A313-3) The four operations center support processors shall be assigned the following functions:

a. Security downgrade,
b. Operations center output,
c. Operations cneter input, and
d. A backup machine.

(A313-4) All operations center support processors shall be identical to enable total flexibility of assignment.

(A313-5) In the worst case an operations center support processor shall interface and support the following peripherals at their rated capabilities: two alphanumeric CRTs, two support processor disk units, one card punch, one low volume digital recording device, five 2000 line per minute and two variable character printers.

(A313-6) The operations center support processor shall provide a processor control panel allowing the operator to display and/or alter the CPU

program status, register contents, or memory contents; to manually stop a program and to halt on a particular instruction or operand address.

(A313-7) The processors in each perimeter shall be provided with a maintenance console that is switchable between support processors and that contains all the resources necessary for stand-alone maintenance of the system.

(A313-8) The special access perimeter forecasting function shall be supported by at least two processors, one primary and one redundant for backup.

(A313-9) The following special access area consoles shall be supported by the processors: 3 forecaster consoles, one SESS console, and one quality control console.

(A313-10) The special access forecaster support processors shall be provided with a maintenance console that is switchable between processors and that contains all the resources necessary to perform stand-alone maintenance of the system.

(A313-11) The special access forecaster support processor shall provide a processor control panel allowing the operator to display and/or alter the CPU program status, request contents, or memory contents; to manually stop a program or to halt on a particular instruction or operand address.

(A313-12) At least three support processors shall be provided for the normal access forecaster and satellite support function. One shall support each of the two functions and one shall provide backup.

(A313-13) The three forecaster/satellite support processors shall be identical to enable total flexibility.

(A313-14) The forecaster/satellite support processors shall be provided with a maintenance console that is switchable between processors and that contains all the resources necessary to perform stand-alone maintenance of the system.

(A313-15) The forecaster/satellite support processors shall provide a processor control panel allowing the operator to display and/or alter the CPU program status, register content, or memory content; to manually stop a program or to halt on a particular instruction or operand address.

(A313-16) The forecaster/satellite support processor shall be capable of at least a 2M byte per second transfer rate plus necessary processing overhead.

(A313-17) Support processors shall have a hardware bootstrap capability that is remoteable to Network Control console.

3.7.3.2 Software (A32)

3.7.3.2.1 System Software (A321)

(A321-1) System software shall be standardized within any given level of the processor hierarchy, however, within the support processor level standardization is only required within a support processor subsystem (see section 3.7.3.1.3 Support Processors for the delineation of subsystems).

(A321-2) System software support within a processor hierarchy level shall be fully compatible with the dynamic resource allocation implemented by network control.

(A321-3) System Software support shall provide the capability to configure and run in both multiprocessor and uniprocessor environments.

(A321-4) System software shall provide a standard interface to network control and the operations centers.

(A321-5) Each processor system software shall provide options for gathering statistical data on program execution and task performance.

(A321-6) The system software of all processor levels shall provide system environment recording and machine check handlers.

(A321-7) An algorithm that recognizes abnormal CPU and resource utilization shall be provided. The tolerance criteria for their function shall be dynamically controlled by the operator.

(A321-8) The system software shall not preclude the processor from running in a function dedicated mode in the event of network control failure.

(A321-9) In the event of system failure, the system software shall be restored by a method that does not disturb the elements that survived the original failure or those that have been previously restored.

(A321-10) To the limits possible, no custom designed system software shall be implemented.

(A321-11) All enhancements and custom features implemented in the system software shall conform to structured programming guidelines.

(A321-12) The capability shall exist to transfer a data set from any normal access disk to the Mass Storage Facility by operator command.

3.7.3.2.2 Support Software (A322)

(A322-1) Support software shall be standardized within any given level of the processor hierarchy. Within the support software for the support processor the standardization shall occur within subsystems.

(A322-2) To the limits possible, no custom designed support software shall be developed.

3.7.3.2.3 Applications Software (A323)

(A323-1) Applications software shall be integrated into the enhanced architecture in a manner that provides for the fullest measure of transferable code with minimum recompilation.

(A323-2) All future applications development shall conform to the principles of structured programming.

3.7.3.2.4 Numerical Models (A324)

(A324-1) All future numerical model development shall, to the fullest extent possible, utilize the capacities and resources of the array processor.

(A324-2) All future numerical model development shall conform to the principles of structured programming.

3.7.3.3 Purchased Software (A33)

3.7.3.3.1 Programmer Interface (A331)

(A331-1) Normal access programmer interface software shall support a minimum of 26 on-line terminals.

(A331-2) There shall be four special access programmer terminals.

(A331-3) The number of on-line terminals supported by any single processor system shall be expandable to 50.

(A331-4) Programmer interface software shall support the on-line entering of code and editing of this code from the terminal.

(A331-5) It shall be possible to search large amounts of code for given text, and it shall be possible to automatically change all of one text to another text.

(A331-6) It shall be possible to save text on disk data sets and call the disk data sets back for editing.

(A331-7) It shall be possible to submit batch jobs from the terminals and have these jobs allocated to different processors through network control, with the results coming back either to the terminal or being printed out at the central operations printer location.

(A331-8) It shall be possible to compile or assemble programs without submitting a batch job.

(A331-9) It shall be possible to interactively debug programs from an on-line terminal. The debug facility shall contain the capability to put break points into programs at the terminal without having to compile these break points as part of the program.

(A331-10) It shall be possible to display the contents of selected main storage and registers automatically as a result of entering a break point.

(A331-11) It shall be possible to initiate utilities from on-line terminals.

(A331-12) It shall be possible to set up command lists, save these in data sets, and execute the command lists. The command lists shall be capable of causing the allocation of data sets, the execution of programs in the foreground, the submission of a batch job, and the setting up of an interactive debugging environment.

(A331-13) Response time at the interactive terminals for edit modes shall be no greater than 1 second.

(A331-14) Response for foreground compilations shall be no lonter than 1 minute plus compute time on the main processor.

(A331-15) Response times to batch jobs shall be on the basis of the priority established by network control.

(A331-16) It shall be possible to set up hierarchical structures of data sets into which code can be save from the terminal.

(A331-17) Data sets allocated from a terminal shall be qualified by programmer ID.

(A331-18) It shall be possible for the network controller to limit the percent of the CPU utilization that is allocated to programmer support.

3.7.3.3.2 Data-Oriented Language (A332)

(A332-1) The data-oriented language shall conform to CODASYL conventions and shall augment FORTRAN.

3.7.3.4 Developed Software (A34)

3.7.3.4.1 Master Data Base Program (A341)

(A341-1) The data base interface to all applications programs shall occur via the data base manager.

(A341-2) The master data base program shall be designed in a manner that facilitates optimization of the time to store data and the time to retrieve data.

(A341-3) There shall be one active and one passive data base manager. The former is the master data base program and the latter is the backup data base program.

(A341-4) The master data base program shall insure that all active requests and status are provided to the backup for utilization in the event fall-back processing is provided.

(A341-5) The backup shall receive the master program status at a maximum of one second intervals.

(A341-6) The backup program shall, in the event of a master failure, assume all data mangement functions.

(A341-7) Both the master data base program and the backup shall be resident on separate unclassified main processors.

(A341-8) The Master Data Base Program shall queue multiple requests for data base access and shall optimize access to data base elements by taking advantage of redundant requests in the queue.

(A341-9) The Master Data Base Program shall have the ability to reserve sections of the data base to allow multiple simultaneous updates of the data base.

(A341-10) The Master Data Base Program shall be structured to allow the use of both halves of a main processor system to process requests simultaneously.

(A341-11) The Master Data Base capability shall provide a variety of options, including:

a. Obtain data by location,
b. Obtain data by value,
c. Search upon update based on threshold, and
d. Initiate action based on update.

3.7.3.4.2 Network Control Program (A342)

(A342-1) The network control software shall schedule resources, schedule tasks, maintain system status and reallocate resource and tasks in the event of a component failure.

(A342-2) The network control software shall provide the capability to output scheduling aids for use in the event it becomes necessary to manually schedule the system components and tasks.

(A342-3) The network control software shall provide security management functions associated with the upgrading and downgrading of system components.

(A342-4) There shall be a minimum of 50 levels of priority associated with the network control scheduling algorithms.

(A342-5) The network control software shall reside on a separate special access processor.

(A342-6) There shall be both a primary and backup network control program executing in real time.

(A342-7) The primary network control program shall pass the backup a status message at a maximum of one second intervals.

(A342-8) The backup network control program shall issue a status query to the primary in the event that the standard status message is not received.

(A342-9) The backup network control program shall assume the primary network control function in the event that no response is received to the status query.

(A342-10) The network control program shall notify the network controller of all major status changes via CRT or the configuration display panel.

3.7.3.4.3 Communications Data Routing (A343)

(A343-1) The requirements associated with the communication data routing software are specified in paragraph 3.7.4.5.1, Line Handler/ Decoder Router.

3.7.4 Terminal Interface (A40)

(A40-1) There shall be limited buffering capability where data line capacities exceed ingestion capability.

(A40-2) Real time communication shall be accomplished by constant monitoring of time critical external interfaces.

(A40-3) Where verification of receipt is required, this shall be automatically propagated to the sender.

(A40-4) There shall be a message logging capability for all communications links.

(A40-5) The inability of the AFGWC system to respond to specific requests shall be automatically identified to the requester with specific conditions/instructions as to valid response.

(A40-6) The capability shall exist for automatic or manual requests for retransmission.

(A40-7) Noncorrectable malfunctions shall result in a request for retransmission or notification to the communications console.

(A40-8) All unrecognized messages shall be routed to the communications console.

(A40-9) No output message shall be transmitted without security certification.

(A40-10) In case of inability to certify, the message shall be output to the communications console.

3.7.4.1 Normal Access (Classified) (A41)

(A41-1) All messages shall be identifiable by a header and an end code including appropriate security classification.

(A41-2) All incoming messages shall be routed into the appropriate job queue.

(A41-3) Requests to communicate shall be polled at a frequency consistent with the minimum polling requirements for each circuit.

(A41-4) Receipt of time limited communications shall result in a clocking (timing against time requirement) of associated functions.

(A41-5) Security classification identification shall be accomplished at all classified terminal interfaces.

(A41-6) Communications messages shall be routed according to classification.

(A41-7) Lower level security requests shall have the capability to be forwarded to a higher level path if so designated.

(A41-8) Where multilevel security may exist as output over a single termination link, there shall be extensive software testing with human certification, as practical.

(A41-9) Classification identification and routing to an appropriate level path shall be accomplished as early as possible with a minimum of mixed mode software exposure and by a physically isolated and protected piece of hardware.

(A41-10) Line handler/decoder routers shall always operate at the level of the line (i.e., security classification is determined as early as possible and message is forwarded to the appropriate path).

(A41-11) Lines shall be separated according to their distinct security entity; Unclassified, Confidential/Secret, Top Secret, and Special Access (1, 2 and 3).

(A41-12) The query/response mode of operation requests that a support product be prepared when requested by a WWMCCS user. The total environmental data base shall be in a real time demand posture. When a query is received, the query shall be accepted, the required product shall be determined, a formatted message shall be produced, and the proper communications link selected for the response per instructions in the query.

(A41-13) Response times to queries shall be as follows:

a. One minute for anything in the data base, and
b. Ten minutes for formatted responses.

3.7.4.1.1 AUTODIN II (A411)

(A411-1) To support the WWMCCS network in 1980, AFGWC shall interface with the DOD AUTODIN II system. The Datanet 355 shall be modified as a line handler/decoder router. This data link will handle classified information from Unclassified through Top Secret.

3.7.4.1.2 AUTODIN I (A412)

(A412-1) The Datanet 355 shall also interface with the DOD AUTODIN I system. This data link is encrypted and handles classified information from Unclassified through Top Secret/SIOP.

3.7.4.1.3 NSA (A413)

(A413-1) The Secret line handler/decoder router shall interface with two dedicated circuits connected to the National Security Agency which use one KSR circuit at 110 baud and one DCT at 2400 baud. These data links are encrypted and handle classified information from Unclassified through Secret.

3.7.4.1.4 SAC (A414)

(A414-1) The Secret line handler/decoder router shall interface with a dedicated circuit connected to Headquarters, Strategic Air Command. The line is rated 2400 baud. This data link is encrypted and handles classified information from Unclassified through Secret. Included shall be the task of driving the SAC displays as is presently done by the UNIVAC 1108.

3.7.4.2 Normal Access (Unclassified) (A42)

3.7.4.2.1 Carswell Backup (A421)

(A421-1) The Unclassified line handler processor (line handler/decoder router) shall interface with the Carswell Backup intercommunication system, making the interface transparent to outside data users.

(A421-2) Backup data shall be routed to the Mass Storage Facility.

3.7.4.2.2 Digital Radar (A422)

(A422-1) The Unclassified line handler processor shall interface with the digital radar link, which shall provide data from a network of CONUS weather radar stations via satellite. This communciations link shall initially provide digital weather radar data in 1980 with full operation beginning in 1982. The satellite terminal at AFGWC will be provided by the Air Force. Interface shall be with this satellite terminal.

(A422-2) The AFGWC communications link shall handle a data rate of approximately 2×10^5 bits/second in four second bursts with a burst of data occurring approximately every 15 minutes.

3.7.4.2.3 DSP (A423)

(A423-1) The Unclassified line handler processor shall interface with the dedicated circuit inputting data from the Defense Support Program. This line is rated at 150 baud.

3.7.4.2.4 NOAA (A424)

(A424-1) The Unclassified line handler processor shall interface with the dedicated circuit existing for transfer of data between AFGWC and the National Oceanic and Atmospheric Administration. This line is rated at 2400 baud.

3.7.4.2.5 Navy (A425)

(A425-1) The Unclassified line handler shall interface with the dedicated circuit existing for the purpose of transferring data between AFGWC and the Fleet Numerical Weather Central (FNWC). The current line is rated at 4800 baud.

3.7.4.2.6 AWN (A426)

(A426-1) The Unclassified line handler shall interface with the Automated Weather Network on which data is input and output over a pair of redundant 4800 baud lines of which only one is used at a time.

3.7.4.2.7 MAC Det 14 (A427)

(A427-1) The Unclassified line handler shall interface with the dedicated circuit to MAC Detachment 14, which is rated at 3600 baud for DCT use.

3.7.4.2.8 ASR/KSR (A428)

(A428-1) The Unclassified line handler shall interface with 20 additional external circuits. There are seven at 300 baud, five at 110 baud, four at 75 baud and three at 56 baud, plus a 4800 baud DCT line.

3.7.4.3 Special Access (A43)

(A43-1) Three line handler/decoder routers shall be provided to interface with the special access circuits.

3.7.4.4 Satellite Data (A44)

3.7.4.4.1 DMSP (A441)

(A441-1) Hardware shall be provided to interface the Satellite Support Processor (section 3.7.4.5.2) to the DMSP Site 3 Data Formatters.

(A441-2) The interface equipment shall be expandable to include support of a minimum of three (3) DMSP vehicles; each vehicle providing both smoothed and fine data readout.

(A441-3) The interface equipment shall provide the capability to ingest all six DMSP links (3 vehicles x 2 links each) at satellite data link rates up to 2.6624 Mbps.

3.7.4.4.2 GOES (A442)

(A442-1) Hardware shall be provided to interface the GOES ground station with the Satellite Support Processor (section 3.7.4.5.2).

3.7.4.4.3 TIROS-N (A443)

(A443-1) Hardware shall be provided to interface the TIROS-N ground station with the Satellite Support Processor (section 3.7.4.5.2).

3.7.4.4.4 Satellite Imagery Dissemination (A444)

(A444-1) Hardware shall be provided to interface the communication links utilized for satellite imagery dissemination with the Satellite Support Processor (section 3.7.4.5.2).

3.7.4.5 Routing (A45)

3.7.4.5.1 Line Handler/Decoder Router (A451)

(A451-1) The line handler/decoder router shall perform:

a. Line interface;
b. Message assembly;
c. Classification determination, routing to and writing on disk;
d. Notification of network control;
e. Responding to notification of outgoing messages;
f. Interface with the communications console; and
g. Driving of communications console functions.

(A451-2) There shall be a line handler/decoder router dedicated to each security level except TS/SIOP.

(A451-3) The individual reliability shall be no less than .995 for each line handler/decoder router that is not currently in the AFGWC inventory.

(A451-4) There shall be four line handler/decoder routers utilized in special access communication processing, three as primary interface devices with one available as backup.

(A451-5) The existing SA1 communications processor shall function as one of the special access line handler/decoder routers.

(A451-6) The existing SA1 communications processor shall be upgraded to conform to all other specifications addressed in this section.

(A451-7) There shall be eight line handler/decoder routers utilized in the normal access communications processing, six as primary interface devices with two available as backup.

(A451-8) The AUTODIN II Datanet 355 shall function as one of the normal access line handler/decoder routers.

(A451-9) The Interdata 50 which is dedicated to facsimile transmission shall function as a dedicated line handler/decoder router.

(A451-10) The existing Datanet 355 and Interdata 50 shall be upgraded to conform to all other specifications addressed by this section.

(A451-11) One line handler/decoder router shall act as display driver for the SACCS communication line.

(A451-12) All line handler/decoder routers shall perform all communication protocols necessary to the communication networks to which they are interfaced.

(A451-13) All line handler/decoder routers shall perform disk communication for the purpose of "maildropping" messages destined for the main processor and for retrieving messages for distribution to the communications circuits.

(A451-14) Line handler/decoder routers shall use fixed head disk areas for store-and-forward operations. These fixed head disk areas shall be used for "maildropping" until overflow occurs, when movable head areas may be used.

(A451-15) Classified messages shall be stored on combination disks of a level equal to that of the message. Messages may be downgraded by being sent to a lower level line handler/decoder router.

(A451-16) Due to the nature of mixed mode security in the line handler/decoder routers, all line handler/decoder routers shall provide hardware and software features that will ensure the protection of the software implemented in the line handler/decoder routers.

(A451-17) All messages that cannot be routed due to error conditions shall be routed to the communications console for operator intervention.

(A451-18) All line handler/decoder routers shall perform two-way interface to the communications console.

(A451-19) All line handler/decoder routers shall interface and support all assigned communications circuits at their rated capacities.

(A451-20) The line handler/decoder routers shall provide a power failure protection feature to ensure CPU operations are brought to an orderly halt in an event of a drop in the primary power source. Upon return of power, the CPU shall be capable of automatically bootstrapping.

(A451-21) The line handler/decoder routers shall provide a processor control panel allowing the operator to display and/or alter the CPU program status, request contents, or memory contents; to manually stop a program or to halt on a particular instruction or operand address.

(A451-22) The line handler/decoder routers in each perimeter shall be provided with a switchable maintenance console which contains all the resources necessary to perform stand-alone maintenance of the system.

3.7.4.5.2 Satellite Data Router (A452)

(A452-1) The Satellite Data Router function shall reside in the Satellite Support Processor and shall be compatible with all specifications in section 3.7.3.1.3.

(A452-2) The Satellite Data Router function shall have the capability of receiving and identifying data from the three satellite data sources (DMSP, TIROS-N, and GOES interface hardware).

(A452-3) The Satellite Data Router function shall input and buffer the data to the satellite ingest dedicated mass storage.

(A452-4) The Satellite Data Router shall write the data to one of four dedicated disk subsystems (DMSP smoothed, DMSP fine, TIROS-N smoothed and GOES).

(A452-5) The Satellite Data Router shall input imagery data from manually operated devices associated with the satellite ground stations and store it on support processor mass storage. Typically these devices would be imagery scanning/digitizing devices utilized to supplement the gridded and mapped data base.

3.7.4.6 General (A46)

3.7.4.6.1 Protocol (A461)

(A461-1) A protocol standard shall be prepared for AFGWC data communications. This standard will be used as a goal, realizing that present interfaces may not be able to comply completely.

3.7.4.6.2 Control (A462)

(A462-1) There shall be no capability for generating software instructions and/or activating software instructions from external data sources.

(A462-2) There shall be a priority scheme established associated with incoming messages. This shall be linked to the Network Control function so that the same priority scheme is used in both functions.

3.7.4.7 Other (A47)

3.7.4.7.1 Teletype (A471)

(A471-1) A dedicated 75 baud line provides teletype data directly to the SESS area from the Carswell ADWS. Appropriate hardware and software (if required) shall be provided to continue this function.

3.7.4.7.2 Facsimile (A472)

(A472-1) A Weather Facsimile Switching Center (WFSC) will be developed by the Air Force at AFGWC. The WFSC will consist of three Interdata Model 50 minicomputers (including one spare), a Keyboard Video Display Terminal, a teletype device and a disk storage device. The design shall accommodate all AFGWC non-satellite facsimile products being transmitted through WFSC. The contractor shall provide the appropriate hardware and software to interface with the WFSC. This interface shall accommodate:

a. Digitized chart products prepared at Forecast Consoles which can be directly connected to the WFSC, and

b. Manually drawn charts.

3.7.5 Consoles (A50)

(A50-1) Each console (with the exception of programmer consoles) shall be associated with an interface processor, responsible for coordinat-int functions between hardware components. The interface processor will in turn be connected to a support processor which shall link consoles of similar classification and application to the main processor system.

(A50-2) Programmer consoles will employ multiplexors to interface them with the rest of the system.

(A50-3) Console components shall be modular to the extent that they can be easily replaced or interchanged to allow adaptation to changing requirements.

(A50-4) Operator interface functions shall be standardized throughout the system.

(A50-5) Consoles shall be designed so that operator personnel have the capability to immediately answer all requests appearing on the console.

(A50-6) There shall be a capability to change operators at logical break points within the processing operations.

(A50-7) The capability shall exist for operator positions to be vacated for certain lengths of time with no radical impact unless specifically identified. Consoles not requiring permanent manning (forecaster or programmer consoles for example) shall contain a deactivation switch. Other consoles shall contain hardware and software necessary to allow temporary vacancies.

(A50-8) Operator positions shall accommodate on-the-job training.

3.7.5.1 Mission Support Consoles (A51)

(A51-1) Message formats and console interface for mission support consoles shall be standardized.

3.7.5.1.1 Network Control (A511)

(A511-1) The network control console shall be the central control resource used to monitor the automated divisions of the network control algorithm running in the network control processor and interface the human control function, including the override capability.

(A511-2) The network control console shall exist at the highest AFGWC classification level.

(A511-3) The network control console shall be connected to the network control processor and its backup via direct I/O channel interface.

(A511-4) The network control console shall be manually switched between processors as part of the network control configuration switching function.

(A511-5) The network control console shall be designed to be operated by a single controller; it shall be possible under heavy workload for two controllers to work at the network control console.

(A511-6) The functions of the network control console shall include monitoring: system resource status, job status, security allocation, queueing status, environmental status, system resource utilization, and current systems resource allocation.

(A511-7) The capability to manually change resource configuration and to reallocate job system assignments shall include the ability to allocate: network control and backup, data base manager and backup, tape drives to disk, variable perimeter, and equipment for preventive maintenance.

(A511-8) The network control console shall have the capability to idle, terminate, or roll out for later processing any current function being performed within AFGWC.

(A511-9) All network control devices shall be fully redundant, e.g., backed up by identical equipment or replaceable within 1 minute of failure detection.

(A511-10) The following specific equipment shall be provided in the network control console:

a. Two alphanumeric CRTs,
b. Two alphanumeric keyboards,
c. One network switch panel, and
d. One configuration display panel.

3.7.5.1.2 Operations (A512)

(A512-1) An operations console shall exist in each of the special and normal access perimeters, providing a centralized computer control center at the highest security classification of each perimeter.

(A512-2) Input and output shall be physically isolated via hardware to prevent throughput to lower classification processors (software isolation is not sufficient).

(A512-3) The operations console shall provide complete status and configuration of the entire perimeter when called for by the operations controller to include, but not be limited to, the following:

a. System configuration,
b. Equipment status,
c. Operation status,
d. Schedule status,
e. System file status, and
f. Data base maintenance status.

(A512-4) Inputs to the system through the operations console shall encompass such items as equipment status updates because of maintenance activities, initiation and updates to operational schedules, and equipment availability status.

(A512-5) All operation console equipment shall be fully redundant, e.g., backed up by identical devices or replaceable within one minute of failure detection.

(A512-6) The primary function of the computer operations consoles shall be to monitor CPU, memory or other errors, instead of monitoring applications-peculiar computer program errors; the option shall exist however, to route applications-peculiar messages to the operations console for jobs initiated on the operations console.

(A512-7) The capability shall exist to initiate jobs via the computer operations console.

(A512-8) Preliminary initialization of main processors shall be done via the computer operations console.

(A512-9) The operations consoles shall be designed to be operated by a single controller, but shall accommodate two personnel; when manned by two operators:

a. Either operator may respond to a given message, or

b. Messages will be automatically split between operators based on the main processor system where whey originated.

(A512-10) The following specific equipment shall be provided in the operations console:

a. Two alphanumeric CRT's, and
b. Two alphanumeric keyboards.

3.7.5.1.3 Security Downgrade/Remote Job Entry (A513)

(A513-1) A security downgrade/remote job entry console shall be implemented in both the special access and normal access perimeters. (However, remote job entry facility will be used only as a backup in the normal access perimeter.)

(A513-2) The security downgrade/remote job entry consoles shall be manually switchable to a selected security level disk subsystem to allow jobs which are isolated from their source to be manually routed.

(A513-3) Downgrade information shall be received from the operations output support processor.

(A513-4) Security downgrade information shall be input to Low Capacity Storage Device (A118).

(A513-5) Each individual storage device shall contain data at only a single security level.

(A513-6) Input and output shall be isolated manually by transferring the storage medium between separate input and output storage devices; the recorded data shall be displayable on the security downgrade/ remote job entry console prior to switching to a receiving system.

(A513-7) The storage medium shall be cleanable by writing random ones and zeroes three times in the memory within 120 seconds.

(A513-8) Output data shall be coded at the appropriate classification level using the authentication encoder.

(A513-9) All messages or data sets for downgrade shall be output at the security monitor station in hardcopy form via standard printer.

(A513-10) The security downgrade/remote job entry consoles shall contain a card reader for job entry purposes.

(A513-11) Interface software for both security downgrade and remote job entry functions shall be provided.

3.7.5.1.4 Communications (A514)

(A514-1) There shall be a communication console associated with both the normal and special access perimeters.

(A514-2) The communication control console shall have access to the log of all messages being received or sent within the AFGWC system from the line handler/decoder routers.

(A514-3) Statistics associated with the messages received and sent within the AFGWC system shall be available at the communication control console from the line handler/decoder routers.

(A514-4) All communications problems at the line handler/decoder routers shall be reported to the communication control console.

(A514-5) The communications control console shall exist at the highest security level afforded the communication lines with which it interfaces in each security perimeter.

(A514-6) There shall be a separate input low-volume digital recording device associated with each security level (at a console).

(A514-7) The communication console shall provide the capability of continuous recording of messages received from the line handler/ decoder routers without any data loss.

(A514-8) The recording of line handler/decoder router output shall be accomplished utilizing low capacity storage devices.

(A514-9) The communication console shall provide an operator controlled "review and edit" function; this function shall be performed on a single storage medium unit.

(A514-10) The communication console shall provide an operator controlled routing function which will be able to selectively route individual messages from a single storage medium unit to any line handler/ decoder router.

(A514-11) All messages received at the communication console shall be output in hardcopy via standard printer.

(A514-12) Interface software to the line handler/decoder routers shall be provided.

3.7.5.1.5 Satellite Image Dissemination (A515)

(A515-1) The Satellite Image Dissemination (SID) console shall perform the function of interfacing the SID operator with the satellite support processor for purposes of centralizing the distribution function and quality control of the products.

(A515-2) The SID console shall provide the capability to schedule all product distribution and product requests.

(A515-3) High resolution, alphanumeric CRT's and an alphanumeric keyboard shall be provided for quality control and communication.

(A515-4) The SID equipment shall be switchable, allowing interface with whichever support processor is acting as satellite support processor.

3.7.5.1.6 Maintenance (A516)

(A516-1) The maintenance console on main processor systems shall provide (in a central location in close proximity to the mainframe) all resources necessary for stand-alone maintenance of the system, e.g., the main processor system shall be augmented with any necessary equipment the vendor decided is necessary for a minimum maintainable configuration. This equipment shall be centralized and located next to the mainframe.

(A516-2) The maintenance consoles associated with the main processor systems shall be used for maintenance of: combination, satellite, and bulk disks; programmer consoles; tape drives; and the mass storage facility.

(A516-3) Peripherals attached to the support processors (such as forecaster consoles) are maintained via support processor maintenance equipment.

(A516-4) The maintenance console shall be capable of assuming the computer operation function in the event of failure of the total operations console subsystem. (This would be limited to the assigned mainframe only.)

3.7.5.2 Mission Operations Consoles (A52)

(A52-1) Message formats and console interfaces for mission operations consoles shall be standardized.

(A52-2) Although their purposes may be different, mission operations consoles have requirements in common. The hardware/software associated with all graphic CRTs shall provide the following capabilities:

a. Zoom in on a window or local area;

b. Numerically average a displayed data set;

c. Redefine, change, or modify subset areas of the total display by controlling a cursor or light pen;

d. Split screen;

e. Blinking;

f. Roll frame;

g. Non-destructive overlay;

h. Selective erase, read and write;

i. Variable resolution;

j. Threshold;

k. Contour;

l. Priority establishment; and

m. Accessibility to all GWC data bases (provided no security restrictions exist) by initiating retrieval functions on main processors.

(A52-3) Consoles which are to provide geographic maps as displays shall allow any area to be requested (at any scale) which is a section of a polar stereographic, Mercator, or Lambert conformal projection. Specific areas shall be requestable in any of the following ways:

a. By giving the latitude and longitude of corners of the map;

b. By giving a coded name of a predefined area;

c. By giving grid number limits of the desired area using any one of the AFGWC grid systems;

d. By giving one or more of the AFGWC data regions;

e. By giving one or more World Meteorological Organization (WMO) block numbers; or

f. By giving the center point of an area and the scale, and having the display automatically truncated to the maximum field of view that can be shown on the screen.

(A52-4) It shall be necessary for some consoles to communicate outside their normal range of components. Specifically, consoles in the mission support category shall be able to:

a. Initiate jobs in the system which will produce aids needed to successfully complete tasks, and

b. Transmit displays produced on one console to another provided they are attached to the same support processor.

(A52-5) Programmer, studies and analysis, and forecaster consoles (except for special operations and those located in the special access perimeter) shall all be maintained at an unclassified level, connected only with an unclassified data path, and located outside of the enclosed perimeters.

(A52-6) There shall be six types of forecaster consoles: TAF/METWATCH, military weather advisory, synoptic, forecaster (special access), SESS (normal access), and SESS (special access).

(A52-7) All forecaster consoles shall have the ability to modify any satellite or meteorological data presented for display on any CRT. This requires an ability to make changes down to an accuray of one pixel for graphic CRTs. The light pen is one example of hardware which will provide the capability.

(A52-8) Unclasified forecaster and programming consoles shall be able to make use of the mass storage facility where data can be achieved

for taining purposes or to document data sets of special interest.

(A52-9) Where color CRTs are used the ability shall exist to attribute color to any data base characteristics recognizable automatically or designated by the operator.

(A52-10) The capability shall exist to transform the grid to different mapping coordinates, zoom in on a portion, photo overlay with land boundaries, overlay with computer flight plans or overlay with specific meteorological parameters from the models.

(A52-11) The capability shall exist to display any of the meteorological parameters at the forecaster consoles.

(A52-12) The capability shall exist to change any of the values in the meteorological data base from the forecaster consoles by creating an overlay entry associated with the data base and the specific classification level. There shall be a table associated with each version of the meteorological data base which identifies the source of modifications. Several overlays may be associated with a single classification level, or they can be built upon.

(A52-13) The forecaster shall be able to trace curves using a manual capability (for example, lightpen) with predefined standard meteorological symbology and the results of this shall be imbedded and displayed on the CRT display.

(A52-14) Forecaster consoles shall have the capability to erase a portion or all of a drawn curve or identified symbol.

(A52-15) Forecaster consoles shall have the capability to have black and white hardcopy of either color or black and white displays with a method (e.g., gray shades) being provided to differentiate color.

(A52-16) Hardcopy of CRT displays shall be directed image of the CRT forecaster consoles.

(A52-17) The capability shall exist for computer-generated or other communication messages to be displayed at the forecaster console.

(A52-18) Forecaster consoles shall be capable of requesting printouts associated with certain runs to be accomplished within the closed vault area and delivered once the classification level has been certified.

(A52-19) The capability shall exist to request a set of archival data to be used in a future run through the forecaster console.

(A52-20) The capability shall exist for preparation of facsimile products at forecaster consoles and for the routing of these products to the Weather Facsimile Switching system (Interdata-50's) for distribution over facsimile circuits.

(A52-21) The capability shall exist to change any of the values in the meteorological data base from the forecaster consoles by creating an overlay entry associated with the data base and the specific classification level. There shall be a table associated with each version of the meteorological data base which identifies the source of modifications.

3.7.5.2.1 TAF/Metwatch (A521)

(A521-1) There shall be 26 personnel positions provided for 13 TAF/Metwatch consoles. In the North American area, eight console positions

shall be needed for TAF/Metwatch: two for FOUS, two for point weather warnings, two for training, and two for contingency operations. For the European window three consoles shall provide six positions of which three will be used for TAF/Metwatch and one each will be used for point weather warnings, contingency operations and backup. In the Asian area, two shall be required for TAF/Metwatch, two for point weather warnings, and one for contingency operations.

(A521-2) Two forecaster positions shall be located at each console, and components shall be shared between forecasters.

(A521-3) Each console shall contain two alphanumeric CRTs, two high-resolution, black and white, graphic CRTs, and two alphanumeric keyboards.

(A521-4) When required for Metwatch, the alphanumeric CRTs shall make use of the split screen capability, with the top several lines of the screen being permanently dedicated to that function.

(A521-5) TAF/Metwatch consoles shall be maintained at an unclassified level but shall have the capability through network control to activate classified jobs within appropriate data paths.

3.7.5.2.2 Military Weather Advisory (A522)

(A522-1) One forecaster console shall be dedicated solely to the Military Weather Advisory function. This console shall provide two forecast positions and will be located in the North American window area.

(A522-2) The Military Weather Advisory console shall consist of the following equipment:

a. 2 high-resolution, black and white, graphic CRTs;
b. 1 graphic, color CRTs;
c. 2 alphanumeric keyboards;
d. 1 function keyboard; and
e. 1 digitizing tables.

(A522-3) The Military Weather Advisory console should be maintained at an unclassified level but shall have the capability through network control to activate classified jobs within appropriate data paths.

3.7.5.2.3 Synoptic (A523)

(A523-1) Five consoles shall be required which shall be used to aid the synoptician and help in preparation of horizontal weather depiction. One each shall be located in the North American, European and Asian windows with two more being needed in the global area (one for each of the northern and southern hemispheres).

(A523-2) Each console shall provide three forecaster positions.

(A523-3) A synoptic console shall contain the following equipment:

a. 2 high-resolution, black and white, graphic CRTs;
b. 2 graphic, color CRTs;
c. 2 alphanumeric keybaords;
d. 1 function keyboard; and
e. 2 digitizing tables.

(A523-4) One synoptic console should be maintained at an unclassified level but shall have the capability through network control to activate classified jobs within appropriate data paths.

3.7.5.2.4 Forecaster (Special Access) (A524)

(A524-1) Three forecaster consoles shall be dedicated to special access functions.

(A524-2) Each console shall provide one working position but will also provide space for a supervisor and shall contain four CRTs:

a. One alphanumeric;
b. Two high-resolution, black and white; and
c. One color.

(A524-3) The CRTs shall be controlled by two keyboards, one alphanumeric and the other for special functions.

(A524-4) The special access forecaster console shall exist in the special access environment.

3.7.5.2.5 SESS (Normal Access) (A525)

(A525-1) One console shall be required for operations in the SESS normal access area which provides working positions for two personnel: a data base monitor and a geophysical forecaster.

(A525-2) The data base monitor shall have only an alphanumeric keyboard and an alphanumeric CRT.

(A525-3) The geophysical forecaster shall require three additional CRTs: color, high-resolution black and white, and alphanumeric. These CRTs shall be controlled by two keyboards, one alphanumeric and the other for special functions.

(A525-4) The SESS console shall have the capability to initiate and provide control for modules which reduce and model space environment data.

(A525-5) The capability shall exist at the SESS console to modify the resulting space environment data base.

(A525-6) The capability shall exist to monitor solar activity messages.

(A525-7) There shall be audio alarms at the SESS console identifying the crossing of data base thresholds associated with certain space environment parameters.

(A525-8) This SESS console shall operate within normal access security paths.

3.7.5.2.6 SESS (Special Access) (A526)

(A526-1) One console shall be required for operations in the SESS special access area. This console shall provide a working position for one person, a geophysical forecaster.

(A526-2) The SESS (special access) console shall require three CRTs: one color, one high-resolution black and white, and one alphanumeric. These CRTs shall be controlled by two keyboards, one alphanumeric and the other for special functions.

(A526-3) The SESS console shall have the capability to initiate and provide control for modules which reduce and model space environment data.

(A526-4) The capability shall exist at the SESS console to modify the resulting space environment data base.

(A526-5) The capability shall exist to monitor solar activity messages.

(A526-6) There shall be audio alarms at the SESS console identifying the crossing of data base thresholds associated with certain space environment parameters.

(A526-7) This SESS console shall operate within special access security paths.

3.7.5.2.7 Quality Assurance (A527)

(A527-1) Quality assurance for the data base shall be assigned to one work center which shall provide positions for two people. It shall be located in the special access area.

(A527-2) This console shall contain two alphanumeric CRTs controlled by two alphanumeric keyboards.

(A527-3) The quality assurance console shall exist for monitoring and control of the quality control function.

(A527-4) The capability shall exist to enter manually-provided quality assurance assessment data.

(A527-5) Quality assurance statistics by area for various time intervals shall be available at the quality assurance console.

(A527-6) The capability shall exist to alter quality control statistics from the quality assurance console.

(A527-7) The quality assurance console shall be capable of initiating quality control functions not performed on a periodic basis.

(A527-8) Statistics according to functions, personnel, user, or computation module may be provided at the quality assurnace console.

(A527-9) Quality assurance function may be provided on a non-interference basis to normal operations.

3.7.5.2.8 Programmer (A528)

(A528-1) Programmer consoles shall include automated work areas supporting studies and analysis functions as well as normal software development and maintenance. In all there shall be 30 consoles, with four for studies and analysis, four for special access software development and maintenance, and the remaining 22 for normal access software development and maintenance. The number of on-line terminals supported by any single processor system (special or normal access) shall be expandable to 50.

(A528-2) Each console shall provide one working position and will primarily consist of one alphanumeric CRT controlled by an alphanumeric keyboard. The programmer consoles serving studies and analysis shall also contain a plotter for use in designing displays.

(A528-3) There shall be a programmer support software subsystem which can be activated and utilized from the programmer console.

(A528-4) There shall be an alphanumeric status indicator associated with each programmer console.

(A528-5) The capability shall exist to request hardcopy from programmer consoles; however, this will be printed out in the generalized printer area and distributed to programmers after the fact.

(A528-6) From the programmer console, a programmer may request archival data or other data not existing within the data system prior to running a job.

(A528-7) Programmers shall be forced to decide whether or not to release archival storage for old configurations as part of the programming console function.

(A528-8) There shall be no capability to interface with the executive or control functions from the programmer console.

(A528-9) The study and analysis console shall have the capabilities of the programmer console.

(A528-10) There shall be a language associated with studies and analysis consoles which allows the specification of runs in engineering terms.

(A528-11) Any data which is unclassified within the operational system shall be available for use by the study and analysis consoles.

(A528-12) Programmer and study/analysis consoles associated with the normal access perimeter shall be unclassified and the programming consoles associated with the special access perimeter shall be at the highest level of classification.

3.7.5.2.9 Special Operations (A529)

(A529-1) One forecaster console shall be designed to handle the special operation functions. This console shall provide a work area for two personnel.

(A529-2) The special operations console shall contain both an alphanumeric and a high-resolution, black and white CRT. These CRTs shall be controlled by two keyboards, one alphanumeric and the other for special functions.

(A529-3) Special operations console shall exist within the Top Secret SIOP environment.

(A529-4) The capability shall exist to run jobs on any lower-level path from the operations console.

(A529-5) There shall be the capability at the special operations console to generate messages for transmission.

(A529-6) There shall be a card reader capability at the special operations console.

(A529-7) There shall be a printer data distribution function associated with printers which have been configured to the various security classification levels.

(A529-8) The capability shall exist to display any high-resolution data.

(A529-9) The capability shall exist to transform the grid to different mapping coordinates, zoom in on a portion, photo overlay with land boundaries, overlay with computer flight plans, or overlay with specific meteorological parameters from the models.

(A529-10) The capability shall exist to display any of the meteorological parameters.

(A529-11) The special operations console may request printouts associated with certain runs to be accomplished within the closed vault area and delivered once the classification level has been certified.

3.7.6 Data Input/Display (A60)

3.7.6.1 Rapid Response Visual (A61)

(A61-1) The rapid response visual displays shall provide the operator with displayed information (tabular, graphic and imagery) without the inherent time lag associated with hardcopy devices.

3.7.6.1.1 Alphanumeric CRT/Control (A611)

(A611-1) Density shall be 24 lines x 80 characters per line.

(A611-2) Character matrix shall be 5 x 7.

(A611-3) The character set shall be a standard 96 character ASCII (upper and lower case) plus 16 special symbols.

(A611-4) The screen size shall be a minimum of 14 inches measured on the diagonal.

(A611-5) The following program control functions shall be available:

a. Cursor location,
b. Erase and edit,
c. Blink characters,
d. Underline capability,
e. Roll and scroll, and
f. Split screen.

3.7.6.1.2 Color CRT/Control (A612)

(A612-1) Resolution shall be 512 lines x 512 elements.

(A612-2) Eight primary display colors shall be available expandable to a total of 4096 pseudo color shades.

(A612-3) A grayline and alphanumeric overlay capability shall exist.

(A612-4) The screen size shall be a minimum of 19 inches measured diagonally.

(A612-5) The following program control functions shall be available:

a. Cursor location,
b. Erase and edit, and
c. Character or graphic entity blink.

3.7.6.1.3 High Resolution CRT/Control (A613)

(A613-1) Resolution shall be 6 bit elements displayed on 1024 lines x 1024 elements per line.

(A613-2) A graphic and alphanumeric overlay capability shall exist.

(A613-3) The screen size shall be a minimum of 19 inches measured diagonally.

(A613-4) The following program control functions shall be available:

a. Cursor location,
b. Erase and edit, and
c. Character or graphic entity blink.

3.7.6.2 Documentary Visual (A62)

(A62-1) The documentary visual devices shall be utilized to produce information (tabular, graphic, and imagery) in a hardcopy form.

3.7.6.2.1 Variable Character Printer (A621)

(A621-1) The printing speed (at single-line spacing) shall be at least 2,000 lines per minute.

(A621-2) The printer shall print equal to or greater than 132 print positions per line.

(A621-3) The character set shall be 128 ASCII programmable characters.

(A621-4) The printer shall process form width from 11 to 22 inches.

(A621-5) There shall be two variable character printers located in the normal access operation center.

3.7.6.2.2 Standard Printer (A622)

(A622-1) The printing speed (at single-line spacing) shall be at least 2000 lines per minute.

(A622-2) The printer shall print equal to or greater than 132 print positions per line.

(A622-3) The character set shall contain the 96 ASCII characters.

(A622-4) The printer shall process 11 to 22 inch from width.

(A622-5) There shall be a total of seven standard printers; three located in the special access operations center and four in the normal access operations center.

3.7.6.2.3 Plotter (A623)

(A623-1) The plotting area shall be not less than 20 x 36 inches.

(A623-2) The character set shall contain 64 ASCII characters plus 32 programmable characters.

(A623-3) The plotter shall produce a minimum of 1000 increments per second.

3.7.6.2.4 Hardcopy Device (A624)

(A624-1) The hardcopy device(s) shall be capable of producing reasonable black and white hardcopy from the rapid response visual display devices specified in section 3.7.6.1.

(A624-2) The pixel resolution shall be equal to or greater than the device resolution specified in section 3.7.6.1 for each display device.

3.7.6.3 Miscellaneous Status (A63)

(A63-1) The miscellaneous status displays shall provide network system and subsystem status to the control areas of AFGWC.

3.7.6.3.1 Configuration Display Panel (A631)

(A631-1) The configuration display panel shall be implemented in discrete status displays.

(A631-2) The configuration display panel shall provide the network controller with information necessary in the performance of the network control responsibilities (normal and fall-back). This information shall include, but not be limited to the following items:

a. Assigned function of all support processors;

b. Classification of all main processors;

c. All systems in failure or maintenance status;

d. Disk system classification level;

e. Line handler/decoder router assignment and operating security level;

f. Status of all mission support and mission operation consoles;

g. Active satellite readout operations: duration, status, etc.; and

h. Variable perimeter assignment.

(A631-3) The configuration display panel shall be updated and driven via direct I/O channel interface with the network control processor and backup.

(A631-4) All display changes shall be blinked after activation by the network control processor until reset by operator action. If the status changes prior to operator reset - this display shall be updated without reset.

(A631-5) The configuration display panel shall be located above the network control CRT devices and clearly legible by the operator located at a normal seated or standing position at the console.

(A631-6) The configuration display panel shall provide redundancy necessary to meet the required reliability of .995.

(A631-7) The configuration display panel switches shall, at a minimum be individual modules, plug replaceable within one minute, remain in position if failure occurs, provide visual failure indications, and be electronic.

3.7.6.3.2 Security Level Display (A632)

(A632-1) All operation center printers, tape drives or other devices that will have occasion to be configured at variable security levels shall be provided with a display that will indicate to the operator the security level of the device.

3.7.6.4 Selection (A64)

3.7.6.4.1 Network Switch Panel (A641)

(A641-1) The network switch panel shall be located at the network control console.

(A641-2) The network switch panel shall provide the following switch capabilities:

a. Variable perimeter switching, and

b. Switching of primary and backup support processors including the input and output equipment components.

(A641-3) The network switch panel shall provide redundancy necessary to meet the required system reliability of .995.

(A641-4) The network switch panel switches shall at a minimum be individual modules, plug replaceable within one minute, remain in position if failure occurs, provide visual failure indications, and be electronic.

3.7.6.4.2 Unit Switch Panel (A642)

(A642-1) Switches shall be provided for all manually configurable system and subsystem components.

(A642-2) Functions for these switches shall include but not be limited to the following items:

a. Switching of disk units between control units, and
b. Switching of tape units between control units.

3.7.6.4.3 Data Base Selector Panel (A643)

(A643-1) A selector panel shall be provided that has the capability of switching the data base associated components (disk drive, dedicated communication channel, main storage facility, etc.) between the main processors that can assume the master data base management function.

(A643-2) The control for this switch shall be remoted to the network control console.

3.7.6.4.4 Processor Selector Panel (A644)

(A644-1) A selector panel shall be provided that, in the event of network control failure, will possess the capability to selectively dedicate the main processors to security levels and to specific functions. Equipment to be switched shall include support processors, line handler/decoder routers, and disk subsystems.

(A644-2) The control of this switch shall be remoted to the network control console.

3.7.6.5 Miscellaneous Communications (A65)

3.7.6.5.1 Card Reader/Punch (A652)

(A652-1) Punching speed shall be equal to or greater than 200 cards per minute.

(A652-2) Reading speed shall be equal to or greater than 1000 cards per minute.

(A652-3) Input hopper shall have a 1000 card capacity.

(A652-4) Output stacker shall have a 2000 card capacity.

3.7.6.6 Manual Inputs (A66)

3.7.6.6.1 Alphanumeric Keyboard (A661)

(A661-1) The keyboard shall contain at least three key pads, one each for: ASCII, control, and numerical selections.

(A661-2) The ASCII selection pad shall provide 96 upper and lower case ASCII characters.

(A661-3) The numerical selection pad shall contain the numbers 0 thru 9, decimal, positive and negative designators.

(A661-4) The keyboard shall contain a programmable audible alarm.

(A661-5) The keyboard shall contain a minimum of four programmable status lights.

(A661-6) Each key shall generate a unique code.

3.7.6.6.2 Fixed Function Keyboard (A662)

(A662-1) The keyboard shall contain one key pad.

(A662-2) The keys shall illuminate when activated.

(A662-3) The functions shall be activated via software.

(A662-4) A minimum of 36 keys shall be provided.

3.7.6.6.3 Lightpen (A663)

(A663-1) A lightpen shall be provided at all graphic CRTs. This device shall allow for entry of data via the CRT or modifications of information already displayed there.

(A633-2) At a minimum the lightpen shall allow for identification of data to an accuracy of .5% of the pixel resolution provided by the CRT.

(A633-3) The lightpen shall provide the capability to identify any point or trace any curve on the CRT in use.

3.7.6.6.4 Magnetic Cursor (A664)

(A664-1) A magnetic cursor shall be provided for use with the digitizing tables and graphic CRTs. This device will allow for data entry or modification.

(A664-2) At a minimum the magnetic cursor shall allow for identifiction of data to an accuracy .1% of the pixel resolution provided by the CRT.

(A664-3) The magnetic cursor shall provide the capability to identify a point or trace any curve on the display device in use.

3.7.6.6.5 Digitizing Table (A665)

(A665-1) Digitizing tables shall be provided for use at designated forecaster consoles for use in data modification, especially where large weather charts are concerned.

(A665-2) The digitizing table shall have a minimum active area of 2' by 3'.

(A665-3) The primary means of entering data on the digitizing table shall be with the magnetic cursor.

(A665-4) The effective nominal resolution of the digitizing table shall be 2000 by 2000 positions.

(A665-5) The digitizing table shall be back lighted in order to provide a tracing capability.

3.8 PRECEDENCE

a. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

b. The order of precedence of specifications places this specification first, then the configuration item specifications, with the test plans last.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 GENERAL

Test and evaluations shall be conducted to verify that the design and performance of the AFGWC System Architecture shall meet or exceed the requirements of Section 3 herein and subordinate specifications. A program of tests and inspections, augmented by analysis, shall be conducted to verify compliance with the requirements of this specification and subordinate specifications. Test objectives shall be implemented in accordance with the System Test Plan.

4.1.1 Responsibility for Tests

Testing shall be conducted in accordance with AFR 80-14.

4.1.1.1 Development Test and Evaluation

The contractor shall be responsible for the Development Test and Evaluation (DT&E) program using test plans and procedures approved by the government.

4.1.1.2 Operational Test and Evaluation

AFGWC will be responsible for the Operational Test and Evaluation (OT&E) program.

4.1.1.3 System Test Plan

The government will provide an overall System Test Plan to guide the fulfillment of test requirements. The plan will include basic planning information (planning factors, objectives, scope) for all phases of the test program.

4.1.2 Special Tests and Examinations

This section is not applicable to this specification.

4.2 QUALITY CONFORMANCE INSPECTIONS

Formal qualification inspection, analysis, and test shall be conducted to validate that the design and performance of the system, including hardware and software, satisfy the requirements of Section 3 herein. This activity shall also verify the effectiveness of the manufacturing process.

5.0 PREPARATION FOR DELIVERY

AFGWC System Architecture hardware shall be afforded the level of protection specified in paragraph 3.1.1.2 of MIL-P-009024.