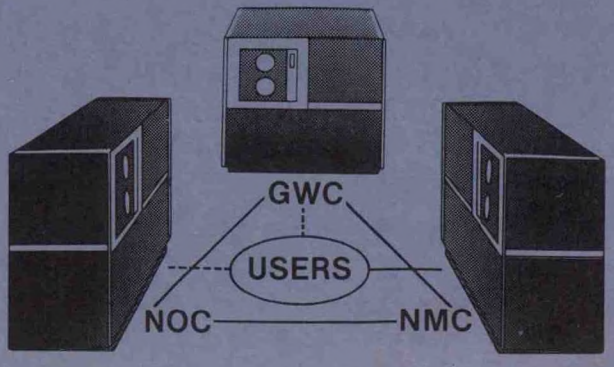
DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration

FEDERAL COORDINATOR FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

Federal Plans for Mutual Support and Cooperative Backup Among Operational Processing Centers



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U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
FEDERAL COORDINATOR
FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

FEDERAL PLANS
FOR
MUTUAL SUPPORT AND COOPERATIVE BACKUP
AMONG OPERATIONAL PROCESSING CENTERS

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FOREWORD

Mutual support and backup among major operational weather processing and communications centers are key to our national interests. Such support and backup provide effective and economic use of available resources.

This plan expands upon the outlines of plans to modify operational systems that were included in the last plan in addition to updating details in the operational backup plans. Previous issuances of this document were limited to emergency backup procedures for high priority user products prepared by the Department of Commerce's National Meteorological Center and National Severe Storms Forecast Center. Backup for these products is provided by the Department of Defense's Air Force Global Weather Central and Fleet Numerical Oceanography Center to ensure that vital weather services are maintained to protect life and property of our nation.

Rapid advances in communications and automated information systems technology continue to facilitate cooperation among agencies. Consequently, the plan that was updated in January 1984 is now updated. Increasing emphasis is being placed on mutual and cooperative support for the exchange of information among agencies. As this mutual support improves, dedicated backup should disappear since backup will be inherent in the system. An example of this is the communication link between the Air Force Global Weather Central and the National Weather Service Forecast Office in Omaha, Nebraska. This link is now used daily on an operational basis. Stress is being placed on information systems standards, including formats and communications interfaces. This is also helping to facilitate mutual support and backup for systems that are not located at the operational processing centers.

In Section 9, a description of satellite communication among the operational processing centers provides more details about shared processing than last year's plan. Also added to Section 9 is the concept of a Direct Satellite Weather Broadcast (DSWB) system that is being developed to provide faster distribution of weather information in large volumes to Government agencies at expected lower costs. This system is also expected to provide inherent backup.

The importance of these evolving capabilities should not be minimized. Users who depend directly on the products and services from all major centers are not only the Department of Commerce's Weather Service Forecast Offices and Weather Service Offices, but also over 500 offices of other Federal agencies, private meteorologists, companies and the military that serve our Nation's demand for weather services and warnings.

William D. Barney
Federal Coordinator for
Meteorological Services and
Supporting Research

PLAN FOR

MUTUAL SUPPORT AND COOPERATIVE BACKUP

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1. INTRODUCTION

1.1 General

These Federal Plans describe cooperative support and backup among civil and military meteorological services, and emergency backup procedures for the National Meteorological Center (NMC) at Suitland, Maryland, and the National Severe Storms Forecast Center (NSSFC) at Kansas City, Missouri. The meteorological services over the years have become increasingly dependent on centralized computer facilities and automated telecommunication facilities. The Department of Defense (DOD) weather and/or oceanographic processing centers are the Air Force Global Weather Central (AFGWC) and the Fleet Numerical Oceanography Center (FNOC). These several processing centers collect and relay meteorological data and are the major source for both analysis and forecast products. Any prolonged disruption in a processing center service will have a profound effect on all users.

The aim of the services is to continually improve capability for mutual support and backup among the centers. The intent is to complete computer-to-computer linkages to the extent that the service missions permit. The services intend to continue to evolve future systems to inherently include backup as part of their operational systems and to avoid, as far as possible, special handling to achieve backup. Nevertheless, some aspects of backup can or must, at times, be degraded. The other centers cannot provide all products of any one center.

Chapter 9 outlines plans to improve mutual support and backup to minimize degradation and to improve responsiveness to the services and to the nation. Appendix A is the Memorandum of Agreement on the Shared Processing of Satellite Data between NOAA, the Navy and the U.S. Air Force Centers. Appendix B is a support agreement between the NMC and the AFGWC that outlines routine scheduled facsimile support by the NMC to the AFGWC.

1.2 Backup Plans

1.2.1 Backup of NMC. The NOAA National Weather Service's NMC prepares meteorological analyses and forecasts disseminated to a large number of users primarily by facsimile, teletypewriter, and computer networks. In addition, large volumes of raw data are received and relayed to other processing centers. An extended power outage or computer failure could cause a serious disruption in NMC operations. If failures occur, NMC guidance products and other products emanating from NMC will not reach users on the Automation of Field Operations and Services (AFOS), teletypewriter, facsimile, and other communications circuits. These include National Weather Service (NWS), Department of Defense (DOD), and Federal Aviation Administration (FAA) field facilities located throughout the country as well as non-government users. Chapter 3 is the Federal Plan for Backup of the NMC. This plan employs the Air Force Global Weather Central (AFGWC) and the Navy's Fleet Numerical Oceanography Center (FNOC) as backup for NMC. Chapter 5 provides for AFGWC backup for the NMC aviation flight level wind and temperature forecasts over the Northern Hemisphere.

1.2.2 Backup of NSSFC. The Federal Plan for Backup of the Severe Local Storms (SELS) Unit of the NSSFC is given in Chapter 4. When SELS backup is needed, support will be provided by the AFGWC.

1.2.3 Routine Communications Support for DOD. The DOD depends on the NWS for observed ("raw") data from Canada, Alaska, parts of South America, and most ocean vessels other than those of the U.S. Navy. Communication computers at NMC handle these raw data. Chapter 8 shows details of the NWS' communication support to the Air Force and Navy weather computers.

1.2.4 Backup Limitations. Backup support from the AFGWC or the FNOC shall not interfere with DOD support requirements and, in cases of conflict, DOD requirements will take precedence.

1.2.5 Revisions to Plans. These plans are provided as separate chapters within this document. The chapters may be revised either jointly or separately as necessary.

1.3 Definitions.

This section defines terms which are special to these backup plans or which refer to operational or communications procedures.

1.3.1 Outage. Power failure or computer failure affecting Center operations.

1.3.2 Extended Outage. An outage that lasts, or is expected to last, 12 hours or longer. Two stages of outage at NMC are possible.

1.3.2.1 Stage 1 Outage. In a Stage 1 Outage at NMC, only the large NOAA computers at Suitland, Maryland, will be inoperative; however the communications system will continue to operate. The Meteorological Operations Division of NMC will continue to transmit some manual products.

1.3.2.2 Stage 2 Outage. In a Stage 2 Outage, the large NOAA computers at Suitland, Maryland, will be inoperative, and the NMC Meteorological Operations Division at Camp Springs, Maryland, will not be able to transmit products to AFOS, or to alphanumeric and facsimile circuits, including the Family of Services (FOS). The outage may be due to power failure, communications failure, or other causes.

Other NMC outage configurations are possible, but present agreements cover only the above two stages.

1.3.3 Transmission Point. Location of the source of entry of data or graphics onto a circuit.

2. RESPONSIBILITIES OF COOPERATING AGENCIES

2.1 National Weather Service (NWS) Responsibilities

2.1.1 Provide timely dissemination of weather warnings and other weather information and forecasts to the general public and specialized users.

2.1.2 Through the National Meteorological Center (NMC), provide much of the synoptic scale guidance material, aviation forecast material, and long range forecasts used by NWS field offices, FAA Flight Service Stations (FSS), and provide much of the North American synoptic scale guidance material, some aviation forecast material, and long range guidance for the DOD. This also includes responsibilities as the World and Regional Aviation Forecast Centers under the auspices of the World Meteorological Organization and the International Civil Aviation Organization.

2.1.3 Through the National Severe Storms Forecast Center (NSSFC) at Kansas City, Missouri, provide Severe Weather Watch Bulletins to the general public and to specialized users.

2.1.4 Individual plans detail specific NMC and NSSFC responsibilities in the event of outages.

2.2 Air Weather Service (AWS) Responsibilities

2.2.1 Mission of AWS. AWS will provide or arrange for staff and operational weather service to active and reserve Air Force units and Army units, designated unified and specified commands, and other agencies as directed by the Chief of Staff, Headquarters, USAF. It shall provide:

2.2.1.1 Basic surface, upper air, and radar observations from its network of observation stations, and additional observations when required.

2.2.1.2 Through the Air Force Global Weather Central (AFGWC), Offutt Air Force Base, Nebraska:

a. Severe weather forecast and warning support (Military Weather Advisories and Point Weather Warnings) in the conterminous United States and 200 miles (370 km) offshore to:

(i) U. S. Air Force, U. S. Army, and selected U. S. Navy installations.

(ii) Air Force and Army Reserve, and National Guard Units.

(iii) Plant sites and facilities operated under Department of Defense (DOD) contracts.

(iv) Airborne military aircraft when under military control.

b. Much of the synoptic-scale guidance material, aviation forecast material, medium-range forecasts, and various mission-tailored products used by the AWS forecasting facilities worldwide.

c. Specific backup support to NWS, as required, and discussed under individual plans.

2.3 Naval Oceanography Command (NOC) Responsibilities

2.3.1 The NOC is responsible for assigned oceanographic, meteorological, and other activities and efforts under the Naval Oceanographic Program, and shall provide technical guidance in such matters throughout the Department of the Navy.

2.3.2 The Naval Oceanographic Office collects, analyzes, and displays oceanographic data to support Naval operations and Naval shore establishment commands; improves methods of oceanographic prediction, data collection and data analysis; and assists other DOD components, U.S. activities, and allied countries in training and in otherwise meeting their oceanographic requirements.

2.3.3 The Fleet Numerical Oceanography Center (FNOC) located in Monterey, California, provides, on an operational basis, numerical oceanographic and meteorological products peculiar to the needs of the Department of the Navy; and develops and tests numerical techniques to solve oceanographic analytical and forecasting problems as directed by the Commander Naval Oceanography Command.

2.3.4 The Naval Polar Oceanography Center (NPOC) located in Suitland, Maryland, provides within its area of responsibility as assigned by the Commander NOC, operational oceanographic services to the Armed Forces of the Department of Defense.

2.3.5 The FNOC and the NPOC provide specific backup support to the NWS, as described in Chapter 3.

3. FEDERAL PLAN FOR COOPERATIVE SUPPORT AND BACKUP FOR THE NATIONAL METEOROLOGICAL CENTER

3.1 Introduction

3.1.1 This plan has been designed to provide limited backup to the National Meteorological Center (NMC) within available resources. The objective of the plan is to provide reasonable continuity of guidance products for field facilities in the event of computer or power outages affecting NMC. The main feature of the plan provides for use of those products generated by the Air Force Global Weather Central (AFGWC) at Offutt Air Force Base, Nebraska, and by the Navy Fleet Numerical Oceanography Center (FNOC), at Monterey, California, that come closest to satisfying high-priority requirements of the National Weather Service (NWS). The AFGWC will also continue to transmit products directly from the AFGWC for backup onto AFOS and onto the National Facsimile System (NAFAX) and the National Digital Facsimile System (DIFAX). The FNOC will transmit charts from Monterey to Suitland where they will be used by the NWS as described later. FNOC has also been requested to provide backup support to the Digital Facsimile System (DIFAX).

3.1.2 This plan is not intended to cover all possible extended outage situations involving NMC at Suitland and Camp Springs, Maryland, but to cover only those outages described below as either a Stage 1 or Stage 2 outage. An extended outage at NMC may be due to a power outage or computer failure affecting center operations and may be either a partial or total outage.

3.1.3 NMC will rely on numerical guidance from FNOC as internal backup for upper level analyses and prognoses. With this guidance, NMC will still supply a few manually prepared charts to AFOS and facsimile circuits.

3.1.4 At present there is no backup for high priority teletypewriter guidance in the event of an outage at NMC in which the large computers are inoperative - (Limited-area Fine-mesh Model 6-hourly detailed values at stations, or model output statistical (MOS) forecast products such as probability of precipitation and maximum/minimum temperatures).

3.1.5 In the event of a total (Stage 2) outage of all NMC operations, hand analyses and forecasts will be unavailable from the NMC Meteorological Operations Division. Upper-level analyses and prognoses, as well as surface analyses and manually prepared prognoses, including horizontal cloud and weather depiction, will be transmitted on the AFOS, NAFAX, and DIFAX circuits by AFGWC, as shown in Tables 3-1 and 3-2.

The AFGWC has developed software needed to produce graphic products for transmission to AFOS as initially agreed and in accordance with preliminary specification.

3.1.6 Table 3-1 is the AFOS Graphics Backup Schedule for providing graphics to NWS field offices. Table 3-2 is the NAFAX/DIFAX Backup Schedule for providing high-priority charts to users of NMC products. Table 3-3 contains FNOC products for Stage 1 guidance to the NMC Meteorological Operations Division.

3.2 Emergency Backup Processing Centers

3.2.1 When an extended Stage 1 outage occurs causing backup support to be requested, FNOC will supply automated guidance products to NMC. Stage 1 is the more probable situation where the NOAA NAS 9000 and the CYBER 205 computer systems are inoperative but the NMC complex of IBM 4341's is operating. In Stage 1 no NMC automated analyses and models would be computed, but NMC would have full communications.

The Meteorological Operations Division of NMC will be backed up with FNOC model products for guidance and services. The backup products will be transmitted to NMC and will include selected marine charts.

AFGWC will transmit AFOS backup products via the Omaha Weather Service Forecast Office (WSFO) AFOS terminal. AFGWC will also provide Aviation Digital Forecasts as specified in Chapter 5.

3.2.2 Stage 2 is a total outage where NMC is without communications. All products will originate, and the communication networks will be driven, external to NMC. Should an extended Stage 2 outage occur which causes backup support to be requested, AFGWC will provide both manual and computer products for AFOS and for the DIFAX and NAFAX circuits.

3.2.3 Transmission schedules of high-priority products shown in Tables 3-2, 3-3, and 3-4 will be used for the duration of the outage. The schedule of AFOS products to be transmitted is given in Table 3-1.

3.3 Communications Circuits and Backup Schedules and Lists

3.3.1 During a Stage 1 or Stage 2 outage, AFGWC will transmit AFOS backup products via the Omaha WSFO AFOS terminal. The schedule of AFOS graphics to be prepared and transmitted is given in Table 3-1.

3.3.2 The NAFAX circuit GD-60144 and the DIFAX circuit GF-63717 will be fed backup charts from AFGWC directly into the NAFAX/DIFAX transmit terminals at Offutt AFB during a Stage 2 outage. The emergency schedule of facsimile charts to be prepared and transmitted on the NAFAX/DIFAX circuit(s) is Table 3-2. This schedule will be printed and distributed to all NAFAX and DIFAX users. The emergency schedule for the DIFAX circuit is initially expected to be the same as the NAFAX schedule. Further information on communications procedures is contained in Chapter 6.

3.3.3 Transmission Points. The AFGWC and the FNOC will serve as the transmission points for backup graphics products during an extended outage.

3.3.4 Transmission Procedures. The AFGWC has direct transmit capability on NAFAX circuit GD60144 and DIFAX circuit GD63717. During a Stage 2 outage AFGWC will be advised by NWS when backup transmission procedures are to be initiated on either system.

3.4 NMC Responsibility

In the event of an outage affecting NMC operations, the Director, NMC, or his designee shall be responsible for the following actions:

3.4.1 Estimate Duration of Outage

3.4.1.1 Estimates of the duration of a Stage 1 outage will be obtained from the Computer Operations Division (COD), of the National Meteorological Center.

3.4.1.2 Estimates of the duration of a Stage 2 outage will be provided by the Director, NMC, or his designee.

3.4.2 Decision to Implement Backup Plan

Based on these estimates, the Director, NMC, or his designee, will decide to implement either the Stage 1 or the Stage 2 backup plan. Telephone will be used to invoke the plan. If NMC is incommunicado, the Assistant Administrator, National Weather Service, or his designee, at Silver Spring, Maryland, will invoke the plan. The telephone numbers of all key individuals and installations involved have been distributed separately. The telephone numbers and names of key individuals will be updated as required. As a guideline, the NMC backup plan will be implemented if:

a. The outage is expected to last at least 12 hours, or

b. The outage has already lasted 12 hours and resumption of normal operation is not imminent.

3.4.3 Notification of AFGWC and FNOC

If the decision is made to implement the backup plan, telephone contacts will be made with the designated officials at AFGWC and FNOC. They will be requested to begin emergency transmissions and to assume their assigned roles as planned. See AFGWC Responsibility [3.5] and FNOC Responsibility [3.6]. If the requested backup is expected to last more than 48 hours, the National Weather Service, at the request of AFGWC, will provide AFOS operator assistance at AFGWC. The NMC will also provide AFGWC and FNOC with a forecast of the duration of the outage and updated information when available.

Should a Stage 1 outage occur, NMC will notify FNOC that backup is required to support the Meteorological Operations Division at NMC as described in Section 3.6 in this chapter. NMC will notify AFGWC that backup is required for AFOS and for Aviation Digital Forecasts as specified in Chapter 5.

3.4.3.2 Should a Stage 2 outage occur, NMC or National Weather Service Headquarters will notify AFGWC and FNOC that full backup is required.

3.4.4 Resumption of Normal Operations. When normal capability at NMC is restored, notification will be given to AFGWC and FNOC of this fact together with the time that NMC will resume normal operations.

3.5 AFGWC Responsibility

3.5.1 Procedures. Upon notification from the Director, NMC, or his designee, that the NMC backup plan will be implemented and that a stage of backup is needed, AFGWC will begin transmitting the required charts on the NAFAX and DIFAX systems according to the backup schedules no later than 4 hours after receipt of the notification. Aviation digital information will be transmitted as required by Chapter 5. AFGWC will coordinate communication procedures with the 390th Information Systems Operations Squadron (ISOS). AFGWC will also transmit the necessary graphics on the AFOS system when NWS requires backup.

3.5.2 Air Force Digital Graphics System (AFDIGS). In October 1980, the AWS implemented the AFDIGS which includes NMC products among its transmissions to AWS detachments. The AWS will adjust its operations to mitigate missing NMC products.

3.5.3 Initiation. The initial AFGWC AFOS, DIFAX or NAFAX transmission will be made according to the backup list contained in Tables 3-1 and 3-2 and will be made within 4 hours of the time of notification.

3.5.4 Annotation. The AFGWC will annotate or precede its first transmission with a message indicating that emergency backup procedures are in effect and that transmissions on the AFOS, DIFAX or NAFAX are originating from AFGWC. An indication will be given, if possible, when normal operations will resume.

3.5.5 Termination of Backup Responsibility. The AFGWC will continue transmissions to AFOS, DIFAX, and NAFAX, and other circuits according to the backup schedules until such time as NMC notifies AFGWC that normal NMC operations at a specifically agreed upon time are ready to resume.

3.6 FNOC Responsibility

3.6.1 Procedures. Upon notification from the Director, NMC, or his designee, that the NMC Backup Plan will be implemented, FNOC will begin transmitting charts to support the NMC Meteorological Operations Division no later than four hours after receipt of the notification.

When the Stage 1 backup requirement for NMC is invoked, FNOC will provide 0-72 h output for use by the NMC Meteorological Operations Division. The list of charts to be provided is shown in Table 3-3. The backup products will be transmitted to NMC. The backup package and the times charts are valid and available and are listed in Table 3-4. Backup will be from the operational run for the Navy Environmental Display Station (NEDS).

The plan can be invoked at anytime by calling the FNOC Command Duty Officer. Telephone numbers have been distributed separately. The telephone numbers and names of key individuals will be updated as required.

3.6.2 Initiation. The initial FNOC transmission will be made according to the backup schedule contained in Table 3-4 and will correspond to the approximate time of notification plus four hours, or less, if possible.

3.6.3 Termination of Backup Responsibility. The FNOC will continue transmitting products to the NMC according to the backup schedules until such time as notification is received from NMC to cease.

3.7 Additional Information

3.7.1 Special Instructions. Special instructions for National Weather Service offices will be contained in a future issuance of a National Weather Service Operations Manual chapter entitled, "Cooperative Backup Among Operational Processing Centers." Also, a description of the AFGWC and FNOC charts to be transmitted during emergency situations will be prepared and distributed as numbered revisions to the National Weather Service Forecasting Handbook No. 1 - Facsimile Products.

3.7.2 Description of Communications and Schedules. Chapter 6 of this document contains a description of the communication facilities and operational communication procedures for backup.

3.7.3 Testing the Backup System. Chapter 10 contains information about procedures and scheduling tests of the backup system.

TABLE 3-1. AFOS GRAPHICS BACKUP SCHEDULE

CHART#	AFOS PI	AFOS START TIME (UTC) (APPROX.)	VALID TIME (UTC)*	AREA	PRODUCT DESCRIPTION
1	L4W	0000	12	NA	24-H PROG LO-LVL WX DEPICT
2	9AI	0030	18	NH	SFC ISOBARS
3	L4P	0040	12	NA	24-H PROG CLDS & PRECIP
4	L6P	0050	00	NA	36-H PROG CLDS & PRECIP
5	P0A	0100	00	NA	SFC PLOT FILE
6	3EY	0130	12	NH	24-H PROG 300 MB ISOTACHS
7	96F	0150	00	NA	36-H PROG SFC FRONTS
8	3GH	0220	00	NH	36-H PROG 300 MB HT
9	90F	0230	00	NA	SFC FRONTS
10	98F	0240	12	NA	48-H PROG SFC FRONTS
11	L8P	0310	12	NA	48-H PROG CLDS & PRECIP
12	90I	0340	00	NA	SFC ISOBARS
13	50A	0350	00	NA	500 MB PLOT FILE
14	P0A	0400	03	NA	SFC PLOT FILE
15	80A	0410	00	NA	850 MB PLOT FILE
16	70A	0420	00	NA	700 MB PLOT FILE
17	50H	0450	00	NA	500 MB HT ANAL
18	50T	0500	00	NA	500 MB TEMP ANAL
19	80H	0510	00	NA	850 MB HT ANAL
20	80T	0520	00	NA	850 MB TEMP ANAL
21	70H	0540	00	NA	700 MB HT ANAL
22	70T	0550	00	NA	700 MB TEMP ANAL
23	9AI	0620	00	NH	SFC ISOBARS
24	30H	0630	00	NA	300 MB HT ANAL
25	30Y	0640	00	NA	300 MB ISOTACH ANAL
26	92F	0650	12	NA	12-H PROG SFC FRONTS
27	P0A	0700	06	NA	SFC PLOT FILE
28	L2W	0710	12	NA	12-H LO-LVL WX DEPICT
29	72V	0740	12	NA	12-H PROG 700 VERT VEL
30	L2P	0750	12	NA	12-H PROG PRECIP
31	52H	0800	12	NA	12-H PROG 500 MB HT
32	52V	0810	12	NA	12-H PROG 500 MB VORT
33	84H	0820	00	NA	24-H PROG 850 MB HT
34	90F	0830	06	NA	SFC FRONTS
35	L2G	0840	12	NA	12-H PROG LO-LVL TURB
36	84T	0850	00	NA	24-H PROG 850 MB TEMP
37	74V	0920	00	NA	24-H PROG 700 MB VERT VEL
38	74H	0930	00	NA	24-H PROG 700 MB HT
39	54H	0940	00	NA	24-H PROG 500 MB HT
40	54V	0950	00	NA	24-H PROG 500 MB VORT

*Universal Time Coordinated

TABLE 3-1. AFOS GRAPHICS BACKUP SCHEDULE
(CON'T)

CHART #	AFOS PI	AFOS START TIME (UTC) (APPROX.)	VALID TIME (UTC)	AREA	PRODUCT DESCRIPTION
41	P0A	1000	09	NA	SFC PLOT FILE
42	90I	1010	06	NA	SFC ISOBARS
43	56H	1020	12	NA	36-H PROG 500 MB HT
44	56V	1030	12	NA	36-H PROG 500 MB VORT
45	58V	1040	00	NA	48-H PROG 500 MB VORT
46	58H	1050	00	NA	48-H PROG 500 MB HT
47	88H	1100	00	NA	48-H PROG 850 MB HT
48	88T	1110	00	NA	48-H PROG 850 MB TEMP
49	3EH	1140	00	NH	24-H PROG 300 MB HT
50	L4W	1150	00	NA	24-H PROG LO-LVL WX DEPICT
51	94F	1210	00	NA	24-H PROG SFC FRONTS
52	9AI	1240	06	NH	SFC ISOBARS
53	L4P	1250	00	NA	24-H PROG PRECIP
54	P0A	1300	12	NA	SFC PLOT FILE
55	L6P	1310	12	NA	36-H PROG PRECIP
56	3EY	1340	00	NH	24-H PROG 300 MB ISOTACHS
57	96F	1350	12	NA	36-H PROG SFC FRONTS
58	3GH	1420	12	NH	36-H PROG 300 MB HT
59	90F	1430	12	NA	SFC FRONTS
60	98F	1440	00	NA	48-H PROG SFC FRONTS
61	L8P	1510	00	NA	48-H PROG PRECIP
62	90I	1540	12	NA	SFC ISOBARS
63	50A	1550	12	NA	500 MB PLOT FILE
64	P0A	1600	15	NA	SFC PLOT FILE
65	80A	1610	12	NA	850 MB PLOT FILE
66	70A	1620	12	NA	700 MB PLOT FILE
67	50H	1650	12	NA	500 MB HT ANAL
68	50T	1700	12	NA	500 MB TEMP ANAL
69	80H	1710	12	NA	850 MB HT ANAL
70	80T	1720	12	NA	850 MB TEMP ANAL
71	70H	1740	12	NA	700 MB HT ANAL
72	70T	1750	12	NA	700 MB TEMP ANAL
73	9AI	1820	12	NH	SFC ISOBARS
74	30H	1830	12	NA	300 MB HT ANAL
75	30Y	1840	12	NA	300 MB ISOTACH ANAL
76	92F	1850	00	NA	12-H PROG SFC FRONTS
77	P0A	1900	18	NA	SFC PLOT FILE
78	L2W	1910	00	NA	12-H PROG LO-LVL WX DEPICT
79	72V	1940	00	NA	12-H PROG 700 MB VERT VEL
80	L2P	1950	00	NA	12-H PROG PRECIP

TABLE 3-1. AFOS GRAPHICS BACKUP SCHEDULE
(CON'T)

CHART #	AFOS PI	AFOS START TIME (UTC) (APPROX.)	VALID TIME (UTC)	AREA	PRODUCT DESCRIPTION
81	52H	2000	00	NA	12-H PROG 500 MB HT
82	52V	2010	00	NA	12-H PROG 500 MB VORT
83	84H	2020	12	NA	24-H PROG 850 MB HT
84	90F	2030	18	NA	SFC FRONTS
85	L2G	2040	00	NA	12-H PROG LO-LVL TURBC
86	84T	2050	12	NA	24-H PROG 850 MB TEMP
87	74V	2120	12	NA	24-H PROG 700 MB VERT VEL
88	74H	2130	12	NA	24-H PROG 700 MB HT
89	54H	2140	12	NA	24-H PROG 500 MB HT
90	54V	2150	12	NA	24-H PROG 500 MB VORT
91	P0A	2200	21	NA	SFC PLOT FILE
92	90I	2210	18	NA	SFC ISOBARS
93	56H	2220	00	NA	36-H PROG 500 MB HT
94	56V	2230	00	NA	36-H PROG 500 MB VORT
95	58V	2240	12	NA	48-H PROG 500 MB VORT
96	58H	2250	12	NA	48-H PROG 500 MB HT
97	94F	2300	12	NA	24-H PROG SFC FRONTS
98	88H	2310	12	NA	48-H PROG 850 MB HT
99	88T	2320	12	NA	48-H PROG 850 MB TEMP
100	3EH	2350	12	NH	24-H PROG 300 MB HT

TABLE 3-2. NAFAX/DIFAX BACKUP SCHEDULE

CHART#	MOMSS	START TIME	HEADING	VALID TIME	CHART DESCRIPTION
1	009	0034Z	ADUS	2335Z	RADAR SUMMARY
2	001	0100Z	FAUS	----	SFC CLDS 24, 36, 48-H PROGS
3	027	0130Z	ADUS	0035Z	RADAR SUMMARY
4	013	0155Z	ASUS	0000Z	SURFACE ANALYSIS/FXN4/
5	020	0220Z	AUUS50	0000Z	500MB ANALYSIS/FXN1/
6	019	0236Z	ADUS	0135Z	RADAR SUMMARY
7	030	0250Z	AUUS85	0000Z	850MB ANALYSIS/FXN1/
8	026	0304Z	AUUS70	0000Z	700MB ANALYSIS/FXN1/
9	054	0330Z	ADUS	0235Z	RADAR SUMMARY
10	252	0400Z	ASNH	0000Z	NH SFC ANALYSIS
11	013	0420Z	ASUS	0300Z	SURFACE ANALYSIS/FXN4/
12	050	0529Z	ADUS	0435Z	RADAR SUMMARY
13	170B	0600Z	FVWH	0000Z	VERT VEL/FXN3/
14	177B	0600Z	FVWH	1200Z	12-H LFM-VERT VEL/FXN3/
15	185B	0600Z	FVWH	0000Z	24-H LFM-VERT VEL/FXN3/
16	182B	0600Z	FVWH	1200Z	36-H LFM-VERT VEL/FXN3/
17	051	0636Z	ADUS	0535Z	RADAR SUMMARY
18	301	0650Z	FUWH30	1800Z	18-H 300 MB PROG/FX1/
19	304	0710Z	FUWH85	0000Z	24-H 850 MB PROG/FX2/
20	205	0725Z	FUWH70	0000Z	24-H 700 MB PROG/FX2/
21	170C	0740Z	FUXW2	0000Z	INIT 500 MB HGT/VORT/FXN2/
22	177C	0740Z	FUXW2	1200Z	12-H 500 MB HGT/VORT/FXN2/
23	185C	0740Z	FUXW2	0000Z	24-H 500 MB HGT/VORT/FXN2/
24	182C	0740Z	FUXW2	1200Z	36-H 500 MB HGT/VORT/FXN2/
25	160	0810Z	FANH2	0000Z	24-H SIG WEA
26	085	0833Z	ADUS	0735Z	RADAR SUMMARY
27	083	0845Z	ASUS	0600Z	SURFACE ANALYSIS/FXN4/
28	307	0910Z	FUNH30	1200Z	36-H 300 MB PROG/FX3A/
29	291	0928Z	ACUS	1200Z	SVR WEA OUTLOOK
30	099	0945Z	ADUS	0835Z	RADAR SUMMARY
31	013	0958Z	ASUS	0900Z	SURFACE ANALYSIS/FXN4/
32	110	1027Z	ADUS	0935Z	RADAR SUMMARY
33	130	1135Z	ADUS	1035Z	RADAR SUMMARY
34	128	1235Z	ADUS	1135Z	RADAR SUMMARY
35	113	1235Z	FAUS	----	24, 36, 48-H SFC PROG
36	140	1330Z	ADUS	1235Z	RADAR SUMMARY
37	150	1345Z	ASUS	1200Z	SURFACE ANALYSIS/FXN4/
38	020	1422Z	AUUS50	1200Z	500 MB ANALYSIS/FXN1/
39	030	1440Z	AUUS85	1200Z	850 MB ANALYSIS/FXN1/
40	026	1500Z	AUUS70	1200Z	700 MB ANALYSIS/FXN1/
41	164	1526Z	ADUS	1435Z	RADAR SUMMARY
42	254	1600Z	ASNH	1200Z	NH SFC ANALYSIS
43	013	1630Z	ASUS	1500Z	SFC ANALYSIS - US/FXN4/
44	119	1725Z	ADUS	1635Z	RADAR SUMMARY
45	170C	1800Z	FUXW2	1200Z	INIT 500 MB HGT/VORT/FXN2/
46	177C	1800Z	FUXW2	0000Z	12-H 500 MB HGT/VORT/FXN2/
47	185C	1800Z	FUXW2	1200Z	24-H 500 MB HGT/VORT/FXN2/
48	182C	1800Z	FUXW2	0000Z	36-H 500 MB HGT/VORT/FXN2/
49	301	1850Z	FUWH30	0600Z	18-H 300 MB PROG/FX1/

TABLE 3-2. NAFAX/DIFAX BACKUP SCHEDULE
(CON'T)

CHART#	MOMSS	START TIME	HEADING	VALID TIME	CHART DESCRIPTION
50	304	1910Z	FUWH85	1200Z	24-H 850 MB PROG/FX2/
51	305	1924Z	FUWH70	1200Z	24-H 700 MB PROG/FX2/
52	279	1936Z	ADUS	1835Z	RADAR SUMMARY
53	170B	1947Z	FVWH	1200Z	INIT VERT VEL/FXN3/
54	177B	1947Z	FVWH	0000Z	12-H VERT VEL/FXN3/
55	185B	1947Z	FVWH	1200Z	24-H VERT VEL/FXN3/
56	182B	1947Z	FVWH	0000Z	36-H VERT VEL/FXN3/
57	161	2011Z	FANH2	1200Z	24-H SIG WEA
58	265	2033Z	ADUS	1935Z	RADAR SUMMARY
59	217	2045Z	ASUS	1800Z	SURFACE ANALYSIS/FXN4/
60	307	2109Z	FUNH30	0000Z	36-H 300 MB PROG/FX3A/
61	234	2127Z	ADUS	2035Z	RADAR SUMMARY
62	282	2233Z	ADUS	2135Z	RADAR SUMMARY
63	013	2245Z	ASUS	2100Z	SURFACE ANALYSIS - U.S./FXN4/
64	261	2329Z	ADUS	2235Z	RADAR SUMMARY

NOTES:

1. KGWC transmissions by 390 ISOS, Bldg 301D, Offutt AFB, NE.

2. NH - Northern Hemisphere.

3. US - United States.

4. WH - Western Half NH.

5. XW - Special NA Section.

6. All transmissions at 120 SPM use MOMSS code 300.

7. All transmissions on NAFAX are analog; all transmissions on DIFAX are digital.

8. Z = UTC = Universal Coordinated Time

TABLE 3-3. NAVY (FNOC) BACKUP PACKAGE

Surface Analysis (PS)	Area	Initial Time
Northern Hemisphere	N.H.	00Z, 06Z, 12Z, 18Z
North America	N.A.	00Z, 03Z, 06Z, 09Z 12Z, 15Z, 18Z, 21Z
Prog Charts		
12, 24*, 36, and 48*-h Surface forecasts (PS)	N.A.	00Z, 12Z
24, 36, 48, and 72-h 50 kPa forecasts (D500)	N.A.	00Z, 12Z
12, 24, 36-h 30 kPa forecasts (D300)	N.H.	00Z, 12Z
12, 24, 36-h Quantitative Precipitation	N.A.	00Z, 12Z

N.H. = Northern Hemisphere

N.A. = North America

*Thickness available on these progs (must be requested).

Wind and Temperature fields available on 50 and 30 kPa (500 and 300 mb) charts must be requested.

NOTES:

1. This schedule will continue on each operational cycle until FNOC and NPOC are informed that backup is no longer needed.

2. North American products will be extracted from northern hemisphere fields or from North American regional fields as available.

TABLE 3-4. CHARTS AVAILABLE AT NMC

Product		Area	Produced at FNOC	Est. Chart Avail. at Suitland
PS	Analysis	N.H.	0430/1030 *	0445/1045
	"	"	1630/2230 *	1645/2245
PS	"	N.A.	0430/0620/1030	0445/0645/1045
	"	"	1145/1630/1820	1200/1645/1845
	"	"	2230/2345	2245/0015
PS	12-h Prog	N.A.	0530/1730	0545/1745
D300	"	N.H.	" *	0615/1815
Pcpn	"	N.A.	"	0545/1745
PS	24-h Prog	"	"	0630/1830
D500	"	"	"	0730/1930
D300	"	N.H.	" *	"
Pcpn	"	N.A.	"	0630/1830
PS	36-h Prog	"	0600/1800	0745/1945
D500	"	"	"	0730/1930
D300	"	N.H.	" *	"
Pcpn	"	N.A.	"	0745/1945
PS	48-h Prog	"	0615/1815	0730/1930
D500	"	"	"	"
D500	72-h Prog	"	0700/1900	0800/2000

*These Charts are Northern Hemisphere, all others are North American.

Assumptions:

1. Transmissions to NMC are on time.
2. Times are based on:
   a. Scheduled transmission times at FNOC
   b. Estimated receipt time at Suitland
   c. Two minutes per chart preparation time.
3. Fourteen minutes for each chart to be transmitted.

NOTE:

This schedule will continue on each operational cycle until NAVPOLAROCEANCEN is informed that backup is no longer needed.

4. FEDERAL PLAN FOR BACKUP OF THE NATIONAL SEVERE STORMS FORECAST CENTER

4.1 Introduction

4.1.1 The National Severe Storms Forecast Center (NSSFC), Kansas City, Missouri, through its Severe Local Storms (SELS) Unit, has the responsibility for issuing and cancelling severe local storm watches and for preparing other material which is essential to the National Weather Service Severe Local Storms Warning Service. In the event that NSSFC is unable to discharge its functions, another unit must, on short notice, operate the severe local storms forecasting program until NSSFC can resume operations.

4.1.2 The Air Force Global Weather Central (AFGWC) is in a unique position to provide backup for SELS. Presently, AFGWC provides area and point warnings of tornadoes and severe thunderstorms for military operations within the conterminous United States, and in the process, frequently coordinates with SELS during severe weather situations. Consequently, AFGWC will distribute backup products for NSSFC on AFOS via the Omaha WSFO. These products will also be distributed by NWS at Suitland, MD, onto the Service A teletypewriter system via the FAA's Weather Message Switching Center (WMSC) in Kansas City.

4.2 SELS Responsibility

4.2.1 In the event that SELS cannot fulfill its responsibility, the SELS forecaster will make telephone contacts with the designated AFGWC focal point and request backup if normal operations are not expected to be resumed in a short time interval during which the likelihood of severe weather is slight. The SELS forecaster will give AFGWC an estimate of the duration of the outage, the number of the last valid watch, and updated information when available. Telephone numbers of all key individuals and installations involved have been distributed separately.

4.2.2 SELS will notify AFGWC of the time to discontinue backup support, when SELS can resume its normal responsibilities.

4.3 AFGWC Responsibility

4.3.1 Upon notification from SELS that the Backup Plan is to be implemented, AFGWC will prepare and transmit watches, outlooks, and other advices regarding severe local storm activity as prescribed in National Weather Service Operations Manual (NWSOM) Chapter C-40.

Specifically, AFGWC will issue, for the duration of the backup, the following SELS products for transmission on AFOS. These will be relayed by NWS onto Service A via the FAA WMSC as required and as described by NWSOM Chapter C-40:

- Severe Weather Outlook Narrative (C-40, Sec. 4.1) transmitted daily at 0800Z, 1500Z, and 1930Z. AFOS Product Identifier (PI) OMASWOMKC.
- Combined Severe Weather Watches (C-40, Sec. 4.3.1), AFOS PI OMASSEL0 through 9.

- Preliminary notification of Forthcoming Watch Areas (C-40, Sec. 4.3.2) AFOS PI OMASAW0 through 9.

- Severe Weather Watch Cancellation (C-40, Sec. 4.4) AFOS PI OMASEL0 through 9.

- Status Reports (C-40, Sec. 4.5). AFOS PI OMAWWAMKC.

In addition, AFGWC will coordinate with the affected WSFOs by telephone, prior to watch issuance or cancellation, if time permits. Likewise, WSFOs will contact AFGWC directly, when necessary.

4.3.2 The AFGWC will coordinate with the National Hurricane Center, Coral Gables, Florida, when tropical cyclones are affecting the conterminous United States.

4.3.3 Part A of all AFGWC backup watches will begin as follows: "A....THE USAF AIR WEATHER SERVICE ACTING IN A BACKUP CAPACITY FOR THE NATIONAL SEVERE STORMS FORECAST CENTER, HAS ISSUED A....ETC."

4.4 NMC Responsibility

NMC will continue to prepare and transmit on AFOS, NAFAX, and DIFAX the Severe Weather Outlook Graphic as specified in Section 4.2 of National Weather Service Operations Manual Chapter C-40. Transmission times now are 0927Z on NAFAX, and 1030Z on DIFAX. The graphic will be sent on AFOS as soon as it becomes available from NMC. However, in the backup mode the NMC Meteorological Operations Division will prepare this chart from the 0800Z Severe Weather Outlook Narrative transmitted by AFGWC. A description of this product may be found in Technical Procedures Bulletin No. 279 and a supplement to this Bulletin dated January 12, 1981. This chart should be suitably annotated to indicate that it is a backup chart.

4.5 Communications

AFGWC will transmit alphanumeric bulletins directly onto AFOS via the Omaha WSFO. NMC at Suitland, Maryland, will relay these bulletins directly to the FAA Weather Message Switching Center in Kansas City, Missouri, for relay onto Service A.

4.6 Materials and Software

NSSFC will provide AFGWC with a copy of NWSOM Chapter C-40 (and other pertinent directives) and the necessary message preformats for AFOS.

4.7 Backup System Tests

Testing the product backup system will be accomplished periodically. Details concerning these tests are given in Chapter 10.

5. FEDERAL PLAN FOR BACKUP OF AVIATION WIND FORECASTS

[This chapter may be superseded by international arrangements.]

5.1 Introduction

5.1.1 The National Meteorological Center (NMC) Suitland, Maryland, has the responsibility for issuing wind and temperature forecasts for aviation. The areal coverage of these NMC products currently includes the entire Northern Hemisphere and the Southern Hemisphere to 75°S. Under the provisions of the World Meteorological Organization, NMC has been designated as the Washington World Meteorological Center with international cooperative responsibilities. Also, NMC has been designated a World Aviation Forecast Center by the International Civil Aviation Organization (ICAO) and the WMO.

In the event that NMC should be unable to discharge its functions, another domestic unit capable of continuing the service on short notice must provide the aviation wind forecasts until such time as NMC is able to resume normal operations. This Plan is based on the assumption that NMC's communication computers will remain operational even though the large NOAA computers are inoperative.

5.1.2 The Air Force Global Weather Central (AFGWC) currently provides digital aviation wind and temperature forecast data for military operations. With a modification of the data, NMC can process the AFGWC aviation digital forecasts on the NMC communication computers for distribution. The AFGWC backup will initially be limited to Northern Hemisphere data for selected pressure levels and forecast periods. Backup will be initiated by NMC when experiencing or expecting an extended outage at the NMC computational center. Extended outages are defined as those of 12 hours or more duration.

5.1.3 During an extended Stage 1 outage, products produced as part of the U.S. World Aviation Forecast Center responsibility will be automatically backed up with products in the format routinely received from the World Aviation Forecast Center in Bracknell, U.K. These new aviation products are now available on the NMC family of services.

5.2 Procedures

5.2.1 The Director, NMC, or his designee, will request AFGWC backup when, in his judgement, a significant computer outage is experienced by NMC with a high risk that the outage will continue. The AFGWC Duty Officer will be contacted and will be requested to send backup products. Normally, the SDM will not request a 12-hour forecast because a "significant outage" determination will not likely occur until 12 hours or more after 0000Z or 1200Z. However, should a computer outage extend beyond one data processing cycle, subsequent requests will be for all four forecast periods.

5.2.2 Upon receipt of the forecasts, NMC will process them on the communications computer to produce the necessary output, in grid point form, for insertion into the flight planning and air traffic control computers. For data bulletins required for subsonic jet flight planning and for air traffic control, NMC may, if possible, add tropopause height information derived from the preceding NMC computer run. [Note: The tropopause height is not included in the AFGWC model.]

5.3 Digital Aviation Wind Forecast Format and Content

Data time.

Data base time.

Forecast period.

U & V wind components (U/2 & V/2 kts (U + V m/s)).

Temperatures: Degrees Celsius. (See sign convention, Figure 5-2.)

Grid: As shown in Figure 5-1.

Message Format: As shown in 5-2.

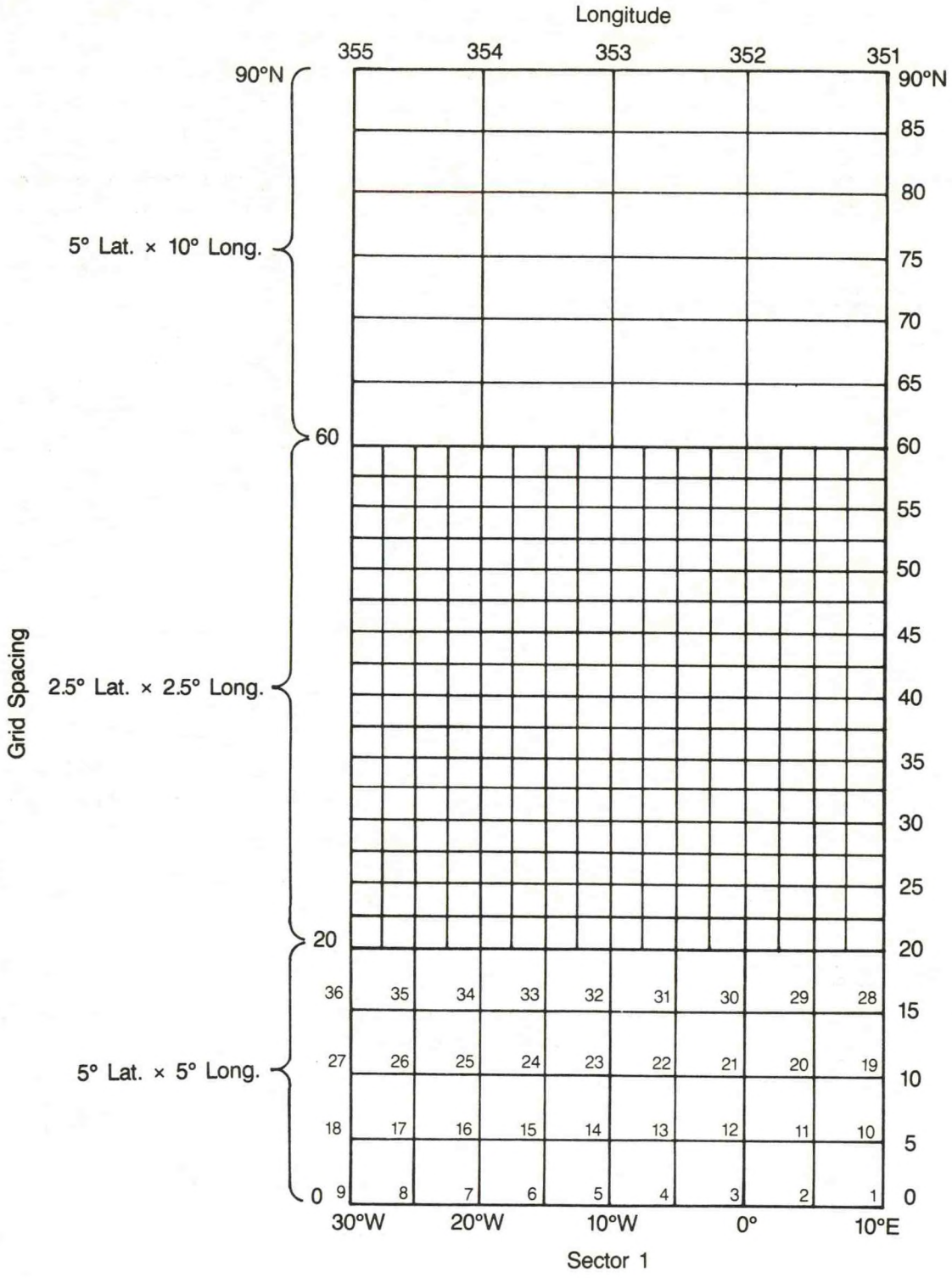
Bulletin Headings: As shown in Table 5-1.

Transmission Method: The NWS circuit between NMC and the DOD Automated Weather Network Management Center (AWNMC), Carswell AFB, and DOD circuitry between the AWNMC and AFGWC will be used.

Volume: There are approximately 8,700 bits per sector record or approximately 78,000 bits per data field (one level for one forecast period).

5.4 Testing the Backup System

The product backup system will be tested periodically. Details concerning these tests are given in Chapter 10.



NOTE: Nine sectors per hemisphere, 355 points per sector. Point number 1 is lower right and Point number 355 is upper left.

Figure 5-1. Grid Array from AFGWC for Digital Aviation Wind and Temperature Forecasts.

Figure 5-2. Sample Aviation Wind Forecast Message

```
7 4 1 7 3 7 6 0 7 4 1 7

111  100  00/1  111  011  1/11  110  000/  111  100  00/1  111

     0              7             0             0

FCST VALID DATE/TIME  07/00Z

0 7 6 2 7 4 1 7 1 1 2 0

000  1/11  110  010/  111  100  00/1  111  001  0/01  010  000

  1            2            0            2         Spcl Chr.

FCST PERIOD              Sector Number

7 4 3 7 4 3 6 5 7 7 1 7

111  100  01/1  111  100  0/11  110  101/  111  111  00/1  111

     1             8             5          u'=-4

Level Number     Level (MB)                U component

6 7 7 3 7 6 4 0 0 0 0 2

110  1/11  111  011/  111  110  10/0  000  000  0/00  000  010/

v'=-3     t'=-5       u'=-6          v'=0         t'=2

V comp    Temp        U comp         V comp       Temperature

v=v'*2          t= |t'|     when t' negative
u=u'*2          t=-t'       when t' positive
```

Table 5-1. Bulletin Headings for Aviation Wind Forecasts

Messages will be transmitted under bulletin headings as follows:

Bulletin Heading		Contents
FDXN851/2/3/4	KGWC	85 kPa (850 mb) forecast for all required sectors (first 2 digits). The third digit (1, 2, 3, or 4) identifies the forecast period as being 12, 18, 24, or 30 hours.
FDXN701/2/3/4	KGWC	70 kPa (700 mb) forecast for all required sectors, and so forth, as before.
FDXN501/2/3/4	KGWC	50 kPa (500 mb) forecast, etc.
FDXN401/2/3/4	KGWC	40 kPa (400 mb) forecast, etc.
FDXN301/2/3/4	KGWC	30 kPa (300 mb) forecast, etc.
FDXN251/2/3/4	KGWC	25 kPa (250 mb) forecast, etc.
FDXN201/2/3/4	KGWC	20 kPa (200 mb) forecast, etc.
FDXN151/2/3/4	KGWC	15 kPa (150 mb) forecast, etc.

6. COMMUNICATION FACILITIES AND OPERATIONAL COMMUNICATION PROCEDURES FOR BACKUP

The communication facilities and the operational procedures for the backup of the National Meteorological Center (NMC) and the National Severe Storms Forecast Center (NSSFC) are described here. Figure 6-1 depicts arrangements of the circuits.

6.1 Automation of Field Operations and Services (AFOS)

6.1.1 AFOS is the primary communication and display system for all WSFOs and most of the WSOs in the NWS within the conterminous states. The backbone of the system consists of the Regional Distribution Circuits which connect WSFOs and National Centers in four regional loops. These loops are driven and interconnected by a Systems Monitoring and Coordination Center (SMCC) located in Suitland, Maryland.

6.1.2 During backup, the AFOS Central Region Distribution Circuit will be fed directly through the Omaha WSFO from an AFOS terminal located at AFGWC. If the SMCC of NWS is operating, AFGWC backup charts will be relayed by the SMCC to the other three regional circuits of the AFOS system (Eastern, Southern, and Western). If the SMCC is not operational, dial-around procedures to connect the circuits can be established.

6.2 Facsimile

The National Facsimile System (NAFAX) is the largest of the National Weather Service (NWS) facsimile systems, with Department of Defense (DOD), Federal Aviation Administration (FAA), NWS, and other government and non-government user connections. Some NWS Forecast Offices in the conterminous United States, several Service Offices, and several other government and non-government users now are connected to the National Digital Facsimile System (DIFAX). Present facsimile backup arrangements include NAFAX and DIFAX backup by the AFGWC. The NAFAX and DIFAX backup schedules will be the same.

6.2.1 NAFAX

6.2.1.1 The National Facsimile (NAFAX) circuit, GD-60144, is a one-way only analog transmission system. The primary entry point is the American Telephone and Telegraph Company (AT&T) facility in Washington, D.C. Transmissions originating at Suitland, Maryland, are entered on local loops feeding through the test board at AT&T and then out to the national system.

6.2.1.2 During backup, the Air Force Global Weather Central will transmit directly on circuit GD-60144 (NAFAX) from its communications center operated by the AFCC. The secondary point of entry to the NAFAX circuit for AFGWC is the AT&T facility at Omaha, NE.

6.2.2 DIFAX

6.2.2.1 The National Digital Facsimile circuit (DIFAX), GD-63717, is a one-way digital transmission system which uses raster scan data compaction coding. Primary transmission entry for the system is at Washington, D. C.; however, transmission for DIFAX originates at the NMC, Suitland. The DIFAX network services about 44 backbone users located in the conterminous U. S.

6.2.2.2 During backup, AFGWC will transmit digital graphics for backup directly onto the DIFAX circuit from the 390 ISOS ID-50 computers at AFGWC at the secondary point of entry located at the AT&T facility at Omaha, NE.

6.3 Emergency Power

The NMC has emergency power for all essential communications facilities such as the communication computers and associated peripheral equipment. Emergency power is also provided to operate facsimile scanners, amplifiers, switches, relays, etc. The Air Force Global Weather Central (AFGWC) has uninterruptible power for its computers and emergency power for the operational facilities.

6.4 NMC Meteorological Operations Division Backup

The Fleet Numerical Oceanography Center (FNOC), Monterey, California, will provide charts to NMC in accordance with Section 3.6.

6.5 Notification Procedures

6.5.1 In the event NMC requires Stage 1 backup by FNOC, the Director, NMC, or his designee, will notify the FNOC Command Duty Officer. NMC will notify AFGWC when additional backup is required.

6.5.2 In the event NMC requires Stage 2 backup, NMC or National Weather Service Headquarters (NWSH) will notify AFGWC and FNOC of the need for full backup.

6.5.3 In the event the NSSFC requires backup, the Director, NSSFC, or his designee, will notify AFGWC. The AFGWC will transmit NSSFC backup products from the AFOS terminal located in AFGWC.

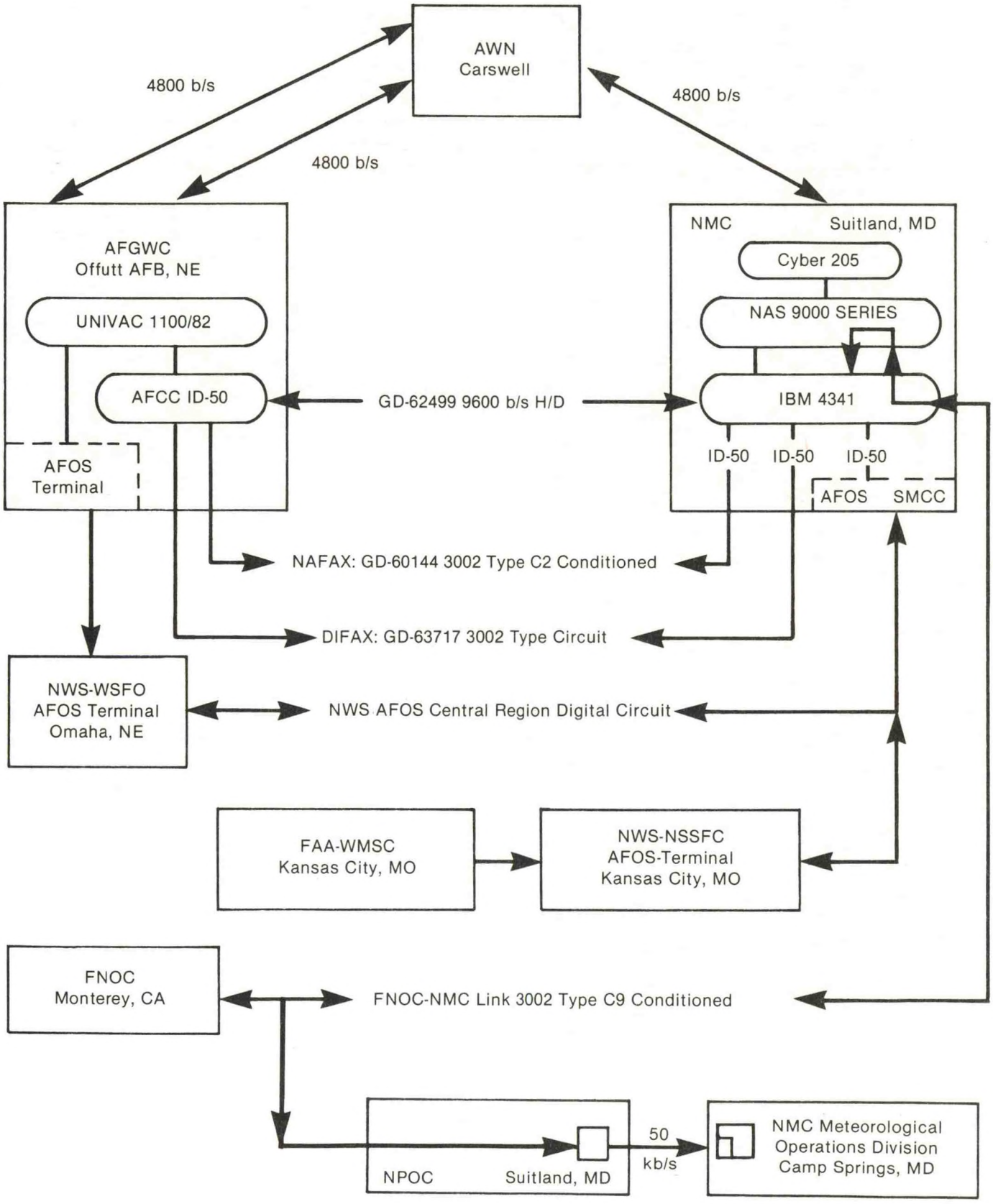


Figure 6-1. Current Backup Circuits.

7. FEDERAL PLAN FOR ROUTINE OPERATIONAL/BACKUP SUPPORT BETWEEN AFGWC AND NOAA/SPACE ENVIRONMENTAL LABORATORY

7.1 Introduction

7.1.1 Air Force Global Weather Central - (AFGWC) is the primary environmental support and production facility of AWS. It is located at Offutt AFB, Nebraska. AFGWC is responsible for building and maintaining a broad range of meteorological and space environmental support capabilities, including both technique development and operational applications. The AFGWC Special Support Division (AFGWC/WS) is responsible for AFGWC's space environmental support products. AFGWC provides services to USAF and other Department of Defense activities.

7.1.2 Environmental Research Laboratories - (ERL) Laboratories of the National Oceanic and Atmospheric Administration (NOAA) conduct basic research in a variety of related scientific disciplines throughout the United States.

7.1.3 Space Environment Laboratory - (SEL) is a laboratory of ERL which conducts basic research and provides operational support in the space and geophysical environment. SEL is located in Boulder, Colorado.

7.1.4 Space Environmental Services Center - (SESC) is a branch of the SEL Services division, also located at Boulder, Colorado. It provides the technique development, environmental data base, and operational support in the space and geophysical environment as required by ERL, NASA and other U.S. Government agencies. As the World Warning Agency, SESC cooperatively exchanges data with various international scientific agencies.

7.1.5 OL-B, AFGWC - (OL-B) is an AFGWC operating location that is physically collocated with SEL/SESC at Boulder, Colorado.

7.1.6 SEL Data Acquisition and Display System - (SELDADS) is the real-time solar-terrestrial environment monitoring system and data base that is operated by the SEL. It uses data from a variety of ground-based and satellite sensors.

7.2 Situation

7.2.1 In consequence of its national and international role of providing basic environmental products and services, the SESC operates and maintains a broad unclassified space environmental data base, SELDADS. This data base incorporates real time data from civil, international and AWS sources, employing equipment and procedures to update the data base routinely and rapidly and to respond automatically to requests via computer and communications devices.

7.2.2 A comprehensive space environmental data base resides at AFGWC and is used operationally to support the USAF and other DOD activities. AWS will employ the SELDADS data base to the extent technically, economically and operationally feasible. Rapid data and product exchange to permit useful AFGWC employment of the SELDADS data base, and the extent to which cooperative efforts can expand, are highly dependent upon the responsiveness of the communications link between SELDADS and AFGWC and the reliability of the SELDADS computers.

7.3 Cooperative Activities

7.3.1 Basic Products.

SESC produces certain basic solar-geophysical analyses and forecasts which are required by AFGWC. A list of SESC basic products, to include their content description, and transmission schedule, will be provided to AFGWC annually, or more frequently if required. AFGWC will document its requirements for the SESC basic products. All changes, additions, and deletions to the list of AFGWC required products will be precoordinated with AFGWC, if at all possible.

7.3.2 Space Environmental Data Base

7.3.2.1 AWS recognizes the advantage of the ERL desire to upgrade capabilities of the SELDADS data base. OL-B, AFGWC, will continue to assist in building and maintaining that data base.

7.3.2.2 Recognizing AWS reliance upon the SESC acquired data, the Director of SEL will, within resource capabilities and limitations, ensure the adequacy and responsiveness of that data for AWS use at AFGWC. AWS will have access to the SELDADS data base. SEL will advise AFGWC at the earliest possible date of any planned changes in data base content and availability.

7.3.3 Acquisition and Exchange of Data and Products

7.3.3.1 Acquisition of space and geophysical data and preparation of basic products in support of common national needs (principally civil) is a basic ERL responsibility.

7.3.3.2 To support unique requirements of USAF and other DOD activities, AWS is responsible for observing, acquiring and distributing unique operational products.

7.3.3.3 SEL and AFGWC data and products will be freely exchanged except as prohibited by security regulations. The Director of SEL and the Commander of AFGWC will define mutually agreeable data formats, bulletin content, and transmission processes for data exchanged, and will plan for exchange of data from future sources.

7.3.3.4 An AF funded and cooperatively operated computer-to-computer comunication link exists between SESC and AFGWC for the purpose of exchanging environmental data and products.

7.4 Contingency Backup Plan

General: AFGWC provides rapidly-disseminated decision assistance space environment products to several high priority military customers. AWS and ERL recognize the need of these customers to receive products in the event AFGWC loses its capability to provide this service.

7.4.1 Definitions:

7.4.1.1 Category I Products. Those products which require prompt notification via telephone to key military decision makers.

7.4.1.2 Category II Products. Those products (teletype bulletins) which require less rapid response but are important to customer operations.

7.4.1.3 YELLOW Outage. AFGWC/WS loses its capability to monitor the solar/geophysical environment and/or disseminate Category I products.

7.4.1.4 RED Outage. AFGWC/WS experiences a YELLOW outage for 30 minutes and anticipates this condition to persist for an additional 60 minutes.

7.4.2 Procedures:

7.4.2.1 AFGWC/WS will notify SESC as soon as possible after the occurrence of a YELLOW outage. SESC will assume responsibility for monitoring the solar/geophysical environment within 10 minutes and begin disseminating Category II products 30 minutes after this notification.

7.4.2.2 AFGWC/WS will notify SESC when RED outage conditions are met. SESC will continue YELLOW outage support and begin disseminating Category II products 30 minutes after this notification.

7.4.2.3 Extensive RED outage conditions (24 hours) may necessitate augmentation of OL-B, AFGWC to assist SESC.

7.4.2.4 AFGWC/WS will provide SESC with a list of Category I and II products and notification time lines. These backup products will be limited to products used operationally by customers.

7.4.2.5 SESC will inform AFGWC/WS of the content of all phone notifications/bulletins after they have been issued. AFGWC will relay unique telephone reports for solar/geophysical activity it receives during an outage to SESC.

8. OTHER MUTUAL SUPPORT AND COOPERATIVE BACKUP AMONG CENTERS

8.1 Routine Communication Support for the Department of Defense

8.1.1 The communication computers at the National Meteorological Center (NMC), Suitland, Maryland, are required to support weather communications affecting both the Department of Defense and the Department of Commerce.

8.1.2 The NMC will maintain emergency power for all essential communications-oriented facilities as noted above.

8.1.3 The communication center and the communication computers must remain operable to relay messages and data for NWS installations. In addition, the DOD depends on NMC for observed data from Canada, Alaska, parts of South America, and most ocean vessels other than those of the U.S. Navy. All of these data enter the NMC computers for which emergency power is provided.

8.2 Other Support of NMC to AWS

8.2.1 The Air Force and Army rely upon facsimile products provided by the National Meteorological Center (NMC). These products are transmitted by NMC on a dedicated computer-to-computer circuit to the Weather Facsimile Switching Center (WFSC), located within the Air Force Global Weather Central (AFGWC) at Offutt AFB, NE. The WFSC is operated by the 390th Informattion Systems Operations Squadron (390 ISOS). The WFSC stores these products and automatically redistributes them to Air Weather Service units supporting Air Force and Army missions worldwide. NMC adds or deletes products as requested when within existing resources.

8.2.2 AFGWC routinely uses the NESDIS satellite-derived winds and TIROS Operational Vertical Sounder (TOVS) data in its upper-air analyses. These data are currently obtained via the AWN from teletype bulletins prepared for the WMO Global Telecommunications System (GTS).

8.2.3 AFGWC routinely uses Medium Range Forecast fields provided by the NMC for preparing 3-10 day forecasts. These data are currently obtained from computer-formatted teletype bulletins via the AWN.

8.2.4 AFGWC routinely uses MOS Data from the NMC for preparing tailored MOS products for AWS units. These data are currently obtained from computer-formatted teletype bulletins via the AWN.

8.3 Mutual Support Between FNOC and AFGWC

8.3.1 The AFGWC and the FNOC provide support to each other over a 4800 b/s duplex circuit.

8.3.2 The FNOC provides AFGWC with sea surface temperatures, the state of the sea, and wave heights. FNOC provides computer-to-computer fields for: Global Sea Surface Temperatures, Sea Heights (N. Hemisphere), and Surface Pressure Analyses (S. Hemisphere).

8.3.3 The AFGWC provides the following computer-to-computer products to the FNOC: RAOBs, AIREPs, PIBALs, land and ship synoptic observations, and visual and infrared grid point data from the Global Satellite Data Base.

8.4 Routine U. S. Air Force Communications Support

8.4.1 The Air Force will provide global conventional data to the NMC and FNOC via the AWN. The FNOC and NMC will specify their AWN data requirements to Det 7, AFGWC, Carswell AFB, Texas.

8.4.2 The AWN computer at Carswell AFB must remain operational. These computers, owned and operated by AFCC, are supported by uninterruptable power.

8.4.3 The FLENUMOCEANCEN will forward data received on the backup line from the Carswell ADWS to AFGWC when the two circuits connecting AFGWC and the Carswell ADWS are both inoperative.

8.4.4 The NMC will send data received from the FAA to the Carswell ADWS upon request when the circuit linking the FAA (Kansas City) and the Carswell ADWS is inoperative.

9. PLANS AND OPPORTUNITIES FOR MUTUAL SUPPORT AND BACKUP

9.1 Standardization

The three services have agreed on the need:

a. To work toward reducing the differences in current communication networks,

b. To remove the incompatibilities between systems and data formats, and

c. To prepare plans to standardize the networks among the services.

Agencies recognize that expanded backup and mutual support among the Centers require standardizing communication protocols and data formats. The Task Group for Communications Interface and Data Exchange (TG/CIDE) is responsible for developing these standards. FCM-S3-1984 titled, "Network Interface Control Standards for Automated Weather Information Systems," contains standards for the physical, electrical, and logical interfaces while the FCM-S2-1982 titled, "Standard Formats for Weather Data Exchange Among Automated Weather Information Systems," contains data format standards. Federal agencies have agreed to implement these standards for meteorological purposes to facilitate interoperability of systems and data exchange. Therefore, these standards and subsequent revisions will be used in developing and implementing mutual support and backup.

9.2 Open Systems Interconnection

Future Federal Plans for mutual support and systems backup among the Centers should include steps toward standardization through the adoption of Open Systems Interconnection (OSI). The following information taken from desJardins, Richard, 1982: An OSI Architecture for Federal Government Information Systems. Prepared for presentation to IEEE Computer Society COMPCON Fall 82, Washington, DC, Sept. 1982. It describes OSI:

> "Open Systems Interconnection (OSI) is a simple yet powerful conceptual architecture for the standards required to interconnect information systems. OSI consists of seven layers of protocol by which application-processes in systems from different manufacturers can exchange information and thus cooperate to perform distributed activities. The OSI approach has been adopted by all the major information systems standardization bodies in the world. In this paper, the OSI conceptual architecture--the Reference Model of OSI--and its seven layers of protocol are described. Some compatible implementation designs oriented toward United States Federal Government information systems are presented, focusing on practial near-term achievability. The necessary protocol standards are identified and their development status is presented. By the mid-1980s, implementation of the Federal OSI architecture is expected to be well underway within several agencies."

desJardins further states:

> "In four years since its inception, OSI has become a worldwide standardization movement. By the end of 1984, the first phase of Draft

Proposals for International Standards for OSI will be complete. These standards will form the basis of a Federal OSI architecture enabling Federal information systems to easily interwork in the interest of more cost-effective and responsive government operations. By the end of the decade, Federal information systems will have achieved universal connectivity and interworking capability, using OSI-compatible standards defined by the Federal Telecommunication Standards Program and the Federal Information Processing Standards Program."

9.3 Total Communication Systems Backup

The three centers are considering standardization to permit total communications systems backup. As an initial step the three agencies are moving toward the new Communications Interface Data Exchange (CIDE) standards.

With regard to improved communications systems backup, AFGWC has cited the need for (1) a direct circuit to NMC, and (2) direct switching between AFGWC, Carswell, and FNOC. The latter need has also been cited by FNOC.

9.3.1 Interconnection of Centers by Terrestrial Communication

To meet routine operational needs with inherent backup, the centers and the respective agencies--AWS, NWS, USN, and the FAA--have agreed to interconnect their centers by communications as shown in Figure 9-1. Some of these circuits are currently installed and operating; however, some modes of operation currently do not lend themselves to facilitate backup. The planned interconnection system, when completed, will allow automatic alternate path routing of data over in-place communication channels to ensure reliability, to provide fast response, and to minimize the use of special procedures and manual intervention.

The communications channels shown in Figure 9-1 are full duplex point-to-point operating at up to 9600 b/s. Some interconnections may require greater capacity. Channels which exist today are shown as solid lines. These channels are not necessarily compatible. Some can only handle graphics, some only alphanumerics, and some both graphics and alphanumerics. To overcome this situation, the participating agencies have agreed to standardize the interagency connections in an evolutionary way to ensure that service is not jeopardized and that major expenses are avoided. The dashed lines in Figure 9-1 represent new channels that are planned to serve increased data requirements, to reduce delays in data exchange and to provide inherent backup. The physical, electrical, and logical interfaces and communications protocols are described explicitly in the FCM-S3-1984 standard which is being prepared for approval by the Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR). This standard complies with the Federal Information Processing Standards (FIPS), Department of Defense standards, and American National Standards Institute Standards (ANSI). The communication protocol also complies with the International Standards Organization's (ISO) recommendations for the High-level Data Link Control (HDLC) communication protocol. Formats for data carried in the envelope of the protocol described in FCM-S3-1984 are described in FCM-S2-1982 titled, "Standard Formats for Weather Data Exchange Among Automated Weather Information Systems," and subsequent revisions.

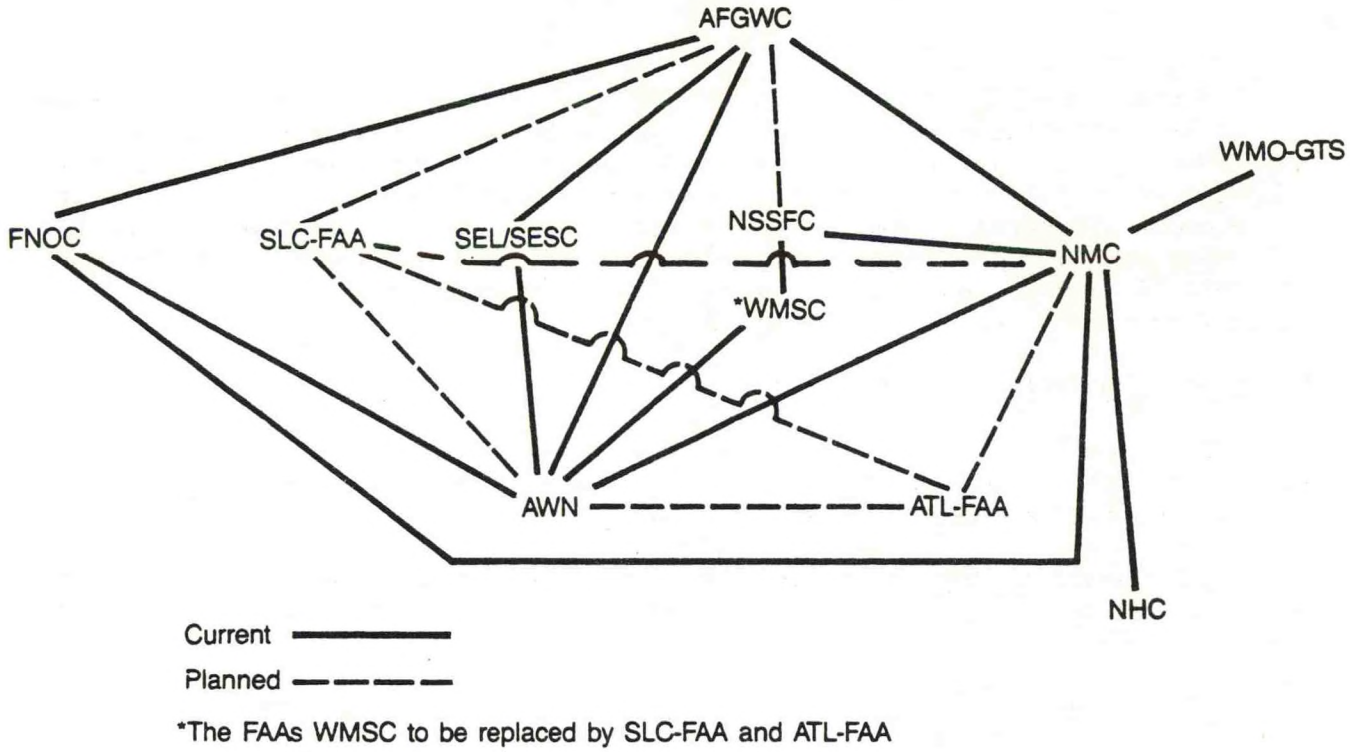


Figure 9-1. Current and Planned Mutual Support and Backup Product Distribution of Up to 19.2 kb/s.

9.3.2 Interconnection of Centers by Satellite Communications

The planned system shown in Figure 9-1 will be used primarily for low volume data and product distribution among agencies. Channel capacities are too small to carry large volumes of satellite data that need to be exchanged between the FNOC, AFGWC, and NMC. Therefore, a broadband Satellite Shared Processing Network is planned to interconnect these three centers for bulk transfer of satellite (SSPN) and other data. Figure 9.2 depicts the network.

Data and Products will be exchanged among the three centers in Shared Processing through the RCA Americom communications satellite system (SATCOM). Data transfers will be simplex, at 1,3308 Mb/s over a dedicated 24-hour channel. A dedicated satellite-based control system will be located in Suitland as part of the Data Processing and Services Subsystem (DPSS) of NESDIS. The control system will turn on and off the processing center transmissions (as well as verify receipt of commands) by means of a tone generator and receiver. The actual order of transmissions will be done on a schedule basis. Each of the processing centers will also be interconnected via leased voice-grade lines for operator coordination.

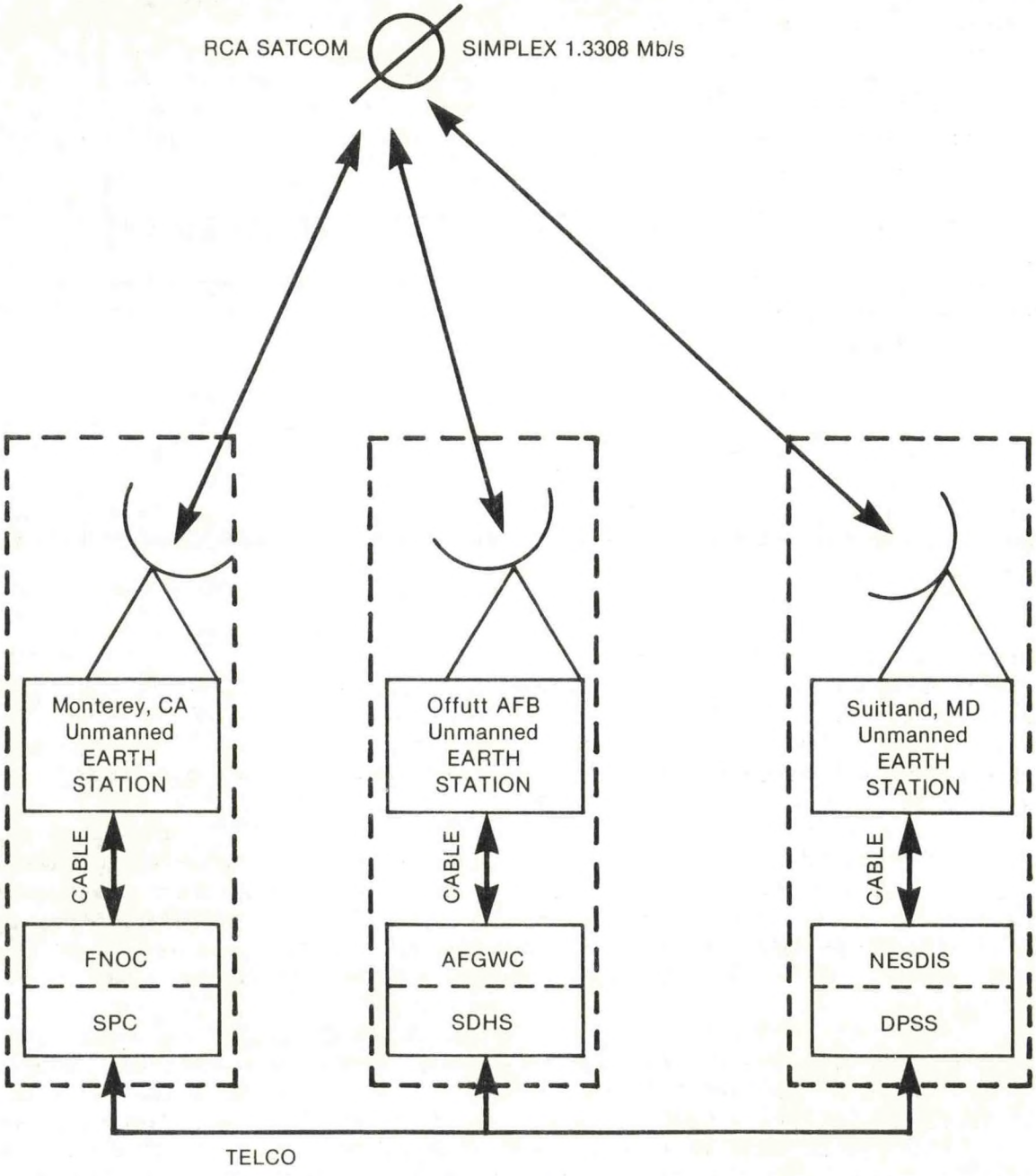


Figure 9-2. Shared Processing Network (SPN) Configuration.

Each processing center presently uses an RCA earth station. These stations will be modified for Shared Processing with the following service start dates: November, 1985 (AFGWC); November, 1985 (NESDIS); and May, 1986 (FNOC). Initial Operating Capability (IOC) will be May 1986 for AFGWC and NESDIS, and November 1986 for FNOC. Most of the data and products carried on this SPN will not be in a form for direct distribution to users although it is envisioned that sophisticated users may arrange to receive transmissions directly. These sophisticated users may then provide value added products to other users. The FCM-S2 publication titled "Standard Formats for Weather Data Exchange Among Automated Weather Information Systems" is being used to develop data formats to be used on the Shared Processing Network.

9.3.3 Distribution of Products to Users by Satellite Broadcast

The objective of all services is to get weather information to users - government and non-government - as quickly and accurately and as economically as possible. Because of technology, communications is undergoing a revolution.

The National Weather Service (NWS) has decided to take advantage of new communications technology. The NWS plans to broadcast bulk weather data and information at megabite transmission rates via commercial satellite from its National Meteorological Center (NMC) in Suitland, Maryland. This Satellite Weather Broadcast System (SWBS) will allow any user in the United States to receive these data directly from the satellite using a low cost satellite receiver. Figure 9-3 depicts the system.

This approach to distribution of large volumes of weather data removes substantial bottlenecks in communicating current weather information to users in a timely manner. It will relieve congestion on communication systems of Federal agencies; it will provide more efficient and effective distribution to all users; it will reduce duplicaton; and it will allow agencies and users to concentrate on mission tailored or value added product preparation and distribution within their own systems.

As the Centers of Expertise develop end user products for distribution, the Satellite Weather Broadcast system may be used to transmit these products directly to users from each center, when each center gains this transmit capability. This will not only eliminate data relay to a single transmit center but will inherently provide direct backup capability in case one center has problems.

The National Environmental Satellite, Data, and Information Service (NESDIS) intends to augment and later replace, its existing Central Data Distribution Facility (CDDF) equipment used to produce and distribute analog facsimile images. This will be accomplished by using commercial communications satellites to broadcast GOES data and other products to the user community. A tenative approach is to use a plug-in adaption of a low-cost receiving station developed for the radio broadcast industry already in volume production. These receiving stations provide an aggregate digital throughput rate of 7.68 megabits per second and accommodate voice grade analog channels in addition to digital service. This will enable users to receive all digital data from two GOES satellites and perhaps twenty or more analog channels while retaining over two megabits per second for future growth and other products. It is anticipated

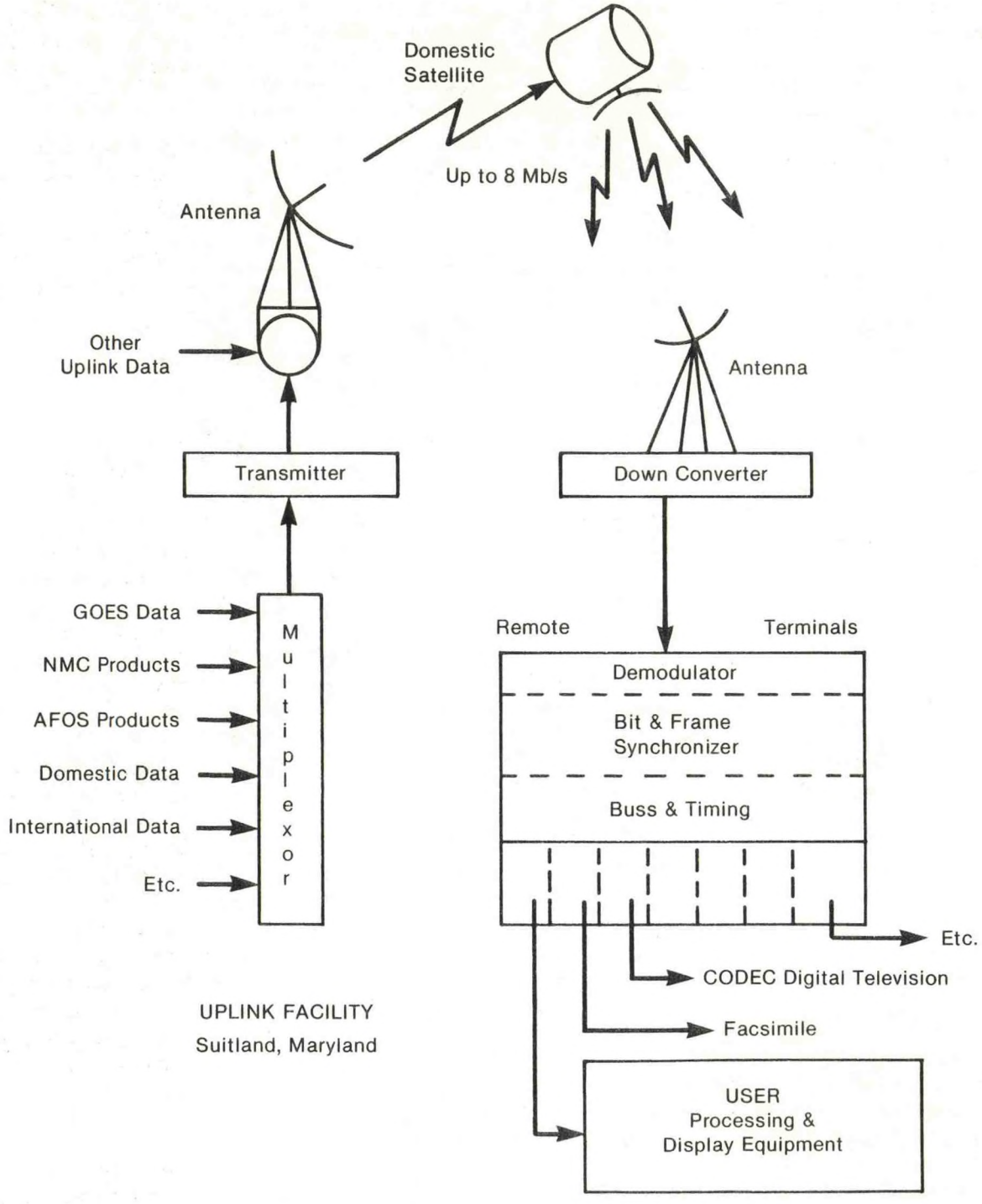


Figure 9-3. Satellite Direct Weather Broadcast System.

that implementation of the system will result in a significant cost saving to the Government through reduction or elimination of land line costs and through the reduced capital investment rerquired to receive satellite digital for processing. Recurring costs for operating expenses, including transponder lease, may be at least partially funded by sharing costs.

Basic receiving station cost is approximately $8,000, including a 2.8 to 3.8 meter antenna. A station, including installation and plug-in modules for receiving GOES data from either GOES and two of the analog channels, is estimated to cost less than $15,000.

The satellite broadcast will provide a medium for distribution of other data and products - such as those in the NMC, AFGWC, and FNOC data bases - to government and civilian user communities. Other agencies such as the National Ocean Service, the National Weather Service, the U.S. Air Force, Navy and Federal Aviation Administration have been invited to participate in the planning and development of this system. There are no technological reasons why any organization needing NOAA data should not benefit from the broadcast system.

Three implementation phases are planned. In the first phase, all GOES-TAP analog facsimile data will be broadcast, starting in CY'86. In CY'88, digital data from both GOES satellites will be broadcast simultaneously with analog facsimile. Around 1990, analog facsimile will be removed from the broadcast, leaving digital data from both GOES satellites and other products added as demand dicatated.

The National Environmental Satellite Data, and Information Service has taken the lead in developing this system. To reinforce the concept of mutual support and cooperative backup among operational processing centers, the possibility of a transmit and receive capability at AFGWC and FNOC will be explored. If this approach is taken, it will be a major step toward the goal of providing inherent backup in the operational system and should reduce the complexity and cost of mutual support and backup.

The terrestrial communications system described in Section 9.3.1 complements the SWBS. It provides relatively low volume data collection and exchange and will be used for network control.

9.3.4 Packet Switching

Agencies have also expressed the need to communicate with packet switched data networks within and outside of the Government. Some agencies are already using this type of communication. Therefore, agencies have agreed to install packet switching capability in their major centers which complies with the Federal Information Processing Standard 100 (FIPS-100) and which has been verified by the National Bureau of Standards. FIPS-100 meets the ISO/ANSI X.25 standard and Defense Data Network (DDN) standards.

The packet switching capability provides an added dimension to data exchange, dissemination and backup. Many agencies are already using this capability for purposes other than weather; therefore, by adding this capability at major weather centers, agencies with small weather data requirements may be served through packet switched networks at costs lower than providing circuits

and terminal equipment dedicated to weather information. Existing packet switched networks provide inherent backup. Since each of the major centers will have packet switching capability, backup can be provided for these users. Additionally, these networks could be used as a second level of backup among centers, if needed, as well as providing for increased data exchange capacity when the dedicated circuits become overloaded for short periods of time. Development of procedures and use of packet switching will be undertaken subsequent to publication of these cooperative backup plans.

9.4 Shared METSAT Processing

The Air Weather Service (AWS), The National Environmental Satellite, Data, and Information Service (NESDIS), and the Naval Oceanography Command (NOS), through a Memorandum of Agreement signed in June 1984 (Appendix A), agreed to share the centralized processing of METSAT data from Defense Meteorological Satellite Program (DMSP), the Navy Remote Oceanographic Sensing Satellite (N-ROSS), and the NOAA Polar-orbiting meteorological satellites.

Under this agreement, AFGWC is the center of expertise (COE) for cloud imagery, the Fleet Numerical Oceanography Center is the COE for sea surface measurements, and NESDIS is the COE for atmospheric soundings. A dedicated wideband channel on the RCA American satellite will be used for data exchange between the three COE. This has been described in Section 9.3.2.

9.5 Future OPC Backup Opportunities

In addition to shared METSAT, the improved communication capability will allow for a wide range of cooperative backup. The following describes some opportunities for cooperative backup that could take advantage of the bulk data transfer capabilities of the Shared METSAT Processing network. It does not reflect any current agency plans. Figure 9-2 depicts the communication links.

9.5.1 For NMC:

9.5.1.1 Global Model Output: In 1985/6 AFGWC will have output from Global Analysis and Global Spectral models nearly similar to NMC's model. The forecast output will probably be available during the 00 and 12Z cycle before or shortly after NMC's scheduled model start time. This will permit making the output fields available to NMC at or before their normal output time, providing the high speed communication channels exist.

9.5.1.2 Data: AFGWC could provide NMC with validated worldwide data at any time during any cycle if high speed communication channels exist.

9.5.1.3 Model Contingency Backup: AFGWC, after 1985/6, will produce Global Spectral forecast fields from the 06Z and 18Z cycles. These data could be sent to NMC routinely and be available for early guidance products in the event the NMC scientific computer becomes inoperative.

9.5.1.4 LANDSAT Cloud Forecasts: AFGWC can, after development of software and procurement of the necessary communications, provide NASA with orbit-by-orbit cloud/no-cloud forecasts for the LANDSAT.

9.5.2 For NESDIS

Satellite-Derived Soundings: AFGWC will be able to produce soundings from DMSP SSM/T (Passive Microwave Temperature Sounder) data which could be made available to NESDIS, NMC, and FNOC when NESDIS is unable to do so under the shared-METSAT agreement.

9.5.3 For FNOC

9.5.3.1 Data Backup: AFGWC could increase its backup to the FNOC for data. This would require some software and an upgraded circuit.

9.5.3.2 Models Backup: AFGWC could, after 1985/6, provide global data fields from the AFGWC Global Spectral Model when the FNOC Model Computer becomes inoperative. These data could probably be available earlier in the cycle than normally available from the FNOC computer.

9.5.3.3 Computer Flight Plans (CFP) Backup: AFGWC could provide backup CFPs to Navy units when the FNOC's Optimum Path Aircraft Routing System (OPAR) production ceases. This would require a TYMENET (packet switching) communication terminal capability at AFGWC.

9.5.4 For AFGWC

9.5.4.1 AWDS Backup: With the adoption of the Open Systems Interconnection (OSI) standard, AWS could seek cooperative backup as well as real-time interchange of products on AWDS.

9.5.4.2 Models Backup: After 1985-86, there will be little difference in the model output at AFGWC and NMC. Although not as timely, NMC could provide Global Spectral Model forecast fields to AFGWC in the event of extended outages of the AFGWC scientific computer.

10. BACKUP TESTS

The services intend to maintain in-house capability to provide backup by conducting frequent internal backup graphics or message production tests. In addition, there will be frequent circuit tests that may not include graphics or data transmission beyond any two centers involved. Finally, there should be both scheduled and unscheduled tests of graphics or message transmission to users with test products so identified.

10.1 Testing Backup Systems Among the Major Centers

10.1.1 System Tests. Tests of the backup system will be made once every six months. FNOC and AFGWC will simulate graphics backup internally once every six months. Some graphics products should be provided for an on-line test to users at least once a year. The duration of these tests will be agreed to by the parties involved. Advance notification will be given to facsimile subscribers whenever such tests take place.

The AFOS circuit between AFGWC and the Omaha WSFO is now used operationally on a daily basis and, therefore, no scheduled communication test is needed for backup purposes.

10.1.2 Communication Tests

10.1.2.1 Monthly tests of the transmission of graphic products onto the NAFAX and DIFAX circuits will be conducted by the 390th Information Systems Operations Squadron (390 ISOS) at AFGWC. The supervisor of the NWS communication unit at Suitland will be responsible for arranging the details with the Offutt AFCC unit.

10.1.2.2 The circuit between the Fleet Numerical Oceanography Center (FNOC), Monterey, California, and the NMC, Suitland, Maryland, is fully operational. This circuit operates at 4800-baud on a C4-type line and is called the FNOC-NMC link. Since this circuit operates continuously 24 hours a day, seven days a week, no special tests are required. However, the supervisor of the NWS communication unit at Suitland is responsible for arranging details with the FNOC communication unit when the need arises.

10.1.3 Emergency Power Tests. Testing of emergency power at all switches, nodal points, terminals, and processing centers will be simulated to determine the operational readiness of the power backup system for adverse real-time situations. National Communication System Instructions (NCSI) 195-1 provide the concept of an effective emergency power test and evaluation procedure program. Adherence to NCSI 195-1 is recommended for participating facilities.

10.2 Testing Backup for NSSFC

AFGWC will test NSSFC backup including test transmission to users at least once every six months. Test of the AFOS circuit between AFGWC and the Omaha WSFO is used operationally on a daily basis and, therefore, no scheduled

communications test is needed for backup purposes. Samples of the alphanumeric products described in Chapter 4 should be transmitted and clearly labelled as "BACKUP" and "FOR TESTING PURPOSES ONLY". Notification will be given to circuit subscribers whenever tests take place.

Unscheduled test transmissions may also be made with test products so identified.

10.3 Testing Backup for Aviation Wind Forecasts

AFGWC will test backup for the Aviation Wind Forecasts described in Chapter 5 at least once every six months. Advance notification will be given to circuit subscribers whenever such tests take place.

APPENDIX A

MEMORANDUM OF AGREEMENT
ON THE SHARED PROCESSING OF SATELLITE DATA

1. Purpose:

This Memorandum of Agreement (MOA) establishes the policy, management structure, and the areas of responsibility whereby the National Oceanic and Atmospheric Administration (NOAA), the Department of the Navy, and the Department of the Air Force will jointly share in the proccessing of satellite data at their central processing facilities at the National Environmental Satellite, Data and Information Service (NESDIS), the Fleet Numerical Oceanography Center (FLENUMOCEANCEN) and the Air Force Global Weather Central (AFGWC), respectively and will exchange specified data and products with each other as mutually agreed upon.

2. Scope:

This MOA is applicable to the National Environmental Satellite, Data, and Information Service (NESDIS) representing NOAA, the Naval Oceanography Command (NAVOCEANCOM) representing the Navy, and the Air Weather Service (AWS) representing the Air Force. The Office of Satellite Data Processing and Distribution is the processing center for NESDIS, the Fleet Numerical Oceanography Center (FLENUMOCEANCEN) is the processing center for NAVOCEANCOM, and the Air Force Global Weather Central (AFGWC) is the processing center for the AWS. Shared processing of data will be restricted to the sensors on the Defense Meteorological Satellite Program (DMSP), Navy Remote Oceanographic Sensing Satellite (N-ROSS) and the NOAA polar orbiting meteorological satellites.

3. Management:

The management structure to accomplish the objectives of the MOA will function at two levels. The Executive Comittee, consisting of the NOAA Deputy Assistant Administrator for Satellites, the Commander NAVOCEANCOM, and the Commander AWS, determines policy and general guidance. Meetings are held as required, and the chairmanship will rotate annually. Each member of the Executive Committee has an Agency Coordinator to staff budget and policy isssues. The Agency Coordinators will meet as required. Operational management will be conducted at the processing centers. Each participant to the MOA will establish a Center Coordinator and maintain a Liasion Officer at the other two centers. The Center Coordinator and the two Liasion Officers will compose the Center Working Group which will be responsible to the Center Commander/Operational Head for coordination of the system. The three Center Working Groups will meet as a group as required to establish common procedures.

4. Centers of Expertise (COE):

The concept of COE is developed to describe the areas of primary emphasis of each of three participants to the MOA. In this context, NESDIS is the COE for atmospheric soundings, FLENUMOCEANCEN for sea surface measurements, and AFGWC for cloud imagery.

5. Communications:

Wideband satellite communications will be used for data exchange between the three COE's. A dedicated channel on the RCA Americom satellite will be used. This is the same communicatons satellite used for the NOAA polar orbiter system. NESDIS will be the communications manager. Data rate will be 1.3308 million bits per second. Data transmission will be unclassified. NESDIS is planning to use SSM/I data concurrently with SSM/T data in deriving soundings. To ensure concurrent data reception, AFGWC will "bent-pipe" SSM/I and SSM/T data to NESDIS for processing.

6. Products:

In order to provide for an orderly and economical division of the processing tasks, the assignment of processing of satellite data by sensors at each COE is made as follows:

(a) NESDIS

1. TOVS (NOAA)
2. SSM/T (DMSP)
3. SSM/I (DMSP)

(b) FLENUMOCEANCEN

1. SSM/I (DMSP, N-ROSS)
2. Altimeter (N-ROSS)
3. Scatterometer (N-ROSS)
4. Low Frequency Microwave Radiometer (N-ROSS)

(c) AFGWC

1. OLS (DMSP)
2. AVHRR (NOAA)

The following products will be transmitted by each COE with times and specifications to be negotiated by the three Center Working Groups to meet Agency requirements:

(a) NESDIS

1. Atmospheric temperature soundings
2. Atmospheric water vapor soundings

(b) FLENUMOCEANCEN

1. Sea surface and land skin temperature
2. Ocean surface wind speed
3. Ice coverage, age, and location
4. Precipitation over water and land areas

5. Cloud and liquid water
6. Soil moisture
7. Brightness temperature fields (SSM/I)
8. Radiative transmissivity

c. AFGWC

1. Visual and infrared mapped imagery of the Satellite Global Data Base (SGDB)
2. Three dimensional cloud analysis (RTNEPH)
3. Unprocessed SSM/T and SSM/I data.

Major changes in product specificaton may be requested by the requiring Agency under their own or joint funding if agreed upon by the Executive Committee.

7. Archiving:

NESDIS will be responsible for archiving all products resulting from this MOA. In doing so, NESDIS will become the repository for all imagery and other sensor data from the DMSP, N-ROSS, and NOAA polar orbiters.

8. Implementation:

It is recognized that budget constraints at any or all of the three Agencies may preclude or delay implementation of any or all parts of this MOA. For this reason an implementation plan will be developed separate from this MOA by the Agency Coordinators and presented to the Executive Committee for review prior to dissemination to the three COE's for execution.

9. Funding:

The following funding is agreed upon:

(a) COE manpower, hardware and software will be programmed by the implementing Agency.

(b) The dedicated communications network will be equally funded by the three Agencies.

(c) All hardware and software for new or improved products will be funded by the requesting Agency/Agencies.

This MOA does not represent a funding obligation on the part of the Agencies. Each Agency will implement the MOA to the extent possible consistent with the availability of funding, personnel, and hardware resources.

10. Termination:

This MOA, executed in triplicate original, will be effective on the date the last signature is affixed and will remain in effect until terminated. It supersedes the original MOA effective on 31 December 1980 and its Implementation Annex effective on 20 August 1981. This MOA will be reviewed by the Executive Committee on an annual basis to determine if it should be continued, modified, or terminated. Additionally, each agency has the right to unilaterally terminate this agreement upon six months written notice.

/s/ W. P. BISHOP	/s/ J. L. PINGEL	/s/ G. E. CHAPMAN
Deputy Assistant Administrator for Satellites NOAA	CAPT, USN Commander, Naval Oceanography Command	COL, USAF Commander, Air Weather Service
Date: 5/29/84	Date: 4/2/84	Date: 6/18/84

APPENDIX B

SUPPORT AGREEMENT
ON SCHEDULED FACSIMILE SUPPORT FROM NMC TO AFGWC

1. Purpose

This Support Agreement (133222-82305-001) establishes the policy for the National Meteorological Center (NMC) to provide routine facsimile products to the Air Weather Service's AF Global Weather Central (AFGWC) at Offutt AFB, NE. This support will be provided on a nonreimbursable basis.

2. Definitions

2.1 Operationally restrictive conditions: Conditions defined as the inability of NMC to transmit within one hour of scheduled delivery time at least half of the products scheduled during any hour.

2.2 Restoration requirement: The Air Force requires NMC to provide programmer and electronic technician remedial support within two hours of an outage that denies NMC products to the AFGWC. HQ Air Weather Service (AWS) and NMC agree to jointly develop a program to completely satisfy the AF requirements.

2.3 Option "A": The manual override which allows disk retrieval of products stored which are more than six hours old. The use of this option will cause an incorrect chart or a garbage transmission if the requested chart has not been produced or is not stored on the disk.

3. Product Flow

3.1 NMC will provide scheduled facsimile products to the AFGWC, assure uninterrupted flow of these products, and identify and solve problems at NMC which disrupt scheduled deliveries. They will also reload G1 controlling software as soon as possible when requested by AFGWC.

3.2 AFGWC will establish procedures for on-the-spot trouble-shooting of equipment, software, and circuitry and insure coordination of trouble-shooting efforts with the NMC operators when it appears the problem may be at NMC. AFGWC will also complete circuit checklist to confirm effective operations of the dedicated circuit and the 390th Information Systems Operations Squadron (390ISOS) ID50 computer before requesting NMC to reload their ID50 computer.

4. Assistance

4.1 NMC will make every reasonable effort to obtain the assistance of critical personnel when operationally restrictive conditions occur. When specifically requested by the AFGWC Duty Officer in support of major military contingencies, NMC will accelerate corrective actions. During these contingencies NMC would immediately obtain assistance of critical personnel.

4.2 AFGWC will monitor NMC product delivery and retransmissions to identify operationally significant disruptions in NMC support and assist in resolving problems. The AFGWC Duty Officer will obtain specific authorization from the AFGWC Director of Operations before requesting NMC accelerated action.

5. Product Requirement Changes

NMC will add or delete products as requested by HQ AWS when within existing resources. They will coordinate stop dates and start dates of newly added NMC charts with AFGWC (FTS-866-5984) at least 10 days prior to the change implementation.

6. Product Retransmission

6.1 NMC will retransmit products requested by the Weather Facsimile Switching Center (WFSC) at Offutt, NE. The NMC operator will execute option "A" (AVAIL OFF) only at the request of the NMC Senior Duty Meteorologist (SDM). The SDM will request the use of option "A" at his discretion when the NMC operational cycle is significantly late or when there has been an outage on the Offutt facsimile line which makes products six or more hours late.

6.2 AFGWC will request transmission of products which have not been automatically transmitted. Such products will be requested no sooner than 90 minutes after their scheduled time and no later than six hours after their scheduled time. After extended circuit outages or when the NMC cycle is so late as to make charts six hours late, the Global Duty Officer (GDO) will discuss the situation with SDM and request that Option "A" be invoked by the NMC operator.

7. Outages

NMC will notify the patch and test facility at OFFUTT AFB (FTS-866-4455) at least 24 hours prior to planned NMC outages, and immediately when unplanned outages occur or are corrected.

APPENDIX C

ABBREVIATIONS AND ACRONYMS

ADWS	Automatic Digital Weather System
AFB	Air Force Base
AFCC	Air Force Communications Command
AFDIGS	Air Force Digital Graphics System
AFGWC	Air Force Global Weather Central
AFGWC/WS	Air Force Global Weather Central Weather Service
AFOS	Automation of Field Operations and Services
ANSI	American National Standards Institute
AWDS	Automated Weather Distribution System
AWN	Automated Weather Network
AWNMC	Automated Weather Network Management Center
AWS	Air Weather Service
b	bit
CFP	Computer Flight Plans
CIDE	Communications Interface and Data Exchange
COD	Computer Operations Division (NMC)
COE	Centers of Expertise
CONDIGS	Continental Digital Graphics System
CONUS	Conterminous United States
DDN	Defense Digital Network
DIFAX	Digital Facsimile System
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
ERL	Environmental Research Laboratories
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FIPS	Federal Information Processing Standard(s)
FLENUMOCEANCEN	Fleet Numerical Oceanography Center
FNOC	Fleet Numerical Oceanography Center
FOD	Facility Operations Division
FOS	Family of Services
FSS	Flight Service Station
FTS	Federal Telecommunications System
GDO	Global Duty Officer (at AFGWC)
GTS	Global Telecommunications System
h	hour
HDLC	High-level Data Link Control
ICMSSR	Interdepartmental Committee for Meteorological Services and Supporting Research
ISO	International Standards Organization
ISOS	Information Systems Operations Squadron

KCRT	Keyboard Cathode Ray Tube
KGWC	AFGWC Communications Identifier
kPa	kilopascal
KWBC	NMC Communications Center Identifier
mb	millibar
Mb	Megabit
METSAT	Meteorological Satellite
MOA	Memorandum of Agreement
MOS	Model Output Statistics
NA	North America
NAFAX	National Facsimile System
NAVOCEANCOM	Naval Oceanography Command
NCSI	National Communication System Instructions
NEDS	Navy Environmental Display Station
NESDIS	National Environmental Satellite, Data, and Information Service
NH	Northern Hemisphere
NHC	National Hurricane Center
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NOC	Naval Oceanography Command
NPOC	Naval Polar Oceanography Center
NSSFC	National Severe Storms Forecast Center
NWS	National Weather Service
NWSH	National Weather Service Headquarters
NWSOM	National Weather Service Operations Manual
OPARS	Optimum Path Aircraft Routing System
OSI	Open Systems Interconnection
Pa	Pascal (unit of pressure)
QPF	Quantitative Precipitation Forecast
s	Second
SDM	Senior Duty Meteorologist
SDR	Sensor Data Record
SEL	Space Environment Laboratory
SELDADS	SEL Data Acquisition and Display System
SELS	Severe Local Storms Unit
SESC	Space Environmental Services Center
SMCC	Sysstem Monitoring and Control Center (AFOS)
SSM/T	DMSP Passive Microwave Temperature Sounder
TIROS	Television Infrared Observational Satellite
TOVS	TIROS Operational Vertical Sounder

UTC	Universal Time Coordinated
USAF	United States Air Force
USN	United States Navy
WH	Western Half of the Northern Hemisphere
WMO	World Meteorological Organization
WWB	World Weather Building

APPENDIX D

STANDARD METRIC CONVERSION TABLE

This appendix presents in capsular form a description of the International Systems of Units (SI) metric system and selected standard conversion factors commonly used in meteorology and hydrology. The American National Standard Institute/IEEE Standard 268-1982 Metric Practice has been approved for use by the Department of Defense, other Federal agencies, and by many industries. Users are encouraged to acquire and use the ANSI/IEEE 268-1982 Standard Metric Practice to ensure consistent conversion and implementation.

The first part of the appendix is the Federal Register Notice of February 26, 1982, titled: "Metric System of Measurement; Interpretation and Modification of the International System of Units for the United States." The table herein is a list of selected conversion factors by classification excerpted from the ANSI/IEEE Standard. Finally, the figure shows the relationships of SI units with names. It shows graphically how the 19 SI derived units with special names listed in Table 2 of the Federal Register Notice are derived in a coherent manner from the base and supplementary units. A description of the chart precedes the figure.

The Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR) has adopted the kilopascal for use in the U. S. except for aeronautical operations where inches of mercury of hectopascal may be used as appropriate. Termination of the use of the unit bar should begin to be phased in immediately to facilitate conversion to meet the official termination date of 31 December 1985. Also, all Federal Automated Weather Inforamtion Systems should use metric units as the common denominator within the systems and for use in weather data exchange. Retrofitting existing systems or modifying existing specifications for new systems is not required.

National Bureau of Standards

Metric System of Measurement; Interpretation and Modification of the International System of Units for the United States

Section 3 of Pub. L. 94–168, the Metric Conversion Act of 1975, declares that the policy of the United States shall be to coordinate and plan the increasing use of the metric system in the United States. Section 403 of Pub. L. 93–380, the Education Amendments of 1974, states the policy of the United States to encourage educational agencies and institutions to prepare students to use the metric system of measurement as part of the regular education program. Under both these acts, the "metric system of measurement" is defined as the International System of Units as established by the General Conference on Weights and Measures in 1960 and interpreted or modified for the United States by the Secretary of Commerce (sec. 4(4), Pub. L. 94–168; sec. 403(a)(3), Pub. L. 93–380). The Secretary has delegated his authority under these subsections to the Director of the National Bureau of Standards.

In implementation of this authority, tables and associated materials were published in the **Federal Register** of October 26, 1977 (42 FR 56513–56514), setting forth the interpretation and modification of the International System of Units (hereinafter "SI") for the United States.

In accordance with recent decisions of the International Committee for Weights and Measures of the General Conference on Weights and Measures, and to refine the earlier interpretation and modification, it is deemed appropriate to amend that interpretation and modification, as published in the above-cited **Federal Register** notice of October 26, 1977. To assist interested parties and encourage the proper use of SI, the entire interpretation and modification, as hereby amended, is republished. Accordingly, this notice supersedes the notice of October 26, 1977.

The amendments consist of the inclusion in table 2 of the sievert, a special name for the SI derived unit of dose equivalent, the inclusion in table 6 of the electronvolt and the unified atomic mass unit, and the inclusion in table 7 of the rem, a unit of dose equivalent. The unit "standard atmosphere" is no longer included in table 7. The amendments are indicated by a dagger symbol (†).

The SI is constructed from seven base units for independent quantities plus two supplementary units for plane angle and solid angle, listed in table 1.

TABLE 1.—SI BASE AND SUPPLEMENTARY UNITS

Quantity	Name	Symbol
SI base units		
length	meter	m
mass [1]	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd
SI supplementary units		
plane angle	radian	rad
solid angle	steradian	sr

[1] "Weight" in common parlance is often used to mean "mass."

Units for all other quantities are derived from these nine units. In table 2 are listed 19 SI derived units with special names which were derived from the base and supplementary units in a coherent manner, which means, in brief, that they are expressed as products and quotients of the nine base and supplementary units without numerical factors.

TABLE 2.—SI DERIVED UNITS WITH SPECIAL NAMES

Quantity	SI unit		
	Name	Symbol	Expression in terms of other units
frequency	hertz	Hz	s^{-1}
force	newton	N	$kg\,m/s^2$
pressure, stress	pascal	Pa	N/m^2
energy, work, quantity of heat	joule	J	N·m
power, radiant flux	watt	W	J/s
electric charge, quantity of electricity	coulomb	C	A·s
electric potential, potential difference, electromotive force	volt	V	W/A
capacitance	farad	F	C/V
electric resistance	ohm	Ω	V/A
conductance	siemens	S	A/V
magnetic flux	weber	Wb	V·s
magnetic flux density	tesla	T	Wb/m^2
inductance	henry	H	Wb/A
luminous flux	lumen	lm	cd·sr
illuminance	lux	lx	lm/m^2
Celsius temperature [1]	degree Celsius	°C	K
activity (of a radionuclide)	becquerel	Bq	s^{-1}
absorbed dose, specific energy imparted, kerma, absorbed dose index	gray	Gy	J/kg
†dose equivalent, dose equivalent index	sievert	Sv	J/kg

[1] In addition to the thermodynamic temperature (symbol T) expressed in kelvins (see table 1), use is also made of Celsius temperature (symbol t) defined by the equation $t = T - T_0$ where $T_0 = 273.15$ K by definition. The unit "degree Celsius" is equal to the unit "kelvin," but "degree Celsius" is a special name in place of "kelvin" for expressing Celsius temperature. A temperature interval or a Celsius temperature difference can be expressed in degrees Celsius as well as in kelvins.

All other SI derived units, such as those in tables 3 and 4, are similarly derived in a coherent manner from the 28 base, supplementary, and special-name SI units.

TABLE 3.—EXAMPLES OF SI DERIVED UNITS EXPRESSED IN TERMS OF BASE UNITS

Quantity	SI unit	Unit symbol
area	square meter	m^2
volume	cubic meter	m^3
speed, velocity	meter per second	m/s
acceleration	meter per second squared	m/s^2
wave number	1 per meter	m^{-1}
density, mass density	kilogram per cubic meter	kg/m^3
specific volume	cubic meter per kilogram	m^3/kg
current density	ampere per square meter	A/m^2
magnetic field strength	ampere per meter	A/m
concentration (of amount of substance)	mole per cubic meter	mol/m^3
luminance	candela per square meter	cd/m^2

TABLE 4.—EXAMPLES OF SI DERIVED UNITS EXPRESSED BY MEANS OF SPECIAL NAMES

Quantity	Name	Unit symbol
dynamic viscosity	pascal second	Pa·s
moment of force	newton meter	N·m
surface tension	newton per meter	N/m
heat flux density, irradiance	watt per square meter	W/m^2
heat capacity, entropy	joule per kelvin	J/K
specific heat capacity, specific entropy	joule per kilogram kelvin	J/(kg·K)
specific energy	joule per kilogram	J/kg
thermal conductivity	watt per meter kelvin	W/(m·K)
energy density	joule per cubic meter	J/m^3
electric field strength	volt per meter	V/m
electric charge density	coulomb per cubic meter	C/m^3
electric flux density	coulomb per square meter	C/m^2
permittivity	farad per meter	F/m
permeability	henry per meter	H/m
molar energy	joule per mole	J/mol
molar entropy, molar heat capacity	joule per mole kelvin	J/(mol·K)
exposure (x and γ rays)	coulomb per kilogram	C/kg
absorbed dose rate	gray per second	Gy/s

For use with the SI units there is a set of 16 prefixes (see table 5) to form multiples and submultiples of these units. It is important to note that the kilogram is the only SI unit with a prefix. Because double prefixes are not to be used, the prefixes of table 5, in the case of mass, are to be used with gram (symbol g) and not with kilogram (symbol kg).

TABLE 5.—SI PREFIXES

Factor	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

Certain units that are not part of the SI are used so widely that it is impractical to abandon them. The units that are accepted for continued use in the United States with the International System are listed in table 6.

TABLE 6.—UNITS IN USE WITH THE INTERNATIONAL SYSTEM

Name	Symbol	Value in SI unit
minute (time)	min	1 min = 60 s
hour	h	1 h = 60 min = 3 600 s
day	d	1 d = 24 h = 86 400 s
degree (angle)	°	$1° = (\pi/180)$ rad
minute (angle)	′	$1′ = (1/60)° = (\pi/10\,800)$ rad
second (angle)	″	$1″ = (1/60)′ = (\pi/648\,000)$ rad
liter	L*	$1\ L = 1\ dm^3 = 10^{-3}\ m^3$
metric ton	t	$1\ t = 10^3$ kg
hectare (land area)	ha	$1\ ha = 10^4\ m^2$
†electronvolt	eV	1 eV = 1.602 × 10^{-19} J, approximately**
†unified atomic mass unit	u	1 u = 1 660 57 × 10^{-27} kg, approximately**

* Both L and l are international symbols for liter. Because "l" can easily be confused with the numeral "1" the symbol "L" is recommended for United States use.
** The values of these units in terms of SI units are obtained experimentally.

In those cases where their usage is already well established, the use, for a limited time, of the units in table 7 is accepted, subject to future review.

TABLE 7.—UNITS IN USE TEMPORARILY WITH THE INTERNATIONAL SYSTEM

nautical mile	angstrom	curie
knot	barn	roentgen
	bar	rad [2]
	gal [1]	†rem [3]

[1] Unit of acceleration.
[2] Unit of absorbed dose.
[3] Unit of dose equivalent.

Metric units, symbols, and terms that are not in accordance with the foregoing Interpretation and Modification are no longer accepted for continued use in the United States with the International System of Units. Accordingly, the following units and terms listed in the table of metric units in section 2 of the Act of July 28, 1866 that legalized the metric system of weights and measures in the United States are no longer accepted for use in the United States:

myriameter
stere
millier or tonneau
quintal
myriagram
kilo (for kilogram)

For more information regarding the International System of Units, contact Dr. David T. Goldman, National Measurement Laboratory, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C. 20234, telephone (301) 921-3304.

Dated: February 2, 1982.

Ernest Ambler,

Director.

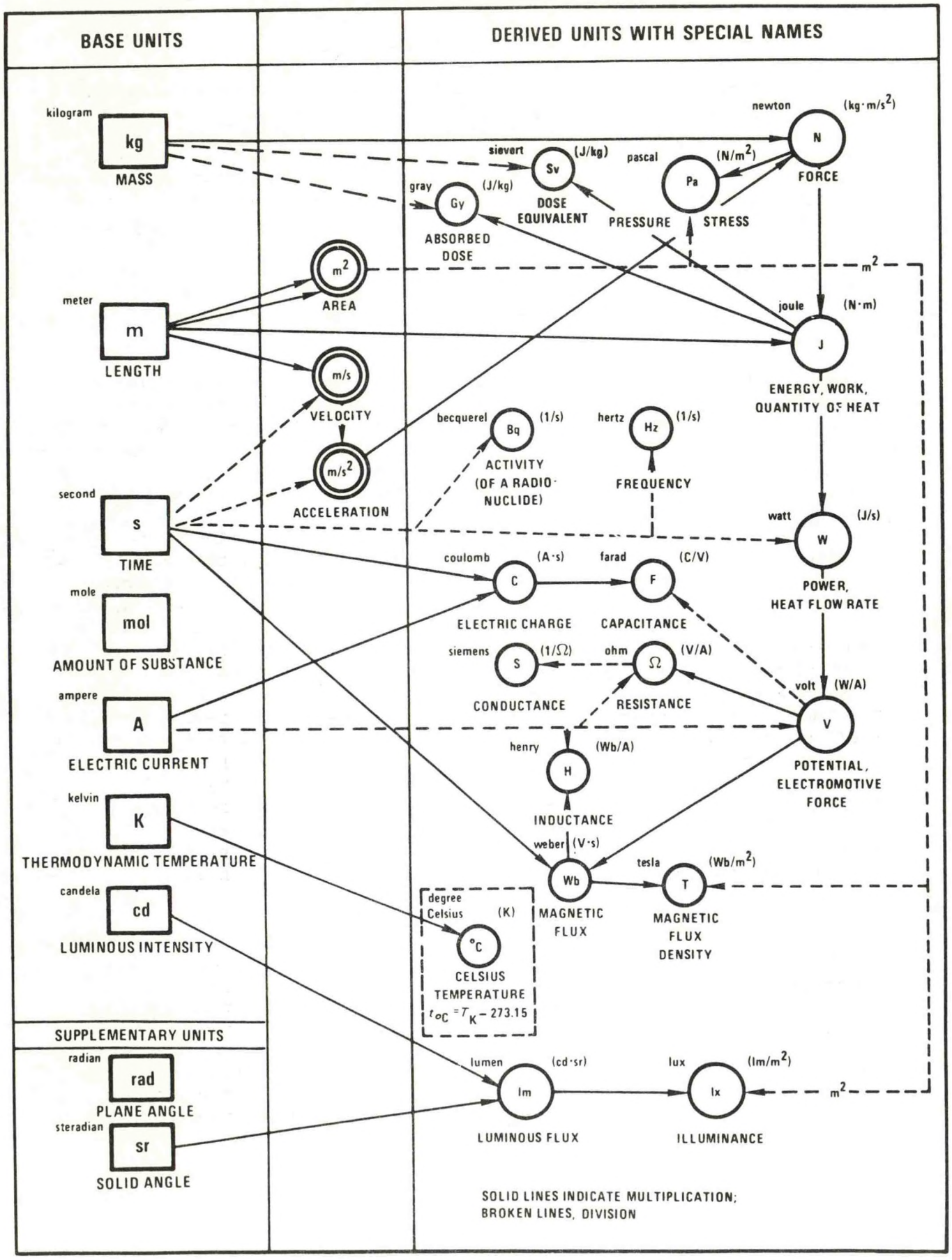
[FR Doc. 82-5150 Filed 2-25-82; 8:45 am]
BILLING CODE 3510-13-M

The following chart shows graphically how the 19 SI derived units with special names listed in Table 2 of the Federal Register Notice are derived in a coherent manner from the base and supplementary units. In the first column the symbols of the base and supplementary units are shown in rectangles, with the name of the unit shown toward the upper left of the rectangle and the name of the quantity (measurable attribute) shown below the rectangle. In the third column the symbols of the derived units with special names are shown in solid circles, with the name of the quantity shown below the circle, and an expression of the derived unit in terms of other units shown toward the upper right. In the second column are shown those derived units without special names that are used in the derivation of the derived units with special names. In the chart the derivation of each unit is indicated by arrows bringing in numerator factors (solid lines) and denominator factors (broken lines).

The degree Celsius, shown on the chart in a broken-line rectangle, is a special name for the kelvin, for use in expressing Celsius temperatures or temperature intervals. Where it is used to express temperature intervals, it is equal to the kelvin, as shown on the chart, with the symbol K toward the upper right of the ^{o}C circle; where it is used to express Celsius temperatures, the equation below "CELSIUS TEMPERATURE" relates Celsius temperature (t_{oC}) to thermodynamic temperature (T_K).

As stated in the ANSI/IEEE 268 Standard Metric Practice, "The SI unit of pressure and stress is the pascal (newton per square meter) and with proper SI prefixes is applicable to all such measurements. Old metric gravitational units for pressure and stress such as kilogram-force per square centimeter shall not be used. Widespread use has been made of other non-SI units such as bar and torr for pressure, but this use is strongly discouraged. The millibar has been widely used by meteorologists for communication within their profession; there is now some attempt to introduce the name hectopascal as a substitute for millibar. However, the kilopascal should be used in presenting meteorological data to the public."

RELATIONSHIPS OF SI UNITS WITH NAMES



SELECTED STANDARD CONVERSION FACTORS

Factors with an * are exact

Unit	=	SI Standard Unit
ACCELERATION		
1 ft/s^2	=	3.048 000*E-01 m/s^2
standard acceleration of free fall	=	9.806 650*E+00 m/s^2
ANGLE		
1 degree	=	1.745 329 E-02 rad
AREA		
1 acre	=	4.046 873 E+03 m^2
1 ft	=	9.290 304*E-02 m^2
1 hectare	=	1.000 000*E+04 m^2
1 in	=	6.451 600*E-04 m^2
BENDING MOMENT OR TORQUE		
1 dyne.cm	=	1.000 000*E-07 N.m
1 lbf.ft	=	1.355 818 E+00 N.m
ELECTRICITY AND MAGNETISM		
1 ampere hour	=	3.600 000*E+03 C
1 EMU of capacitance	=	1.000 000*E+09 F
1 EMU of current	=	1.000 000*E+01 A
1 EMU of electric potential	=	1.000 000*E-08 V
1 EMU of inductance	=	1.000 000*E-09 H
1 EMU of resistance	=	1.000 000*E-09
1 ESU of capacitance	=	1.112 650 E-12 F
1 ESU of current	=	3.335 641 E-10 A
1 ESU of electric potential	=	2.997 925 E+02 V
1 ESU of inductance	=	8.987 554 E+11 H
1 ESU of resistance	=	8.987 554 E+11
ENERGY (Includes WORK)		
1 British thermal unit (International Table)	=	1.055 056 E+03 J
1 British thermal unit (thermochemical)	=	1.054 350 E+03 J
1 calorie (International Table)	=	4.186 800*E+00 J
1 calorie (thermochemical)	=	4.184 000*E+00 J
1 electronvolt	=	1.602 19 E-19 J
1 erg	=	1.000 000*E-07 J
1 kW.h	=	3.600 000*E+06 J
1 therm	=	1.054 804*E+08 J

ENERGY PER UNIT AREA TIME

1 Btu (International Table)/(ft^2.h)	=	3.154 591 E+00 W/m^2
1 erg/(cm^2.s)	=	1.000 000*E-03 W/m^2

FLOW (See MASS PER UNIT TIME or VOLUME PER UNIT TIME)

FORCE

1 dyne	=	1.000 000*E-05 N
1 kilogram-force	=	9.806 650*E+00 N
1 pound-force (lbf)	=	4.448 222 E+00 N

FORCE PER UNIT AREA (See PRESSURE)

FORCE PER UNIT LENGTH

1 lbf/ft	=	1.459 390 E+01 N/m

HEAT

1 Btu (International Table).ft/(h.ft^2.^oF) (thermal conductivity) W/(m.K)	=	1.730 735 E+00
1 Btu (thermochemical).ft/(h.ft^2.^oF) (thermal conductivity)	=	1.729 577 E+00 W/(m.K)
1 Btu (International Table)/lb	=	2.326 000*E+03 J/kg
1 cal (thermochemical)/(cm.s.^oC)	=	4.184 000*E+02 W/(m.K)
1 cal (thermochemical)/s	=	4.184 000*E+00 W
1 ft^2/h (thermal diffusivity)	=	2.580 640*E-05 m^2/s

LENGTH

1 angstrom	=	1.000 000*E-10 m
1 astronomical unit	=	1.495 979 E+11 m
1 foot	=	3.048 000*E-01 m
1 inch	=	2.540 000*E-02 m
1 micron	=	1.000 000*E-06 m
1 mile (nautical)	=	1.852 000*E+03 m
1 mile (statute)	=	1.609 344*E+03 m

LIGHT

1 footcandle	=	1.076 391 E+01 lx
1 lambert	=	3.183 099 E+03 cd/m^2
1 lumen per ft^2	=	1.076 391 E+01 lm/m^2

MASS

1 gram	=	1.000 000*E-03 kg
1 pound (avoirdupois)	=	4.535 923 7*E-01 kg
1 tonne	=	1.000 000*E+03 kg

MASS PER UNIT TIME (Includes FLOW)

1 lb/min	=	7.559 873 E-03 kg/s

MASS PER UNIT VOLUME (Includes DENSITY and MASS CONCENTRATION)

1 g/cm^3	=	1.000 000*E+03 kg/m^3
1 lb/ft^3	=	1.601 846 E+01 kg/m^3

POWER

1 Btu (International Table)/h	=	2.930 711 E-01 W
1 Btu (thermochemical)/h	=	2.928 751 E+01 W
1 cal (thermochemical)/s	=	4.184 000*E+00 W
1 erg/s	=	1.000 000*E-07 W
1 horsepower (electric)	=	7.460 000*E+02 W
1 ton of refrigeration (12 000 Btu/h)	=	3.517 E+03 W

PRESSURE OR STRESS (FORCE PER UNIT AREA)

1 atmosphere (standard)	=	1.013 250*E+05 Pa
1 inch of mercury ($60^{\circ}F$)	=	3.376 85 E+03 Pa
1 millibar	=	1.000 000*E+02 Pa
1 psi	=	6.894 757 E+03 Pa

RADIOLOGY

1 rem (dose equivalent)	=	1.000 000*E-02 Sv
1 roentgen	=	2.58 E-04 C/kg

TEMPERATURE

Celsius Temperature	=	$(t_{^{\circ}F}-32)/1.8$
Fahrenheit Temperature	=	$1.8t_{^{\circ}C}+32$
Kelvin Temperature	=	$t_{^{\circ}C}+273.15$

TIME

1 day (mean solar)	=	8.640 000*E+04 s
1 day (sidereal)	=	8.616 409 E+04 s
1 year (sidereal)	=	3.155 815 E+07 s
1 year (tropical)	=	3.155 693 E+07 s

1 VELOCITY (Includes SPEED)

1 ft/min	=	5.080 000*E-03 m/s
1 knot (international)	=	5.144 444 E-01 m/s
1 mi/h (international)	=	4.470 400*E-01 m/s
1 mi/h (international)	=	1.609 344*E+00 km/h

VISCOSITY

1 poise	=	1.000 000*E-01 Pa.s
1 lb/ft.s	=	1.488 164 E+00 Pa.s

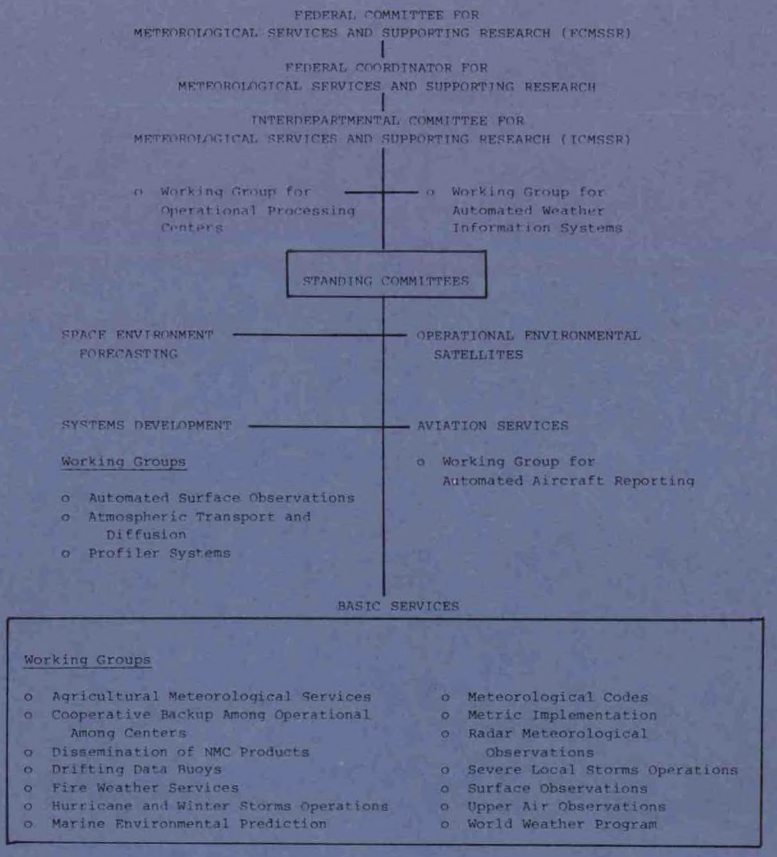
VOLUME (Includes CAPACITY)

1 acre-foot	=	1.233 5 E+03 m^3
1 barrel (oil, 42 gal)	=	1.589 873 E-01 m^3
1 in^3	=	1.638 7064*E-05 m^3
1 L (liter)	=	1.000 000*E-03 m^3

VOLUME PER UNIT TIME (Includes FLOW)

1 ft^3/min	=	4.719 474 E-04 m^3/s

*U.S. GOVERNMENT PRINTING OFFICE: 1985-461-135:36607



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