CHAPTER 5

AIRCRAFT RECONNAISSANCE

5.1. General. All Department of Commerce (DOC) tropical and subtropical cyclone aircraft reconnaissance needs will be requested and provided in accordance with the procedures of this chapter. As outlined in the Air Force Reserve Command (AFRC)/National Oceanic and Atmospheric Administration (NOAA) Memorandum of Agreement (see Appendix F), DOC has identified a requirement for, and the Department of Defense (DOD) maintains aircraft to support, up to five sorties per day (see Figure 5-1). Requirements exceeding five sorties will be accomplished on a "resources-permitting" basis. Congress has directed the DOD to fund an AFRC flying hour program of 1600 hours in support of hurricane reconnaissance coverage. In times of national emergency or war, some or all DOD reconnaissance resources may not be available to fulfill DOC needs. The Global Decision Support System (GDSS) JCS Priority Code for tasked, operational weather reconnaissance is **1A3** (IAW DOD Regulation 4500.9-R and Joint Publications 4-01 and 4-04). The Force Activity Designator (FAD)/Urgency of Need Designator (UND) Supply Priority Designator Determination code is **IIA2** (IAW Joint Publication 4-01 and Air Force Manual 23-110, Volume 2, Part 13, Attachment 3A-2.)

5.2. Responsibilities. The DOD, through the AFRC's 53rd Weather Reconnaissance Squadron (53 WRS), and DOC, through NOAA's Aircraft Operations Center (AOC), operate a complementary fleet of aircraft to conduct hurricane/tropical cyclone reconnaissance, synoptic surveillance, and research missions.

5.2.1. DOD. The DOD is responsible for:

- Providing operational aircraft for vortex fixes and data, synoptic surveillance missions, and investigative flights in response to DOC needs.
- Developing operational procedures and deploying data buoys to satisfy DOC needs.

5.2.2. DOC. The DOC is responsible for aircraft operations that may be requested to:

- Provide synoptic surveillance soundings (see Figure 5-2).
- Augment AFRC aircraft reconnaissance when DOC needs exceed the capabilities of DOD resources (see Figure 5-3).
- Assume responsibility for hurricane reconnaissance over foreign airspace that may be restricted for military operations.
- Conduct research flights.

Figure 5-1. WC-130 Weather Reconnaissance Aircraft

Figure 5-2. G-IV Weather Surveillance Aircraft

Figure 5-3. NOAA P-3 Weather Surveillance Aircraft

5.2.3 DOT. The DOT is responsible for providing air traffic control services to aircraft when within airspace controlled by the FAA. This includes offshore oceanic airspace. To expedite the handling of reconnaissance aircraft, paragraph 5.5.4, Air Traffic Control Procedures, has been significantly revised to update and incorporate the procedures in the FAA/AFRC/NOAA Letter of Agreement (LOA) entitled, Meteorological Reconnaissance Flights, found in Appendix F.

5.3. <u>Control of Aircraft</u>. Operational control of aircraft flying tropical and subtropical cyclone reconnaissance will remain with the operating agencies which own the aircraft.

5.4. <u>Reconnaissance Requirements</u>.

5.4.1. Meteorological Parameters. Data needs in priority order are as follows:

- Geographical position of the flight level vortex center (vortex fix) and relative position of the surface center, if known.

- Center sea-level pressure determined by dropsonde or extrapolation from within 1,500 ft of the sea surface or from the computed 925 hPa or 850 hPa height.

- Minimum 700, 850 or 925 hPa height, if available.
- Wind profile data for surface and flight level.
- Temperature at flight level.
- Sea-surface temperature.
- Dew-point temperature at flight level.

5.4.2. Accuracy.

5.4.2.1. Geographic Position.

- Aircraft position: within 3 nm.
- Storm surface center (wind/pressure): within 6 nm.
- Flight level storm center (wind/pressure): within 6 nm.

5.4.2.2. Wind Direction.

- Surface: within 10 deg.
- Flight level for winds greater than 20 kt: within 5 deg.

5.4.2.3. Wind Speed.

- Surface: within 10 kt.
- Flight level: within 4 kt.

5.4.2.4. Pressure Height.

- Surface: within 2 hPa.
- Flight level at or below 500 hPa: within 10 m.
- Flight level above 500 hPa: within 20 m.

5.4.2.5. Temperature.

- Sea surface: within 1°C.
- Flight level: within 1°C.

5.4.2.6. Dew-Point Temperature.

- From -20°C to +40°C: within 1°C.
- Less than -20°C: within 3°C.

5.4.2.7. Absolute Altitude: Within 10 m.

5.4.2.8. Vertical Sounding.

- Pressure: within 2 hPa.
- Temperature: within 1°C.
- Dew-point temperature:
  From -20°C to +40°C: within 1°C.
  Less than -20°C: within 3°C.
- Wind direction: within 10 deg.
  Wind speed: within 5 kt.

[NOTE: Present weather reconnaissance capabilities do not completely satisfy these requirements; data will be collected as close to stated requirements as possible.]

5.4.3. High Density/High Accuracy (HD/HA) Data Requirements. The HD/HA data include time, latitude, longitude, pressure altitude, D-value, radar altitude, peak winds, flight-level wind speed and direction, temperature, and dew-point temperature. The DOC requires rapid acquisition and transmission of tropical cyclone data, especially within the 24-hour period prior to landfall. If HD/HA capability is lost on an operational mission, the airborne meteorologist will contact CARCAH immediately to determine whether a backup aircraft is required and available.

5.4.4. Synoptic Surveillance Data Requirements. When required, the TPC/NHC will request mid- and/or upper-tropospheric sounding data on the periphery of systems approaching the United States. The TPC/NHC and HRD will coordinate to provide specific tracks including control points, control times and dropwindsonde frequency allocations to Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) for coordination with the reconnaissance units.

5.4.5. Required Frequency and Content of Observations. Requirements, where applicable, are summarized in Table 5-1.

5.4.5.1. Horizontal Observations. Standard RECCO Section 1, plus 4ddff and 9VTTT, if applicable, (9-groups are not required for WC-130s). The format is as specified in Appendix G of the National Hurricane Operations Plan (NHOP).

- En route. Horizontal observations will be taken and transmitted approximately every 30 minutes. If an automated system is not in use, encode observations every 15 minutes when over water within 15 degrees of the tasked coordinates, and transmit hourly.

- Fix Missions. A horizontal observation is required at the end point of each Alpha pattern leg. If HD/HA data are not available, then one additional horizontal observation is required midway between the outbound leg and inbound leg of the Alpha pattern.

- Invest Missions. A horizontal observation is required every 15 minutes and at major turn points.

Table 5-1. Requirement for aircraft reconnaissance data

	RECCO	VORTEX	SVD[1]	VERTICAL
EN ROUTE	Approximately every 30 minutes while over water.	NA	NA	Every 400 nm while over water
INVEST	Every 15 minutes and major turn points.	After closing the circulation.	NA	NA
FIX	At the end points of Alpha pattern legs. (non HD/HA) At end points and midway between outbound and inbound legs.	Tasked: VDM[2] Intermediate: VDM[2]	Two per mission. (non HD/HA) One per fix.	Each scheduled fix at 700 mb and above, and as tasked. Others at crew discretion.

5.4.5.2. HD/HA Data. HD/HA data are collected every 30 seconds, organized into a HDOB message with a 30-second, 1-minute, or 2-minute data encoding interval and transmitted to TPC/NHC. See Appendix G for the WC-130 HD/HA data message formats.

5.4.5.3. Vortex and Supplemental Vortex Observations. Vortex and supplemental vortex observations are collected, encoded, and transmitted in accordance with NHOP pattern requirements (see para 5.8). See Figures 5-4 and 5-5; see Table 5-2 for data formats. *Figure 5-6 depicts the differences in the structure of the Vortex Data Message (VDM) and the Supplementary Vortex Data Message (SVDM) between the WC-130H and the WC-130J.*

5.4.5.4. Vertical Observations. The frequency of vertical observations en route to and from the storm or invest area will be approximately every 400 nm over water, unless otherwise specified. Center dropwindsonde data will be provided for scheduled fixes made at 700 hPa or above. The distribution of vertical observations for eyewall and outer-wind field sampling are specified in paragraph 5.8.4. The format for all vertical observations is WMO TEMP DROP code (FM 37-VII). See Appendix G for the format.

[1] SVD = Supplementary Vortex Data
[2] VDM = Vortex Data Message

5.5. Reconnaissance Planning and Flight Notification.

5.5.1. DOC Requests for Aircraft Reconnaissance Data.

5.5.1.1. Coordination. The Tropical Prediction/National Hurricane Center (TPC/NHC) will coordinate with the Central Pacific Hurricane Center (CPHC) to determine a list of the total DOC requirements for data on tropical and subtropical cyclones or disturbances for the next 24-hour period (1100 to 1100 UTC) and an outlook for the succeeding 24-hour period. This coordinated request will be provided to CARCAH as soon as possible, but not later than 1630 UTC each day in the format of Figure 5-7. Amendments will be provided as required.

5.5.1.2. Tropical Cyclone Plan of the Day. From the coordinated DOC request, Figure 5-6, CARCAH will publish the Tropical Cyclone Plan of the Day (TCPOD). The format for the TCPOD is shown in Figure 5-8. When DOC reconnaissance needs exceed DOD and DOC resources, CARCAH will coordinate with the TPC/NHC to establish priorities of requirements.

5.5.1.3. Anticipated Reconnaissance Requests. Reconnaissance requests can be anticipated for a forecast or actual storm location.

- For the Atlantic, Gulf of Mexico, Caribbean, and Central Pacific areas, the requests can be:
  - Up to four 6-hourly fixes per day when a storm is within 500 nm of landfall and west of 55°W in the Atlantic.
  - Up to eight 3-hourly fixes per day when a storm is forecast to be within 300 nm of the U.S. coast, Hawaiian Islands, Puerto Rico, Virgin Islands, DOD installations, and other DOD assets when specified.
  - One synoptic surveillance mission per 24-hour period for potentially landfalling storms.
- Investigative flights may be requested for disturbances in areas defined above, i.e., one or two flights per day dependent upon proximity of landfall and upon known or suspected stage of development.
- Exceptions may be made when additional reconnaissance is essential to carry out warning responsibilities.

DATE	SCHEDULED FIX TIME	AIRCRAFT NUMBER	ARWO

WX MISSION IDENTIFICATION	OB

VORTEX DATA MESSAGE

A	Z	DATE AND TIME OF FIX
B	DEG MIN N S	LATITUDE OF VORTEX FIX
	DEG MIN E W	LONGITUDE OF VORTEX FIX
C	MB M	MINIMUM HEIGHT AT STANDARD LEVEL
D	KT	ESTIMATE OF MAXIMUM SURFACE WIND OBSERVED
E	DEG NM	BEARING AND RANGE FROM CENTER OF MAXIMUM SURFACE WIND
F	DEG KT	MAXIMUM FLIGHT LEVEL WIND NEAR CENTER
G	DEG NM	BEARING AND RANGE FROM CENTER OF MAXIMUM FLIGHT LEVEL WIND
H	MB	MINIMUM SEA LEVEL PRESSURE COMPUTED FROM DROPSONDE OR EXTRAPOLATED FROM FLIGHT LEVEL. IF EXTRAPOLATED, CLARIFY IN REMARKS.
I	C/ M	MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE OUTSIDE EYE
J	C/ M	MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE INSIDE EYE
K	C/ C	DEWPOINT TEMP/SEA SURFACE TEMP INSIDE EYE
L		EYE CHARACTER: Closed wall, poorly defined, open SW, etc.
M		EYE SHAPE/ORIENTATION/DIAMETER. Code eye shape as: C -Circular; CO - Concentric; E-Elliptical. Transmit orientation of major axis in tens of degree, i.e., 01-010 to 190; 17-170 to 350. Transmit diameter in nautical miles. *Examples*: C8 - Circular eye 8 miles in diameter. EO9/15/5 - Elliptical eye, major axis 090-270, length of major axis 15 NM, length of minor axis 5NM. CO8-14 - Concentric eye, diameter inner eye 8 NM, outer eye 14 NM.
N	/	FIX DETERMINED BY/FIX LEVEL. FIX DETERMINED BY: 1 - Penetration; 2 - Radar; 3 - Wind; 4 - Pressure; 5 - Temperature. FIX LEVEL (Indicate surface center if visible; indicate both surface and flight level centers only when same): 0 - Surface; 1 - 1500ft; 9-925mb; 8 - 850 mb; 7 - 700 mb; 5 - 500 mb; 4 - 400 mb; 3 - 300 mb; 2 - 200 mb; NA - Other.
O	/ NM	NAVIGATION FIX ACCURACY/METEOROLOGICAL ACCURACY

p REMARKS

MAX FL WIND_____KT_____QUAD_____Z

SLP EXTRAP FROM (1500 FT/ 925 MB/ 850 MB/ DROPSONDE)

SFC CNTR_____/_____NM FROM FL CNTR

MAX FL TEMP _____C_____/_____NM FROM FL CNTR

INSTRUCTIONS: Items A through G (and H when extrapolated) are transmitted from the aircraft immediately following the fix. The remainder of the message is transmitted as soon as available for scheduled fixes and at the ARWO's discretion for unscheduled (intermediate) fixes.

Figure 5-4. Vortex data message worksheet

SUPPLEMENTARY VORTEX DATA MESSAGE

WX MISSION ID

OB

SUPPLEMENTARY VORTEX DATA MESSAGE

01 ($L_aL_aL_a$)	1 ($L_oL_oL_oL_o$)	1 (jHHH)	1 (TTT_dT_d)	(ddfff)
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
MF ($L_aL_aL_a$)	M ($L_oL_oL_oL_o$)	MF (fff)		

OBS 01 AT: Z	OBS AT Z	OBS 01 SFC WND:

01 ($L_aL_aL_a$)	1 ($L_oL_oL_oL_o$)	1 (jHHH)	1 (TTT_dT_d)	(ddfff)
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
MF ($L_aL_aL_a$)	M ($L_oL_oL_oL_o$)	MF (fff)		

OBS 01 AT: Z	OBS AT Z	OBS 07 SFC WND:

LEGEND

01 INDICATOR FOR DATA COLLECTED APPROXIMATELY 105 NM FROM STORM CENTER (INBOUND) OR APPROXIMATELY 15 NM FROM CENTER (OUTBOUND)

OTHER INDICATORS (02/2, 03/3...) FOR DATA AT APPROXIMATELY 15 NM INTERVALS INBOUND OR OUTBOUND FROM STORM CENTER. INDICATORS MAY BE EXPANDED BEYOND 07(08,09...) AS NECESSARY AT APPROXIMATELY 15NM INTERVALS.

MF = INDICATOR FOR MAXIMUM FLIGHT LEVEL WIND OBSERVED

fff = SPEED OF WIND IN KNOTS

dd = TRUE DIRECTION OF FLIGHT LEVEL WIND SPEED IN TENS OF DEGREES

TTT_dT_d = TEMP/DEWPOINT IN DEGREES CELSIUS: ADD 50 FOR NEGATIVE VALUES

jHHH = PRESSURE HEIGHT DATA IN RECCO FORMAT

$L_aL_aL_a$ = LATITUDE IN DEGREES/TENTHS

$L_oL_oL_oL_o$ = LONGITUDE IN DEGREES/TENTHS

/ = DATA UNKNOWN/UNOBTAINABLE

REMARKS (*end of message*)

Figure 5-5. Supplementary vortex data message

Table 5-2. Vortex data message entry explanation

DATA ITEM	ENTRY
MISSION IDENTIFIER	As determined in Chapter 5, paragraph 5.7.6.
OBSERVATION NUMBER	A two digit number determined by the sequential order in which the observation is transmitted from the aircraft.
A (ALPHA)	Date and time (UTC) of the flight level center fix. If the flight level center cannot be fixed and the surface center is visible, enter the time of the surface center fix.
B (BRAVO)	The latitude and longitude of the center fix associated with item ALPHA. NOTE: If the surface center is fixable, enter bearing and range from the center in item QUEBEC, e.g., SFC CNTR 270/15 nm, if the centers are separated by over 5 nm.
C (CHARLIE)	Indicate the standard atmospheric surface e.g. 925, 850 or 700 hPa. The minimum height of the standard surface observed inside the center. If at 1,500 ft or below or not within 1,500 ft of a standard surface, enter NA.
D (DELTA)	The maximum surface wind observed during the inbound leg associated with this fix.
E (ECHO)	Bearing and range of the maximum surface wind observed (item DELTA) from the coordinates reported in item BRAVO.
F (FOXTROT)	The maximum flight level wind observed during the inbound leg associated with this fix. If a significant secondary maximum wind is observed, report it in remarks.

Table 5-2. Vortex data message entry explanation (continued)

G (GOLF)	Bearing and range of the maximum flight level wind observed (item FOXTROT) from the coordinates reported in item BRAVO.
H (HOTEL)	The minimum sea level pressure (SLP) to the nearest hectopascal observed at the coordinates reported in item BRAVO. Preface the SLP with "EXTRAP" (extrapolated) when the data are not derived from dropsonde or when the SLP is extrapolated from a dropsonde that terminated early. Clarify the difference in remarks (e.g., SLP EXTRAPOLATED FROM BELOW 1500 FEET/850 HPA/DROPSONDE)
I (INDIA)	MAX FLT LVL TEMP--This temperature is taken just outside the central region of a cyclone (i.e., just outside the eyewall or just beyond the maximum wind band). This temperature may not be the highest recorded on the inbound leg but is representative of the environmental temperature just outside the central region of the storm. PRESSURE ALT--Pressure altitude data (meters) are taken at the same location as the maximum temperature data reported in item INDIA
J (JULIET)	MAX FLT LVL TEMP--The maximum temperature observed within 5 nm of the center fix coordinates. If a higher temperature is observed at a location more than 5 nm away from the flight level center (item BRAVO), it is reported in item QUEBEC including bearing and distance from the flight level center. PRESSURE ALT--Pressure altitude data (meters) are taken at the same location as the maximum temperature data reported in item JULIET.
K (KILO)	Dewpoint temperature/sea surface temperature are collected at the same location as the maximum temperature reported in item JULIET. Enter NA if not observed.

Table 5-2. Vortex data message entry explanation (continued)

L (LIMA)	Only report if at least 50 percent of the center has an eyewall, otherwise enter NA. Closed wall--if the center has 100 percent coverage with no eyewall weakness. Open XX--if the center has 50 percent or more but less than 100 percent coverage. State the direction of the eyewall weakness.
M (MIKE)	Self explanatory. Report only if item LIMA is reported, otherwise enter NA.
N (NOVEMBER)	Fix determined by: Always report 1. Report 2 if radar indicates curvature or banding consistent with fix location. Report 3 if recorded or observed winds indicate a closed center. Report 4 if the fix pressure is lower than all reported on the inbound leg. Report 5 if the fix temperature is at least higher than any reported on the inbound leg. Fix level: Report 0 alone if fix is made solely on surface winds. Report 0 and the flight-level code if the centers are within 5 nm of each other.
O (OSCAR)	Navigational and meteorological accuracy are reported as the upper limit of probable error. Meteorological accuracy is normally reported as one-half of the diameter of the light and variable wind center.
P (PAPA)	Remarks to enhance the data reported above. Required remarks include: (1) mission identifier and observation number; (2) the maximum flight level wind observed, time of observation, and the relative quadrant of the storm of the observed wind on the latest pass through any portion of the storm; (3) the method of deriving the central SLP when extrapolated; and (4) the bearing and range of the surface center and/or maximum flight level temperature if not within 5 nm of the flight level center.

WC-130H

```
URNT12 KNHC 161821
VORTEX DATA MESSAGE
A. 16/1821Z
B. 15 DEG 30 MIN N
   68 DEG 53 MIN W
C. 700 MB 2818 M
D. 70 KT
E. 263 DEG 13 NM
F. 329 DEG 81 KT
G. 263 DEG 53 NM
H. 967 MB
I. 10 C/ 3073 M
J. 18 C/ 3098 M
K. 8 C/ NA
L. OPEN SOUTH
M. E34/30/20
N. 12345/7
O. 0.1/2 NM
P. AF866 1016A LENNY OB 07
   MAX FL WIND 81 KT W QUAD 1806Z
```

```
URNT14 KNHC 161853
SUPPLEMENTARY VORTEX DATA MESSAGE
01154 10713 13080 11106 32035
02154 20710 23074 21008 32039
03154 30708 33074 31107 32031
04154 40705 43064 41008 32036
05154 50703 53052 51007 33042
06154 60700 63029 61007 34056
07154 70697 73006 70909 35045
MF154 M0698 MF081
OBS 01 AT 1746Z
OBS 09 AT
OBS 01 SFC WND 01030
01156 10687 13852 11509 13040
02158 20686 23937 21010 14082
03160 30684 33001 31010 16060
04162 40682 43028 41109 16046
05163 50680 53041 51008 17045
06165 60678 63046 61006 17055
07167 70676 73058 70908 17052
MF158 M0686 MF091
OBS 01 AT 1825Z
OBS 07 AT 1849Z
OBS 07 SFC WND /////
RMK AF866 1016A LENNY OB 11
```

WC-130J

```
URNT12 KNHC 162129
VORTEX DATA MESSAGE
A. 16/21:16:20Z
B. 15 DEG 41 MIN N
   068 DEG 07 MIN W
C. NA  MB 2743 M
D. NA  KT
E. NA  DEG     NM
F. 121 DEG 087 KT
G. 034 DEG 010 NM
H. EXTRAP  957 MB
I.   7 C/ 3056 M
J.  16 C/ 3040 M
K. 10 C/ NA
L. OPEN W
M. E270/30/20
N. 12345/07
O. 0.02 / 3  NM
P. AF301 WXWXA LENNYTEST1   OB 05
MAX FL WIND 87 KT NE QUAD 21:13:30Z
SLP EXTRAP FROM 700 MB
```

```
URNT14 KNHC 162152
SUPPLEMENTARY VORTEX DATA MESSAGE
        INBOUND
  LAT   LON   jHHH  TTDD ddfff
01166 10672 13038 10606 16031
02164 20674 23019 20906 17050
03162 30676 33985 30707 15052
04161 40678 43954 40909 16059
05159 50680 53868 51009 14073
MF158 M0680 MF087
OBS 01 AT 20:53:20Z
OBS 05 AT 21:12:00Z
OBS 01 SFC WND /////
        OUTBOUND
  LAT   LON   jHHH  TTDD ddfff
01155 10683 13815 11605 32096
02153 20685 23929 20909 30089
03152 30687 33990 31008 31071
04150 40689 43018 41006 31060
05148 50691 53041 50909 30048
06146 60692 63050 61007 29046
07145 70694 73056 70908 28048
MF155 M0684 MF101
OBS 01 AT 21:20:50Z
OBS 07 AT 21:49:40Z
OBS 07 SFC WND 27045
RMK AF301 WXWXA LENNYTEST1   OB 07
```

Figure 5-6. Example Vortex Data Messages (VDM) and Supplementary Vortex Data Messages (SVDM) for the WC-130H and WC-130J

NHOP COORDINATED REQUEST FOR AIRCRAFT RECONNAISSANCE

__ Original
__ Amendment
(Check One)

I. ATLANTIC REQUIREMENTS

STORM NAME DEPRESSION # SUSPECT AREA	FIX OR ON STATION TIME	COORDI-NATES	FLIGHT PATTERN	FCST MVMT	NHC PRIOR-ITY

SUCCEEDING DAY OUTLOOK _____

_____

REMARKS _____

_____

II. CENTRAL PACIFIC REQUIREMENTS

STORM NAME DEPRESSION # SUSPECT AREA	FIX OR ON STATION TIME	COORDI-NATES	FLIGHT PATTERN	FCST MVMT	NHC PRIOR-ITY

SUCCEEDING DAY OUTLOOK _____

_____

REMARKS _____

_____

III. DISTRIBUTION

A. TO CARCAH BY 1630Z OR AMEND AT ANY TIME

Figure 5-7. NHOP coordinated request for aircraft reconnaissance

TROPICAL CYCLONE PLAN OF THE DAY FORMAT
--ATLANTIC AND CENTRAL PACIFIC OCEANS--

FM: CARCAH, NATIONAL HURRICANE CENTER, MIAMI, FL

TO: (AFRC-APPROVED ADDRESSEES)/(NOAA-APPROVED ADDRESSEES)

SUBJECT: THE TROPICAL CYCLONE PLAN OF THE DAY
VALID _____Z (MONTH) TO _____Z (MONTH) (YEAR)
TCPOD NUMBER.....(YR)-_____

I. ATLANTIC REQUIREMENTS

1. (STORM NAME, DEPRESSION, SUSPECT AREA) or (NEGATIVE RECON REQUIREMENTS)

FLIGHT ONE (NHC PRIORITY, if applicable)

A. _____ZFIX/INVEST TIME

(Resources permitting if applicable)
_____Z

B. _____ MISSION IDENTIFIER

C. _____ZDEPARTURE LOCATION/TIME

D. _____ FORECAST POSITION

E. _____ DESTINATION

F. _____ZTIME ON STATION

G. _____ ALTITUDE(S) ON STATION

H. _____ REMARKS (if needed)

FLIGHT TWO (if applicable, same as FLIGHT ONE)

2. (SECOND SYSTEM, if applicable, same as in 1. above)

3. OUTLOOK FOR SUCCEEDING DAY (NHC PRIORITY, if applicable)

A. POSSIBLE _(Unit)_ ON STATION REQUIREMENT NEAR _(Location)_
AT _(Time)_Z.

II. CENTRAL PACIFIC REQUIREMENTS (Same as in ATLANTIC)

Figure 5-8. Tropical cyclone plan of the day format

5.5.2. DOD and DOC Reconnaissance Aircraft Responsiveness.

5.5.2.1. Requirement Notification. Notification of requirements must precede tasked-on-station time by at least 16 hours plus en route time to the area of concern.

5.5.2.2. Prepositioning. The "Succeeding Day Outlook" portion of the TCPOD provides advance notification of requirements and authorizes units to preposition aircraft to forward operating locations. For missions requiring prepositioning, the "Succeeding Day Outlook" may not provide adequate advance notification. In this situation, an "Additional Day Outlook" may be included in the TCPOD to authorize units to preposition aircraft.

5.5.2.3. Resources Permitting. When circumstances preclude the appropriate notification lead time, the requirement will be levied as "resources permitting." When a "resources permitting" requirement is levied in an amendment, the TPC/NHC will indicate the priority of all existing or remaining requirements.

5.5.2.4. Emergency Requirement. If a storm develops unexpectedly and could cause a serious threat to lives and property within a shorter time than provided for in the paragraphs above, CARCAH will contact the reconnaissance units, or higher headquarters, as appropriate, and request assistance in implementing emergency procedures not covered in this plan. The TPC/NHC and CPHC directors have authority to declare an emergency.

5.5.3. Reconnaissance Tropical Cyclone Plan of the Day.

5.5.3.1. Preparation. The CARCAH will coordinate the TCPOD (Figure 5-8) daily during the period from June 1 to November 30 and at other times during the year as required. Transmitted TCPODs will be serially numbered each season.

- The CARCAH will coordinate the TCPOD with TPC/NHC, the 53 WRS, and NOAA AOC before publication.

- The TCPOD will list all DOC and DOD required tropical and subtropical cyclone operational reconnaissance and research missions. The remarks section of the TCPOD will include appropriate comments whenever research and operational flights overlap.

- The DOD-required tropical or subtropical cyclone reconnaissance missions in the Atlantic or the Pacific west to 180° will be identified in the TCPOD as USN or USAF requirements.

- Amendments to the TCPOD will be published only when requirements change. When amended, the impact on each listed flight will be identified; i.e., No Change, Change Added, or Cancel.

5.5.3.2. Dissemination. The TCPOD will be made available to appropriate agencies, such as FAA, DOD, and NOAA, that provide support to or control of reconnaissance aircraft or are a part of the tropical cyclone warning service. Under normal circumstances, the TCPOD will be disseminated by 1900 UTC each day including weekends and holidays. If there are no current day or succeeding-day reconnaissance requirements, a negative report, which covers the appropriate time frame, will be disseminated. Amendments will be disseminated as required.

[NOTE: The TCPOD is disseminated under the header "MIAREPRPD" for AFOS users and under "NOUS42 KNHC: for AFMEDS/AWDS users. The TCPOD can also be seen on the Internet at www.hurricanehunters.com/wxdata.htm and clicking on Plan of the Day.]

5.5.4. Air Traffic Control (ATC) Clearances.

5.5.4.1. Air Traffic Control Clearances. Flight plans for reconnaissance and research flights shall be filed with the FAA as soon as practicable before departure time.

5.5.4.2. Prior Coordination. *The 53 WRS/DOO, AOC Flight Operations Division, and the appropriate NASA facility shall contact the Air Traffic Control System Command Center (ATCSCC) at 703-708-5144/5149 as soon as possible prior to an NHOP/NWSOP reconnaissance, surveillance, or research mission, and provide the following information:*

- Mission call sign.
- Departure point and estimated time of departure.
- Approximate route to be flown.
- Requested altitude(s).
- Any special requests.

In addition, they shall transmit electronically the information in Appendix D to the U.S. NOTAM office (e-mail address: 9-AWA-NOTAM@FAA.GOV) no later than 2 hours prior to departure or as soon as possible (facsimile should be used in the event of electronic unavailability). The ATCSCC will then coordinate with all impacted FAA facilities if requested to do so.

5.5.4.2.1. *The 53 WRS shall only use the call sign "Teal ##," AOC shall only use "NOAA ##," and NASA shall only use "NASA ##." ATC will provide TEAL and NOAA aircraft priority handling when specifically requested.*

5.5.4.2.2. *For NHOP missions, 53 WRS crews may request one of five "discreet" Mode 3 Beacon Codes, as issued by the Department of Defense (DOD) Code Manager.*

5.5.4.3. Air Traffic Control (ATC) Separation. *The FAA will provide ATC services and separation from nonparticipating aircraft on instrument flight rules to the 53 WRS, AOC, and NASA aircraft operating in other than Class G airspace. Aircraft not flying on instrument flight rules may be operating near the storm environment; therefore, adherence to ATC clearances is mandatory for safety. When appropriate, military pilots shall clearly state to ATC that a segment of flight will be conducted under the provisions of "due regard."*

5.5.4.3.1. *It is the responsibility of the aircraft commander to remain clear of obstacles and nonparticipating aircraft when operating in Class G airspace.*

5.5.4.3.2. *The 53 WRS, AOC, and NASA are responsible for ensuring that air traffic clearances and messages are relayed to/from the FAA in an accurate manner when those relays are initiated by the 53 WRS, AOC, and NASA and are routed through other than Aeronautical Radio, Inc. (ARINC).*

5.5.4.4. Assigned Altitudes. When storm aircraft are unable to maintain assigned altitudes due to turbulence, ATC shall be advised. When deviation from assigned altitude is required, the pilot shall coordinate with ATC and obtain a clearance prior to changing altitudes. When numerous changes in altitude will be required, the pilot should request a "block altitude" clearance from ATC. Any deviations from ATC clearance shall first be coordinated with the appropriate ATC facility.

5.5.4.5. Release of Dropsondes. *During NHOP missions and when operationally feasible, dropsonde instrument releases from FL 190 or higher and sensor activation shall be coordinated with the appropriate ATC by advising of a pending drop or sensor activation at least 10 minutes prior to the event when in direct radio contact with ATC. When contact with ATC is via ARINC, event coordination shall be included with the position report prior to the point where the action will take place, unless all instrument release points have been previously relayed to the affected ATC center(s). Example: "Teal 63, SLATN at 1215, FL290 block 310, estimating FLANN at 1250, CHAMP next; Weather instrument release at FLANN." Contact between participating aircraft will be made using the frequencies listed in paragraph 5.9.3.*

5.5.4.5.1. *During NHOP missions, commencing 5 minutes prior to release of dropsondes from FL190 or higher, the aircraft commander will broadcast in the blind on radio frequencies 121.5 MHz and 243.0 MHz to advise any traffic in the area of the impending drop. Pilots shall not make these broadcasts if they will interfere with routine ATC communications, such as in the vicinity of an airport approach control facility. The aircraft commander is responsible for determining the content and duration of a broadcast, concerning a dropsonde release or sensor activation.*

5.5.4.5.2. *The aircraft commander is the sole responsible party for all dropsonde releases or activation of sensors.*

5.5.4.6. ATC Communications Backup. *When 53 WRS, AOC, or NASA flights are unable to contact ATC to request an en route clearance, a clearance request may be relayed through the Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) or the 53 WRS Mission Commander. This backup procedure will only be used to preclude a potential emergency or safety-related situation.*

5.5.4.7. Hurricane/Tropical Cyclone (NHOP) Mission Procedures*. PARTICIPATING AIRCRAFT will comply with procedures in the NHOP in order to provide separation from other PARTICIPATING AIRCRAFT.*

5.6. Reconnaissance Effectiveness Criteria.

5.6.1. General. Specified reconnaissance times are established to allow sufficient time for the forecaster to analyze the data before issuing an advisory. Every effort should be made to obtain data at scheduled times. The following criteria will be used to assess reconnaissance mission effectiveness:

5.6.1.1. Tropical Cyclone Fix Mission.

- ON-TIME. The fix is made not earlier than 1 hour before nor later than 1/2 hour after scheduled fix time.

- EARLY. The fix is made from 1 hour before scheduled fix time to one-half of the time interval to the preceding scheduled fix, not to exceed 3 hours.

- LATE. The fix is made within the interval from 1/2 hour after scheduled fix time to one-half of the time interval to the succeeding scheduled fix, not to exceed 3 hours.

- MISSED. Data are not obtained within the parameters specified for on-time, early, or late.

[NOTE: Appropriate credit will be given when the aircraft arrives in the requested area but is unable to locate a center due to storm dissipation or rapid movement. Credit will also be given for radar fixes if penetration is not possible due to geographic or other flight restrictions.]

5.6.1.2. Tropical Cyclone Investigative Missions.

- ON-TIME. An observation must be taken within 250 nm of the specified coordinates by the scheduled time.

• LATE. An observation is taken within 250 nm of the specified coordinates after the scheduled time but not later than the scheduled time plus 2 hours.

• MISSED. When the aircraft fails to be within 250 nm of the specified coordinates by the scheduled time plus 2 hours.

5.6.1.3. Synoptic Surveillance Missions.

• SATISFIED. Requirements are considered satisfied upon completion of the assigned track and the acquired dropwindsonde data are transmitted from the aircraft prior to the HPC/MPC deadline for synoptic analysis.

• MISSED. When parameters listed in para A. above are not satisfied.

5.6.2. Mission Assessment. The TPC/NHC or CPHC will provide CARCAH a written assessment of the reconnaissance mission anytime its timeliness or quality is outstanding or substandard (see Figure 5-9). Mission requirements levied as "resources permitting" will not be assessed for timeliness but may be assessed for quality of data gathered.

5.6.3. Summaries. CARCAH will maintain monthly and seasonal reconnaissance summaries, detailing missions actually flown to satisfy TPC/NHC-levied requirements.

5.7. Aerial Reconnaissance Weather Encoding, Reporting, and Coordination.

5.7.1. Vortex Data. A vortex data message (Figure 5-4) will be prepared for all scheduled fixes, using all observed vortex fix information. For intermediate fixes, limited vortex data may be transmitted, depending upon availability of information and forecaster requirements.

5.7.2. Center Fix Data. When proximity to land, air traffic control restriction, or other factors prevent actual penetration of the vortex by the reconnaissance aircraft, it is permissible to fix the cyclone by radar. All aircraft radar fix reports will be made in plain text and appended to a RECCO observation taken at fix time or to a supplementary vortex data message completed up to the time of the radar fix, e.g., RADAR CENTER FIX 21.5N 83.0W, POOR RADAR PRESENTATION, NAV ACCURACY 5NM. The remark stating the type of radar fix and quality of the radar presentation is in accordance with Chapter 7, paragraph 7.3.3.

5.7.3. Peripheral Data. Storm penetration and collection of peripheral data will normally begin at the operational altitude approximately 105 nm from the center as determined by the flight meteorologist. The Supplementary Vortex Data Message (Figure 5-5) will be encoded and reported as specified in Table 5-1.

MISSION EVALUATION FORM

MEMORANDUM FOR: OL-A, 53WRS/CARCAH

FROM: _____(Director, NHC, CPHC)_____

SUBJECT: Mission_____Evaluation
(Mission Identifier)

PUBLISHED REQUIREMENTS:

Premission Coordinates (As Updated Prior to TKO)_____N_____W

Flight Pattern _____

Mission Requirements Times _____

RECONNAISSANCE MISSION PERFORMANCE:

Flight Flown:	_____Completely	_____Partially	_____Other
Horizontal Data Coverage:	_____Complete _____Incomplete	_____Timely _____Untimely	_____Accurate _____Inaccurate
Vertical Data Coverage:	_____Complete _____Incomplete	_____Timely _____Untimely	_____Accurate _____Inaccurate
Requirements Accomplished:	_____On Time _____Missed	_____Early	_____Late

OVERALL MISSION EVALUATION:

OUTSTANDING_____

UNSATISFACTORY_____ FOR:

COMPLETENESS_____ TIMELINESS_____ ACCURACY_____

EQUIPMENT_____ PROCEDURES_____ OTHER_____

REMARKS: (Brief but specific)

_____
FORECASTER's SIGNATURE

Figure 5-9. Mission evaluation form

5.7.4. Mission Coordination. Mission coordination for all missions will be accomplished through CARCAH. Meteorological discussions for Central Pacific missions may be accomplished directly with the CPHC; however, any changes to tasking will be accomplished through CARCAH.

5.7.5. Post-flight Debriefing. Unless otherwise directed, the flight meteorologist will provide either an airborne or post-flight debriefing to the appropriate hurricane center through CARCAH to ensure all observations were received and understood.

5.7.6. Mission Identifier. Regular weather and hurricane reconnaissance messages will include the five-digit agency/aircraft indicator followed by the CARCAH-assigned mission/storm-system indicator. Elements of the mission identifier follow:

Agency/Aircraft	Mission Storm System Indicator			
Agency + Aircraft Number[1,2]	Sequential number of mission in this storm	Depression number or XX/YY/ZZ, if not a depression or greater	Location A,E,C,or W[3]	Storm name or words CYCLONE, INVEST, or TRAIN
	For non-tasked missions, WXWX, or for a numbered depression or stronger, WX+ depression number.			

-EXAMPLES-

AF966 0201C CYCLONE	(USAF aircraft 966 on the second mission on tropical depression number 1 in the Central Pacific. Invest or fix as specified in the TCPOD.)
AF984 0403E CARLOS	(USAF aircraft 984 on the fourth mission on tropical depression 3 which formed in the Eastern Pacific and acquired the name Carlos.)
NOAA2 01XXA INVEST	(NOAA aircraft 42RF on the first mission to investigate a suspect area in the Atlantic, Gulf of Mexico or Caribbean.)
NOAA3 WX01A AGNES	(NOAA aircraft 43RF on a non-tasked mission into AGNES.)

[1] AF plus last 3 digits of tail number
[2] NOAA, plus last digit of aircraft registration number
[3] A=Atlantic, Caribbean, or Gulf of Mexico, E=Eastern Pacific, C=Central Pacific, W=Western Pacific

5.7.7. Observation Numbering and Content. The mission identifier will be the first mandatory remark followed by the observation number.

5.7.7.1. First Weather Observation. In addition, the first weather observation will have appended as remarks the four-letter ICAO identifier for the departure station, time of departure, and estimated time of arrival (ETA) at the invest points, coordinates of the storm, or control point, as applicable.

-EXAMPLE-

URNT11 KNHC DDZZZZ
97779 TEXT TEXT...
RMK AF987 0308A EMMY OB 01 DPTD KBIX AT 10/2100Z ETA 31.5N 75.0W 11/0015Z
NNNN

5.7.7.2. Numbering Scheme. All observations (RECCO, vortex, supplemental, and dropsonde) from the first to the last will be numbered sequentially. The Improved Weather Reconnaissance System (IWRS) will automatically number HDOB sequentially, but separately from other observations. When an aircraft is diverted from its original mission to fulfill TPC/NHC requirements, conclude the original mission by using the last report remark. The next observation from the diverted aircraft will be labeled OB 01, will use the CARCAH-assigned mission identifier, and will include time of diversion and ETA of coordinates of interest.

-EXAMPLE-

URNT10 KNHC DDZZZZ
97779 TEXT TEXT...
RMK AF987 0lXXA INVEST OB 01 DPTD AF987 WX MISSION AT 05/1235Z ETA 18N 85W 05/1630Z
NNNN

5.7.7.3. Final Weather Observation. Append to the final weather observation a remark that includes ETA, destination, number of observations (excluding HDOB), and monitor(s) that copied the observations.

-EXAMPLE-

URNT10 KNHC DDZZZZ
97779 TEXT TEXT...
RMK AF987 0317A JOAN OB 16 ETA KBIX 15/2030Z. LAST REPORT OBS 01 THRU 16 TO KNHC.
NNNN

5.8. <u>Operational Flight Patterns</u>. This section details the operational flight patterns that provide vortex and peripheral data on tropical and subtropical cyclones.

5.8.1. Flight Pattern ALPHA Operational Details.

5.8.1.1. Flight Levels and Sequence. Flight levels will normally be 1,500 ft, 925 hPa, 850 hPa, or 700 hPa, depending on data requirements and flight safety. Legs will normally be 105 nm long and flown on intercardinal tracks (45 degrees off cardinal tracks). The flight sequence is shown in Figure 5-10. The pattern can be started at any intercardinal point and then repeated throughout the mission. Prior to starting an inbound or outbound track the aircrew should evaluate all available data, e.g., radar presentation, satellite photo, for flight safety. Once started on course, every effort should be made to maintain a straight track and the tasked altitude. A horizontal observation is required at each leg end point. This data is transmitted immediately. The ALPHA pattern may be modified to satisfy unique customer requirements (such as extending legs to examine the wind profile of a strong storm) or because of proximity of land or warning areas.

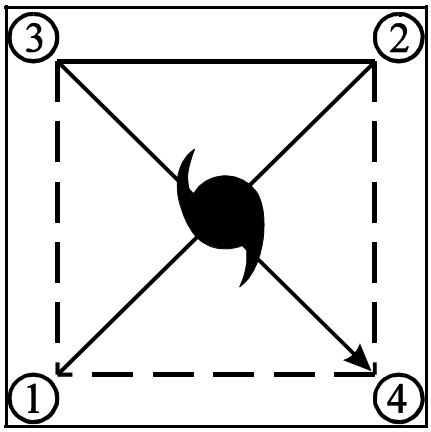

Figure 5-10. Flight pattern ALPHA

5.8.1.2. Vortex fix data. On each transit of the center a fix will be made and a vortex data message completed, using data gathered on the inbound track since the previous fix and will be transmitted immediately. Center dropsonde data will also be provided for scheduled fixes made at 700 hPa or above. The dropsonde will be released at the flight-level center coordinates (item BRAVO of the vortex data message). When making a fix from 925 hPa, 850 hPa, or 700 hPa, the sea-level pressure will be extrapolated using the tables in Appendix F or by using an approved computer program.

5.8.1.3. Supplementary Vortex Messages (SVDM). Two SVDM (one ALPHA pattern) will normally be provided per fix mission. Requests for additional SVDM will be directed to CARCAH. When high density data is not available, supplementary vortex data messages will be provided with each fix.

5.8.2. Investigative Missions. An investigative mission is tasked on tropical disturbances to determine the existence or non-existence of a closed circulation, supply reconnaissance observations in required areas, and locate the vortex center, if any.

5.8.2.1. Flight Levels. Flight level will normally be at or below 1,500 ft absolute altitude but may be adjusted as dictated by data requirements, meteorological conditions, or flying safety factors.

5.8.2.2. Vortex Fix. A vortex data message is required if a vortex fix is made.

5.8.2.3. Closed Circulation. A closed circulation is supported by at least one sustained wind reported in each quadrant of the cyclone. Surface winds are preferred.

5.8.2.4. Flight Pattern. The preferred approach is to fly to the tasked coordinates of the forecasted center and then execute a pattern as observed conditions dictate. Suggested patterns are the X, Box, or Delta patterns, but the flight meteorologist may choose any approach. See Figure 5-11. Turns are usually made to take advantage of tailwinds whenever possible.

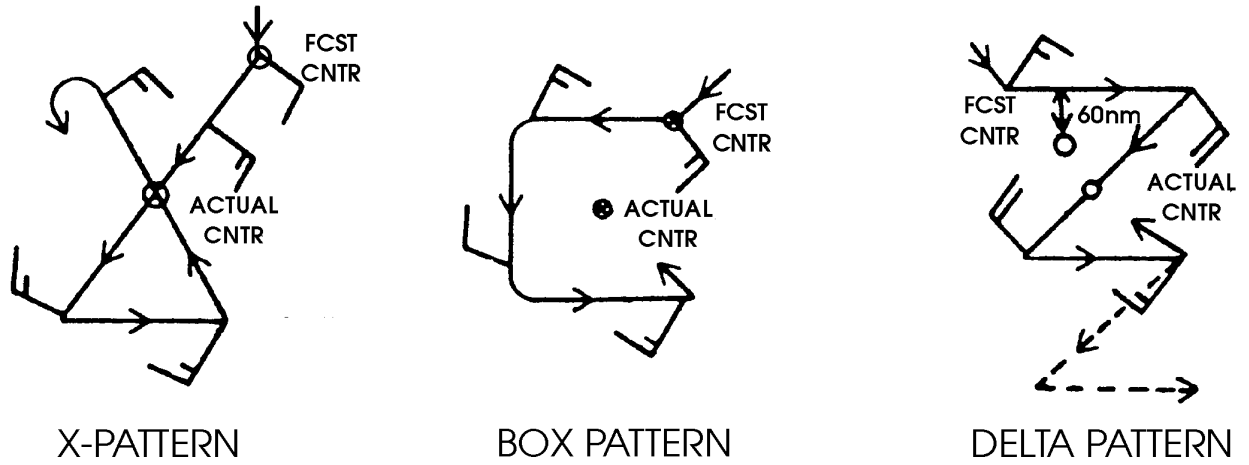

Figure 5-11. Suggested patterns for investigative missions

- On the X pattern, the aircraft is turned to head directly towards the center, as indicated by the surface or flight level winds. The aircraft is flown through the calm center until winds from the opposite direction occur (second quadrant). The aircraft is then turned to a cardinal heading until a wind shift occurs (third quadrant). Finally, the aircraft is turned towards the center and flown straight through the center to the last quadrant.

- On the Box pattern, the aircraft is flown on cardinal headings around the suspected center. The track resembles three sides of a square.

- On the Delta pattern, the aircraft is flown on a cardinal heading to pass 60 nm from the forecasted center. After observing a wind shift (second quadrant) the aircraft is turned to pass through the center until winds from the opposite direction occur (third quadrant). Finally, the aircraft is turned on a cardinal heading (parallel to the initial heading) to pick up the fourth quadrant winds. If data indicate that the aircraft is far north of any existing circulation, the pattern is extended as shown by the dashed lines.

[NOTE: The depicted pattern may be converted to a mirror image if entry is made from a different direction.]

5.8.3. Synoptic Surveillance Missions. A synoptic surveillance mission is tasked to measure the large-scale wind and thermodynamic fields within approximately 800 nautical miles of tropical cyclones. Specific flight tracks will vary depending on storm location and synoptic situation, and multiple aircraft may be required to satisfy surveillance mission requirements.

5.8.4. Eyewall and Outer-Wind Field Sampling Modules. These are patterns of dropwindsonde releases designed to measure the maximum surface wind, as well as the extent of hurricane and tropical storm force surface winds. They are meant to be flown using the operational alpha pattern. Dropwindsonde releases in these modules are in addition to any other releases required by paragraph 5.4.5.4.

5.8.4.1. Eyewall Module. While executing a standard alpha pattern to satisfy a fix requirement, one sounding will be taken during each inbound and outbound passage through the eyewall (except as noted below), for a total of four soundings. The releases should be made at or just inward (within 1-2 km) of the flight-level radius of maximum wind (RMW). If the radar presentation is suitable, the inner edge of the radar eyewall may be used to identify the release point. If possible, and when resources and safety permit, two dropwindsondes, spaced less than 30 seconds apart, should be deployed on the inbound leg on the side of the storm believed to have the highest surface winds (normally the right-hand side). In this case, the outer of the two releases should be made at the RMW, with the second release following as soon as possible. Typically, the eyewall module will be tasked within 48 hours of a forecasted hurricane landfall.

5.8.4.2 Outer-Wind Field Module. On an alpha pattern, deploy dropwindsondes at 50 nm intervals from the center on each of two successive inbound and outbound legs, outward to 200 nm. A release should also be made at the midpoint of the cross (downwind) leg, for a total of 17 soundings. The length of the legs and the sounding interval may be adjusted, depending on the size of the storm.

5.9. Aircraft Reconnaissance Communications.

5.9.1. General. The 53 WRS WC-130 and NOAA WP-3D aircraft will normally transmit reconnaissance observations via the Air Force Satellite Communications System (AFSATCOM), Aircraft-to-Satellite Data Link, or high frequency (HF) radio phone patch. The NOAA G-IV will normally transmit WMO Temp Drop messages via INMARSAT commercial SATCOM. Flight meteorologists should contact CARCAH following the first fix, and periodically throughout the mission.

5.9.2. Air-to-Ground Communications (HF Radio). The weather reconnaissance crew may relay weather data via direct telephone patch to the weather data monitor. Monitors will evaluate these reports and disseminate them through the Air Force's Automated Weather Network (AWN) or to the weather communications facility at Suitland, Maryland. When requested, aeronautical stations will provide a discrete frequency for mission use, if possible. Specific radio procedures and terminology will comply with Allied Communications Publication 125, Standard Telephone and Radio Procedures. The use of IMMEDIATE precedence for transmission of hurricane reconnaissance data is authorized because of the perishable nature and potential operational impact of weather data. Data will be routed by direct phone patch between the aircraft and CARCAH.

5.9.3. Air-to-Air Communications. When more than one aircraft is known to be operating in a particular area of interest, the following frequencies will be used for airplane-to-airplane communications and coordination unless otherwise directed by air traffic control:

- Primary: VHF 123.05 MHz.
- Secondary: UHF 304.8 MHz.
- Back-up: HF 4701 KHz USB.

5.9.4. Aircraft-to-Satellite Data Link (ASDL) Equipped Aircraft. Aircraft equipped with ASDL have the option to utilize the ASDL system. Figure 5-12 depicts these communication links.

5.9.4.1. Data Transmission Test. Prior to the beginning of the hurricane season, each ASDL-equipped aircraft will perform a ground or airborne test of the equipment and data ground handling procedures to determine the equipment reliability, transmission errors, and time lapse between transmission of the data from the aircraft and receipt of the data by the hurricane forecaster. Test data will be forwarded to the Chairman, Working Group for Hurricane and Winter Storms Operations and Research.

5.9.5. Improved Weather Reconnaissance System (IWRS)-Equipped Aircraft. The AFRC aircraft equipped with IWRS will use the SATCOM data link with ground stations at TPC/NHC and at Keesler AFB, MS, to relay data to the TPC/NHC and the AWN. Figure 5-13 depicts these communication links.

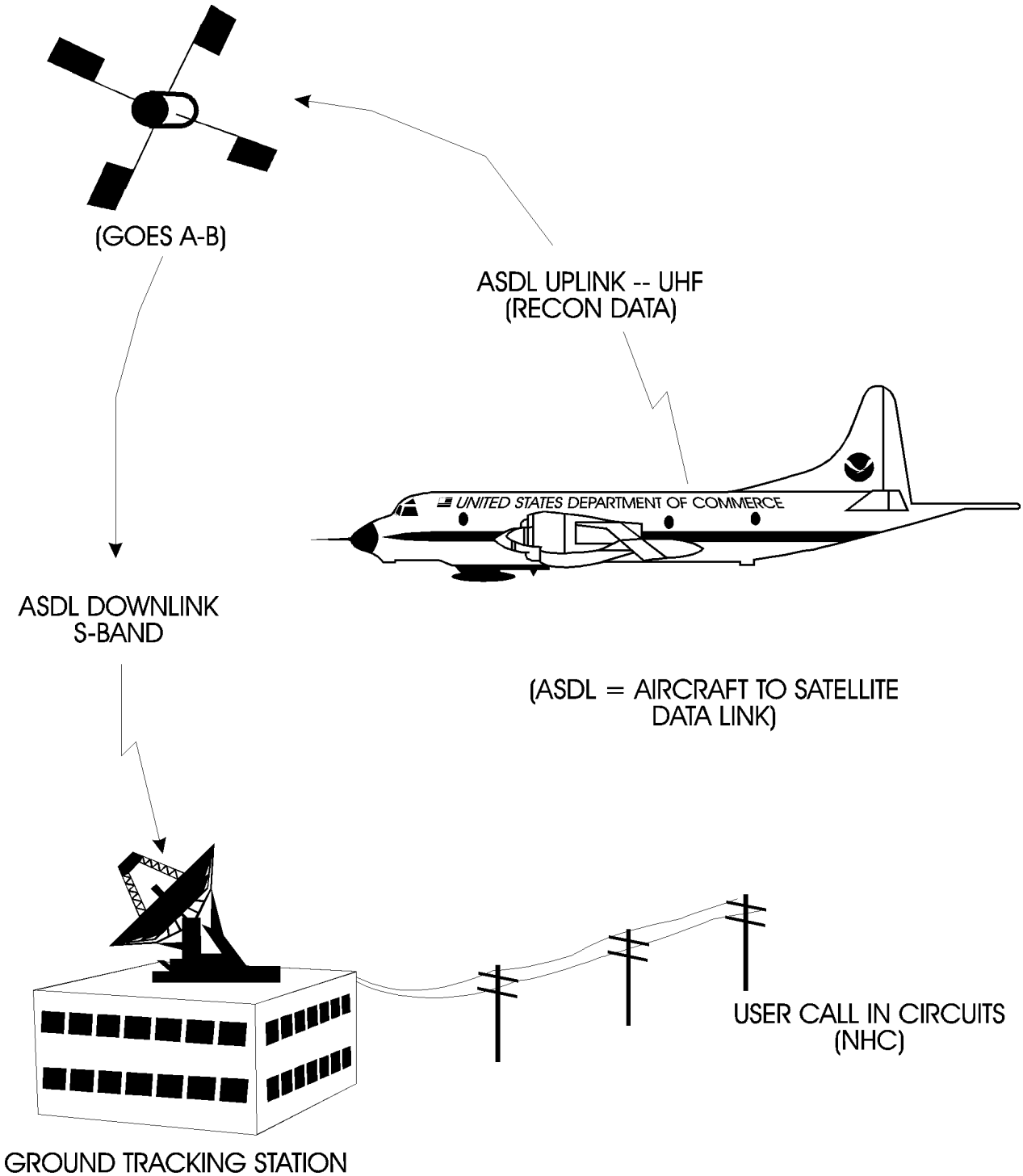

Figure 5-12. Schematic of aircraft-to-satellite data link for NOAA P-3 aircraft

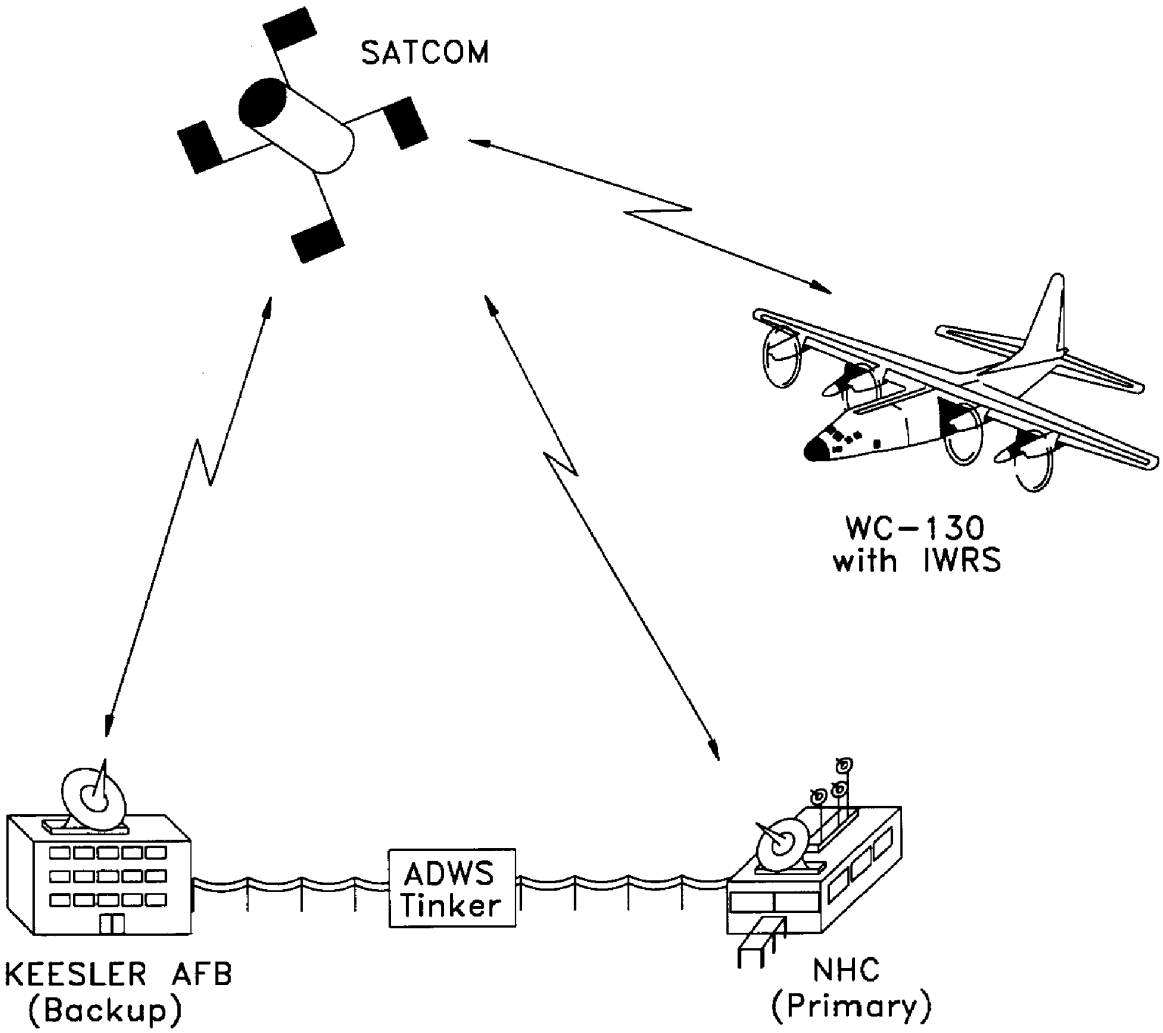

Figure 5-13. Schematic of aircraft-to-satellite data link for AFRC WC-130 aircraft