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. Requirements exceeding five sorties will be accomplished on a "resources-permitting" basis. 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:

5.2.1.1. Providing operational aircraft for vortex fixes and data, synoptic surveillance missions, and investigative flights in response to DOC needs (see Figure 5-1).

5.2.1.2. 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:

5.2.2.1. Provide synoptic surveillance soundings (see Figure 5-2).

5.2.2.2. Augment AFRC aircraft reconnaissance when DOC needs exceed the capabilities of DOD resources (see Figure 5-2).

5.2.2.3. Assume responsibility for hurricane reconnaissance over foreign airspace that may be restricted for military operations.

5.2.2.4. Conduct research flights.

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. Procedures

for the expeditious handling of reconnaissance aircraft are documented in chapter 6, Airspace Operations.

Figure 5-1. WC-130J Weather Reconnaissance Aircraft

Figure 5-2. NOAA G-IV and WP-3D Weather Surveillance/Hurricane Aircraft

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. Reconnaissance Requirements.

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, 850 hPa, or 700 hPa height.
- Minimum 700, 850 or 925 hPa height, if available.
- Wind data (continuous observations along the flight track) for surface and flight level.
- SFMR surface wind.
- High density three-dimensional Doppler radial velocities of the tropical cyclone core circulation.
- Temperature at flight level.
- SFMR rain rate.
- 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 lºC.
- Flight level: within lºC.

5.4.2.6. Dew-Point Temperature.

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

5.4.2.7. Absolute Altitude: Within 10 m.

5.4.2.8. Vertical Sounding.

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

5.4.2.9. Core Doppler Radar.

- Horizontal resolution along aircraft track: 1.5 km
- Radar beam width: 3 degrees.
- Radar radial resolution (gate length): 150 m.
- Error in radar radial velocity: 1 m/s.
- Range: 50 km.

[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 UTC time, aircraft latitude, longitude, static pressure, geopotential height, extrapolated sea level pressure or D-Value, air temperature, dew point temperature, flight-level (FL) wind direction, FL wind speed, peak 10-second (10-s) average FL wind speed, peak 10-s average surface wind speed from the stepped frequency microwave radiometer (SFMR), SFMR-derived rain rate, and quality control flags. Except for the peak values noted above, all data provided in HDOB messages are 30-second averages, regardless of the interval at which the HDOB messages are reported. See Appendix G for HDOB message formats. 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 immediately contact Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) to determine data requirements for the remainder of the mission.

5.4.4. Synoptic Surveillance Data Requirements. When required, NHC will request sounding data on the periphery of systems approaching the United States. NHC will provide specific tracks including control points, control times and dropwindsonde frequency allocations to CARCAH for coordination with the reconnaissance units.

5.4.5. Core Doppler Radar Requirements. When required, NHC and the Environmental Modeling Center (EMC) will coordinate to request high-density three-dimensional Doppler radial velocities in the tropical cyclone core for potential storms impacting the United States, including Puerto Rico and the Virgin Islands. EMC, NHC, and HRD will coordinate to provide specific flight plans to CARCAH for coordination with the reconnaissance units.

5.4.6. Required Frequency and Content of Observations. Observation requirements are summarized in Table 5-1. Deviations to these requirements will be coordinated through CARCAH. The Vortex message format and information are shown in Figure 5-3, Figure 5-4, and Table 5-2. Other data message formats and code breakdowns can be found in Appendix G.

Table 5-1. Requirements for Aircraft Reconnaissance Data

	RECCO Section 1 plus 4ddff and 9VTTT as applicable	Vortex Data Message (VDM)	Vertical Data WMO Temp Drop Code (FM37-VII)	High Density Observation (HDOB)
En route	Approx. every 30 minutes over water not to exceed 200 nm	NA	Approx every 400 nm over water, or fewer/relocated per request or sonde conservation	30-sec interval
Invest area	At major turn turnpoints. Also, every 15 minutes if HDOBs are INOP.	After closing a circulation	NA	30-sec interval
Fix pattern	End points of Alpha pattern legs. When necessary with radar fix information.	Each fix.	Each tasked fix at or above 850 mb. Intermediate fixes and eyewall modules as requested.	30-sec interval

5.4.7. WP-3D Configuration. The minimum operational configuration of the WP-3D will include the stepped frequency microwave radiometer (SFMR), Doppler radar and the advanced vertical atmospheric profiling system (AVAPS).

5.5. Reconnaissance Planning and Flight Notification.

5.5.1. DOC Requests for Aircraft Reconnaissance Data.

5.5.1.1. Coordination. Any agency requesting aircraft reconnaissance (e.g., the NWS Environmental Modeling Center (EMC), the Central Pacific Hurricane Center (CPHC)) should contact the National Hurricane Center (NHC) no later than 1630 UTC the day prior to the requirement, and within the constraints of paragraph 5.5.2.1. NHC will compile the 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 considered the agency's request for assistance (RFA) to DOD and will be provided to CARCAH as soon as possible, but no later than 1630 UTC each day in the format of Figure 5-5.

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

DATE	SCHEDULED FIX TIME	AIRCRAFT NUMBER	ARWO
WX MISSION IDENTIFICATION	STORM NUMBER IDENTIFIER		OB
VORTEX DATA MESSAGE			
A		DATE AND TIME OF FIX	
B	DEG MIN N S	LATITUDE OF VORTEX FIX	
	DEG MIN E W	LONGITUDE OF VORTEX FIX	
C		MINIMUM HEIGHT AT STANDARD LEVEL	
D		ESTIMATE OF MAXIMUM SURFACE WIND OBSERVED	
E		BEARING AND RANGE FROM CENTER OF MAXIMUM SURFACE WIND	
F		MAXIMUM FLIGHT LEVEL WIND NEAR CENTER	
G		BEARING AND RANGE FROM CENTER OF MAXIMUM FLIGHT LEVEL WIND	
H		MINIMUM SEA LEVEL PRESSURE COMPUTED FROM DROPSONDE OR EXTRAPOLATED FROM FLIGHT LEVEL. IF EXTRAPOLATED, CLARIFY IN REMARKS.	
I		MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE OUTSIDE EYE	
J		MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE INSIDE EYE	
K		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		NAVIGATION FIX ACCURACY/METEOROLOGICAL ACCURACY	
P	REMARKS MAX FL WIND_____KT_____QUAD_____Z MAX OUTBOUND FL WIND_____KT_____QUAD_____Z SLP EXTRAP FROM (Below 1500 FT/ 925 MB/ 850 MB/ DROPSONDE) SFC CNTR_____/_____NM FROM FL CNTR MAX FL TEMP _____C_____/_____NM FROM FL CNTR SURFACE WIND OBSERVED VISUALLY		
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.			

Figure 5-3. Vortex Data Message Worksheet

Table 5-2. Vortex Data Message Entry Explanation

DATA ITEM	ENTRY
Mission Identifier	As determined in Chapter 5, paragraph 5.7.6.
Storm Identifier	As determined in Chapter 4, paragraph 4.3.3.
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 FL center in Remarks; 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. When SFMR surface wind data are unavailable, the surface wind is determined visually.
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. All winds reported should be 10-s averages.
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.

Table 5-2 (continued). Vortex Data Message Entry Explanation

DATA ITEM	ENTRY
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 Remarks, 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 temperatures are collected at the same location as the maximum temperature reported in item JULIET. Enter NA if not observed.
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. Spiral band--report Item Juliet with the best approximation of the shape and diameter of the inner core.
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 maximum flight-level wind observed on the outbound leg following the center fix just obtained, if it is higher than the inbound maximum reported in item F. Include time of observation and the relative quadrant of the storm of the qualifying outbound max wind. If, after the transmission of the vortex message but prior to the aircraft reaching the cross-leg turn point, a higher qualifying outbound wind is observed, then the vortex message will be amended with the higher outbound wind reported. If the outbound max FL wind becomes the new overall max FL wind, then consolidate the two max FL wind remarks into one remark; (4) the method of deriving the central SLP when extrapolated; and (5) the bearing and range of the surface center and/or maximum flight level temperature if not within 5 nm of the flight level center.

URNT12 KNHC 072030
VORTEX DATA MESSAGE AL092008
A. 07/20:09:20Z
B. 21 deg 01 min N
074 deg 26 min W
C. 700 mb 2624 m
D. 90 kt
E. 045 deg 13 nm
F. 147 deg 106 kt
G. 047 deg 016 nm
H. 945 mb
I. 10 C/ 3045 m
J. 16 C/ 3057 m
K. 13 C/ NA
L. CLOSED WALL
M. CO16-48
N. 12345/7
O. 0.02 / 1 nm
P. AF307 0909A IKE OB 11
MAX FL WIND 107 KT NW QUAD 18:21:10 Z

Figure 5-4. Example Vortex Data Message (VDM) for the 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	COORDINATES	FLIGHT PATTERN	FCST MVMT	NHC PRIORITY

GULF STREAM _____

SUCCEEDING DAY OUTLOOK _____

_____

REMARKS _____

_____

II. PACIFIC REQUIREMENTS

STORM NAME DEPRESSION # SUSPECT AREA	FIX OR ON STATION TIME	COORDINATES	FLIGHT PATTERN	FCST MVMT	NHC PRIORITY

SUCCEEDING DAY OUTLOOK _____

_____

REMARKS _____

_____

III. DISTRIBUTION

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

B. Date _____ Time _____ FCSTR INITIAL _____

C. 53 WRS _____ AOC _____ Other _____

Figure 5-5. NHOP Coordinated Request for Aircraft Reconnaissance

TROPICAL CYCLONE PLAN OF THE DAY FORMAT

ATLANTIC AND CENTRAL PACIFIC OCEANS

NOUS42 KNHC _____ (DATE/UTC TIME)

WEATHER RECONNAISSANCE FLIGHTS

CARCAH, NATIONAL HURRICANE CENTER, MIAMI, FL

_____ (LOCAL TIME) ___ (TIME ZONE) ___ (DAY) ___ (MONTH/DATE), ____ (YEAR)

SUBJECT: THE TROPICAL CYCLONE PLAN OF THE DAY (TCPOD)

VALID _____Z (MONTH) TO _____Z (MONTH) (YEAR)

TCPOD NUMBER.....(YR)- _____

I. ATLANTIC REQUIREMENTS

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

   FLIGHT ONE (NHC PRIORITY, if applicable)

   TEAL or NOAA _____ (number)

   A. _____Z FIX/INVEST TIME

   B. _____ MISSION IDENTIFIER

   C. _____Z DEPARTURE TIME

   D. _____ FORECAST POSITION

   E. _____Z TIME ON STATION

   F. _____ ALTITUDE(S) ON STATION

   G. _____ 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. PACIFIC REQUIREMENTS (Same as in ATLANTIC)

Figure 5-6. Tropical Cyclone Plan of the Day Format

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

5.5.1.3.1. 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 55ºW in the Atlantic, and resources permitting, up to 52.5W.
- 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.
- Up to two synoptic surveillance missions per 24-hour period for potentially land-falling storms.

5.5.1.3.2. In the Eastern Pacific, reconnaissance missions may be tasked when necessary to carry out warning responsibilities.

5.5.1.3.3. 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.

5.5.1.3.4. Exceptions may be made when additional reconnaissance is essential to carry out warning responsibilities.

5.5.2. DOD and DOC Reconnaissance Aircraft Responsiveness.

5.5.2.1. Requirement Notification. Notification of requirements must proceed 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 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 NHC and CPHC directors have authority to declare an emergency.

5.5.2.5. NOAA WP-3D Availability. At least one WP-3D will be operationally configured (per paragraph 5.4.7) and available to respond to requirements within 24 hours from June 1 through November 30 annually. A second WP-3D with the same operational configuration will be available each hurricane season from July 15 to September 30. When maintenance and programmatic considerations permit, the second aircraft could be made available until November 30 also. The frequency of flights when two aircraft are available and with present staffing shall be every 12 hours.

5.5.3. Reconnaissance Tropical Cyclone Plan of the Day.

5.5.3.1. Preparation. CARCAH will coordinate the TCPOD (Figure 5-6) 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.

5.5.3.1.1. CARCAH will coordinate the TCPOD with NHC, the 53 WRS, and NOAA AOC before publication.

5.5.3.1.1.1. The coordinated TCPOD is the agency's RFA to DOD. Since DOD's support to NOAA is congressionally mandated and funded through the DOD Appropriations Act, the coordinated TCPOD is considered a validated and approved RFA.

5.5.3.1.1.2. Combatant command headquarters and their air component command headquarters will coordinate on missions by reviewing the proposed TCPOD posted at http://www.nhc.noaa.gov/reconlist.shtml, then click 'For Tomorrow' under 'Plan of the Day.'

5.5.3.1.1.3. Combatant command headquarters and their air component command headquarters will pull current DOD missions from http://www.nhc.noaa.gov/reconlist.shtml, then click 'For Today' under 'Plan of the Day.' Additionally, the 403rd Current Operations provides a mission setup sheet with reason of deviation from TCPOD, as required, to the combatant command and their air component operations/command centers.

5.5.3.1.2. The TCPOD will list all DOC/NOAA AOC and DOD required tropical and subtropical cyclone operational reconnaissance missions. Research missions will also be listed in the TCPOD when available by transmission time.

5.5.3.1.3. 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, which 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 1830 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 AWIPS users and "NOUS42 KNHC" for AWDS users. The TCPOD can be accessed via the Internet at the National Hurricane Center homepage at www.nhc.noaa.gov, then click on 'Aircraft Reconnaissance' and then on 'Plan of the Day.']

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 no earlier than 1 hour before nor later than ½ 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 ½ 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, the absence of a fixable center, 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 the 250 nm of the specific coordinates by the scheduled time plus 2 hours or is unable to provide meaningful data.

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/OPC deadline for synoptic analysis.
- MISSED. When the requirements listed above are not satisfied.

5.6.2. Mission Assessment. The NHC or CPHC will provide CARCAH a written assessment of the reconnaissance mission anytime its timeliness or quality is outstanding or substandard (see Figure 5-7). 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 requirements tasked by NHC and CPHC and missions accomplished.

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 fixes, using all observed vortex fix information, each time the aircraft penetrates the center.

5.7.2. Aircraft Radar 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. Radar fixes may be reported in a vortex data message using available observed information or as a remark appended to a RECCO observation taken at fix time. The remark stating the type of radar fix and quality of the radar presentation is in accordance with chapter 8, paragraph 8.3.2. Two examples follow:

Example 1: RADAR FIX PSBL CENTER 21.5N 83.0W, POOR RADAR PRESENTATION, SPIRAL BAND, MET ACCURACY 15NM

Example 2: RADAR FIX EYE 21 DEG 23 MIN N 78 DEG 42 MIN W GOOD RADAR PRESENTATION CIRCULAR EYE DIAM 25 NM OPEN SW.

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.

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. Table 5-3 summarizes elements of the mission identifier.

5.7.7. Storm Identifier <Storm ID>. To facilitate the automatic ingest into the NHC, CPHC, and DOD tropical cyclone forecast computing systems, the storm identifier will be added 3 spaces after the Vortex Data Message title (see Figure 5-4) in the following format: **Vortex Data Message BBCCYYYY**. For the definition of BBCCYYYY, see Chapter 4, paragraph 4.3.3.

5.7.8. Observation Numbering and Content. Air Force aircraft movement information (i.e., departure time and location, and ETA's to locations) will not be included in observation remarks. That information should be passed to CARCAH via SATCOM administrative messages. The mission identifier will be the first mandatory remark followed by the observation number. All observations (RECCO, vortex, dropsonde) from the first to the last will be numbered sequentially. HDOBs will be automatically numbered sequentially but separately from other observations. When an aircraft is diverted from its original mission to fulfill NHC requirements, conclude the original mission by using the last report remark.

The next observation from the diverted aircraft will use the CARCAH-assigned mission identifier, will be numbered OB 01, and will include the time of diversion.

-EXAMPLE-

RMK AF306 0lBBA INVEST OB 01 DPTD AF306 WXWXA AT 05/1235Z

MISSION EVALUATION FORM

MEMORANDUM FOR: OL-A, 53 WRS/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 5-7. Mission Evaluation Form

Table 5-3. Elements of the Mission Identifier

AGENCY/ AIRCRAFT	Mission Storm System Indicator			
Agency + Aircraft Number[1][2]	Sequential number of mission in this storm	Two-digit depression number or two letter identifier if not a depression or greater[3]	Location A, E, C, or W[4]	Storm name or mission type (i.e., CYCLONE or INVEST
-EXAMPLES-				
AF306 0201C CYCLONE	USAF aircraft 5306 on the second mission for Tropical or Subtropical Depression One in the Central Pacific. Mission type can be fix or surveillance, as specified in the TCPOD.			
AF307 0403E CARLOS	USAF aircraft 5307 on the fourth mission for the third classified tropical or subtropical system that formed in the Eastern Pacific and acquired the name Carlos.			
NOAA2 01BBA INVEST	NOAA aircraft 42RF on the first mission to investigate the second unclassified suspect area in the Atlantic, Gulf of Mexico, or Caribbean.			
NOAA9 WAWXA AL92	NOAA aircraft N49RF on the first flight of a sequence of non-tasked research missions into Atlantic suspect area AL92.			
NOAA3 WF13A KARL	NOAA aircraft N43RF on the sixth flight of a sequence of non-tasked research missions into the system that developed from suspect area AL92 into the thirteenth tropical or subtropical cyclone in the Atlantic Basin and acquired the name Karl.			

5.7.9 Corrections to Observations. A correction indicator should be appended to the WMO abbreviated header after the date/time group and to any lines containing the mission identifier and observation number within corrected aircraft messages. This includes the first remark line in a RECCO, Item P in a vortex data, each of the 61616 lines in a sonde TEMP DROP code, and the second line in an HDOB data message. The first corrected message will have an indicator of CCA; subsequent corrections will have indicators of CCB, CCC, etc. Examples of corrected observations are in Table 5-4 below:

[1] AF plus last 3 digits of tail number
[2] NOAA, plus last digit of aircraft registration number
[3] The letters CC should not be used in an invest identifier
[4] A=Atlantic, Caribbean, or Gulf of Mexico; E=Eastern Pacific; C=Central Pacific; W=Western Pacific

Table 5-4. Examples of Corrected Observations

EXAMPLES	
URNT11 KNHC 111629 CCA 97779 16264 51286 90000 30400 09054 11071 /3136 40545 RMK AF303 2709A IKE OB 01 CCA	Correction for RECCO message OB 01 from the AF303 02709A IKE mission.
URNT12 KNHC 130552 CCB VORTEX DATA MESSAGE AL092008 A. 13/04:47:20Z B. 28 deg 52 min N 094 deg 37 min W . . . P. AF301 3509A IKE OB 02 CCB MAX FL WIND 103 KT NE QUAD 04:30:40 Z CORRECTED FOR TIME IN ITEM A	Second correction for vortex data message OB 02 from the AF301 3509A IKE mission.
UZNT13 KWBC 080739 CCA XXAA 58062 99300 70760 11606 99/// ///// ///// 00956 25616 09512 . . . 61616 NOAA9 1109A IKE OB 03 CCA 62626 0629 LST WND 894 AEV 20704 CORRECTED RPT DLM WND 08509 0071 82 = XXBB 58068 99300 70760 11606 00/// ///// 11007 26217 22977 24010 . . . 61616 NOAA9 1109A IKE OB 03 CCA 62626 0629 LST WND 894 AEV 20704 CORRECTED RPT DLM WND 08509 0071 82 =	Correction for sonde TEMP DROP code message OB 03 from the NOAA9 1109A IKE mission.

5.8. Operational Flight Patterns. 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 5-8. 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.

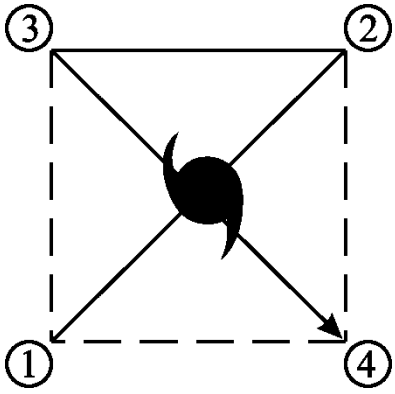

Figure 5-8. Flight Pattern ALPHA

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 850 hPa or above. The dropsonde will be released at the flight-level center coordinates (item BRAVO of the vortex data message). For fixes when dropsonde-measured SLP is not available, an extrapolated SLP will be computed and reported.

5.8.2. Investigative Missions. An investigative mission is tasked on tropical or subtropical 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 5-9. Turns are usually made to take advantage of tailwinds whenever possible. Note: The depicted pattern may be converted to a mirror image if entry is made from a different direction.

- 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.

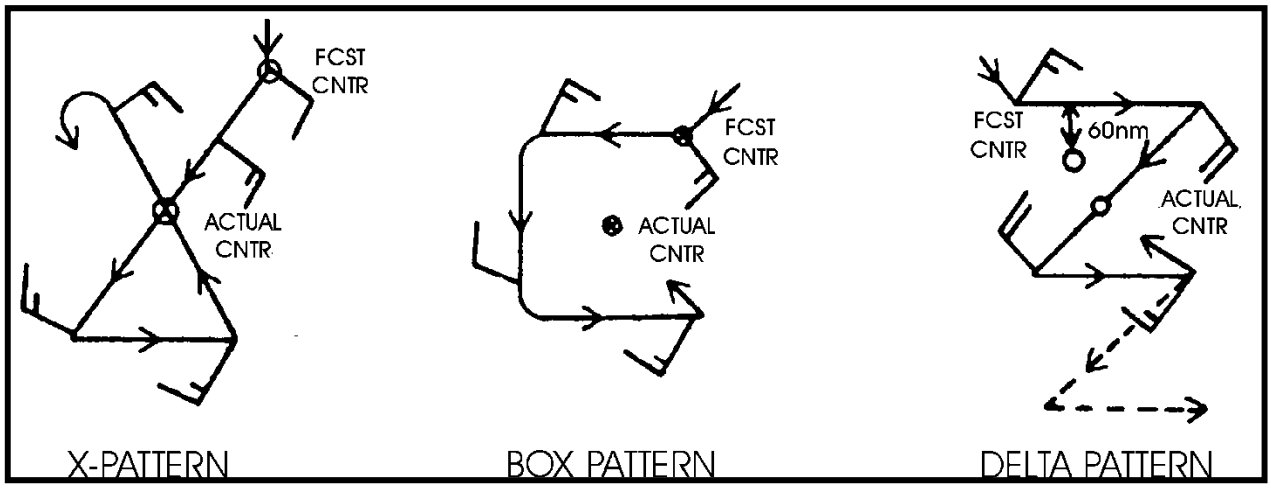

Figure 5-9. Suggested Patterns for Investigative Missions

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 Table 5-1.

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 19 soundings, including center drops. 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) or commercial SATCOM. Figures 5-10 and 5-11 depict the ASDL and AFSATCOM communications links. The NOAA G-IV will normally transmit WMO Temp Drop messages via commercial SATCOM. Flight meteorologists should contact CARCAH following the first fix, and periodically throughout the mission.

5.9.2. Backup Air-to-Ground Communications. The weather reconnaissance crew may relay weather data via SATPHONE or HF phone 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. Specific radio procedures and terminology will comply with Allied Communications Publication 125, Standard Telephone and Radio Procedures.

5.9.3. Aircraft-to-Satellite Data Link (ASDL)-Equipped Aircraft. Aircraft equipped with ASDL have the option to utilize the ASDL system. 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 Chair, Working Group for Hurricane and Winter Storms Operations and Research.

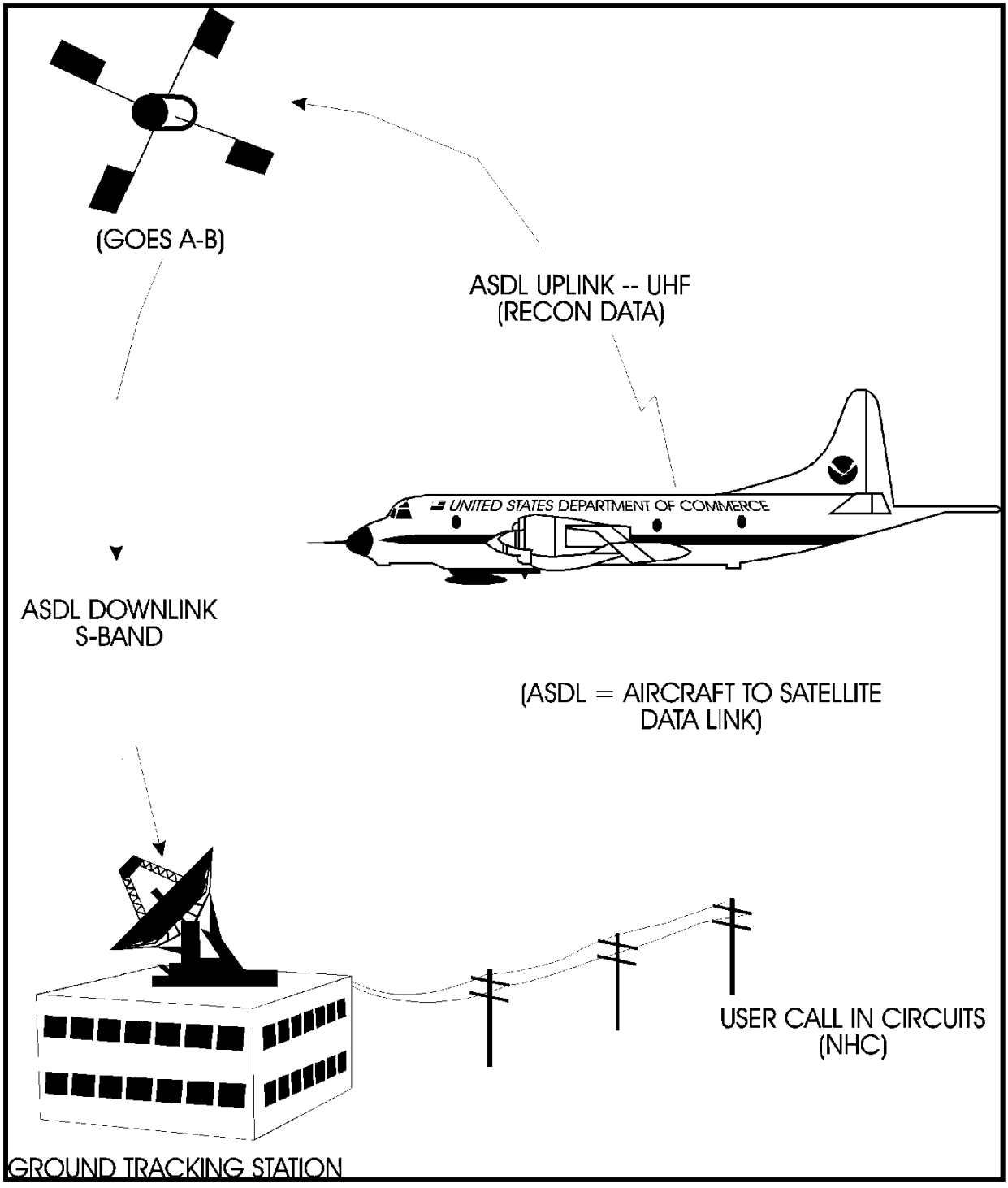

Figure 5-10. Schematic of Aircraft-To-Satellite Data Link for NOAA P-3 Aircraft

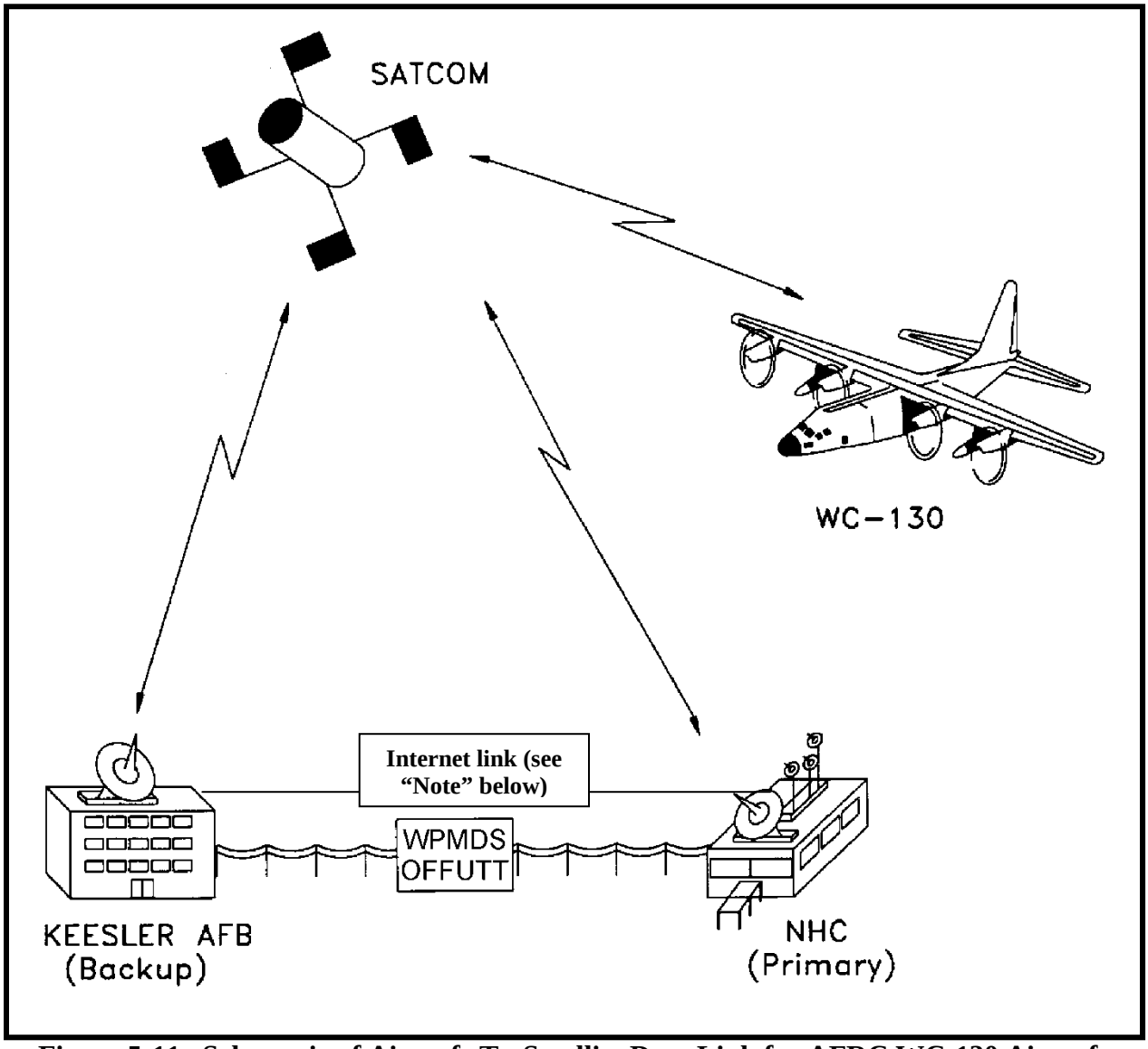

Figure 5-11. Schematic of Aircraft-To-Satellite Data Link for AFRC WC-130 Aircraft

[Note: An Internet link from Keesler AFB to NHC provides the capability for all observation types to be passed directly to NHC without going through Offutt Air Force Base.]

5.9.4. Backup CARCAH Procedures. Satellite ground stations, which are used to receive and process data from AFRC reconnaissance aircraft, are installed at CARCAH (located within NHC) and the 53 WRS (located at Keesler Air Force Base). The 53 WRS ground station has a similar configuration and communications capability as the satellite ground station installed a CARCAH, except that the CARCAH ground station has additional capability to stream data using serial RS-232 communications to NHC local servers. The ground station at the 53 WRS can fully transmit data using SATCOM and land line to the CARCAH ground station. Both ground stations can send data to AFWA's Weather Product Management and Distribution System (WPMDS)—WPMDS then relays all AFRC/53 WRS reconnaissance data to the NWS Gateway for world-wide distribution. In the event that backup procedures are required due to severe communications failures, severe weather conditions, or other extreme events affecting NHC, some or all CARCAH responsibilities will be transferred to the 53 WRS, ensuring reconnaissance service is uninterrupted.

5.9.4.1. Satellite Antenna Communications Failure at NHC. If an outage is expected to be temporary, CARCAH will coordinate with the 53 WRS to have operators man the ground station located at the backup site. They will be responsible for maintaining contact with airborne reconnaissance aircraft and relaying data via land line to the CARCAH ground station. In the event communications lines between the backup site and NHC are also severed, the 53 WRS ground station will be configured to transmit data directly to the WPMDS. No procedure is currently implemented for sending the aircraft data directly to local servers at HPC or CPHC (NHC's COOP backup site); consequently, all data or observations will need to be accessed from the WPMDS or obtained from the NWS Gateway.

For long-term outages, CARCAH will send personnel to the backup site. They will monitor the aircraft data and ensure they are transmitted to the WPMDS, NWS servers, and external users from that location.

5.9.4.2. Internet Communications Failure. In the event there is a long-term network communications outage between NHC and AFWA, the CARCAH ground station will still be able to receive aircraft data and send them to local NHC servers. If Internet access problems originate at NHC, the CARCAH ground station will be configured to relay the data to the backup site ground station via SATCOM. The 53 WRS ground station will in turn be configured to automatically transmit them to the AFWA WPMDS server. However, if the Internet disruptions occur at AFWA, no data can be sent to the AWN, NWS servers, and external users until service is restored.

5.9.4.3. NHC Emergency Backup Plan. In the event NHC activates the HPC or CPHC COOP backup plan, designated CARCAH personnel will deploy to the backup site to operate the 53 WRS ground station. The reconnaissance data will be obtained at the HPC COOP site either through the WPMDS or the NWS Gateway.