SECTION V

INDIVIDUAL TROPICAL CYCLONE DATA

SECTION V

INDIVIDUAL TYPHOON SUMMARIES

Each typhoon will be treated individually. This consists of the life history and characteristics; the Reconnaissance Aircraft Fix data; the Position and Forecast Verification data; and three charts showing Best Track, 12 and 24 hour Verification data.

The heading of the fifth column of each Reconnaissance Aircraft Fix tabulation is "*Unit, Method & Accy." The asterisk was inserted to call attention to the following explanation of the terms used. The first term designates the unit making the fix: "54," "55" or "56" —54th, 55th or 56th Weather Reconnaissance Squadron. "12"—12th Tactical Reconnaissance Squadron. "VW"--Navy early warning aircraft. The second term is the method used to make the fix: "P"--penetration, "R"--radar and "T"--triangulation. The third term is the estimated accuracy of the fix in miles. A double asterisk in Column 5 indicates the fix was made by land-based radar.

Attention is called to the Forecast Verification data. The table is read from left to right with the information corresponding to the date-time group. For example, see the table with Typhoon TILDA 15-1200Z. The 12 hour forecast error, from a forecast made 12 hours previous, is 62 miles on a bearing 300 degrees from the Best Track position 07.6N 146.6E. The 24 hour error made on a forecast 24 hours previous is 95 miles on a bearing of 305 degrees from the same Best Track position. On Typhoons TILDA, BILLIE and ELLEN, the forecasts from the first fix positions were not for a full 12 or 24 hours, and although shown on the charts, the errors were not tabulated.

A. TYPHOON TILDA (14-23 APRIL 1959)

Surface map analyses on 12 April 1959 showed a possible closed cyclonic circulation on the Intertropical Convergence Zone south of Truk. Subsequent analyses showed the center moving slowly westward, while surface reports indicated intensification. The 54th Weather Reconnaissance Squadron was requested to investigate the suspect area. A fix made at 140123Z confirmed the existence of surface winds of tropical storm intensity and positioned Tropical Storm TILDA at 5.5N-148.2E.

Tropical Storm TILDA moved northwestward at 7.5 knots to a position near 7.5N - 146.6E where her speed decreased to 3 knots. At the same time the winds increased to typhoon intensity, having been observed by reconnaissance aircraft to be 80 knots in the northeast quadrant. Twelve hours later Typhoon TILDA resumed a northwesterly movement, with two minor oscillations, at an approximate speed of 7 knots. At 190000Z she began a northerly curvature moving at a speed of 9 knots. At 201200Z, near a point 18.7N - 137.5E, TILDA became quasi-stationary for approximately 30 hours. At the same time intensity decreased, and she was downgraded to a tropical storm in the 121800Z warning. During this 30 hour period the typhoon was fixed 6 times by reconnaissance aircraft with all fixes falling inside a circle 30 miles in diameter. A weak col area aloft apparently provided no push or steering and TILDA drifted aimlessly, unable to cross the ridgeline to the north. Weak troughing to the west of TILDA became evident after 220000Z and the rapidly weakening tropical storm moved northward picking up speed as she moved into the westerlies north of 20 degrees.

TILDA rapidly became extra-tropical and a final warning was issued at 230000Z, with the last position 130 miles southwest of Iwo Jima.

Typhoon TILDA reached her greatest intensity 400 miles west of Guam with maximum surface winds of 130 knots. She followed seasonal climatology quite well with the exception of the quasi-stationary period. Thirty-seven warnings were issued covering a period of 10 days.

Typhoon TILDA spent her fury over the open ocean and no damage was recorded.

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON TILDA

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	140123Z	05.5N	148.2E	54-P-10	--	40	10050	38	--	--	----------
2	140732Z	06.3N	147.8E	54-P-10	--	60	9970	40	12	09	CIRC DIA 30 MI
3	142030Z	07.3N	146.6E	54-P-5	990	45	9920	55	10	07	ELLIP MAJ AXIS 10 MI
4	150200Z	07.4N	146.6E	54-P-7	--	50	9880	48	14	10	ELLIP MAJ AXIS 20 MI
5	150700Z	07.6N	146.6E	54-P-3	987	75	9800	60	14	09	CIRC DIA 30 MI
6	151400Z	08.4N	145.8E	54-R-10	--	--	--	50	--	--	ELLIP 30X25 MI
7	152030Z	08.8N	145.7E	54-P-5	--	75	9380	70	--	--	ELLIP 35X20 MI
8	160200Z	09.5N	145.2E	54-P-5	--	80	9110	50	19	--	CIRC DIA 20 MI
9	160640Z	09.7N	144.4E	VW-R—	--	--	--	--	--	--	----------
10	160800Z	09.8N	144.4E	54-P-5	--	100	8850	--	19	11	CIRC DIA 20 MI
11	161100Z	09.9N	143.9E	54-R—	--	--	--	--	--	--	----------
12	161400Z	09.9N	143.5E	54-P-10	--	--	--	70	--	--	CIRC DIA 20 MI
13	162030Z	10.3N	142.8E	54-P-5	--	--	8470	120	14	13	CIRC DIA 17 MI
14	170200Z	10.5N	142.3E	54-P-10	--	150	8360	135	16	14	CIRC DIA 20 MI
15	170800Z	10.7N	141.9E	54-P-5	--	120	8220	120	15	14	ELLIP 13X15 MI
16	171500Z	11.6N	141.1E	54-R-15	--	--	--	--	--	--	----------
17	172030Z	12.1N	140.5E	54-P-3	--	--	8080	130	17	12	CIRC DIA 10 MI
18	180100Z	12.2N	139.7E	54-P-3	--	150	8080	110	17	11	CIRC DIA 15 MI
19	180800Z	12.6N	139.0E	54-P-5	--	100	8190	110	16	16	CIRC DIA 10 MI
20	181400Z	12.8N	138.1E	54-T-15	--	--	--	--	--	--	----------
21	182030Z	13.5N	137.7E	54-P-1	--	--	8310	--	15	15	CIRC DIA 20 MI

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON TILDA (CONT'D)

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
22	190143Z	13.8N	137.7E	54-P-5	- -	160	8220	110	19	13	CIRC DIA 20 MI
23	190425Z	14.2N	137.2E	VW-R-10	- -	- -	- -	- -	- -	- -	
24	190800Z	14.7N	137.1E	54-P-5	- -	175	8080	125	19	15	CIRC DIA 20 MI
25	191400Z	15.8N	136.8E	54-R-20	- -	- -	- -	- -	- -	- -	
26	192030Z	16.5N	136.6E	54-P-5	- -	125	8510	- -	21	21	CIRC DIA 35 MI
27	201400Z	18.8N	137.5E	54-R-10	- -	- -	- -	- -	- -	- -	
28	202030Z	18.6N	137.0E	54-P-5	964	- -	9290	70	21	15	CIRC DIA 30 MI
29	210329Z	18.7N	137.5E	56-P-10	987	80	9750	60	18	12	CLDS IN EYE
30	210800Z	18.6N	137.6E	54-P-5	985	70	9750	- -	15	10	HORSESHOE SHAPE
31	211400Z	19.0N	137.4E	54-P-10	- -	- -	- -	- -	- -	- -	
32	212155Z	18.7N	137.1E	54-P-15	992	45	- -	47	23	23	CIRC DIA 30 MI
33	220208Z	19.7N	136.9E	54-P-10	993	- -	10080	40	- -	- -	CIRC DIA 30 MI
34	220520Z	20.5N	137.0E	54-P-10	996	70	10070	50	- -	- -	CIRC DIA 30 MI
35	222220Z	24.1N	139.2E	54-P-5	999	40	10080	40	- -	- -	EYE DIFFUSE

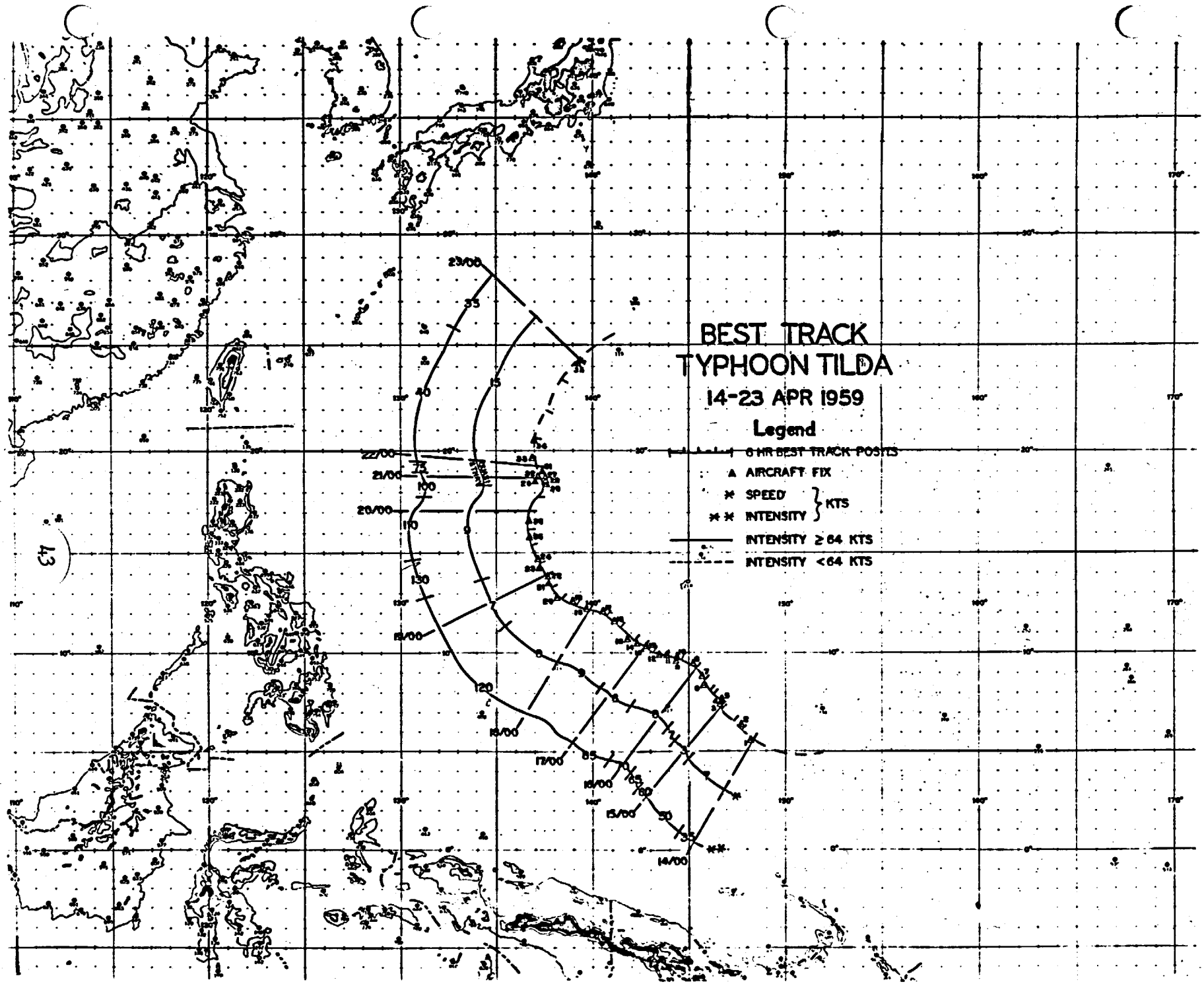
TYPHOON TILDA 14 APRIL - 23 APRIL 1959
POSITION AND FORECAST VERIFICATION DATA

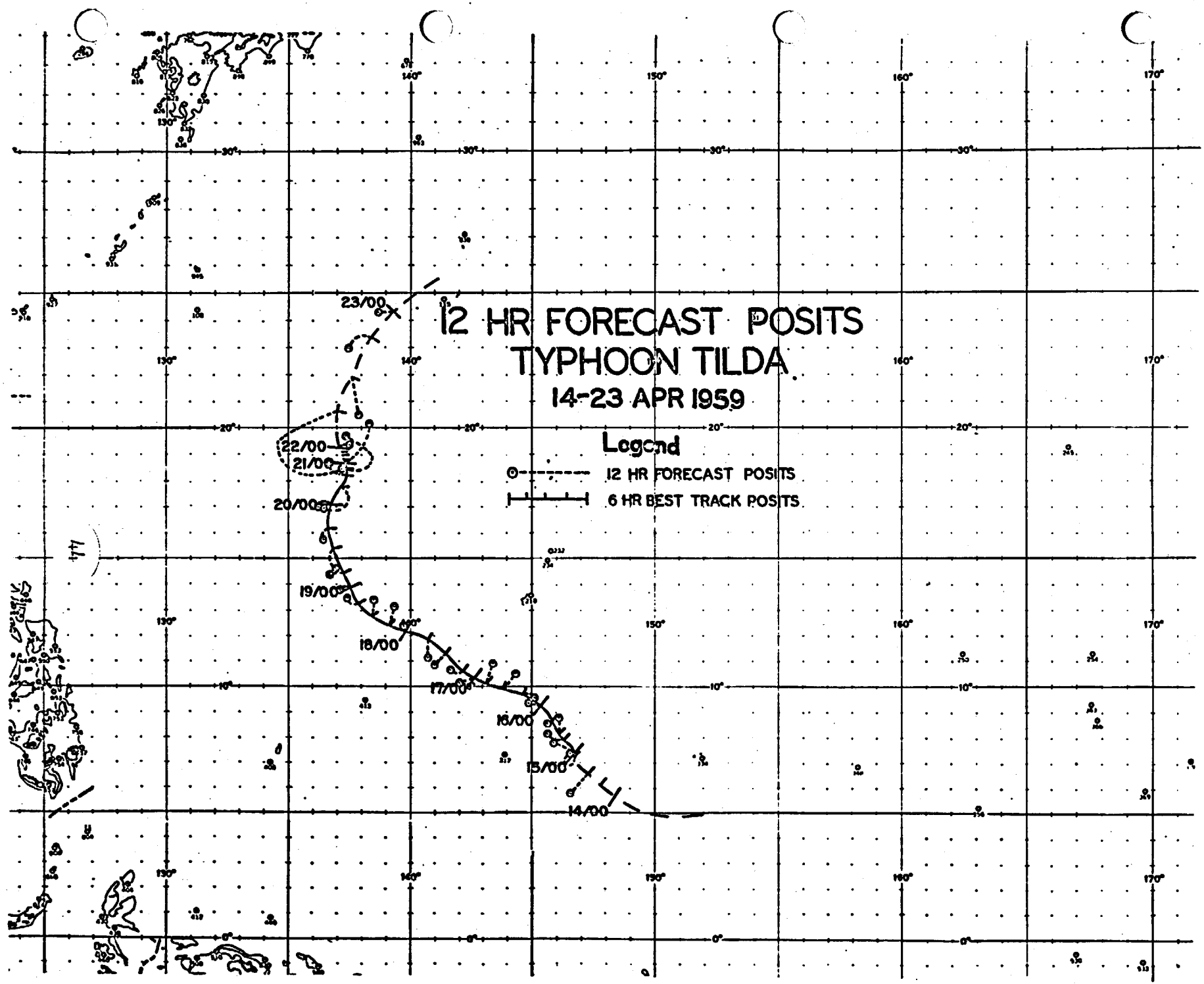
DTG	STORM POSITION LAT. LONG.	12 HR ERROR DEG. DISTANCE	24 HR ERROR DEG. DISTANCE
140000Z	05.6N 148.3E	- - - -	- - - -
140600Z	06.1N 147.8E	- - - -	- - - -
141200Z	06.5N 147.3E	- - - -	- - - -
141800Z	07.1N 146.7E	325 - 17	- - - -
150000Z	07.3N 146.6E	310 - 52	- - - -
150600Z	07.6N 146.6E	300 - 62	305 - 95
151200Z	08.1N 146.1E	180 - 17	300 - 110
151800Z	08.6N 145.8E	320 - 81	292 - 86
160000Z	09.3N 145.3E	280 - 26	168 - 58
160600Z	09.7N 144.6E	118 - 30	140 - 130
161200Z	09.9N 143.8E	042 - 50	006 - 45
161800Z	10.0N 143.2E	016 - 55	070 - 68
170000Z	10.3N 142.6E	256 - 36	030 - 90
170600Z	10.6N 142.1E	270 - 25	010 - 105
171200Z	11.3N 141.4E	225 - 37	230 - 100
171800Z	11.9N 140.7E	180 - 43	220 - 66
180000Z	12.2N 139.8E	360 - 06	208 - 65
180600Z	12.4N 139.1E	019 - 42	162 - 55
181200Z	12.8N 138.4E	358 - 30	332 - 31
181800Z	13.3N 137.9E	360 - 06	350 - 65
190000Z	13.9N 137.5E	250 - 23	320 - 42
190600Z	14.5N 137.2E	246 - 30	270 - 30
191200Z	15.3N 136.8E	162 - 38	254 - 60
191800Z	16.2N 136.6E	213 - 25	240 - 60
200000Z	17.1N 136.7E	266 - 20	192 - 85
200600Z	17.8N 137.1E	281 - 35	248 - 80
201200Z	18.6N 137.4E	278 - 37	270 - 28
201800Z	18.7N 137.3E	360 - 58	285 - 25
210000Z	18.7N 137.3E	033 - 97	014 - 110
210600Z	18.7N 137.3E	022 - 60	010 - 155
211200Z	18.7N 137.3E	028 - 85	040 - 212
211800Z	18.7N 137.3E	035 - 30	042 - 175

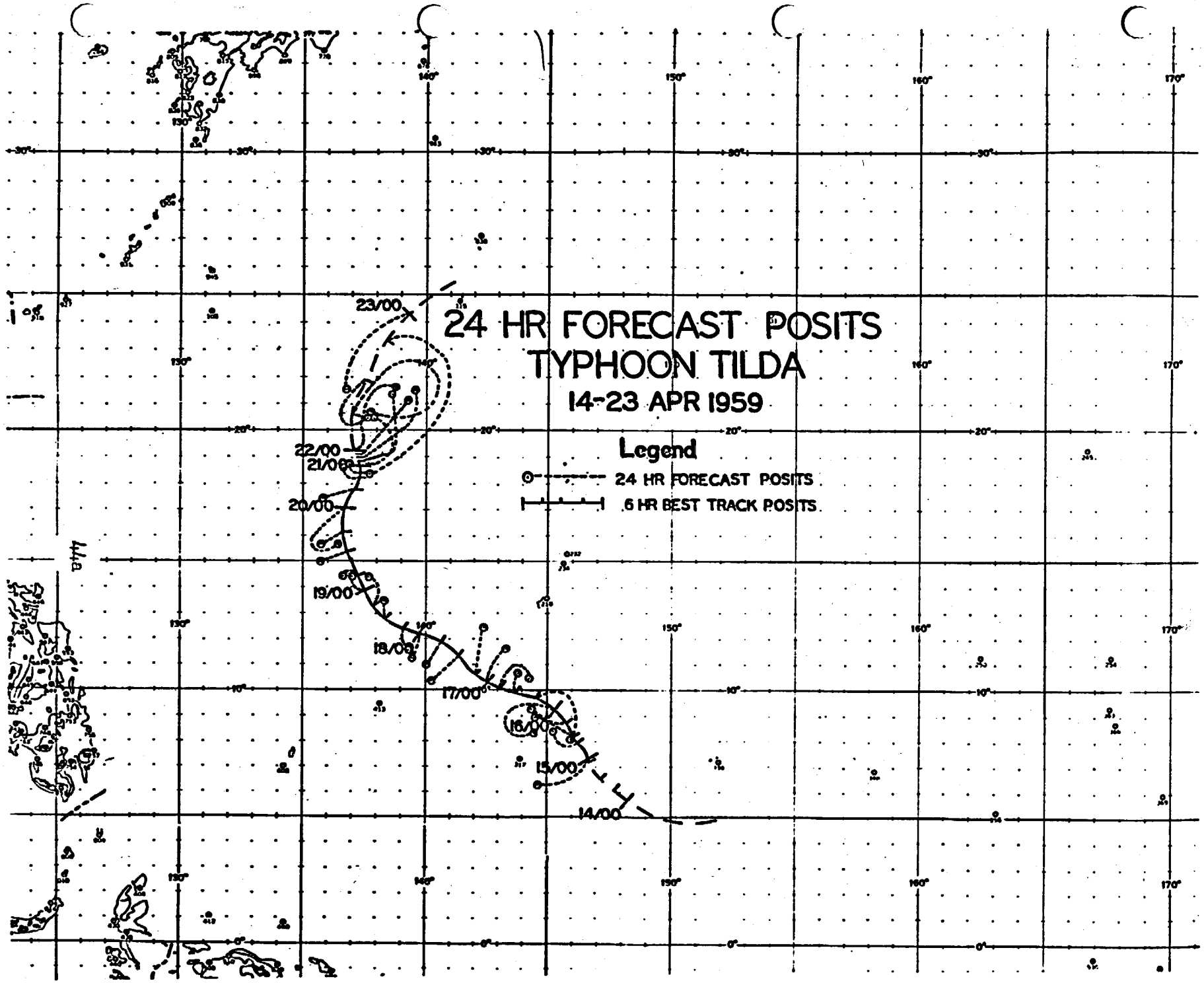
TYPHOON TILDA 14 APRIL - 23 APRIL 1959
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
220000Z	19.3N	137.1E	045	24	033	175
220600Z	20.7N	137.0E	172	130	295	45
221200Z	22.0N	137.6E	205	100	180	83
221800Z	23.3N	138.3E	248	50	188	275
230000Z	24.3N	139.3E	270	36	040	218

AVERAGE 12 HOUR FORECAST ERROR 43.9 NM
AVERAGE 24 HOUR FORECAST ERROR 94.6 NM


BEST TRACK
TYPHOON TILDA
14-23 APR 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY <64 KTS
23/00
22/00
21/00
20/00
19/00
18/00
17/00
16/00
15/00
14/00
43


12 HR FORECAST POSITS
TYPHOON TILDA
14-23 APR 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
23/00
22/00
21/00
20/00
19/00
18/00
17/00
16/00
15/00
14/00
130°
140°
150°
160°
170°
30°
20°
10°
0°


24 HR FORECAST POSITS
TYPHOON TILDA
14-23 APR 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
23/00
22/00
21/00
20/00
19/00
18/00
17/00
16/00
15/00
14/00

B. TYPHOON BILLIE (12-18 JULY 1959)

As early as 090000Z, a reconnaissance aircraft was dispatched to investigate a suspect area between the islands of Yap and Koror. However, it was not until 120000Z that a closed surface circulation was confirmed, and at that time a tropical depression warning was issued by JTWC. Within six hours Tropical Depression BILLIE reached tropical storm intensity and twenty-four hours later, at 130600Z, BILLIE was a full-blown typhoon with winds of 65 knots near the center.

From the beginning, BILLIE moved in a northwesterly direction at an average speed of 11 knots. She reached her maximum intensity at 14-0200Z when surface winds of 100 knots were observed. Later, at 150900Z, reconnaissance aircraft located Typhoon BILLIE approximately 20 miles off the northern tip of Taiwan. She continued to travel in a northwesterly direction and passed inland over the China Mainland at 16-0000Z, at which time JTWC issued a final warning pending recurvature. Orographic effect took its toll and BILLIE gradually degenerated to a tropical storm, curving abruptly northward. Tracking from land data indicated that BILLIE would enter the Yellow Sea at approximately 32N - 122E. JTWC resumed warnings at 170000Z. The storm center rapidly accelerated and moved through North Korea heading for Vladivostok. By 171800Z cold air advection in connection with a polar front rapidly caused BILLIE to become extra-tropical and the final warning was issued.

Typhoon BILLIE's movement followed a decided minor sine wave from inception until near the Chinese coast. Elliptical center reports suggested eccentric movement. Originally, BILLIE was forecast to re-

curve and remain over the open water east of the China coast. However, westward intensification of the subtropical high aloft caused BILLIE to move farther west than forecast, and onto the China coast near 27 degrees north. Marked northward recurvature over the Mainland of China is believed to have been caused by a combination of the orographic effect of the mountains of east-central China and a weak trough over Manchuria. No major forecasting difficulties were encountered and the 24-hour forecast error remained well below the annual average. In general BILLIE followed July seasonal climatology quite well in movement and speed. Twenty-two warnings were issued covering a period of 6 days.

For damage caused by Typhoon BILLIE see Section VI, "Destructive Effects of Typhoons."

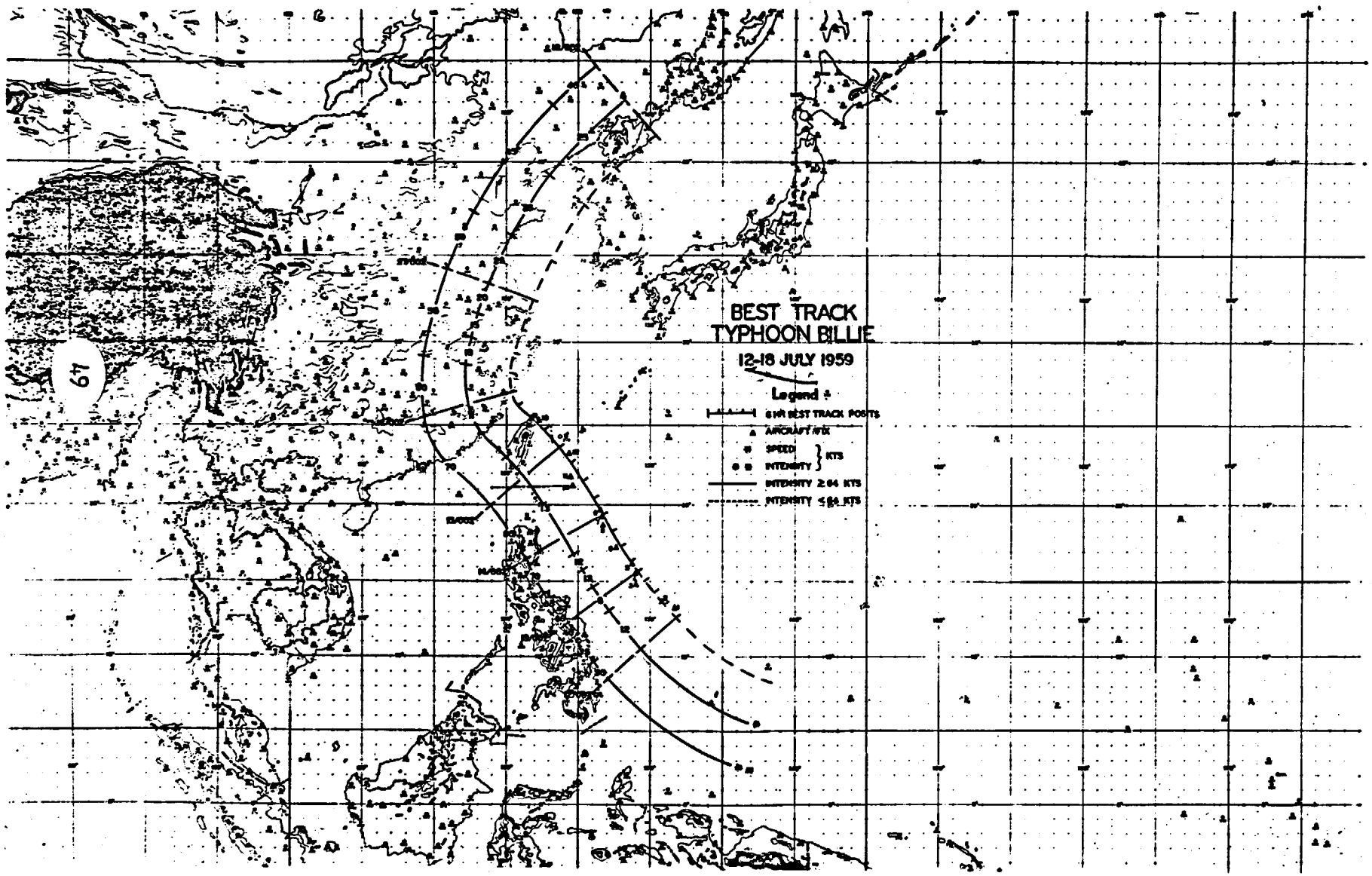
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON BILLIE

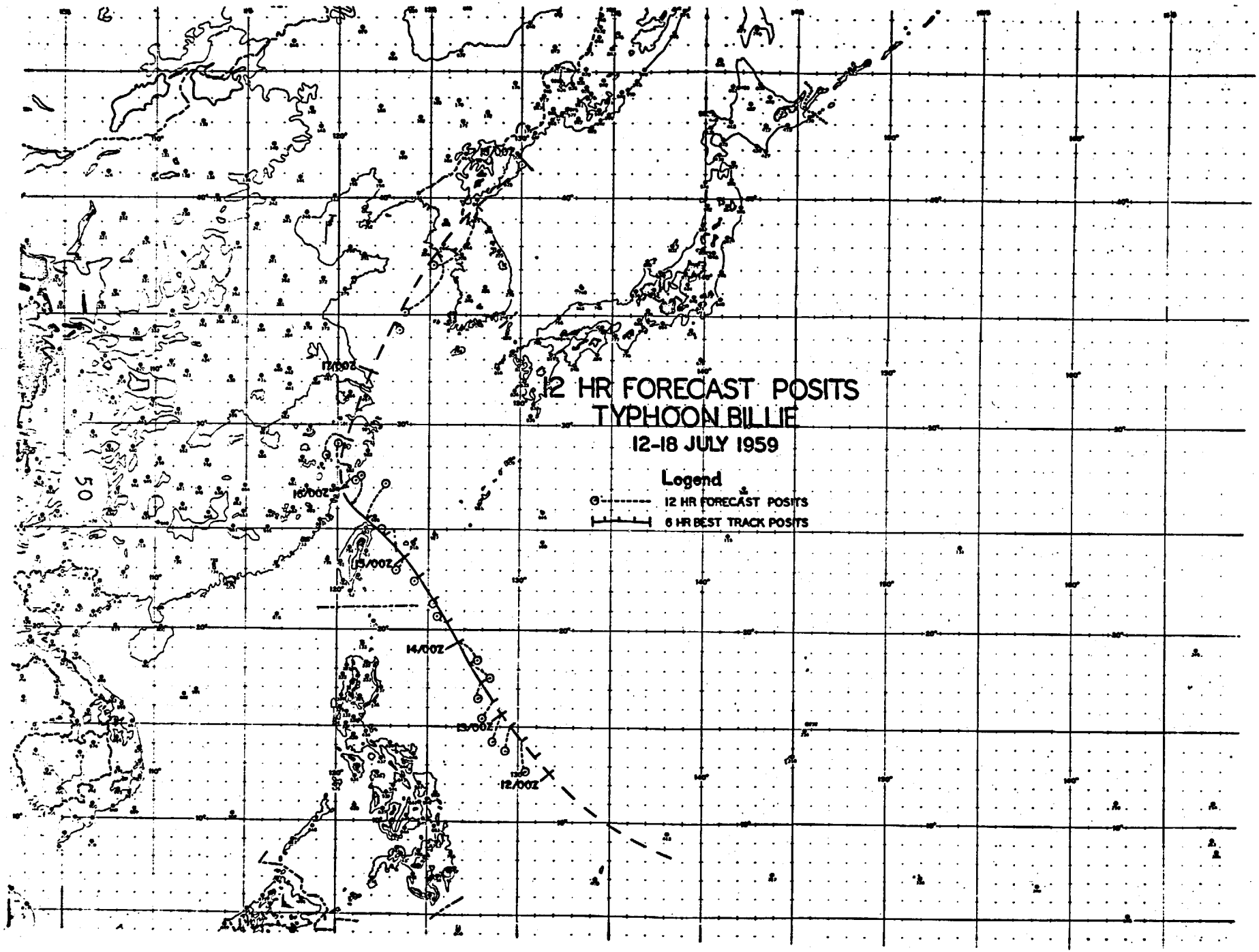
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	120316Z	13.2N	131.8E	54-P-20	997	40	9990	- -	26	21	CIRC DIA 100 MI
2	120700Z	13.7N	130.9E	54-P-15	996	35	- -	- -	27	21	CIRC DIA 30 MI
3	122155Z	14.9N	129.0E	54-P-5	984	45	9830	45	- -	- -	CIRC DIA 40 MI
4	130130Z	15.5N	129.0E	54-P-5	- -	70	9750	60	13	09	CIRC DIA 60 MI
5	130600Z	16.1N	128.9E	54-P-5	984	75	9680	60	18	11	CIRC DIA 20 MI
6	131400Z	17.2N	127.7E	54-R-25	- -	--	- -	- -	- -	- -	CIRC DIA 30 MI
7	132100Z	19.2N	126.7E	54-P-5	974	65	9560	40	15	09	ELLIP 100X75 MI
8	132305Z	18.8N	126.8E	12-R-20	- -	- -	- -	- -	- -	- -	CIRC DIA 30 MI
9	140200Z	19.6N	126.4E	54-P-10	979	100	9560	60	13	12	EYE INDEFINITE
10	141000Z	21.2N	124.6E	12-R-10	- -	- -	- -	- -	- -	- -	
11	141400Z	21.9N	124.4E	54-T-5	- -	- -	- -	58	- -	- -	CIRC DIA 40 MI
12	142100Z	23.2N	124.3E	54-P-5	968	65	9360	85	16	13	CIRC DIA 30 MI
13	150900Z	25.2N	122.2E	54-P-5	969	70	9270	65	15	14	CIRC DIA 25 MI
14	151400Z	25.4N	121.8E	54-R-30	- -	- -	- -	- -	- -	- -	EYE INDEFINITE

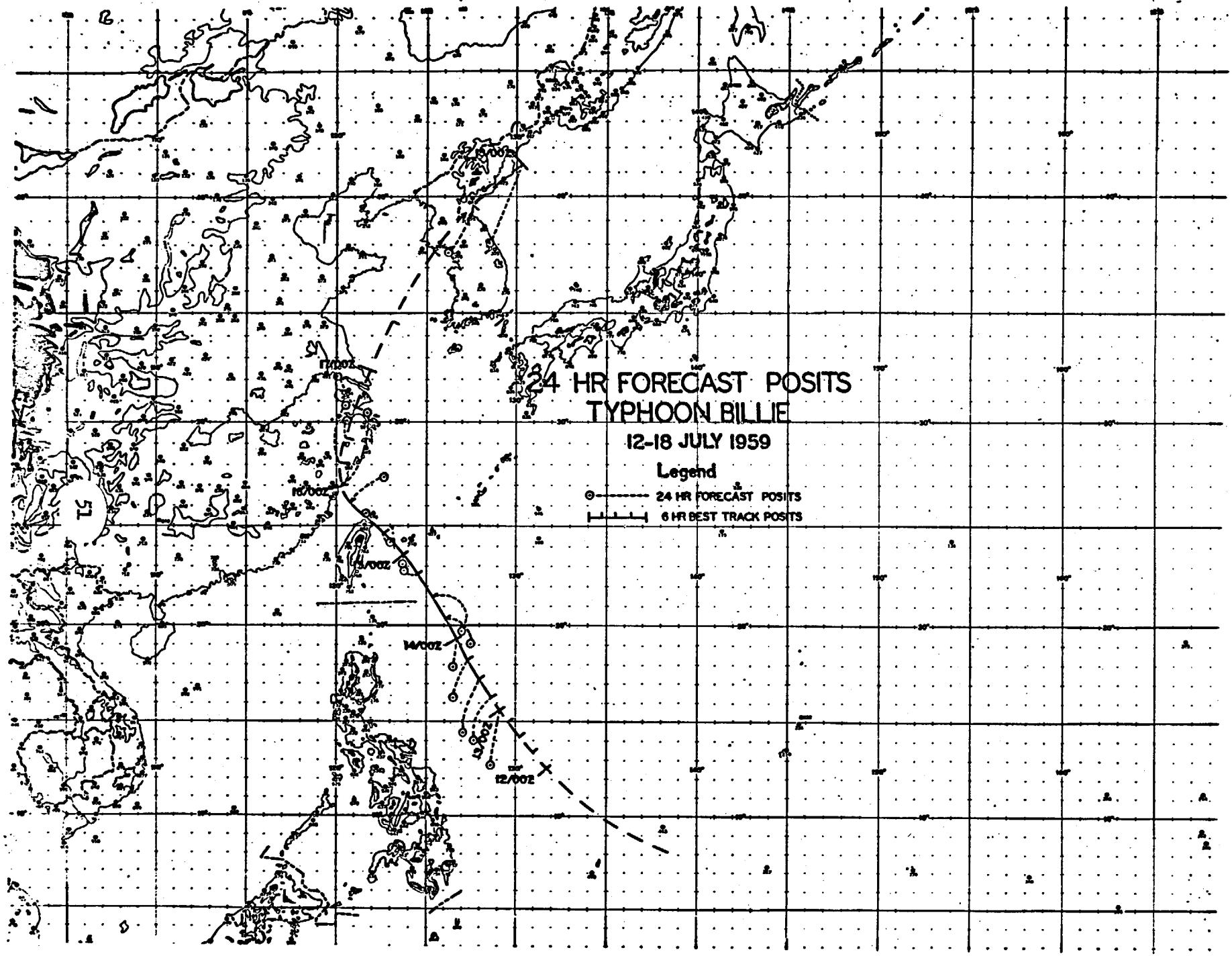
TYPHOON BILLIE 12 - 17 JULY 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
120000Z	12.6N	131.7E	- - - -		- - - -	
120600Z	13.4N	130.8E	- - - -		- - - -	
121200Z	14.2N	130.2E	- - - -		- - - -	
121800Z	15.0N	129.6E	185	71	- - - -	
130000Z	15.7N	129.1E	196	98	- - - -	
130600Z	16.3N	128.6E	211	66	198	145
131200Z	17.2N	128.0E	188	40	200	170
131800Z	18.2N	127.2E	121	71	201	125
140000Z	19.2N	126.5E	130	85	180	80
140600Z	20.3N	125.9E	326	33	145	172
141200Z	21.5N	125.2E	180	20	137	146
141800Z	22.7N	124.5E	243	20	304	38
150000Z	23.7N	123.7E	239	33	173	38
150600Z	24.7N	122.7E	065	41	152	32
151200Z	25.4N	121.8E	025	171	280	08
151800Z	26.1N	120.9E	012	92	052	115
160000Z	27.0N	120.2E	072	50	021	210
160600Z	28.1N	120.1E	355	58	007	167
161200Z	29.3N	120.5E	239	76	023	46
161800Z	30.7N	121.2E	- - - -		325	104
170000Z	32.4N	122.2E	- - - -		- - - -	
170600Z	34.7N	123.5E	- - - -		- - - -	

AVERAGE 12 HOUR FORECAST ERROR 64.1 NM
AVERAGE 24 HOUR FORECAST ERROR 106.4 NM


BEST TRACK
TYPHOON BILLIE
12-18 JULY 1959
Legend :
6HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY ≤ 64 KTS
67


12 HR FORECAST POSITS
TYPHOON BILLIE
12-18 JULY 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z
12/00Z
50


24 HR FORECAST POSITS
TYPHOON BILLIE
12-18 JULY 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z
12/00Z
15

C. HURRICANE DOT (01-08 August 1959)

I. Introduction: This report was prepared by FWC, Pearl Harbor and edited by FWC/JTWC, Guam.

At 0000Z on 24 July the SS PACIFICUS at 19.5N - 127.5W, 1000 miles west of Lower California, reported 35 knot surface winds. Based on this report a tropical warning was issued at 240000Z with the remark that the accuracy of the position was poor. At 240600Z the same ship reported 55 knot winds, and the position given on the 0600Z warning was 18.4N - 120.6W. The movement of the unnamed storm was forecast to be west northwest at 12 knots. From 240600Z until 270000Z, there were no further ship reports. Subsequent warning positions were therefore based upon extrapolation. The storm was "killed" with the 270000Z warning. However, if the storm actually moved west southwest at 6 knots, it would have been positioned, by 2100Z on 1 August, at 15.7N - 141.2W, the point where Tropical Storm DOT was "discovered." This was possibly the case. There was no data available between 240600Z July and 012100Z August in the area of the unnamed storm, so it is impossible to determine whether the original storm dissipated or simply was rediscovered as DOT.

II. Method of Detection:

At 011800Z an unidentified ship reported 60 knot surface winds at 15.7N.- 141.2W. This was fixed as the first warning position (011800Z) of Tropical Storm DOT.

III. Best Track Analysis:

Between the first reconnaissance at 030000Z and the final

eye fix by reconnaissance at 071858Z, there were a total of 16 aircraft reconnaissance fixes on DOT, and many land-based radar fixes. The warnings issued by Fleet Weather Central, Pearl Harbor during DOT are summarized on page 56. The aircraft fixes were considered to be the most accurate. Due to strong attenuation by heavy precipitation, the land-based radar fixes were considered less reliable. As a result of excellent electronic navigation aids in the vicinity of the Hawaiian Islands, most reconnaissance fixes were considered to have been accurate to within 10 miles.

IV. Analysis of Development:

At 020000Z the following message was received from the SS SONOMA:

"0200Z RECORDED LOW PRESS OF 963PT4 AT 012300Z 15PT7N 141PT8W X WIND BACKING FROM NE AT 011800Z TO NW AT 012300Z X WIND SHIFT AND BARO INDICATES VESSEL PASSED THRU SRN PART OF STORM CNTR AT 012300Z"

The maximum surface wind recorded at this time was 90 knots. From 011800Z until 020600Z DOT's position was based upon the reports of this one ship. From 020600Z until the first aircraft fix at 030000Z, positions were based upon extrapolation only. From 030000Z until degeneration into an open wave at 080600Z, DOT's center was fixed continuously by aircraft reconnaissance. The minimum sea level pressure during the period of aircraft reconnaissance fixes was recorded, by dropsonde, as 952 millibar at 030000Z. Using the following equation, developed for determining the maximum winds of a tropical cyclone, the maximum surface wind was computed as 130 knots.

Wind max = $20 - \frac{\phi}{5}\sqrt{1010-Pc}$

(Where ϕ is latitude in degrees, and Pc is central pressure in mb.)

The central pressure rose steadily, as determined from dropsonde observations and from the minimum 700 mb height using the below equation (see TABLE 1):

$$Pc = \frac{H700mb}{28} - 638$$

(Where Pc is central pressure in mb, and H700mb is 700 mb height in feet.)

TABLE 1. CENTRAL PRESSURE HURRICANE DOT

DATE	TIME Z	CENTRAL PRESSURE	LAT N	LONG W	MAX OBSERVED SFC WIND
3 AUG	0000Z	# 952	15.3	145.8	Not observed
3 AUG	1612Z	# 957	15.8	148.1	100 kt
4 AUG	0412Z	# 961	16.2	150.1	100 kt
4 AUG	2104Z	# 966	16.9	154.4	140 kt
5 AUG	1150Z	* 992	17.3	156.0	Not observed
5 AUG	1633Z	# 970	17.6	156.6	Not observed
5 AUG	2222Z	# 968	18.1	157.4	95 kt
6 AUG	1643Z	* 976	20.3	158.9	Not observed
7 AUG	1934Z	* 999	22.8	161.2	45 kt

# Indicates dropsonde observation
* Indicates computed from min 700 mb height

V. Storm Movement:

The indicated 700-500 mb flow during the entire period between the discovery and dissipation of DOT was ESE becoming WSW north of Lihue. The indicated 200 mb flow for the same period was also constant from the ESE, curving gradually northward in the vicinity of the Island of Hawaii. The best track analysis indicates that the fully developed storm was steered by the flow near the 300 mb level. As the

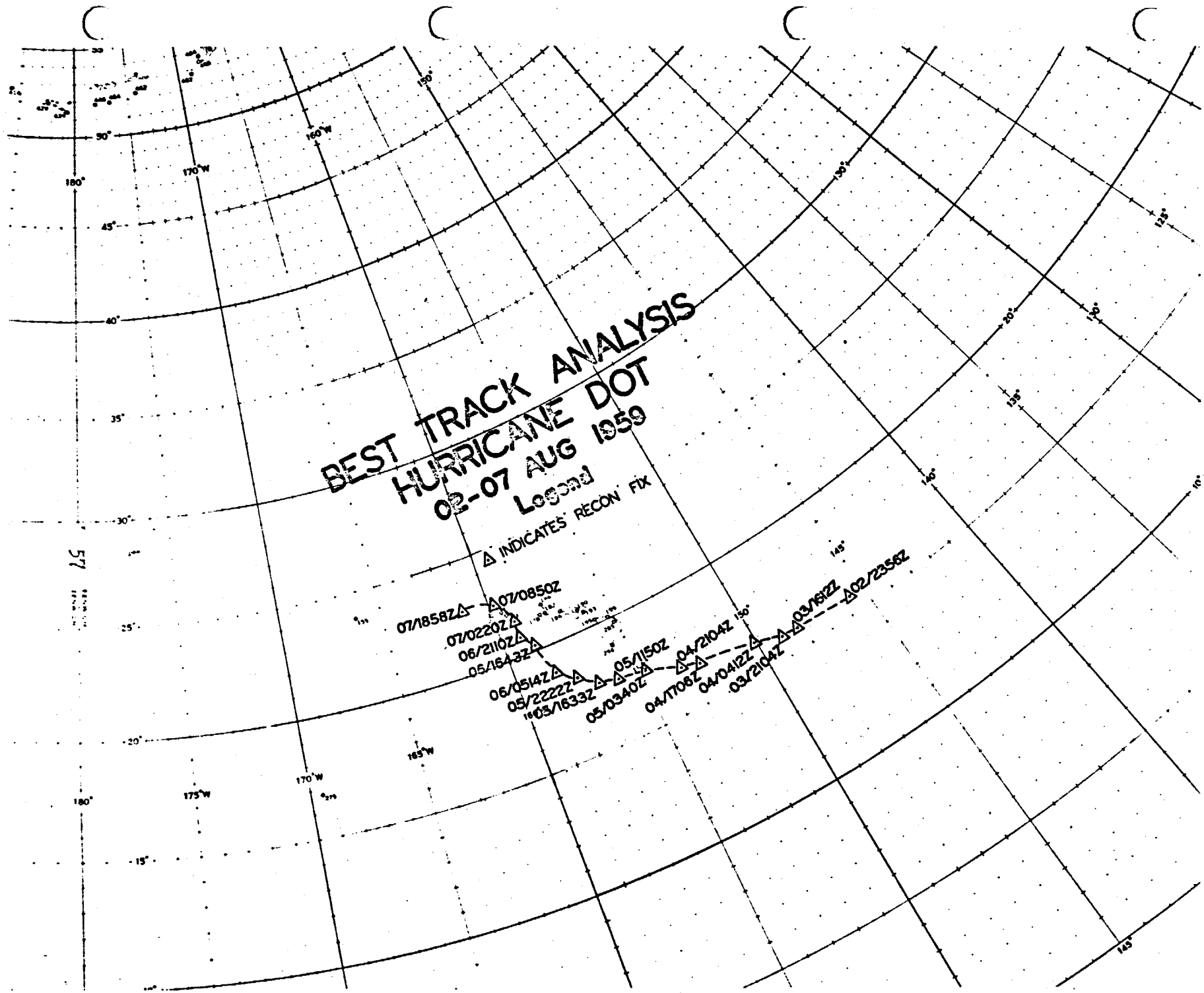
storm weakened after passing Hawaii, the best steering flow appears to have been near the 500 mb level. This indicates the possibility of a direct, or nearly direct, relationship between storm intensity and height of steering level.

VI. Summarization:

South Point, Hawaii received heavy seas and gusty winds to 75 knots as DOT reached her closest point of approach to that island. The most significant effect of DOT on Oahu was the rainfall. The U.S. Weather Bureau, Honolulu recorded 2.66 inches, while normal rainfall for the entire month of August is only 0.80 inches. The greatest damage occurred on Kauai. The track analysis indicates that the storm center passed directly over Lihue, county seat of Kauai, and although that station reported gusts to 65 knots as the highest winds, unofficial reports of 90 knot winds were received from other parts of the island. The hurricane unroofed homes, uprooted trees and knocked down power and telephone lines as it raked the entire island of Kauai. Many roadways were blocked and huge waves pounded the shoreline. Torrential rains swelled rivers and streams to raise flood threats, and Kauai was subsequently proclaimed a disaster area.

WARNINGS ISSUED BY FWC, PEARL HARBOR

WNG NO.	DTG OF WARNING	WARNING BASIS	LAT (N)	LONG (W)	MOVEMENT DIR	MOVEMENT SPD (KTS)	MAX WIND (KTS)	POSIT
1	011800Z	Ship	15.7	141.2	W	9	60	Fair
2	020000Z	Ship	15.8	142.0	WNW	9	90	Fair
3	020600Z	Ship	15.7	142.9	W	10	90	Fair
4	021200Z	Extrap	15.6	144.0	WSW	10	85	Poor
5	021800Z	Extrap	16.0	144.5	W	7	75	Poor
6	030000Z	Recon	15.3	145.8	W	9	120	Good
7	030600Z	Extrap	15.3	146.3	W	7	120	Poor
8	031200Z	Extrap	15.3	147.0	W	7	115	Poor
9(WB)	031800Z	Recon	15.8	148.5	WNW	9	110	Fair
10	040000Z	Extrap	15.9	149.5	WNW	10	115	Fair
11	040600Z	Recon	16.2	150.5	WNW	10	120	Good
12	041200Z	Extrap	16.5	151.5	WNW	10	115	Fair
13	041800Z	Recon	16.7	152.5	WNW	10	120	Good
14	050000Z	Recon	17.0	154.0	WNW	12	115	Good
15	050600Z	Recon	17.5	155.3	WNW	13	115	Fair
16	051200Z	Recon	17.5	156.0	WNW	12	115	Fair
17	051800Z	Recon	17.7	156.8	WNW	11	90	Fair
18	060000Z	Recon	18.2	157.7	WNW	11	1st 12 hrs	
					NW	11	100	Good
19	060600Z	Recon	18.9	158.3	NW	10	100	Good
20	061200Z	Recon	19.6	158.8	N	8	90	Good
21	061800Z	Radar	20.4	158.9	N	4	1st 12 hrs	
					N	10	65	Fair
22	070000Z	Radar	21.2	159.2	NNE	10	1st 12 hrs	
					NE	10	65	Good
23	070600Z	Land Sta	22.1	159.2	NNE	13	90	Fair
24	071200Z	Analysis	22.8	160.0	NNW	13	1st 12 hrs	
					NNE	13	70	Poor
25	071800Z	Recon	22.8	161.1	WNW	9	45	Fair
26	080000Z	Extrap	23.0	162.1	WNW	10	45	Poor
27	080600Z	Recon	23.0	161.0	STNY	—	40	Poor


BEST TRACK ANALYSIS
HURRICANE DOT
02-07 AUG 1959
Legend
Δ INDICATES RECON FIX
07/1858Z
07/0850Z
07/0220Z
06/2110Z
05/1643Z
06/0514Z
05/2222Z
05/1150Z
05/1633Z
05/0340Z
04/2104Z
04/1706Z
04/0412Z
03/2104Z
03/1612Z
02/2356Z
180°
175°W
170°W
165°W
160°W
150°
145°
140°
135°
130°
125°
50°
45°
40°
35°
30°
25°
20°
15°

D. TYPHOON ELLEN (2-9 AUGUST 1959)

On 1 August, a well-developed low pressure cell, accompanied by a strong easterly wave, was evident to the northwest of Guam. A reconnaissance aircraft was directed into the area, and at 020535Z a definite eye with surface winds of 25 knots was found. Thus at 020600Z JTWC issued the first warning on Tropical Depression ELLEN. Six hours later ELLEN had reached tropical storm intensity and twenty-four hours later ELLEN was upgraded to a typhoon with center winds of 65 knots.

ELLEN proceeded to move in a northwesterly direction at an average speed of 12 knots, reaching her peak intensity approximately 200 miles south-southeast of Okinawa with center winds of 100 knots and a sea level pressure of 970 mbs. At 050200Z ELLEN passed abeam of Okinawa at a distance of 10 miles to the east-northeast. The highest wind recorded on the island was at Naha where sustained winds of 35 knots with gusts to 50 knots were observed. ELLEN then veered to a more northerly course and decelerated, finally stagnating off the southwest coast of Kyushu. She remained in this location for approximately 48 hours, blocked from further movement by a strong upper air ridge to the north. During this time ELLEN weakened considerably, and was downgraded to a tropical storm at 080600Z. By 071200Z it was evident that the ridge aloft had weakened to a marked degree, and ELLEN began to accelerate toward the east-northeast. She moved along the southern coast of Japan passing directly over Tokyo, and reached the open sea east of Honshu at 091100Z. ELLEN was now an extra-tropical storm moving in excess of twenty knots.

Typhoon ELLEN was characterized by an erratic path which is typical of early August typhoon climatology. Typhoon MARGE of 1951 had a similar path except that the unusual blocking southwest of Japan did not occur. The diameter of Typhoon ELLEN's eye was very large, averaging 50 miles, and several times reconnaissance aircraft reported the eye as having a diameter of 100 miles. Twenty-five warnings covering a period of 7 days were issued.

For damage caused by Typhoon ELLEN see section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON ELLEN

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	010345Z	18.1N	139.4E	54-P-5	991	35	10090	30	10	09	NO EYE
2	020535Z	18.9N	138.1E	54-P-5	995	25	9980	25	08	07	CIRC DIA 50 MI
3	020820Z	18.9N	137.8E	54-T-10	--	--	--	--	--	--	----------
4	022030Z	22.0N	135.7E	54-P-5	998	--	9900	48	11	06	CIRC DIA 40 MI
5	030215Z	22.8N	135.0E	54-P-5	993	50	9840	35	10	09	EYE DIFFUSE
6	030505Z	22.5N	135.2E	54-P-5	987	75	9760	45	16	08	EYE INDEFINITE
7	031144Z	23.6N	133.9E	12-R-20	--	--	--	--	--	--	HORSESHOE SHAPE
8	031702Z	23.6N	132.6E	12-R-5	--	--	--	--	--	--	HORSESHOE 30X20 MI
9	032030Z	24.0N	131.4E	54-P-2	979	60	9560	--	16	14	CIRC OPEN NORTH
10	032300Z	23.6N	131.4E	12-R-0	--	--	--	--	--	--	HORSESHOE 55X25 MI
11	040200Z	24.2N	130.7E	54-P-0	975	110	9520	40	17	15	CIRC DIA 25 MI
12	040352Z	24.0N	130.3E	56-P-5	970	65	--	--	--	--	EYE INDEFINITE
13	041049Z	25.1N	129.6E	12-R-3	--	--	--	--	--	--	HORSESHOE 60X30 MI
14	041115Z	24.0N	129.9E	54-R-20	--	--	--	--	--	--	----------
15	041400Z	25.0N	129.5E	54-R-20	--	--	--	--	--	--	CIRC DIA 60 MI
16	042030Z	25.7N	128.2E	54-P-2	--	--	9570	60	17	11	CIRC DIA 40 MI
17	050138Z	26.7N	128.6E	56-P-3	971	60	9461	--	--	--	ELLIP 30X25 MI
18	050200Z	26.5N	128.9E	54-P-2	973	50	9460	45	17	16	CIRC DIA 30 MI
19	050800Z	28.3N	128.3E	54-P-0	971	100	9390	60	16	12	CIRC DIA 60 MI
20	051115Z	27.7N	128.7E	12-R-2	--	--	--	--	--	--	HORSESHOE SHAPE

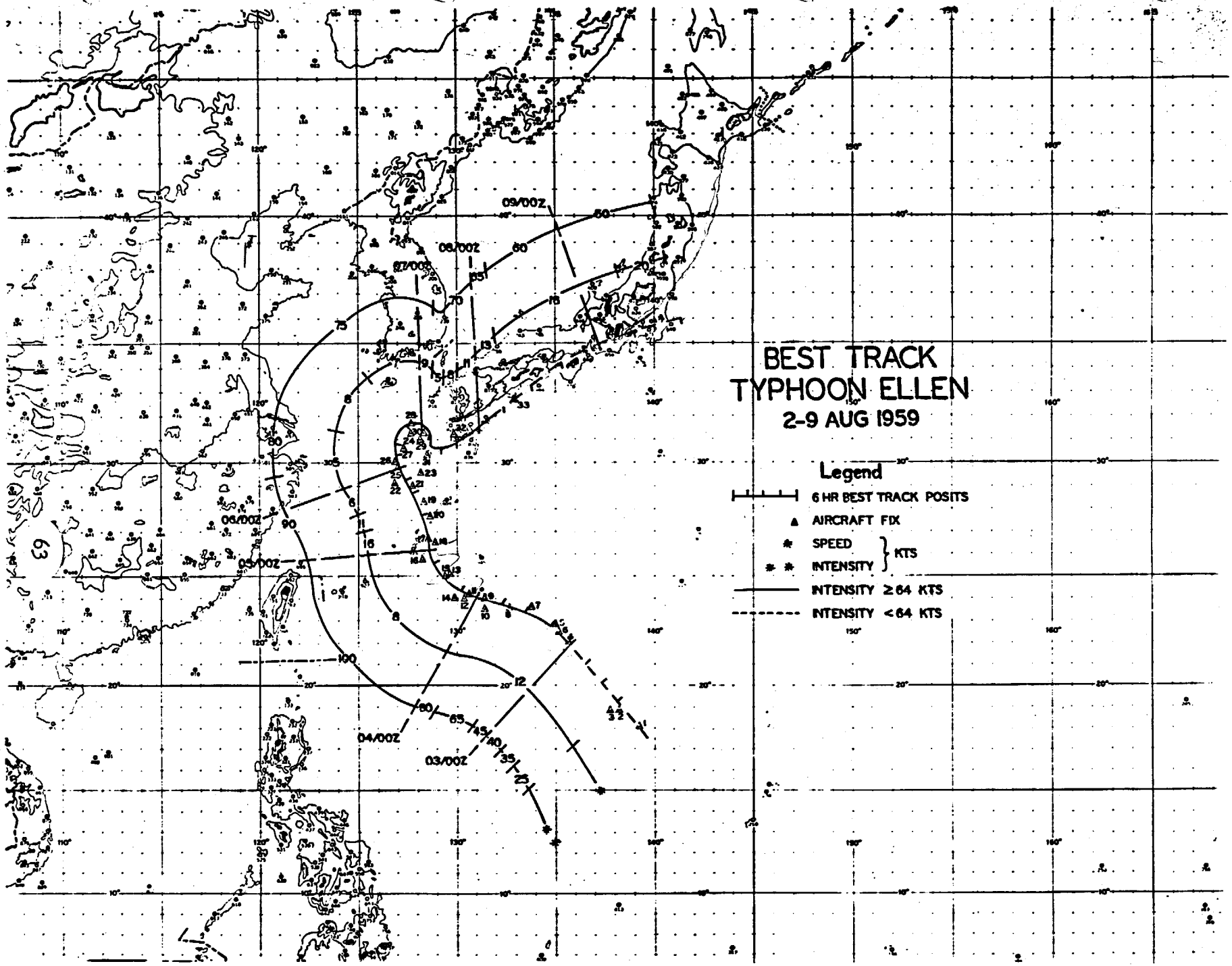
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON ELLEN (CONT'D)

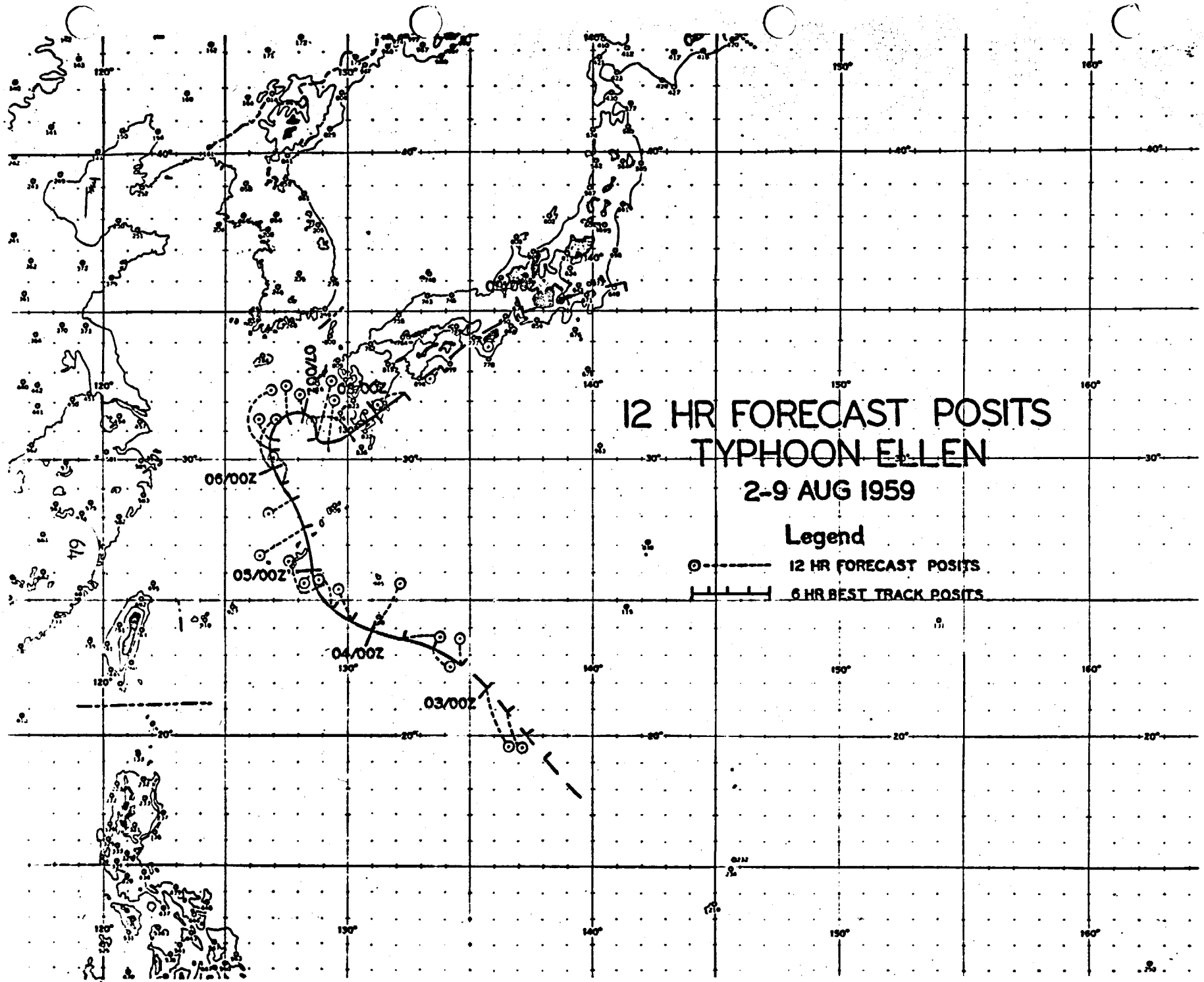
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
21	051300Z	29.0N	127.8E	54-T-20	--	--	--	--	--	--	----------
22	052130Z	29.1N	126.9E	54-P-10	974	75	9270	90	20	13	CIRC DIA 75 MI
23	052220Z	29.6N	128.2E	12-R-0	--	--	--	--	--	--	ELLIP 100X60 MI
24	060103Z	31.3N	127.7E	56-P-5	--	--	--	--	--	--	CIRC DIA 30 MI
25	060200Z	29.9N	127.0E	56-P-7	965	--	--	--	--	--	CIRC DIA 60 MI
26	060845Z	30.0N	126.9E	54-P-5	967	70	9260	--	19	13	CIRC DIA 30 MI
27	061400Z	30.6N	127.4E	54-T-15	--	--	--	65	--	--	----------
28	062200Z	31.7N	127.7E	54-P-6	964	80	9200	60	16	12	CIRC DIA 60 MI
29	062259Z	31.0N	128.1E	12-R-5	--	--	--	--	--	--	CIRC DIA 100 MI
30	070200Z	31.3N	128.4E	54-P-5	964	80	9140	65	18	15	CIRC DIA 100 MI
31	070700Z	30.4N	128.5E	54-P-6	966	60	9120	75	17	15	CIRC DIA 100 MI
32	072000Z	31.2N	129.9E	54-R-2	--	--	--	65	--	--	CIRC DIA 05 MI
33	080940Z	32.8N	133.0E	54-P-0	978	55	9330	50	16	14	EYE VERY DIFFUSE

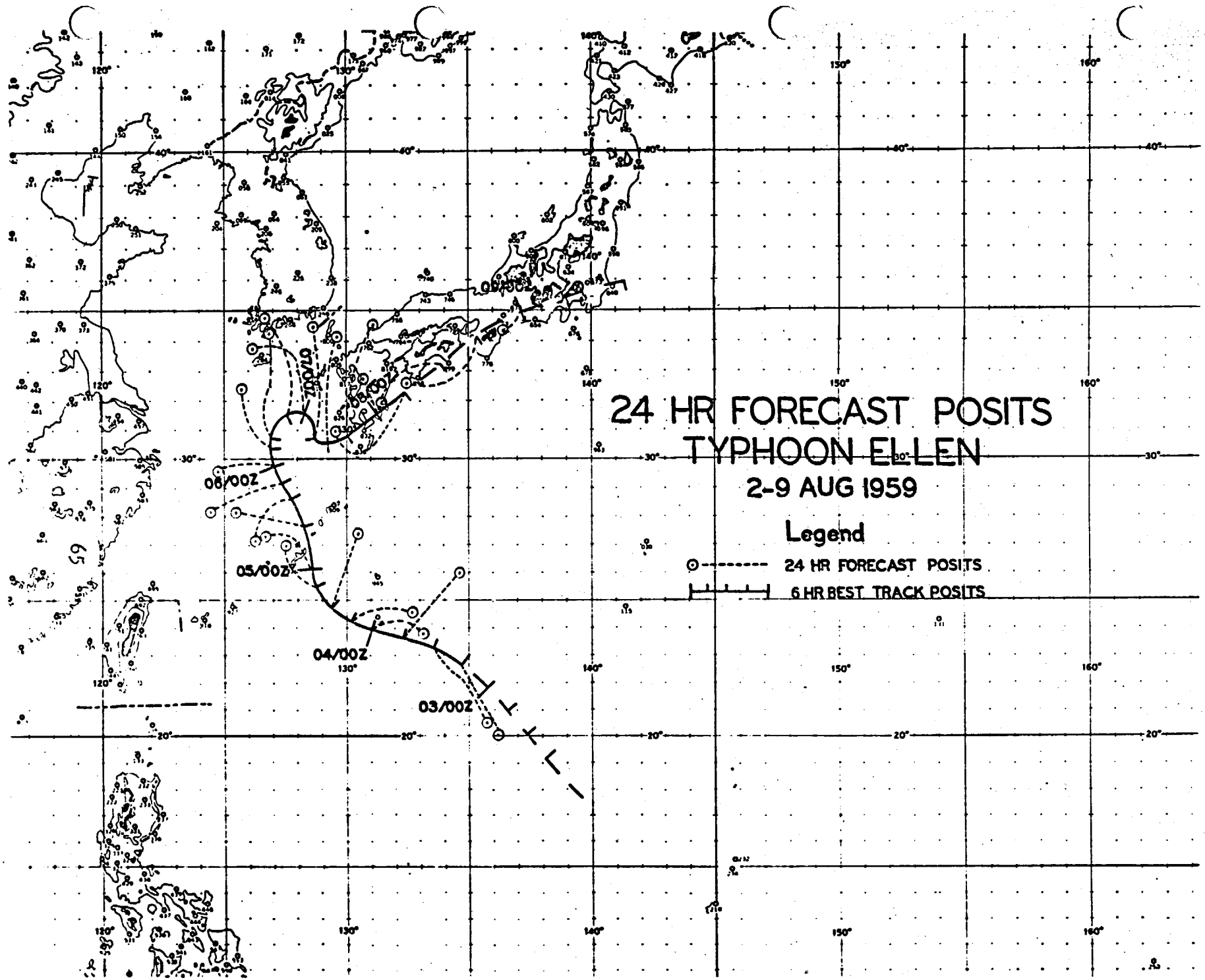
TYPHOON ELLEN 02 - 09 AUGUST 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT. LONG.	12 HR ERROR DEG. DISTANCE	24 HR ERROR DEG. DISTANCE
020600Z	19.1N 138.1E	- - - -	- - - -
021200Z	20.1N 137.3E	- - - -	- - - -
021800Z	21.0N 136.5E	- - - -	- - - -
030000Z	21.9N 135.7E	157 - 141	- - - -
030600Z	22.7N 134.7E	006 - 55	- - - -
031200Z	23.3N 133.5E	143 - 61	146 - 216
031800Z	23.8N 132.3E	097 - 85	045 - 188
040000Z	24.0N 131.0E	035 - 108	095 - 115
040600Z	24.3N 130.2E	338 - 70	083 - 137
041200Z	24.8N 129.4E	330 - 62	019 - 160
041800Z	25.4N 128.8E	315 - 86	323 - 133
050000Z	26.2N 128.6E	158 - 46	300 - 125
050600Z	27.8N 128.2E	234 - 117	278 - 145
051200Z	28.7N 127.6E	225 - 55	219 - 123
051800Z	29.3N 127.3E	339 - 53	245 - 165
060000Z	29.8N 127.1E	002 - 91	264 - 117
060600Z	30.3N 126.9E	360 - 122	330 - 141
061200Z	30.8N 126.9E	004 - 107	359 - 210
061800Z	31.6N 127.4E	007 - 54	349 - 194
070000Z	31.6N 128.2E	353 - 32	351 - 212
070600Z	30.8N 128.7E	015 - 115	360 - 234
071200Z	30.6N 129.2E	008 - 87	007 - 210
071800Z	30.8N 130.0E	250 - 82	013 - 234
080000Z	31.5N 131.1E	068 - 33	347 - 84
080600Z	32.3N 132.3E	245 - 65	241 - 158
081200Z	33.3N 133.7E	220 - 37	233 - 145
081800Z	34.2N 135.3E	317 - 28	235 - 175
090000Z	34.9N 137.1E	- - - -	228 - 43
090600Z	35.4N 138.9E	- - - -	- - - -
091200Z	36.0N 141.3E	- - - -	- - - -

AVERAGE 12 HOUR FORECAST ERROR 74.7 NM
AVERAGE 24 HOUR FORECAST ERROR 158.8 NM


BEST TRACK
TYPHOON ELLEN
2-9 AUG 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
09/00Z
08/00Z
07/00Z
06/00Z
05/00Z
04/00Z
03/00Z
63


12 HR FORECAST POSITS
TYPHOON ELLEN
2-9 AUG 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
06/00Z
05/00Z
04/00Z
03/00Z


24 HR FORECAST POSITS
TYPHOON ELLEN
2-9 AUG 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
08/00Z
07/00Z
06/00Z
05/00Z
04/00Z
03/00Z
120°
130°
140°
150°
160°
40°
30°
20°

E. TYPHOON GEORGIA (12-14 AUGUST 1959)

For several days beginning on 10 August, a weak, ill-defined low pressure system was forming in the vicinity of Guam. A Weather reconnaissance aircraft, directed into the area, located Tropical Depression FRAN approximately 60 miles north of the island at 111200Z. However, some 12 hours later, it was evident that a second center induced by a fracture of the upper air polar trough was forming approximately 400 miles to the north of FRAN. Again a reconnaissance aircraft was sent to investigate and, at 120100Z, Tropical Storm GEORGIA was located at 22.4N - 145.2E with maximum observed surface winds of 45 knots. GEORGIA subsequently became the predominant circulation and FRAN quickly dissipated. At 120900Z, eight hours after initial detection, Tropical Storm GEORGIA was upgraded to a typhoon with center winds of 65 knots.

For twenty-four hours Typhoon GEORGIA moved in a northwesterly direction at an average speed of 14 knots. During this time GEORGIA passed 40 miles northeast of Iwo Jima and 50 miles southwest of Chichi Jima. During the passage of the typhoon, Iwo Jima reported maximum winds of 40 knots with gusts to 53 knots and Chichi Jima reported maximum winds of 30 knots with gusts to 48 knots. The reason neither of the islands experienced stronger winds was due to the fact that in the early stages GEORGIA was a "tight" circulation with maximum winds concentrated within a small distance of the center. After passing Chichi Jima, GEORGIA accelerated and increased in intensity reaching her peak at 130908Z when reconnaissance aircraft reported surface winds of 120 knots. She then turned to a north-northwesterly course and moved

at 25 knots. At 132230Z Typhoon GEORGIA, with center winds of 75 knots, passed approximately 45 miles west of Tokyo. At 140000Z she was downgraded to a tropical storm, having expended much of her energy crossing the Japanese Mainland. Six hours later, at 140600Z, GEORGIA had become an extra-tropical storm.

The formation of typhoons north of 20 degrees due to a fracture of the polar trough, while quite rare, is most common in the month of August. A check of climatology showed none with a history entirely similar to that of Typhoon GEORGIA. A strong gradient, associated with the upper level high oriented north-south to the east of GEORGIA, caused her to rapidly accelerate and move northward over Japan into the Sea of Japan. A total of only 9 warnings covering 3 days were issued.

For damage caused by Typhoon GEORGIA see section VI, "Destructive Effects of Typhoons."

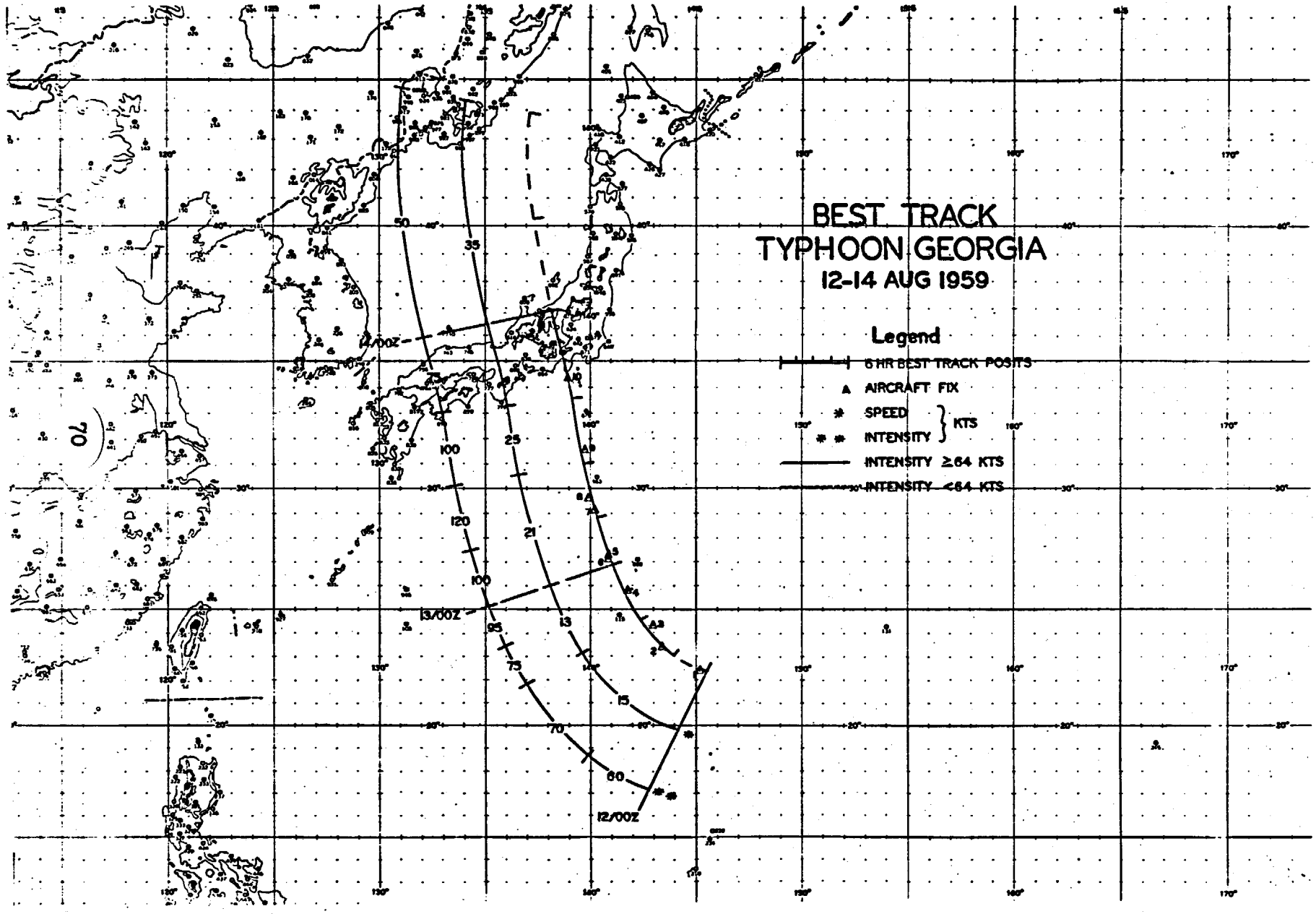
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON GEORGIA

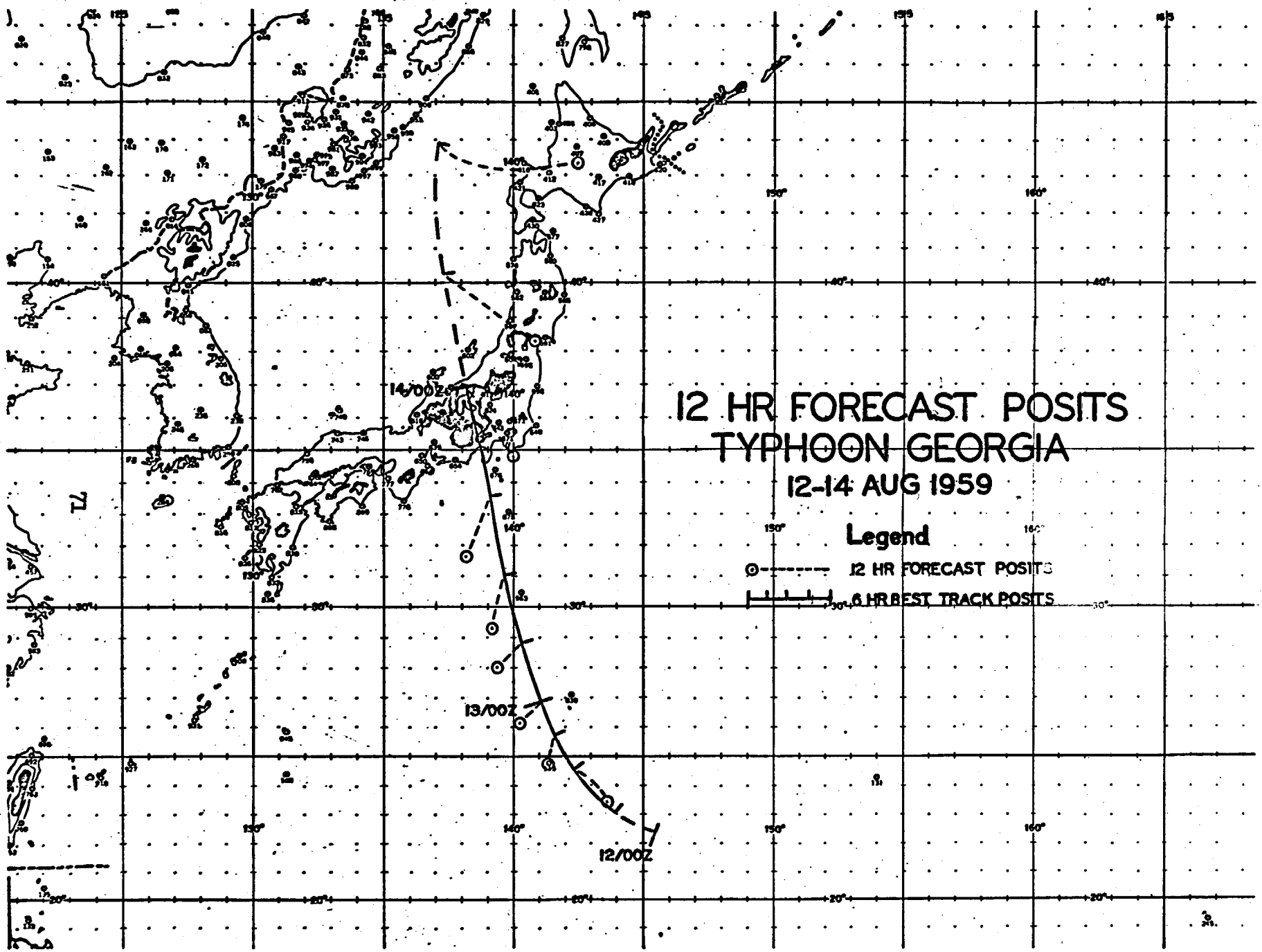
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	120100Z	22.4N	145.2E	54-P-5	991	45	9860	40	11	11	CIRC DIA 25 MI
2	120905Z	23.4N	143.4E	54-P-15	968	65	9620	55	15	11	CIRC DIA 20 MI
3	121100Z	24.3N	143.0E	54-R-20	- -	- -	- -	28	- -	- -	CIRC DIA 20 MI
4	122000Z	25.8N	141.8E	54-P-0	964	95	9050	72	19	16	CIRC DIA 08 MI
5	130200Z	27.3N	140.8E	54-P-0	956	110	8960	60	20	17	CIRC DIA 15 MI
6	130230Z	27.2N	140.8E	54-P-1	953	75	- -	- -	- -	- -	ELLIP 18X09 MI
7	130734Z	29.2N	140.2E	12-R-4	- -	- -	- -	- -	- -	- -	CIRC DIA 09 MI
8	130908Z	29.6N	139.9E	56-P-5	953	120	- -	- -	- -	- -	CIRC DIA 10 MI
9	131400Z	31.5N	139.8E	56-R-5	- -	- -	- -	55	- -	- -	CIRC DIA 10 MI
10	132000Z	34.4N	138.9E	54-P-2	961	90	9030	70	16	15	CIRC DIA 25 MI

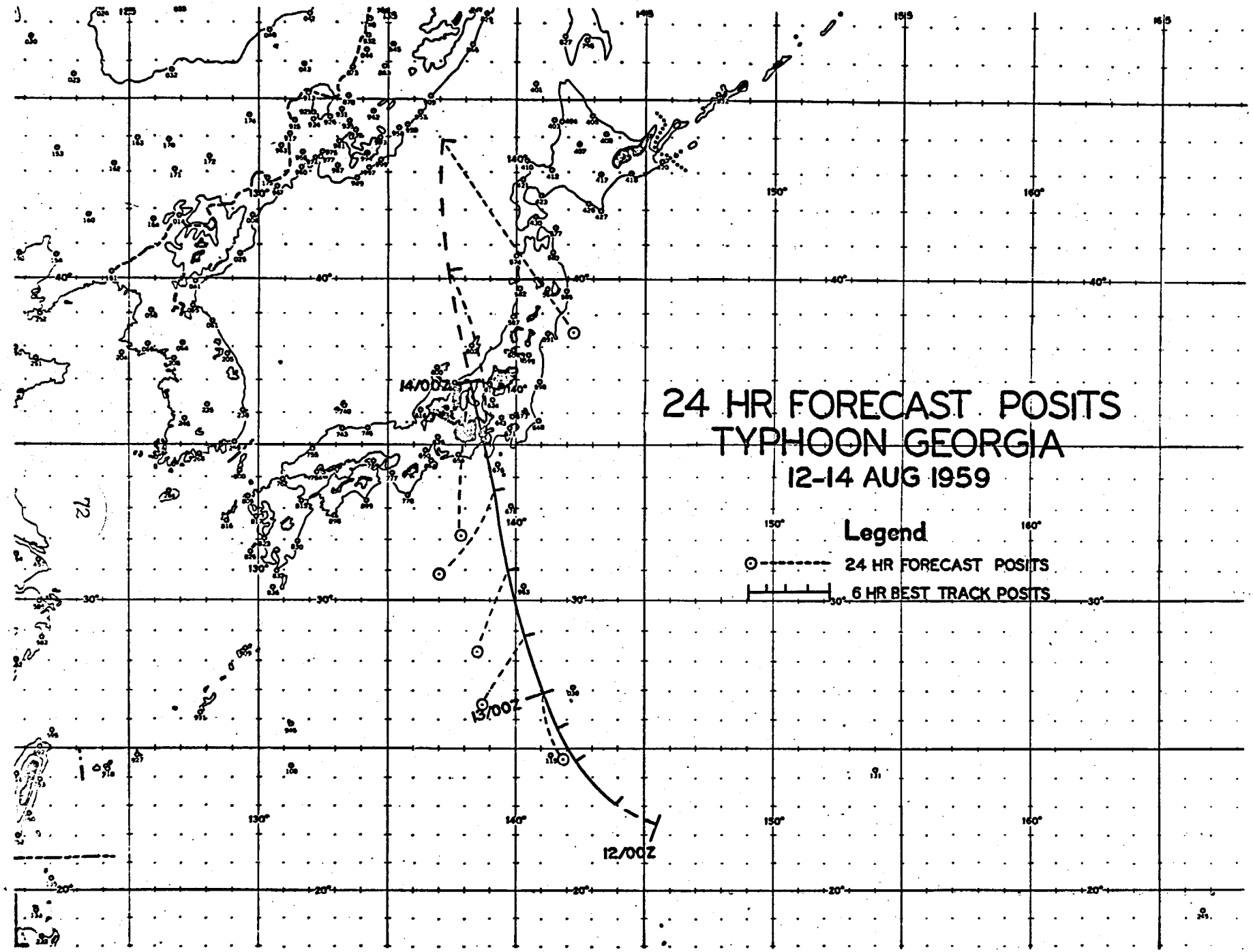
TYPHOON GEORGIA 12 - 14 AUGUST 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
120000Z	22.4N	145.5E	- - - -		- - - -	
120600Z	23.0N	144.0E	- - - -		- - - -	
121200Z	24.6N	142.4E	136	100	- - - -	
121800Z	25.7N	141.7E	193	56	- - - -	
130000Z	26.9N	141.1E	224	66	164	143
130600Z	28.9N	140.3E	219	72	210	163
131200Z	31.0N	139.7E	195	104	209	183
131800Z	33.5N	139.2E	207	115	214	192
140000Z	36.9N	138.2E	146	153	186	252
140600Z	40.3N	137.4E	125	195	165	315
141200Z	43.9N	137.2E	098	240	146	404

AVERAGE 12 HOUR FORECAST ERROR 122.3 NM
AVERAGE 24 HOUR FORECAST ERROR 236.0 NM


BEST TRACK
TYPHOON GEORGIA
12-14 AUG 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥64 KTS
INTENSITY <64 KTS
13/00Z
12/00Z


12 HR FORECAST POSITS
TYPHOON GEORGIA
12-14 AUG 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
14/00Z
13/00Z
12/00Z


24 HR FORECAST POSITS
TYPHOON GEORGIA
12-14 AUG 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
14/00Z
13/00Z
12/00Z
72

F. TYPHOON IRIS (19-23 AUGUST 1959)

The first indication of the tropical disturbance, later to become Typhoon IRIS, was noted on 19 August when analysis of the 0000Z surface chart indicated a weak cyclonic circulation forming on the Intertropical Convergence Zone in the vicinity of 16N - 128E. The area was designated Cyclone 18, and a reconnaissance aircraft was requested to make an investigation. At 200200Z a closed surface circulation was found at 16.5N - 125.9E with maximum observed surface winds of 70 knots. This was the fifth typhoon of 1959, Typhoon IRIS.

At first IRIS moved west-northwesterly at 7 knots, blocked from any pronounced northward movement by a strong high lying across Southeastern Asia. However, the high gradually weakened and receded, enabling the typhoon to veer more northerly. Thus IRIS began moving to the northwest at 15 knots, a track which took her within 45 miles of the southern tip of Taiwan. IRIS then moved on to the coast of China near Kao-Chi where she rapidly became extra-tropical and subsequently dissipated.

IRIS was characterized by rapid intensification. There were no unusual forecasting problems in connection with IRIS, and the forecast errors were near average for 12, 24 and 48 hours. A total of twelve warnings were issued covering a period of 3 days.

For damage caused by Typhoon IRIS see section VI, "Destructive Effects of Typhoons."

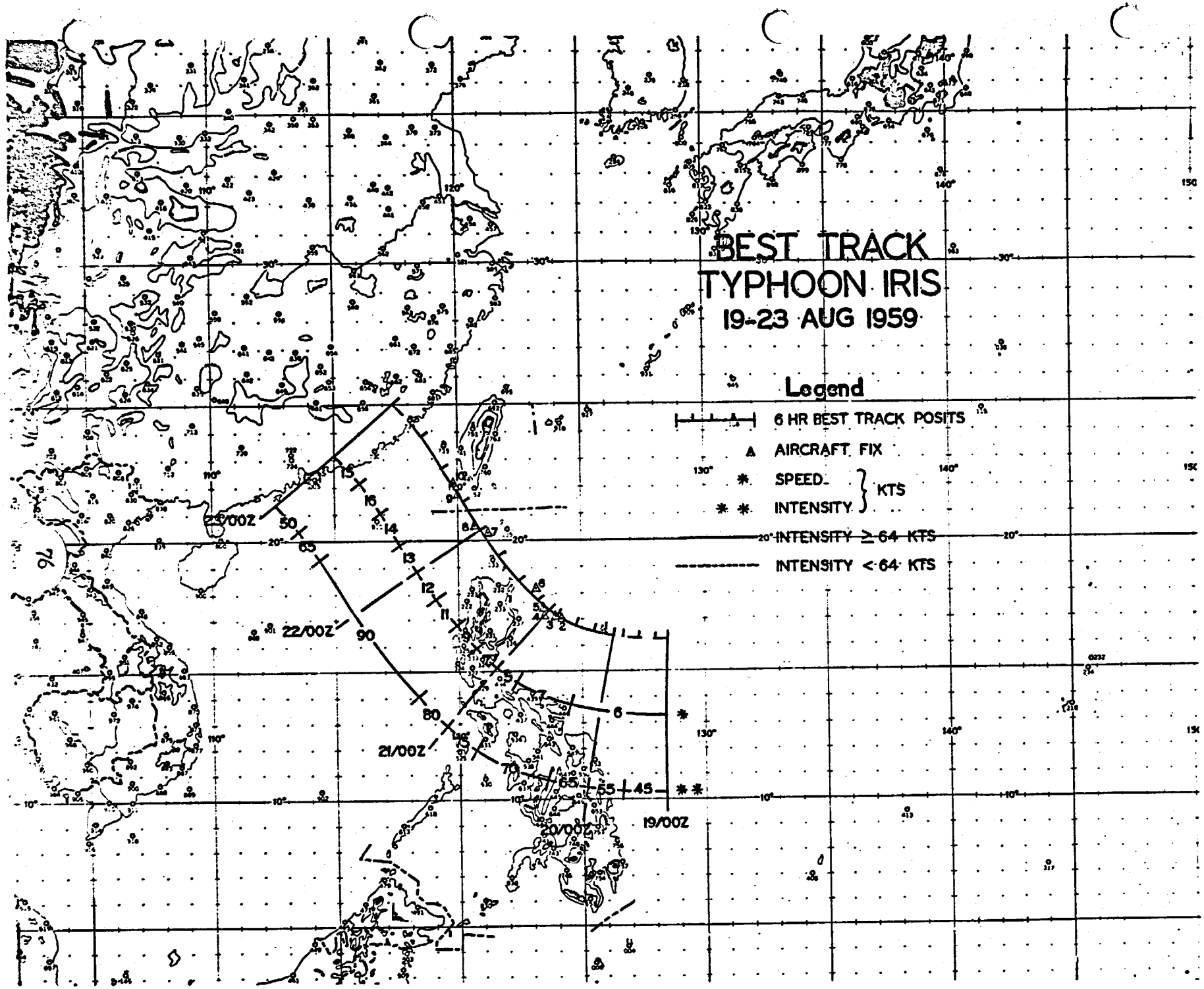
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON IRIS

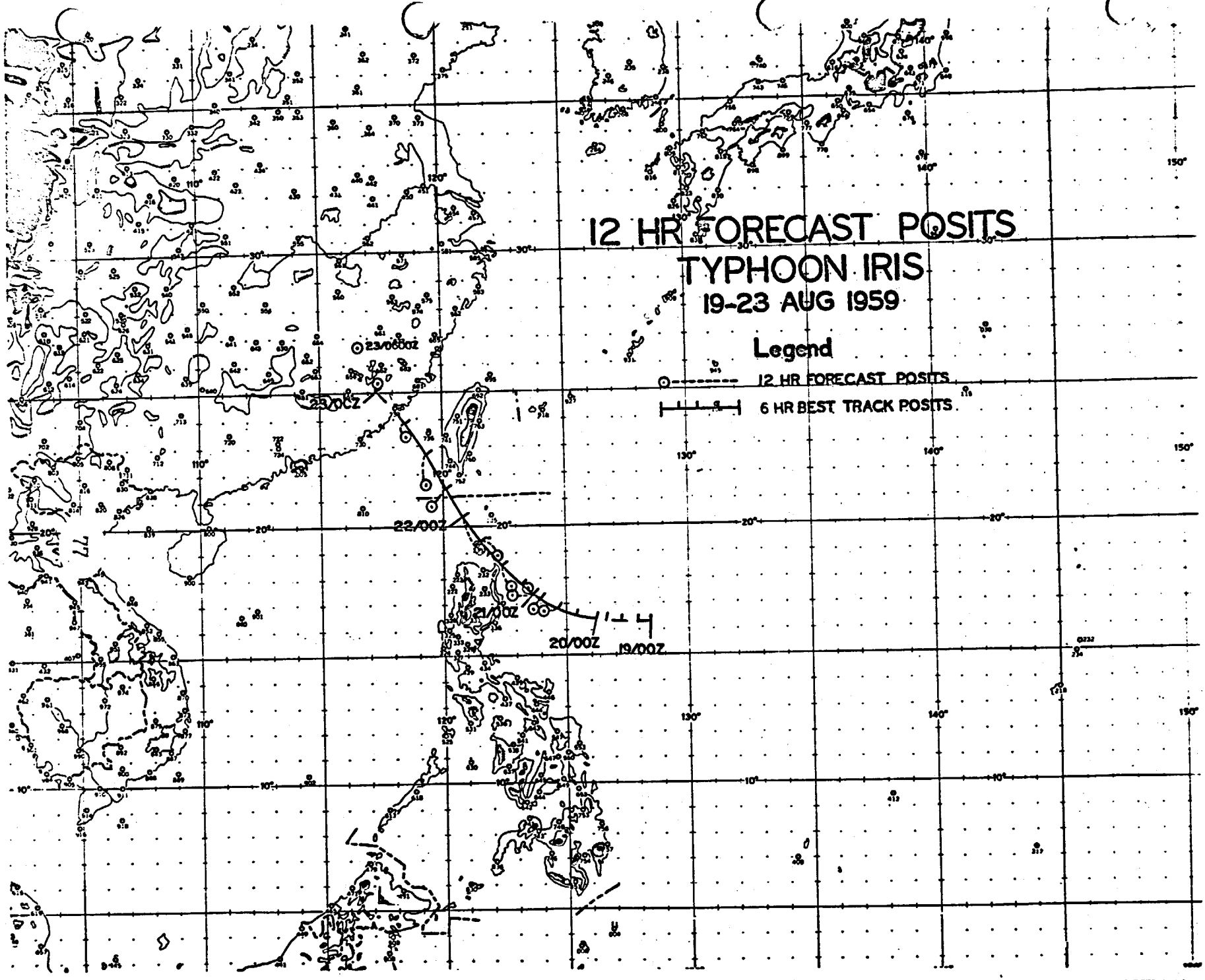
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	200200Z	16.5N	125.9E	54-P-5	994	70	9980	40	12	05	CIRC DIA 20 MI
2	201400Z	17.0N	124.2E	54-R-10	- -	- -	- -	45	- -	- -	HVY SPIRAL BANDS
3	202000Z	17.1N	124.0E	54-R-10	- -	- -	- -	80	- -	- -	CIRC DIA 40 MI
4	202140Z	17.1N	123.6E	54-P-5	985	85	9760	80	14	10	CIRC DIA 45 MI
5	210200Z	17.3N	123.5E	54-P-5	998	85	9650	80	15	10	CIRC DIA 40 MI
6	210800Z	18.2N	123.1E	54-P-2	976	100	9500	80	13	11	EYE ELLIP 45X60 MI
7	212210Z	20.3N	121.2E	54-P-2	971	65	9570	80	17	08	CIRC DIA 20 MI
8	220200Z	20.5N	120.7E	54-P-2	976	85	9430	100	16	07	CIRC DIA 25 MI
9	220800Z	21.8N	120.0E	54-P-2	966	85	9130	75	19	11	CIRC DIA 30 MI
10	221000Z	22.1N	119.9E	54-P-10	966	100	9140	80	19	10	CIRC DIA 15 MI

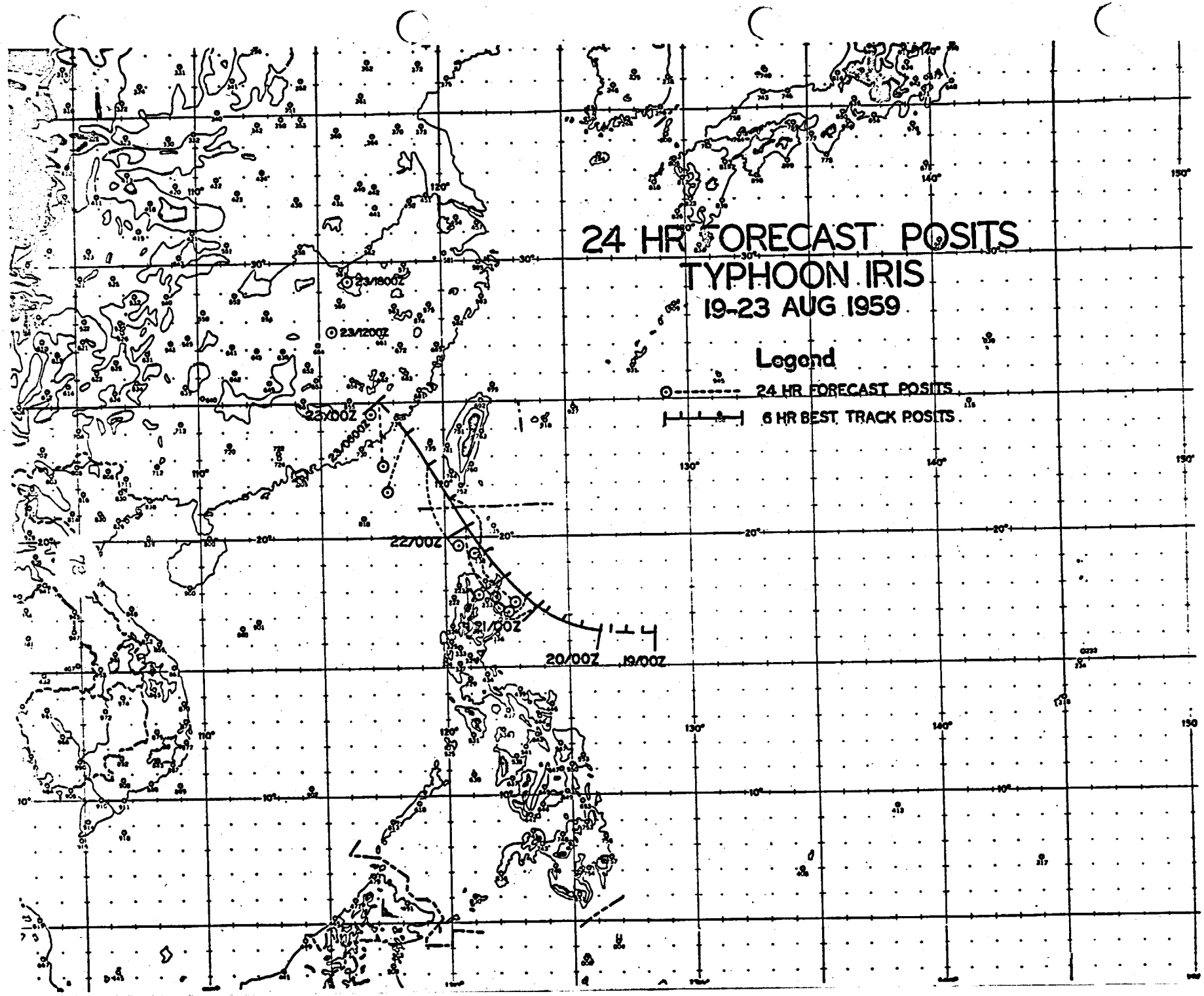
TYPHOON IRIS 19 - 23 AUGUST 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
190000Z	16.2N	128.4E	- - -	-	- - -	-
190600Z	16.2N	128.0E	- - -	-	- - -	-
191200Z	16.3N	127.3E	- - -	-	- - -	-
191800Z	16.3N	126.8E	- - -	-	- - -	-
200000Z	16.4N	126.1E	- - -	-	- - -	-
200600Z	16.6N	125.5E	- - -	-	- - -	-
201200Z	16.8N	124.8E	270	36	- - -	-
201800Z	17.2N	124.1E	215	25	- - -	-
210000Z	17.4N	123.7E	260	45	260	90
210600Z	17.9N	123.2E	155	44	220	64
211200Z	18.5N	122.5E	155	61	235	81
211800Z	19.4N	121.6E	140	43	150	130
220000Z	20.3N	120.9E	145	90	155	154
220600Z	21.4N	120.2E	040	54	155	143
221200Z	22.6N	119.3E	180	64	155	181
221800Z	23.9N	118.4E	165	50	205	127
230000Z	25.0N	117.3E	045	10	175	144

AVERAGE 12 HOUR FORECAST ERROR 47.5 NM
AVERAGE 24 HOUR FORECAST ERROR 123.8 NM


BEST TRACK
TYPHOON IRIS
19-23 AUG 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
23/00Z
22/00Z
21/00Z
20/00Z
19/00Z


12 HR FORECAST POSITS
TYPHOON IRIS
19-23 AUG 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
23/06OZ
23/00Z
22/00Z
21/00Z
20/00Z
19/00Z


24 HR FORECAST POSITS
TYPHOON IRIS
19-23 AUG 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
23/18OOZ
23/12OOZ
23/06OOZ
22/00Z
22/00OZ
21/00Z
20/00Z
19/00Z

G. TYPHOON JOAN (25-30 AUGUST 1959)

On 23 August, Guam's winds aloft shifted from easterly to northerly, and surface analyses indicated a surface center northeast of the island. A reconnaissance aircraft was directed into this suspect area, and a fix was made at 250325Z. On the basis of this information, Tropical Storm JOAN Warning Number 1 was transmitted with maximum surface winds near the center of 40 knots. The storm intensified very rapidly, and 23 hours later was upgraded to a typhoon with winds near the center of 85 knots.

Typhoon JOAN assumed and maintained a northwesterly course boresighted for the island of Taiwan. Movement began with a speed of 10 knots gradually increasing to 17 knots prior to hitting Taiwan. Her peak intensity was reached at 290800Z when aircraft reconnaissance observed maximum surface winds of 200 knots and a sea level pressure of 891 millibars. Orographic effect of the mountains of Taiwan had a decided weakening effect on JOAN as the center moved directly across the island. However, winds in excess of 50 knots were reported by several stations on Taiwan and there was considerable damage. Moving at a slower speed of 10 knots, and with surface winds under 100 knots, JOAN moved on to the Chinese Mainland at 300500Z and began to degenerate. At 301800Z, when it was evident that JOAN would remain inland and continue rapid dissipation, JTWC issued a final warning.

Climatologically JOAN was slightly premature since her track was similar to the path normal for early September. Typhoon NELLIE of September 1949 most closely approximated JOAN's track. JOAN was 1959's strongest typhoon in size and intensity. In horizontal extent, JOAN

dominated an area of the Western Pacific of more than 1,000 miles in diameter, and 50 knot winds extended up to a radius of 300 miles. Her minimum 700 millibar height and minimum sea level pressure set the record lows for the 1959 Typhoon Season. JOAN presented few forecast difficulties, although two questionables fixes on the 28th led to an erroneous recurvature forecast. Twenty-four warnings were issued covering a period of 6 days.

For damage caused by Typhoon JOAN see section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON JOAN

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	250325Z	16.0N	143.3E	54-P-5	1001	20	10040	30	10	10	CIRC DIA 20 MI
2	250600Z	15.9N	143.2E	54-P-5	998	45	10020	45	10	09	CIRC DIA 40 MI
3	252015Z	15.8N	140.4E	54-P-5	992	45	9890	38	12	09	EYE CIRC - OPEN NORTH
4	260215Z	15.6N	139.5E	54-P-10	984	85	9730	50	17	10	CIRC DIA 50 MI
5	260800Z	15.7N	138.7E	54-P-10	979	95	9600	60	16	09	CIRC DIA 50 MI
6	261400Z	16.0N	138.0E	54-R-15	- -	- -	- -	- -	- -	- -	----------
7	262315Z	16.5N	136.1E	54-P-5	972	100	9280	70	15	13	CIRC DIA 30 MI
8	270230Z	16.5N	135.4E	54-P-10	961	100	9190	80	17	12	CIRC DIA 30 MI
9	270745Z	16.7N	134.0E	54-P-5	961	100	8850	80	20	13	CIRC DIA 30 MI
10	271400Z	17.4N	132.7E	54-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 25 MI
11	271730Z	17.9N	132.4E	54-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 25 MI
12	272000Z	18.0N	131.5E	54-R-5	- -	- -	- -	80	- -	- -	CIRC DIA 25 MI
13	272100Z	18.3N	131.0E	54-P-5	916	100	7930	110	23	12	CIRC DIA 25 MI
14	272230Z	18.6N	130.9E	12-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI
15	280200Z	18.8N	130.0E	54-P-5	906	100	7520	125	24	12	CIRC DIA 18 MI
16	280800Z	19.3N	128.8E	54-P-5	906	175	7240	125	23	15	ELLIP AXIS 20 MI
17	281100Z	20.1N	128.3E	12-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI
18	281415Z	21.0N	127.6E	54-R-5	- -	- -	- -	125	- -	- -	CIRC DIA 18 MI
19	282125Z	21.1N	125.3E	54-P-5	891	190	6850	150	25	13	CIRC DIA 18 MI

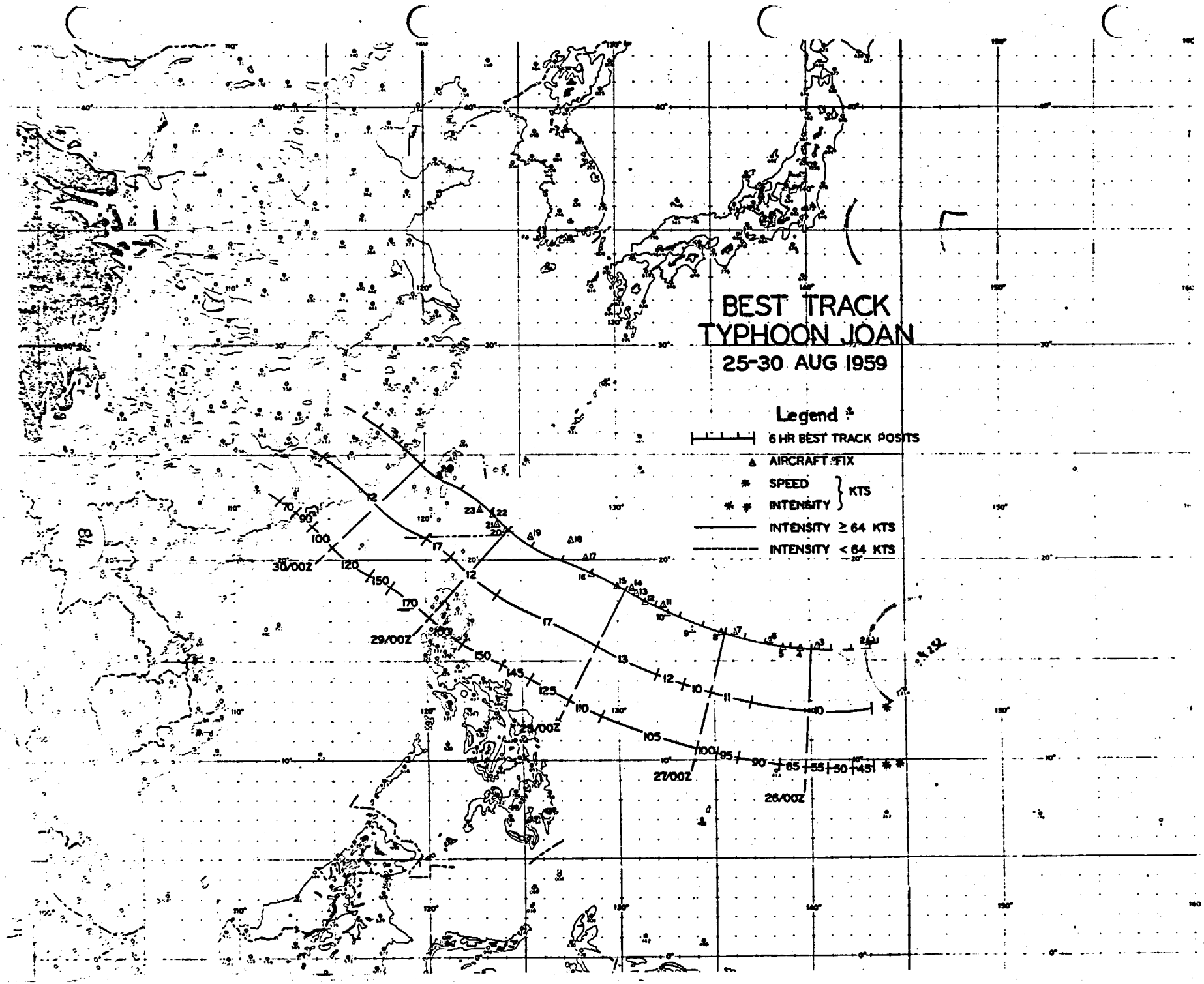
RECONNAISSANCE AIRCRAFT FIXES - JOAN (CONT'D)

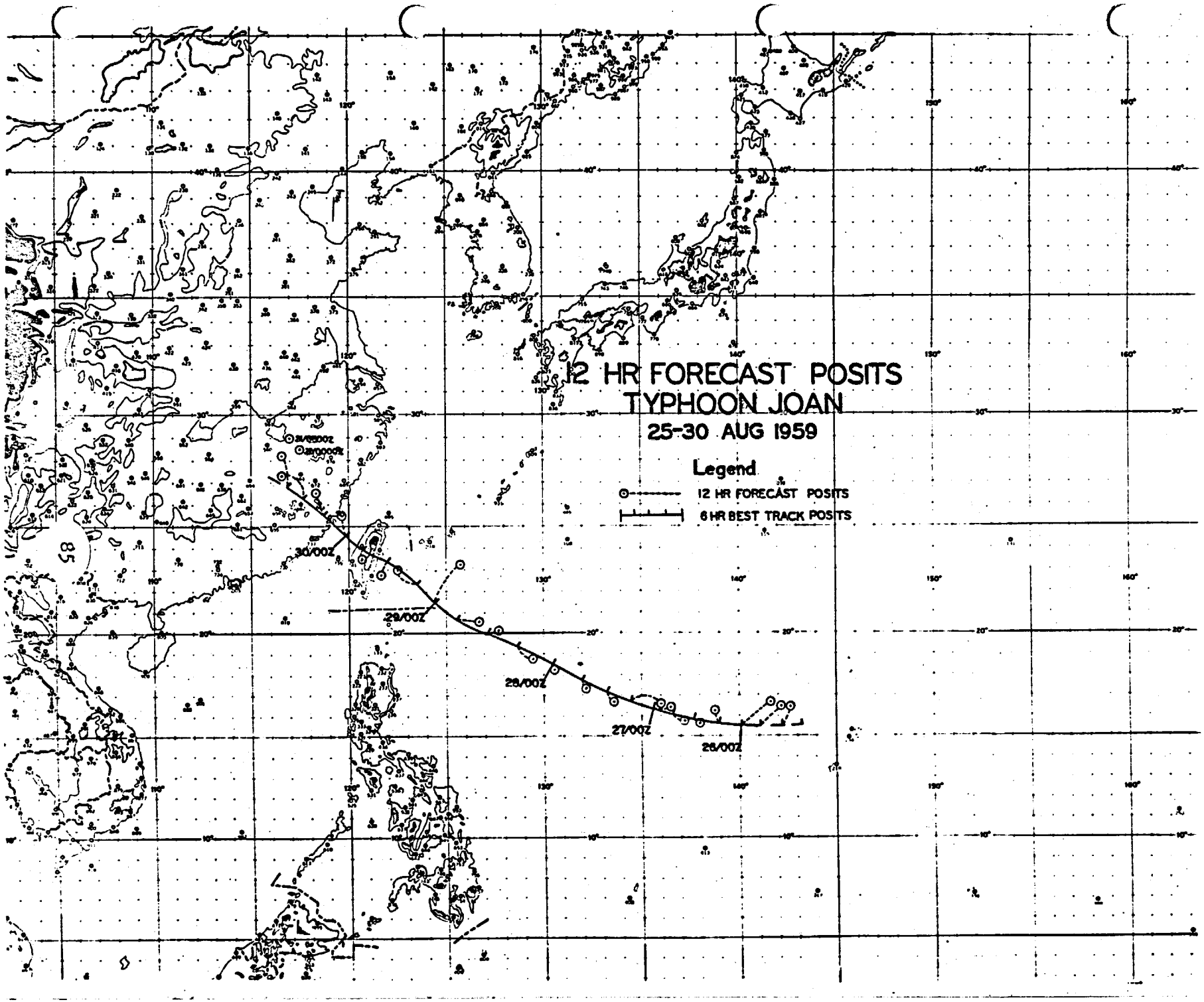
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
20	290200Z	21.5N	124.2E	54-P-2	898	- -	7190	140	17	12	CIRC DIA 20 MI
21	290340Z	21.8N	123.8E	56-R-5	900	150	- -	- -	- -	- -	ELLIP 35E-W 40N-S
22	290800Z	22.4N	123.0E	54-P-2	898	200	7280	180	21	16	CIRC DIA 20 MI
23	290522Z	22.1N	123.7E	12-R-2	- -	- -	- -	- -	- -	- -	----------
24	292050Z	24.0N	120.7E	54-T-30	- -	- -	- -	65	- -	- -	----------

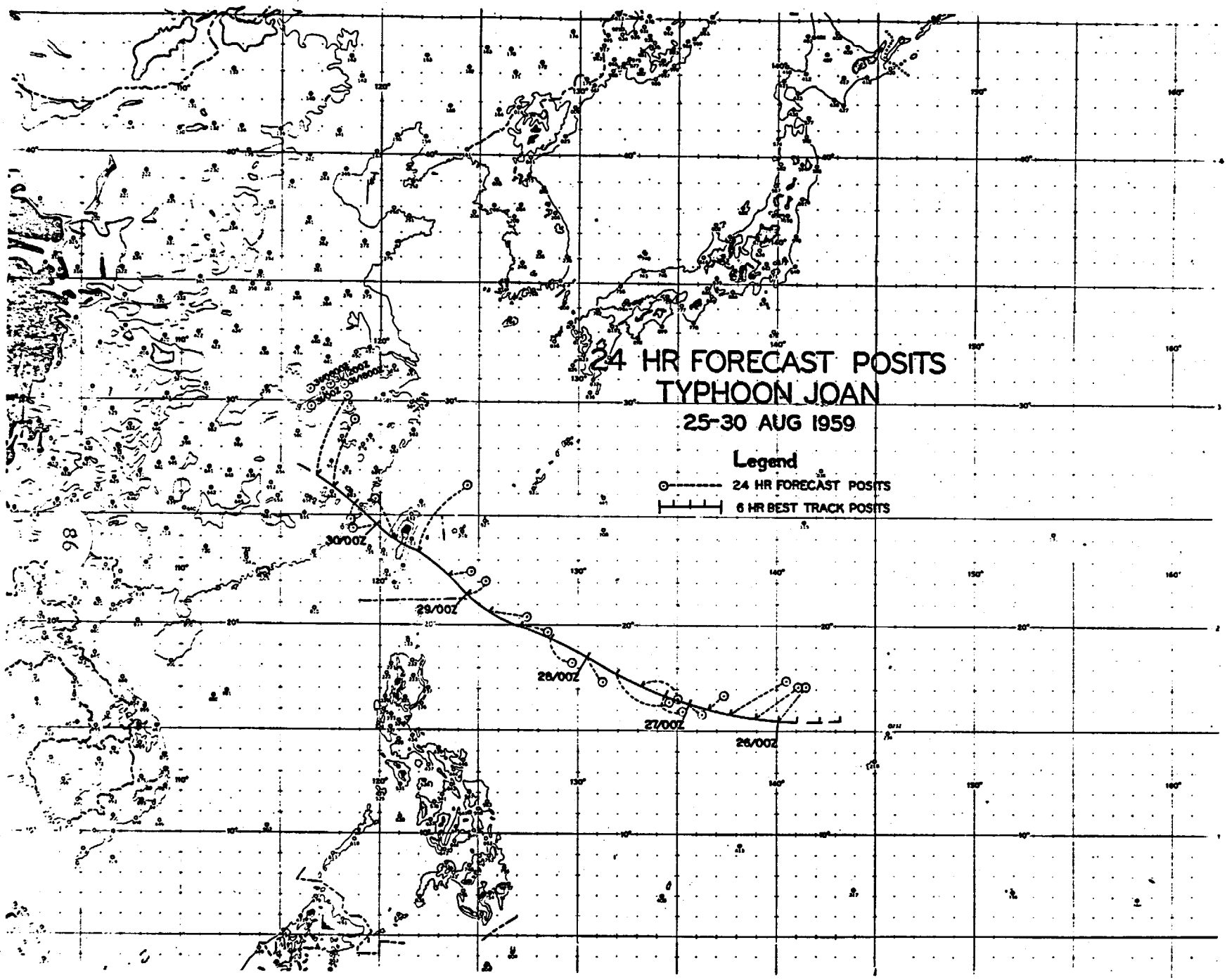
TYPHOON JOAN 25 - 30 AUGUST 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
250600Z	15.5N	143.2E	- - - -		- - - -	
251200Z	15.5N	142.2E	025	58	- - - -	
251800Z	15.6N	141.1E	045	79	- - - -	
260000Z	15.7N	140.1E	051	112	045	118
260600Z	15.8N	139.0E	065	60	057	139
261200Z	15.9N	137.8E	159	17	060	174
261800Z	16.2N	136.7E	120	31	040	51
270000Z	16.4N	135.7E	110	54	145	36
270600Z	16.8N	134.5E	108	130	134	63
271200Z	17.2N	133.3E	122	28	112	106
271800Z	17.7N	132.0E	169	28	114	156
280000Z	18.4N	130.4E	116	13	152	84
280600Z	19.2N	128.8E	116	38	135	85
281200Z	20.0N	127.2E	080	25	099	66
281800Z	20.8N	125.6E	110	66	110	92
290000Z	21.5N	124.5E	036	123	052	46
290600Z	22.2N	123.5E	310	75	072	72
291200Z	23.2N	122.0E	216	23	033	221
291800Z	23.9N	120.9E	213	29	300	108
300000Z	24.7N	119.9E	345	48	253	75
300600Z	25.4N	118.9E	332	76	214	37
301200Z	26.2N	117.9E	278	72	017	180
301800Z	26.9N	116.8E	342	72	019	204

AVERAGE 12 HOUR ERROR 57.1 NM
AVERAGE 24 HOUR ERROR 105.7 NM


BEST TRACK
TYPHOON JOAN
25-30 AUG 1959
Legend :
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z


12 HR FORECAST POSITS
TYPHOON JOAN
25-30 AUG 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z


24 HR FORECAST POSITS
TYPHOON JOAN
25-30 AUG 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z

H. TYPHOON LOUISE (30 AUGUST - 7 SEPTEMBER 1959)

On 27 August, while Typhoon JOAN was approximately 400 miles southeast of Taiwan, an elongated low pressure area extended from the vicinity of Truk eastward along the Intertropical Convergence Zone. Throughout the 28th, surface analyses indicated the formation of a closed circulation between Truk and Guam. Reconnaissance on the afternoon of the 30th confirmed the existence of a closed surface circulation, and Tropical Depression LOUISE was named. Subsequently, multiple circulations in the same general area were reported, but the strongest center, relocated west-northwest of Guam, retained the name LOUISE.

Throughout the 31st, LOUISE intensified and moved westerly at a speed of 12 knots. At 312105Z, based on reconnaissance, LOUISE was upgraded to a tropical storm. Throughout September 1st, slow recurvature toward the north-northwest took place with little change in speed. LOUISE also intensified rapidly so that at 010800Z she was upgraded to a typhoon. From the 2nd through the 5th, Typhoon LOUISE maintained a north-northwesterly movement at speeds varying from 5 to 14 knots accompanied by steady intensification. She appears to have reached peak intensity on the 3rd when maximum winds near the center of 125 knots and a sea level pressure of 964 millibars were reported. LOUISE crossed the northern coast of Taiwan at approximately 031300Z with estimated maximum surface winds of 115 knots. The diameter of the eye at this time was approximately 50 miles, and the center tended to slide over and around northern Taiwan. On reaching the Taiwan Straits, the eye diameter had increased to 100 miles, and the maximum surface winds had decreased to an estimated 65 knots. At

040600Z, due to rapid weakening, LOUISE was reduced to a tropical storm, and at approximately 041200Z she entered the Chinese coast near 26.5 degrees north. Shortly thereafter recurvature toward the north-northeast took place. Due to continued orographic weakening LOUISE was reduced to a tropical depression at 041800Z. At 052100Z, in the vicinity of Shanghai, LOUISE regained the open sea and proceeded northward intensifying slightly. At 060000Z she once again increased to tropical storm intensity. As LOUISE moved farther into northern latitudes she again began to weaken, and at 072100Z she was reduced to a tropical depression and the final tropical warning issued . By this time LOUISE had developed into an extra-tropical low imbedded in the Polar Front.

Post analysis of the upper air charts indicates that the persistence of the semi-permanent Pacific High to the northeast of LOUISE resulted in her prolonged, steady, north northwesterly movement onto the China Coast. This is typical of late August climatology. After reaching approximately 30 degrees latitude, she passed the ridge-line of the high and thereafter had a more northerly to northeasterly movement. Thirty-eight warnings were issued covering a period of 10 days.

For damage caused by Typhoon LOUISE see section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON LOUISE

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	300030Z	14.5N	141.0E	54-P-5	1008	15	- -	- -	24	20	CNTR CALM
2	310645Z	14.3N	134.9E	54-P-5	1001	20	- -	25	24	24	EYE DIFFUSE
3	312105Z	15.0N	131.9E	54-P-5	996	35	9950	45	11	08	WALL CLDS, SPIRAL BANDS
4	010800Z	15.2N	129.7E	54-P-5	986	65	9830	60	13	10	CIRC DIA 60 MI
5	011930Z	16.6N	127.0E	54-P-2	- -	- -	9820	25	13	08	EYE INDEFINITE
6	012110Z	16.9N	127.7E	54-P-2	985	65	9720	- -	13	08	CIRC DIA 40 MI
7	020200Z	16.9N	126.1E	54-P-2	980	85	9660	- -	12	12	CIRC DIA 50 MI
8	020800Z	18.1N	125.2E	54-P-2	977	80	9450	80	16	13	ELLIP 35X20 MI
9	021050Z	18.7N	124.6E	12-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 30 MI
10	021430Z	20.0N	124.4E	54-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 55 MI
11	022000Z	20.4N	123.6E	54-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 50 MI
12	022215Z	20.8N	123.4E	54-P-3	971	100	9180	- -	17	11	CIRC DIA 50 MI
13	022244Z	20.9N	123.5E	12-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 50 MI
14	030200Z	21.8N	122.9E	54-P-5	971	125	9180	- -	16	11	CIRC DIA 40 MI
15	030810Z	22.9N	122.4E	54-P-5	964	95	9120	90	16	13	CIRC DIA 65 MI
16	031042Z	23.6N	121.8E	12-R-0	- -	- -	- -	- -	- -	- -	CIRC DIA 50 MI
17	031400Z	24.3N	121.4E	54-T-20	- -	- -	- -	- -	- -	- -	----------
18	032000Z	25.0N	121.4E	54-T-25	- -	- -	- -	- -	- -	- -	EYE INDEFINITE
19	032315Z	25.0N	120.7E	54-P-2	993	125	9940	- -	11	11	CIRC DIA 50 MI
20	040200Z	25.5N	120.4E	54-P-2	994	65	9910	- -	12	11	CIRC DIA 100 MI

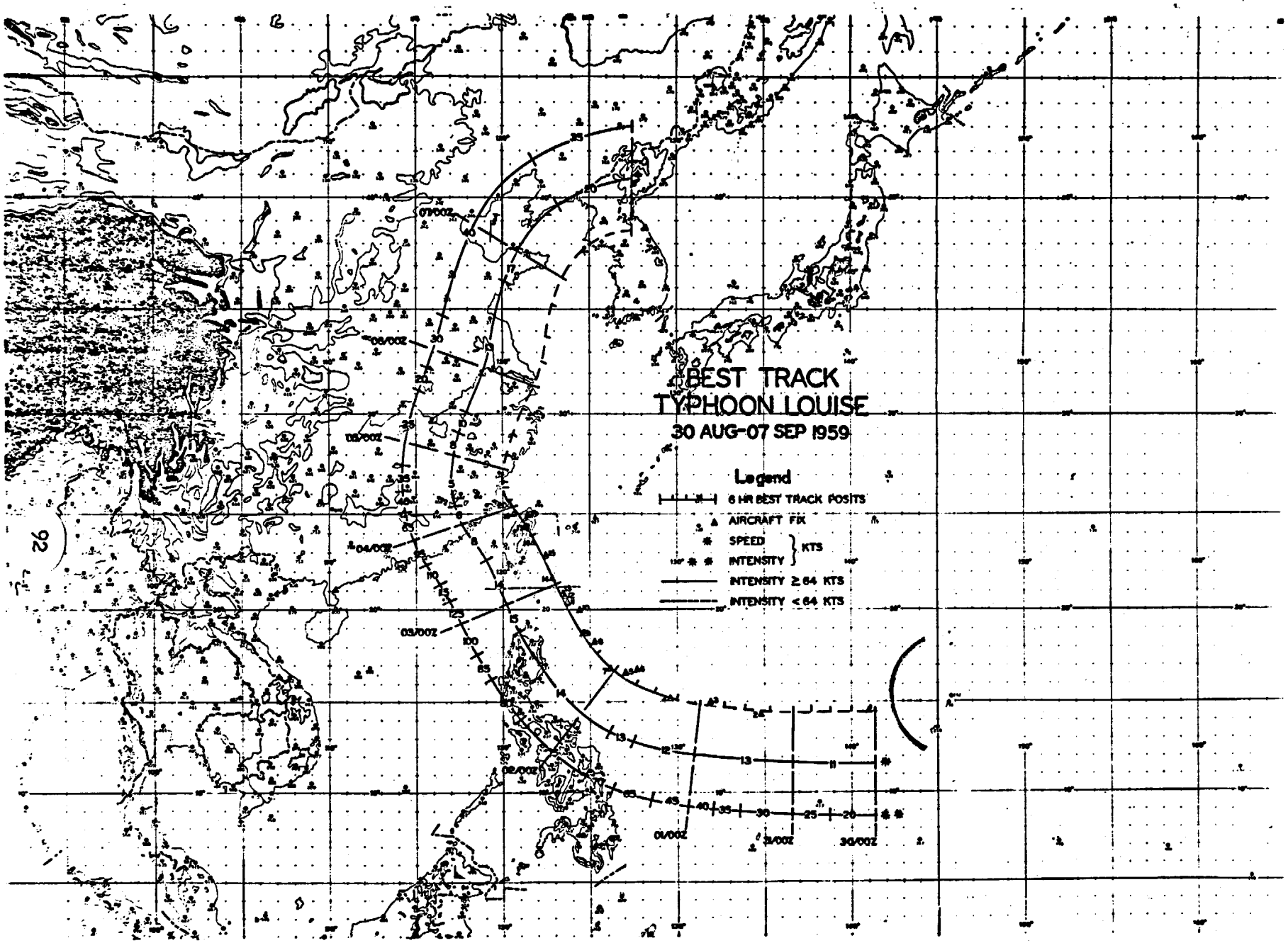
TYPHOON LOUISE 30 AUG - 07 SEPT 1959
POSITION AND FORECAST VERIFICATION DATA

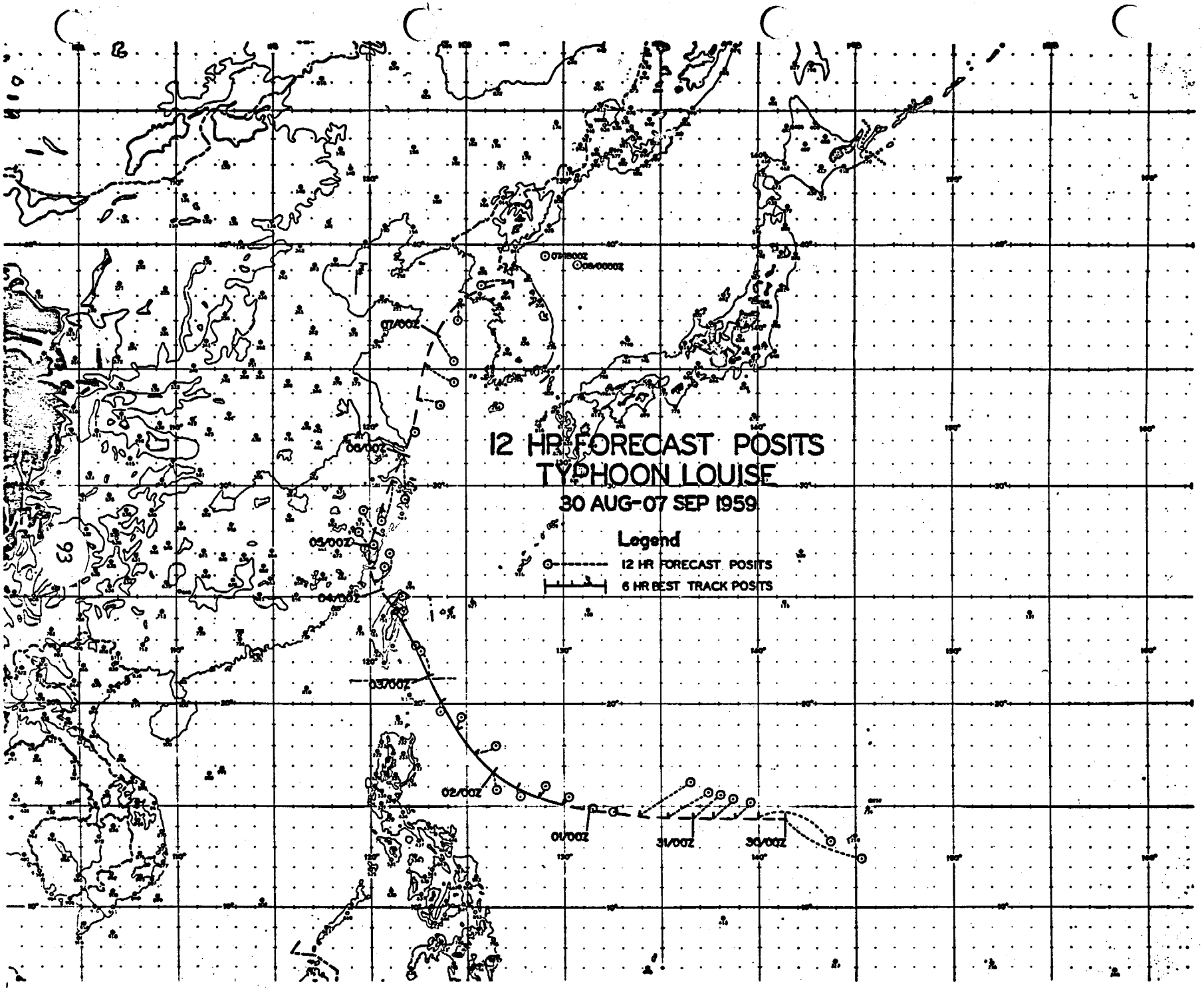
DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
300000Z	14.4N	141.2E	- - - -		- - - -	
300600Z	14.5N	140.0N	- - - -		- - - -	
301200Z	14.5N	138.8E	- - - -		- - - -	
301800Z	14.5N	137.7E	- - - -		- - - -	
310000Z	14.5N	136.6E	- - - -		- - - -	
310600Z	14.5N	135.2E	- - - -		- - - -	
311200Z	14.6N	133.9E	- - - -		- - - -	
311800Z	14.7N	132.6E	- - - -		- - - -	
010000Z	14.9N	131.2E	- - - -		- - - -	
010600Z	15.2N	130.0E	013	22	- - - -	
011200Z	15.5N	128.8E	017	32	- - - -	
011800Z	16.0N	127.6E	175	32	010	18
020000Z	16.8N	126.3E	042	13	076	55
020600Z	17.8N	127.3E	079	69	183	87
021200Z	18.9N	124.5E	171	35	193	122
021800Z	20.1N	123.7E	190	15	112	45
030000Z	21.5N	123.1E	341	75	345	80
030600Z	22.8N	122.4E		0	203	58
031200Z	23.9N	121.6E	040	26	353	144
031800Z	24.6N	121.1E	050	40	025	94
040000Z	25.2N	120.6E	002	72	023	167
040600Z	25.7N	120.2E	028	89	037	162
041200Z	26.2N	120.1E	358	76	005	190
041800Z	26.7N	120.0E	311	70	015	204
050000Z	27.2N	120.0E	325	58	000	195
050600Z	28.0N	120.2E	- - - -		310	123
051200Z	29.0N	120.5E	- - - -		293	90
051800Z	30.2N	121.1E	- - - -		- - - -	
060000Z	31.3N	121.8E	- - - -		- - - -	
060600Z	32.6N	122.2E	- - - -		- - - -	
061200Z	33.8N	122.5E	107	71	- - - -	
061800Z	35.2N	122.8E	- - - -		- - - -	

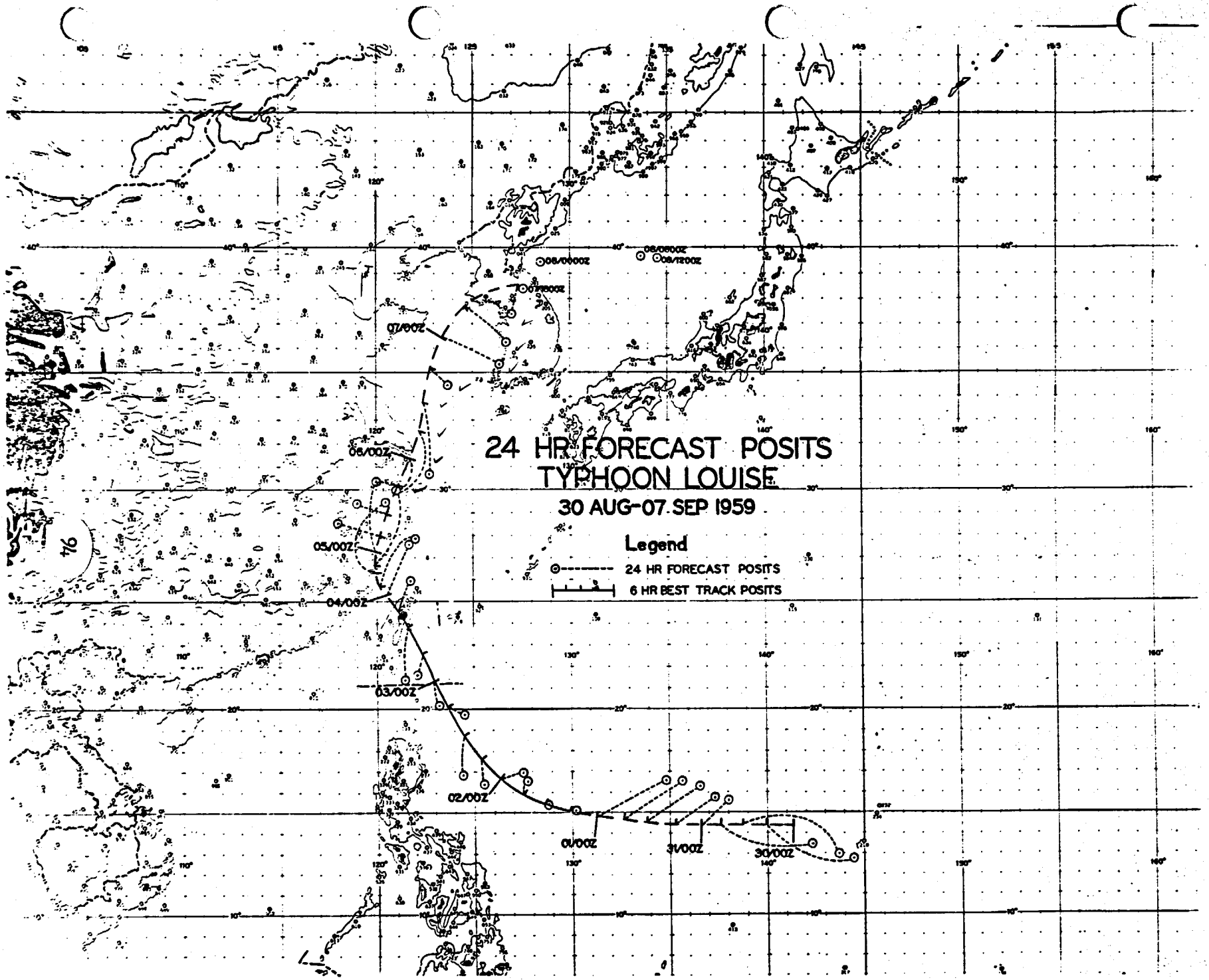
TYPHOON LOUISE 30 AUG - 07 SEPT 1959
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
070000Z	36.3N	123.4E	- - - -		- - - -	
070600Z	37.7N	124.7E	- - - -		- - - -	
071200Z	38.5N	127.0E	- - - -		- - - -	

AVERAGE 12 HOUR FORECAST ERROR 46.8 NM
AVERAGE 24 HOUR FORECAST ERROR 114.6 NM


BEST TRACK
TYPHOON LOUISE
30 AUG-07 SEP 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
01/00Z
02/00Z
03/00Z
04/00Z
05/00Z
06/00Z
07/00Z
21/00Z
30/00Z


12 HR FORECAST POSITS
TYPHOON LOUISE
30 AUG-07 SEP 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
07/00Z
08/00Z
06/00Z
05/00Z
04/00Z
03/00Z
02/00Z
01/00Z
31/00Z
30/00Z


24 HR FORECAST POSITS
TYPHOON LOUISE
30 AUG-07 SEP 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
08/00GZ
08/06GZ
08/12GZ
07/18GZ
07/00Z
06/00Z
05/00Z
04/00Z
03/00Z
02/00Z
01/00Z
31/00Z
30/00Z

I. TYPHOON PATSY (6-10 SEPTEMBER 1959)

Early on 6 September, quite unexpectedly, a series of pilot reports were received which confirmed the existence of a tropical cyclone, of at least tropical storm intensity, approximately 600 miles south-southwest of Midway Island. Based on these reports, which were from scheduled commercial and MATS flights between Honolulu and Wake Island, JTWC issued the first warning on Tropical Storm PATSY. Reconnaissance was requested, and a fix was made by a B-50 of the 54th Weather Reconnaissance Squadron at 061905Z. The maximum observed surface wind was 150 knots. PATSY was therefore upgraded to a typhoon in the next warning. Because of the sparsity of data in the area where PATSY was first discovered, surface and upper air charts, analyzed prior to receipt of the initial pilot reports pertaining to PATSY, failed to show any indication of a tropical cyclone in the formative stage of development.

PATSY at first moved to the northeast at 15 knots, steered by an upper level trough in the westerlies located to the west of the typhoon. However, 48 hours later, a second trough developed to the west of PATSY, and became the dominant trough. Under the influence of the latter trough, which had an unusual northwest-southeast orientation, PATSY curved to the northwest moving at 15 knots. As the trough-line neared the longitude of the typhoon, PATSY decelerated rapidly and began recurving to the northeast. Then, after making the turn, PATSY moved up the 180th meridian at 10 to 12 knots for the next 30 hours, slowly weakening. The final tropical warning was

issued at 101200Z.

PATSY was somewhat unique in that, by oscillating back and forth across the 180th meridian, she was quite properly called both a typhoon and hurricane. Perusal of climatological data covering the past 10 years failed to reveal a track similar to that of PATSY. A total of 17 warnings were issued covering a period of 5 days.

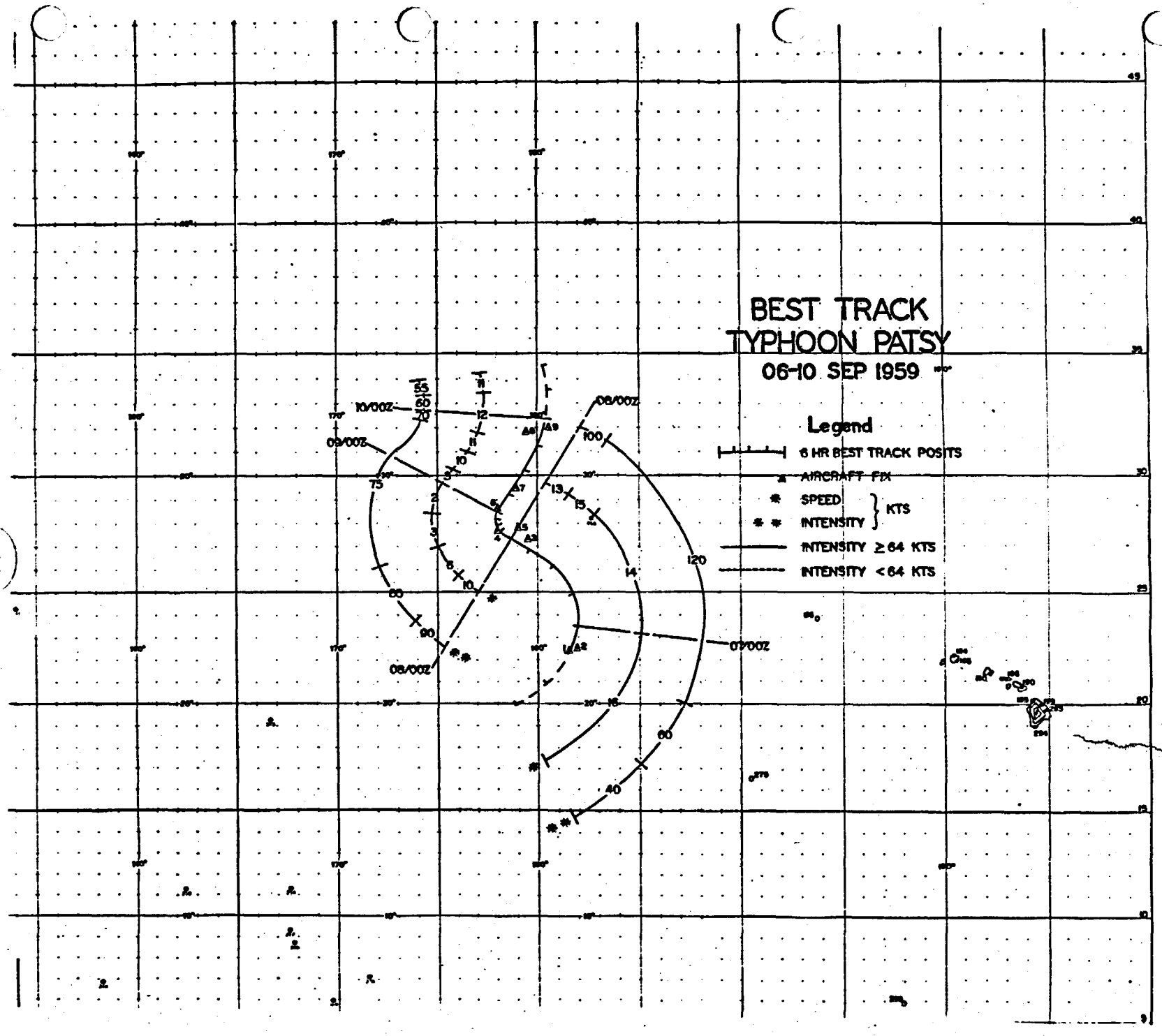
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON PATSY

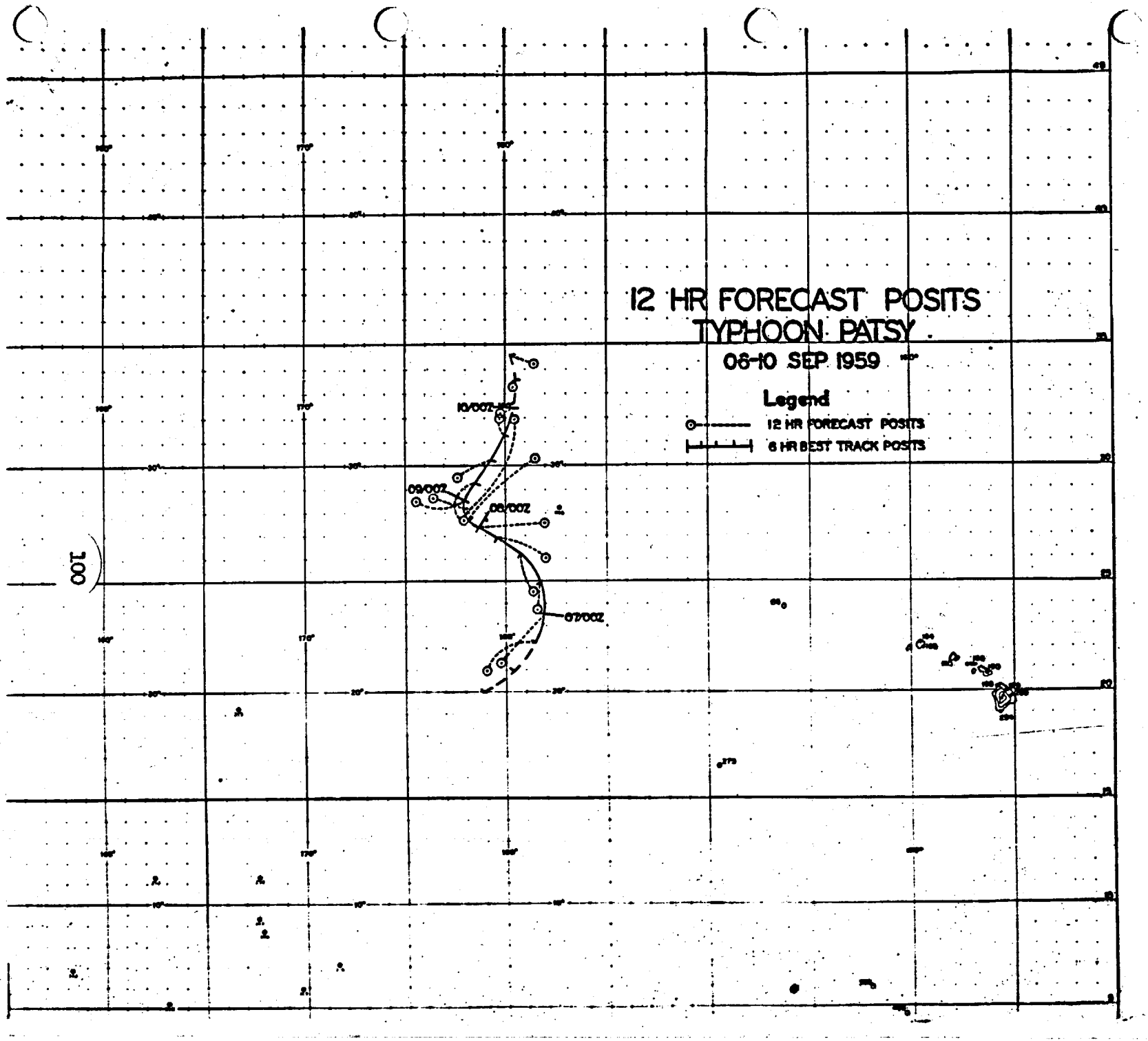
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	061905Z	22.4N	178.4W	54-P-30	960	150	9280	85	21	14	CIRC DIA 10 MI
2	062205Z	22.5N	178.0W	54-P-25	- -	150	9360	50	22	15	CIRC DIA 10 MI
3	072000Z	27.2N	179.4E	54-P-5	972	100	9400	50	- -	- -	CIRC DIA 10 MI
4	080545Z	27.8N	178.0E	55-P-20	960	70	9310	85	- -	- -	CIRC DIA 10 MI
5	081900Z	27.9N	178.0E	55-P—	970	- -	9620	- -	- -	- -	CIRC DIA 10 MI
6	090314Z	28.5N	178.0E	AF-R—	- -	- -	- -	- -	- -	- -	———
7	090650Z	29.3N	179.0E	54-P-10	968	60	9250	60	16	10	CIRC DIA 40 MI
8	092058Z	31.9N	179.5E	VW-R—	- -	- -	- -	- -	- -	- -	———
9	092244Z	32.0N	179.2W	VW-R—	- -	- -	- -	- -	- -	- -	———

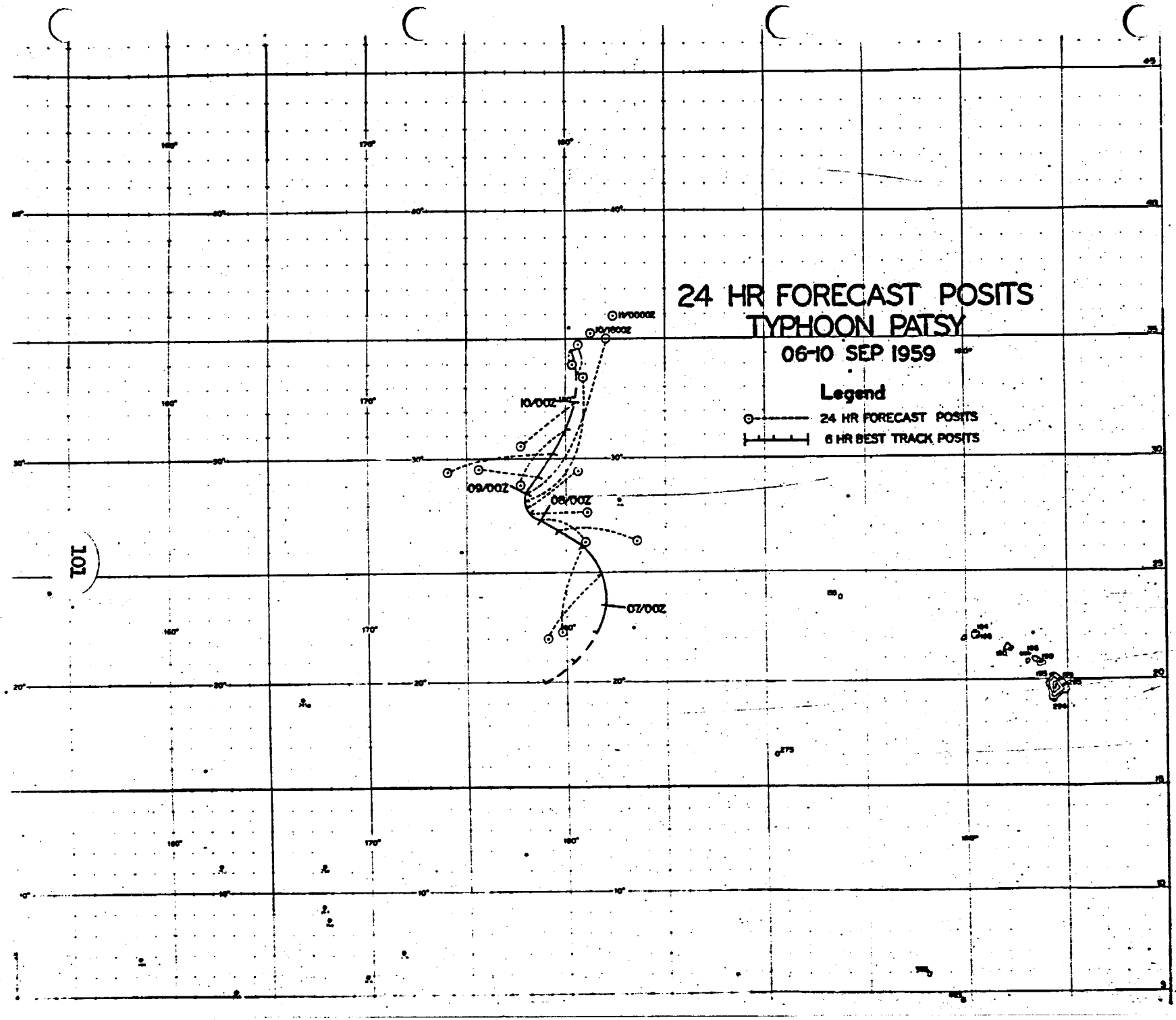
TYPHOON PATSY 06 - 10 AUGUST 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
060600Z	20.0N	179.0E	- - - -		- - - -	
061200Z	20.8N	179.5W	- - - -		- - - -	
061800Z	22.2N	178.5W	243	151	- - - -	
070000Z	23.5N	178.1W	219	179	- - - -	
070600Z	24.9N	178.2W	188	75	222	236
071200Z	26.2N	179.1W	160	114	194	248
071800Z	26.9N	179.7E	113	135	101	212
080000Z	27.3N	178.7E	087	176	119	141
080600Z	27.7N	178.2E	006	152	090	150
081200Z	27.9N	178.0E	019	260	056	164
081800Z	28.1N	177.9E	290	82	025	354
090000Z	28.4N	178.0E	273	134	028	446
090600Z	29.2N	178.7E	203	87	270	161
091200Z	30.2N	179.3E	243	99	254	276
091800Z	31.2N	180.0-	352	46	221	184
100000Z	32.4N	179.6W	252	29	230	185
100600Z	33.5N	179.6W	180	16	010	83
101200Z	34.5N	179.8E	106	80	138	38

AVERAGE 12 HOUR ERROR 113.4 NM
AVERAGE 24 HOUR ERROR 205.6 NM


BEST TRACK
TYPHOON PATSY
06-10 SEP 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
10/00Z
09/00Z
08/00Z
07/00Z
120
100
75
60
40
90
55
60
70
12
11
10
3
2
3
6
10
13
15
14
16
60
40


12 HR FORECAST POSITS
TYPHOON PATSY
06-10 SEP 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
10/00Z
09/00Z
08/00Z
07/00Z
100


24 HR FORECAST POSITS
TYPHOON PATSY
06-10 SEP 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
10/00Z
09/00Z
08/00Z
07/00Z
101

J. TYPHOON SARAH (11-18 SEPTEMBER 1959)

Early on 10 September Tropical Storm NORA in the South China Sea, Tropical Depression RUTH midway between Guam and the Philippines, and a suspect area north of Ponape, all lay along the Intertropical Convergence Zone. By 101200Z RUTH had dissipated and reconnaissance into the suspect area was planned for the next day. The reconnaissance aircraft located a center 70 miles east of Guam at 110200Z. Tropical Depression SARAH was named and warning number 1 was issued with center winds of 30 knots. Subsequent fixes by the same aircraft indicated a rather indefinite situation with several small centers. However, from land radar, it was possible to determine that the primary center (SARAH) passed just north of Guam at 111000Z. Guam experienced only light gusty winds and occasional showers. By 112000Z, SARAH, now a fairly well defined circulation, had reached tropical storm intensity; and twelve hours later, at 120800Z, she was a typhoon with center winds of 65 knots.

SARAH followed a rather classical parabolic track, a track which took her directly over the island of Miyako Jima and just a few miles west of Pusan, Korea. SARAH passed over Miyako Jima at approximately 150900Z. Maximum sustained winds of 106 knots were reported there with gusts to 130 knots (which caused the anemometer to blow away). Although SARAH passed 150 miles to the west of Okinawa, Naha reported winds of 73 knots. After SARAH raked the southeastern tip of Korea she began to weaken and accelerate. Further weakening took place over the Sea of Japan. By 180600Z, over Hokkaido, SARAH had become extratropical and the final tropical warning was issued.

SARAH was the third most intense typhoon of the year. Surface winds reached a maximum of 165 knots, and the surface pressure dropped to a minimum of 905 millibars. Climatologically, SARAH recurved slightly farther west than is normal for mid-September. Although this caused Miyako Jima to bear the brunt of the onslaught, SARAH was also the worst typhoon experienced by Korea in 50 years. As previously indicated, SARAH followed a very stable path, and only minor forecasting difficulties were encountered. Thirty warnings were issued covering a period of 8 days.

For damage caused by Typhoon SARAH see Section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON SARAH

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	110200Z	13.6N	146.2E	54-P-10	1008	35	- -	- -	- -	- -	CNTR OVC HVY RAIN
2	110645Z	13.7N	145.4E	54-P-2	999	20	10140	20	10	09	CNTR DIFFUSE
3	110800Z	13.8N	145.6E	54-P-2	- -	- -	10120	- -	09	09	CNTR DIFFUSE
4	112000Z	13.5N	142.4E	54-P-5	996	30	9900	50	12	09	CNTR DIFFUSE
5	120200Z	13.4N	141.2E	54-P-2	988	60	9760	55	15	10	CIRC DIA 30 MI
6	120800Z	14.0N	140.0E	54-P-5	980	60	9660	65	13	12	CIRC DIA 35 MI
7	121415Z	14.9N	138.3E	54-R-5	- -	- -	- -	55	- -	- -	EYE DIA 35 MI
8	122038Z	16.0N	136.5E	54-P-10	964	75	9090	70	14	11	CIRC DIA 07 MI
9	122330Z	16.3N	135.8E	54-P-5	963	115	9040	85	16	11	CIRC DIA 08 MI
10	130800Z	17.5N	133.7E	54-P-8	959	125	8880	100	16	- -	CIRC DIA UNKN
11	131400Z	18.7N	131.8E	54-R-20	- -	- -	- -	- -	- -	- -	
12	132000Z	19.3N	130.6E	54-R-5	- -	- -	- -	- -	- -	- -	EYE DIA 20 MI
13	132030Z	19.4N	130.4E	54-P-5	943	- -	8530	- -	20	09	CIRC DIA 20 MI
14	132307Z	19.6N	130.0E	12-R-15	- -	- -	- -	- -	- -	- -	CIRC DIA 30 MI
15	140225Z	19.8N	129.3E	54-P-2	- -	- -	8230	100	20	14	OBLONG 35 MI WIDE
16	140800Z	20.6N	128.3E	54-P-3	919	150	7830	120	21	10	CIRC DIA 20 MI
17	141100Z	20.9N	128.0E	12-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI
18	141400Z	21.3N	127.4E	54-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI
19	142200Z	22.4N	126.6E	54-P-2	905	170	7510	135	26	15	CIRC DIA 15 MI

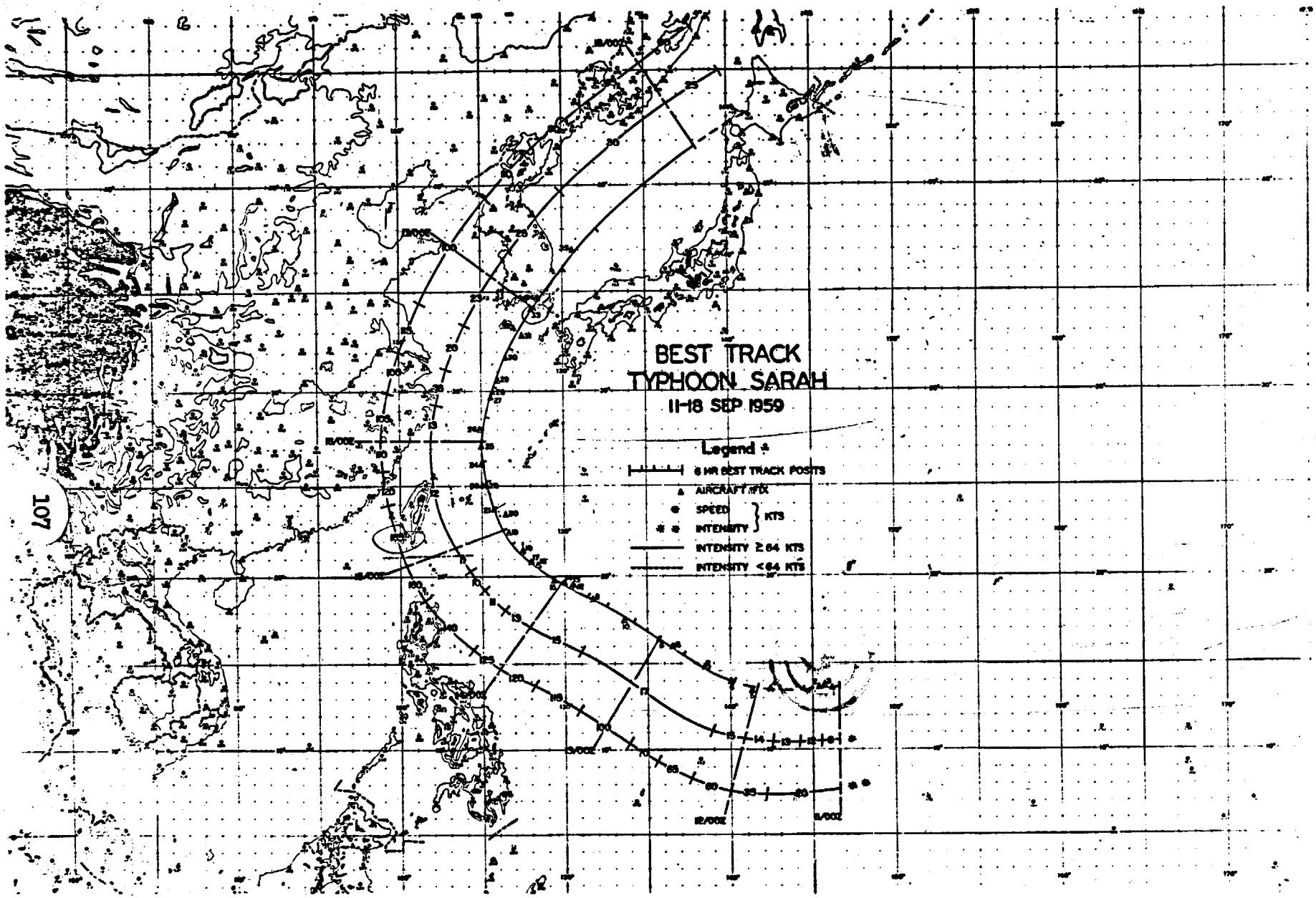
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON SARAH (CONT'D)

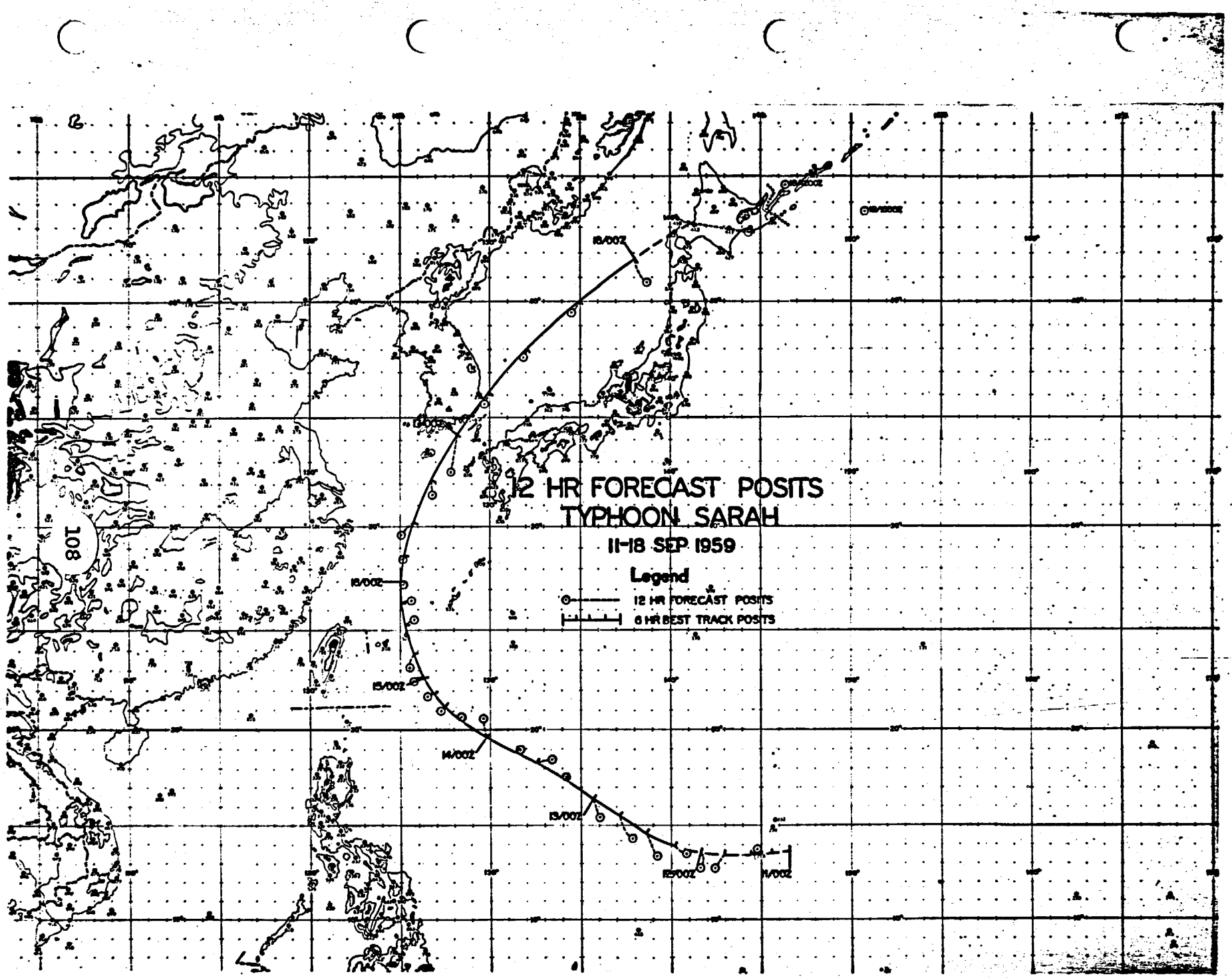
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
20	150156Z	23.4N	126.3E	56-P-5	905	130	- -	- -	- -	- -	CIRC DIA 15 MI
21	150540Z	23.8N	125.8E	56-R-5	- -	- -	- -	- -	- -	- -	----------
22	151110Z	25.0N	125.2E	12-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 25 MI
23	151230Z	25.0N	125.1E	54-R-3	- -	- -	- -	- -	- -	- -	ELLIP 20X15 MI
24	151853Z	26.1N	125.0E	56-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI
25	152309Z	27.1N	125.0E	12-R-2	- -	- -	- -	- -	- -	- -	CIRC DIA 23 MI
26	160342Z	28.0N	124.9E	56-P-5	930	- -	8330	- -	15	15	CIRC DIA 25 MI
27	161030Z	29.7N	125.6E	54-P-5	936	- -	8340	90	19	15	CIRC DIA 20 MI
28	161100Z	30.0N	125.6E	12-R-15	- -	- -	- -	- -	- -	- -	DIA 20 MI
29	161400Z	30.5N	126.0E	54-R-5	- -	- -	8750	95	- -	- -	CIRC DIA 20 MI
30	161700Z	31.6N	126.5E	54-R-20	- -	- -	- -	- -	- -	- -	----------
31	162000Z	32.9N	127.6E	54-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI
32	162140Z	33.1N	127.0E	54-P-5	944	150	8630	90	19	13	CIRC DIA 25 MI
33	170025Z	34.1N	128.1E	12-R-5	- -	- -	- -	- -	- -	- -	CIRC POORLY DEFINED
34	170200Z	34.6N	128.4E	56-P-3	(942)	100	- -	- -	- -	- -	CIRC DIA 20 MI
35	170900Z	37.0N	130.6E	54-P-2	- -	150	9190	60	19	13	CIRC DIA 60 MI

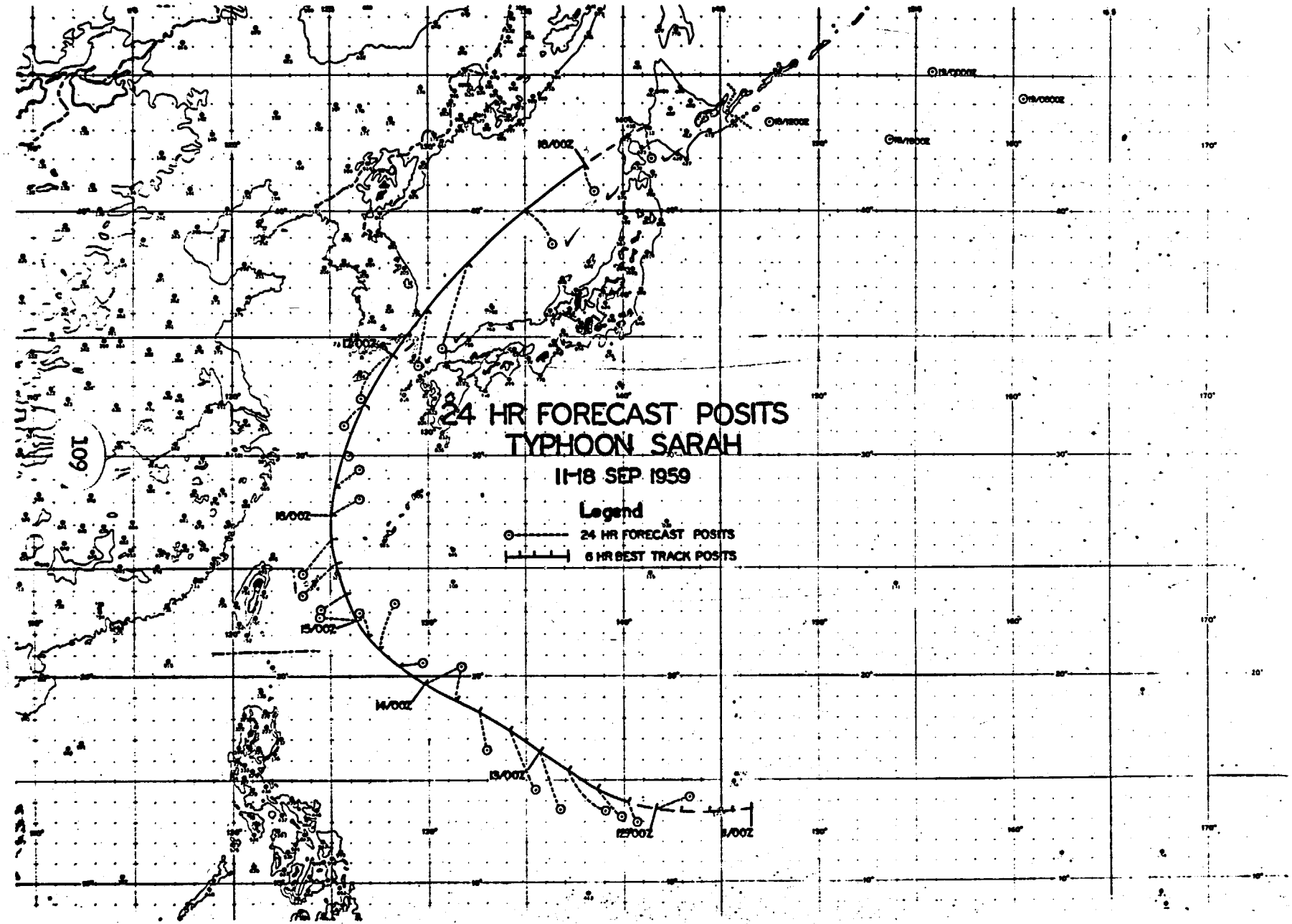
TYPHOON SARAH 11 - 19 SEPT. 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
110000Z	13.8N	146.4E	- - - -		- - - -	
110600Z	13.6N	145.6E	- - - -		- - - -	
111200Z	13.5N	144.3E	- - - -		- - - -	
111800Z	13.4N	143.0E	- - - -		- - - -	
120000Z	13.5N	141.5E	- - - -		- - - -	
120600Z	14.0N	140.1E	123	55	- - - -	
121200Z	14.7N	138.7E	162	85	- - - -	
121800Z	15.5N	137.1E	152	96	137	159
130000Z	16.4N	135.6E	160	70	160	180
130600Z	17.3N	134.1E	352	20	155	175
131200Z	18.2N	132.6E	067	45	165	124
131800Z	18.9N	131.2E	090	27	023	82
140000Z	19.7N	129.8E	270	10	110	112
140600Z	20.5N	128.6E	280	14	073	69
141200Z	21.2N	127.7E	240	30	010	128
141800Z	21.9N	126.9E	255	30	330	74
150000Z	22.8N	126.3E	230	44	268	95
150600Z	23.9N	125.7E	200	52	225	87
151200Z	25.2N	125.2E	040	44	230	114
151800Z	26.2N	125.0E	065	32	220	110
160000Z	27.4N	124.9E	138	23	245	89
160600Z	28.7N	125.1E	195	21	065	73
161200Z	30.2N	125.8E	225	53	240	19
161800Z	32.1N	126.8E	175	32	220	69
170000Z	34.2N	128.1E	190	92	215	138
170600Z	36.2N	129.8E	- - - -		- - - -	
171200Z	38.0N	132.0E	- - - -		- - - -	
171800Z	40.1N	134.8E	- - - -		- - - -	
180000Z	41.9N	138.0E	- - - -		- - - -	
180600Z	43.1N	141.1E	- - - -		- - - -	
181200Z	44.8N	143.6E	- - - -		- - - -	
181800Z	46.8N	145.5E	- - - -		- - - -	
190000Z	48.8N	146.8E	- - - -		- - - -	
190600Z	50.4N	147.3E	- - - -		- - - -	

AVERAGE 12 HOUR ERROR 43.8 NM
AVERAGE 24 HOUR ERROR 105.9 NM


BEST TRACK
TYPHOON SARAH
11-18 SEP 1959
Legend :
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
107


12 HR FORECAST POSITS
TYPHOON SARAH
11-18 SEP 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
18/00Z
16/00Z
15/00Z
14/00Z
13/00Z
12/00Z
11/00Z
108


24 HR FORECAST POSITS
TYPHOON SARAH
11-18 SEP 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
18/00Z
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z
12/00Z
11/00Z

K. TYPHOON VERA (21-27 SEPTEMBER 1959)

As early as 20 September, surface map analyses indicated a diffuse area of low pressure lying between Guam and Truk. During the 21st the low pressure area, now located approximately 300 miles east of Saipan, appeared to intensify and drift slowly westward. Late on the 21st a reconnaissance aircraft, dispatched to investigate the suspect area, was unable to reach the forecast position of the center due to an engine failure. However, periferal data from the aircraft were sufficient to confirm the existence of a tropical cyclone of at least tropical storm intensity. Tropical Storm VERA was named and the first warning, with a valid time of 211800Z, was issued.

At 220645Z an aircraft reconnaissance fix positioned VERA 110 miles north-northeast of Saipan. Later reconnaissance indicated the surface winds to be 75 knots near the center, and VERA was upgraded to a typhoon at 221800Z. VERA intensified rapidly, and at 231200Z reached her greatest intensity with winds of 165 knots near the center. At this time VERA was centered 400 miles north-northwest of Guam. During the 23rd and 24th VERA moved in a northwesterly direction at an average speed of 10 to 12 knots, with little change in intensity. Iwo Jima, although 225 miles northeast of VERA, reported gusts of 77 knots and minor damage. On the 25th, a gradual recurvature to the north began, together with a rapid acceleration in speed of movement to 18 knots. At approximately 260900Z, VERA crossed the coast of Honshu just to the west of Shiono-Misaki. The pressure tendencies and wind shifts at this station were quite classical in depicting the passage of the typhoon. At 260900Z the 3 hourly pressure tendency

showed a drop of 41.8 millibars with sustained winds of 60 knots from the southeast. At 261200Z, 3 hours after the passage of VERA, the station showed a pressure rise of 51.0 millibars and sustained winds of 50 knots from the west-southwest. To depict the lateral size as well as the intensity of Typhoon VERA, a checkerboard, showing surface reports from a number of representative stations in Japan, is included as page 113. As she passed inland, VERA moved at speeds as high as 33 knots. She thus made a rapid transit across Central Honshu, passed just to the west of Nagoya, and entered the Sea of Japan at 261530Z at a point north of Toyama. Moving into the Westerlies, VERA assumed a more easterly component and moved over the north coast of Honshu near Sakata. Movement over land plus strong cold air advection rapidly weakened her as she headed into the North Pacific Ocean at 262300Z. At 270600Z VERA was reduced to a tropical storm and the final tropical warning issued. By this time she was obviously losing her tropical characteristics and was imbedded in the Polar Front.

Typhoon VERA reached her peak intensity early in her history, and did not weaken appreciably until reaching well into northern latitudes. This may be attributed in part to strong divergence aloft which accompanied VERA until she moved into the Zonal Westerlies over Japan. As VERA moved northeastward across central Honshu, a wide swath of 50 knot winds was reported. Komaki Air Base, near Nagoya, reported 80 knot winds with gusts to 120, as the eye passed slightly to the west. Widespread heavy rain and floods accompanying the typhoon winds caused the greatest loss of life and destruction of property in Japanese Typhoon History. Climatologically, VERA followed

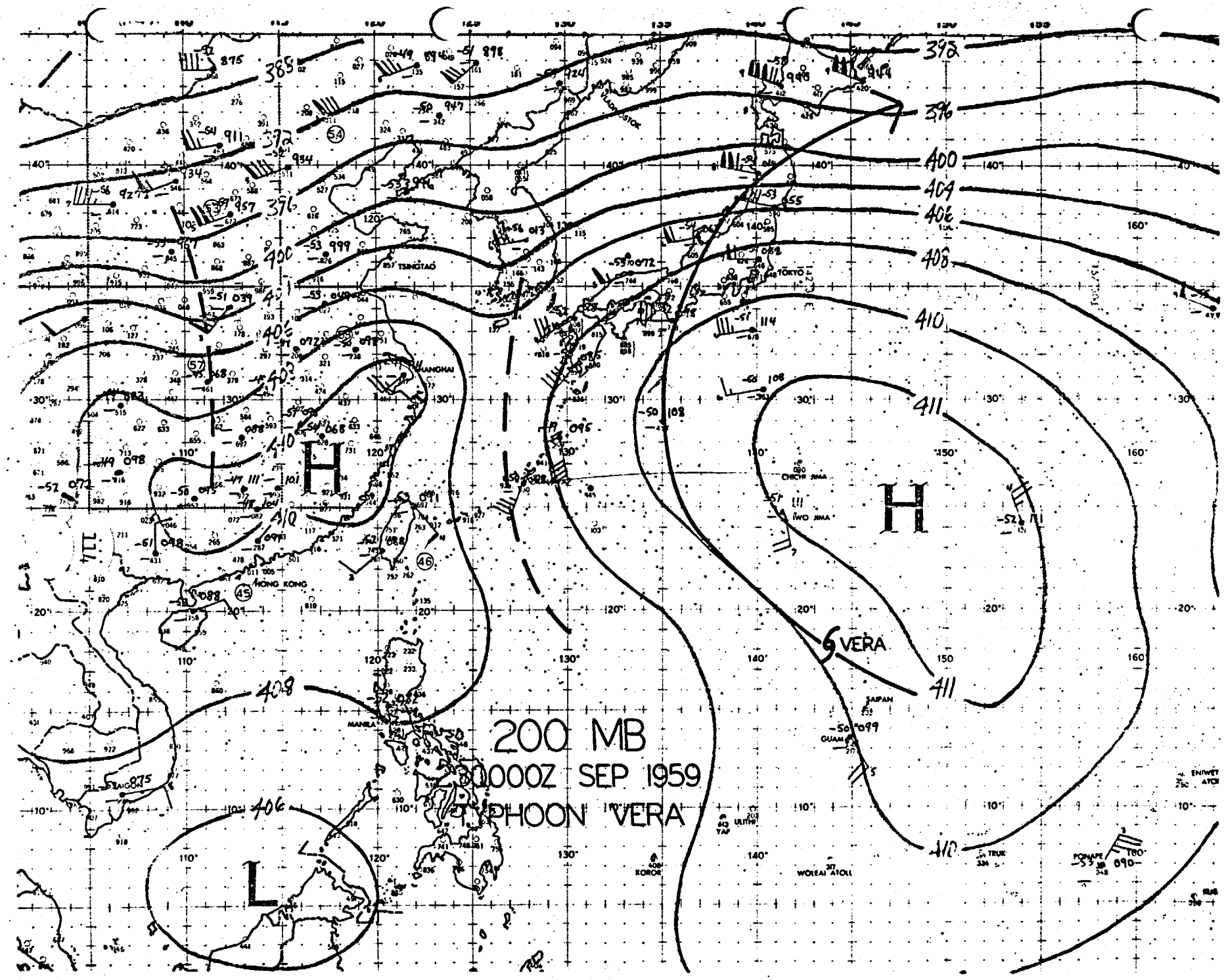
the normal September track. Forecasting accuracy was considerably better than average because of excellent steering results obtained using the 200 millibar flow (see page 114).

VERA caused an appalling loss of life and property in Japan. For details on the damage see Section VI, "Destructive Effects of Typhoons."

SEQUENCE WEATHER REPORTS – TYPHOON VERA

DATE 26-27 SEPTEMBER 1959

STATION \ TIME	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	0000	0100	0200	0300
600 WAJIMA																			
602 AIKAWA																			
604 NIIGATA																			
605 KANAZAWA																			
612 TAKADA																			
618 MATSUMOTO																			
624 MEABASHI																			
635 NAGOYA/KOMAKI AB																			
636 NAGOYA																			
637 LIDA																			
655 OMAEZAKI																			
696 YOKOSUKA																		
750 MAIZURU																		
771 OSAKA/ITAMI AB																		
772 OSAKA																			
891 TAKAMATSU																			
898 SHIMIZU/ASHIZURI																		
899 MUROTOMISAKI																		
778 SHIONOMISAKI																		


200 MB
2000Z SEP 1959
TYPHOON VERA
VERA
H
H
L
SHANGHAI
HONG KONG
MANILA
SAIGON
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOLL
TRUK
PONAPE
ENIWET ATOLL

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON VERA

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	220645Z	16.8N	146.7E	54-P-2	969	60	9360	- -	15	11	CIRC DIA 10 MI
2	220800Z	17.0N	146.3E	54-P-2	964	60	9260	65	15	10	CIRC DIA 10 MI
3	221400Z	17.9N	145.6E	54-R-2	964	- -	- -	- -	15	10	CIRC DIA 10 MI
4	222000Z	17.5N	144.5E	54-P-3	925	75	8160	50	22	06	CIRC DIA 20 MI
5	230200Z	18.7N	143.4E	54-P-10	899	175	7450	80	28	17	CIRC DIA 15 MI
6	230600Z	19.0N	142.9E	54-P-2	896	175	7180	85	30	18	ELLIP 15X30 MI
7	231400Z	20.0N	141.3E	54-T-50	- -	- -	- -	- -	- -	- -	----------
8	232000Z	20.4N	140.6E	54-P-5	897	140	7280	110	21	13	CIRC DIA 30 MI
9	240200Z	20.8N	139.6E	54-P-10	911	165	7490	110	20	20	CIRC DIA 20 MI
10	240800Z	21.9N	139.1E	54-P-5	909	166	7660	105	23	23	CIRC DIA 25 MI
11	241400Z	22.4N	137.9E	54-T-10	- -	- -	- -	110	- -	- -	----------
12	242230Z	23.5N	136.2E	54-P-10	906	150	7300	140	18	18	CIRC DIA 25 MI
13	242302Z	24.4N	136.6E	12-R-15	- -	- -	- -	- -	- -	- -	CIRC DIA 30 MI
14	250200Z	24.7N	136.3E	54-P-5	905	120	7340	- -	20	17	CIRC DIA 25 MI
15	250800Z	24.8N	135.5E	54-P-5	910	- -	7390	110	23	17	CIRC DIA 20 MI
16	251115Z	26.5N	135.5E	12-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 30 MI
17	251400Z	26.8N	134.3E	54-T-15	- -	- -	- -	- -	- -	- -	----------
18	252045Z	28.9N	134.8E	54-P-2	929	- -	7960	100	18	16	CIRC DIA 20 MI
19	252252Z	29.2N	134.3E	12-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI

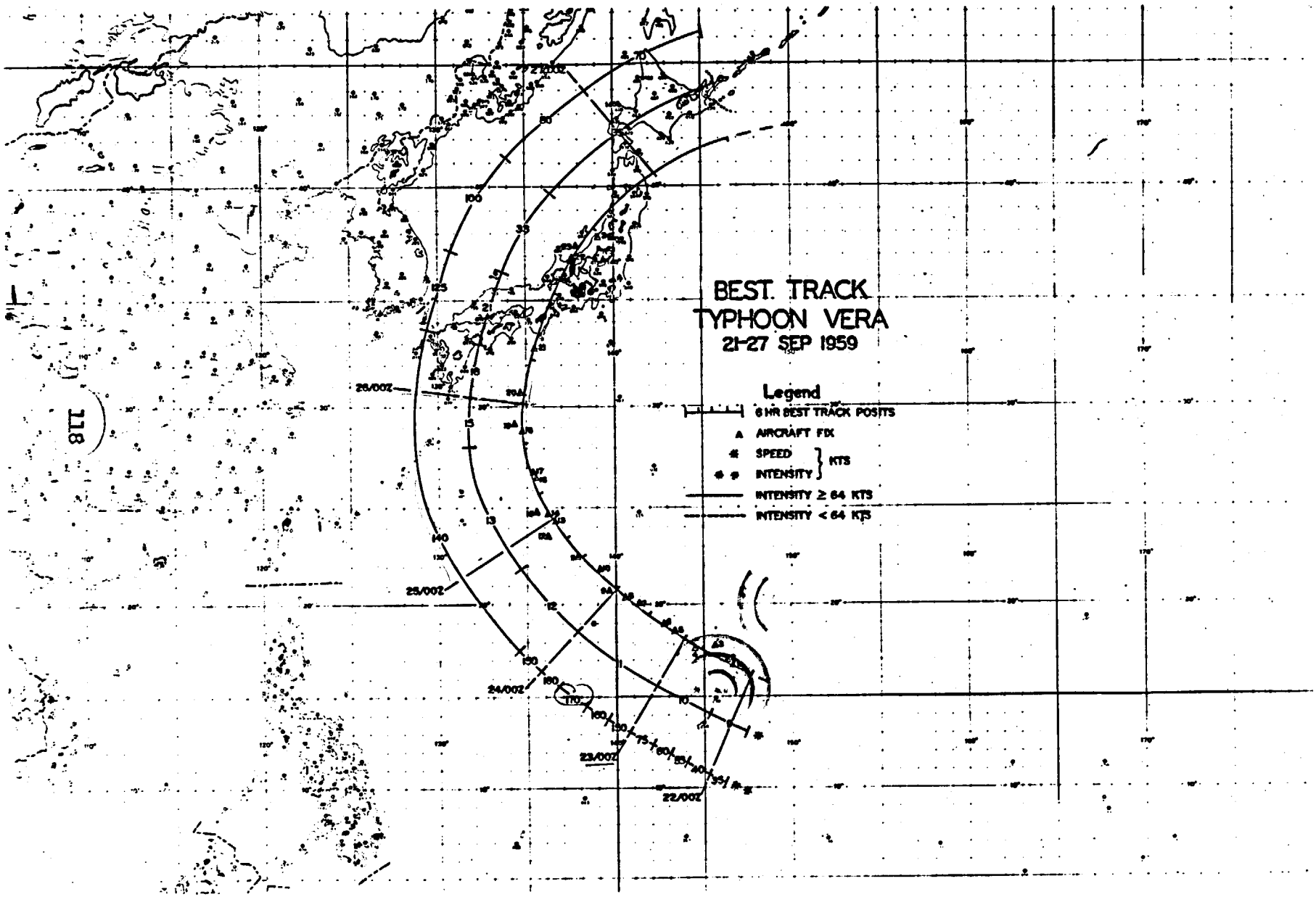
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON VERA (CONT'D)

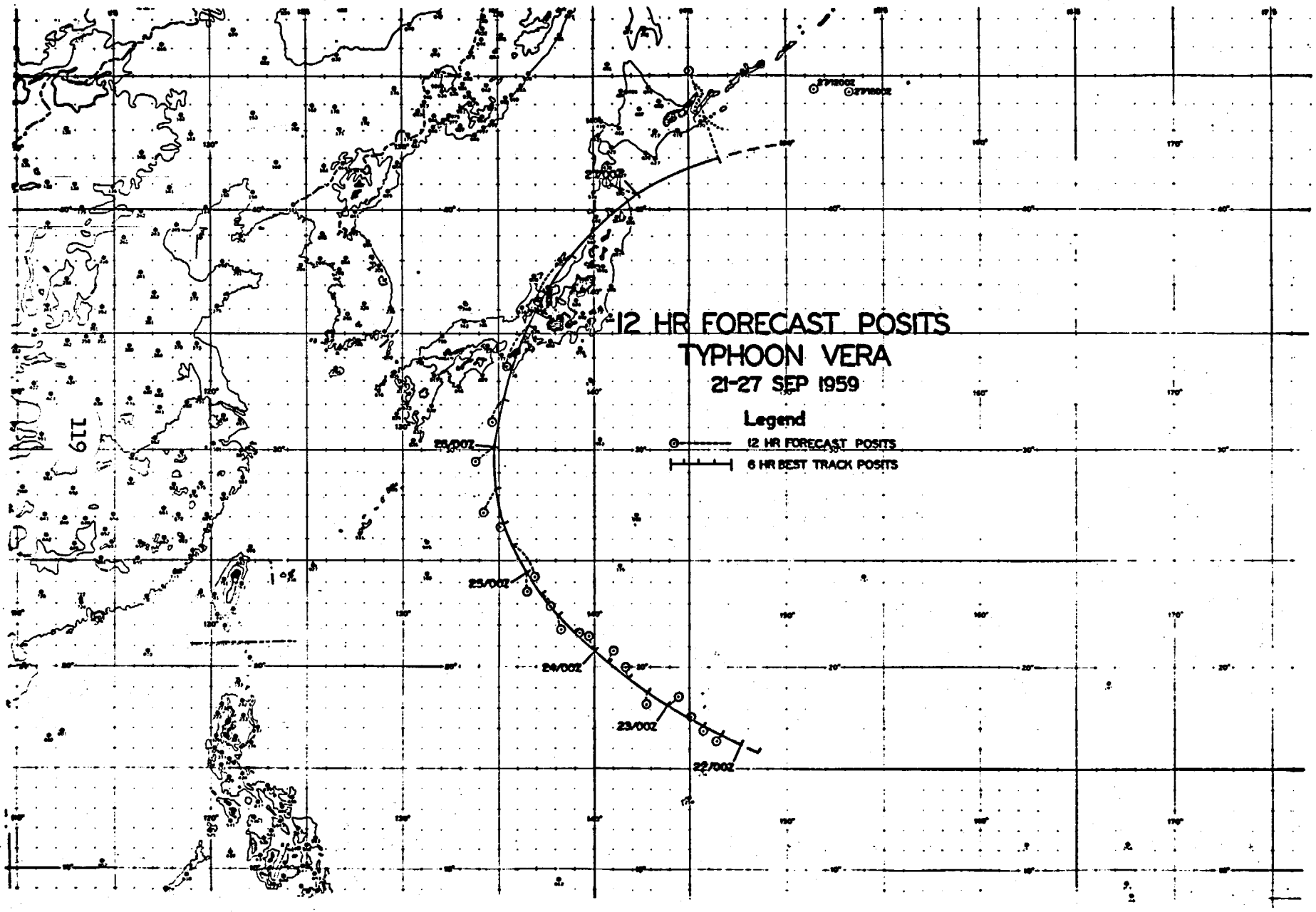
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
20	260200Z	30.7N	134.7E	54-P-10	929	160	8010	100	20	17	EYE INDEFINITE
21	260800Z	32.8N	135.5E	54-P-2	926	100	8020	150	18	18	CIRC DIA 20 MI
22	261500Z	36.8N	137.6E	* *	- -	- -	- -	- -	- -	- -	----------
23	261600Z	37.4N	137.9E	* *	- -	- -	- -	- -	- -	- -	----------
24	261700Z	37.8N	139.1E	* *	- -	- -	- -	- -	- -	- -	----------

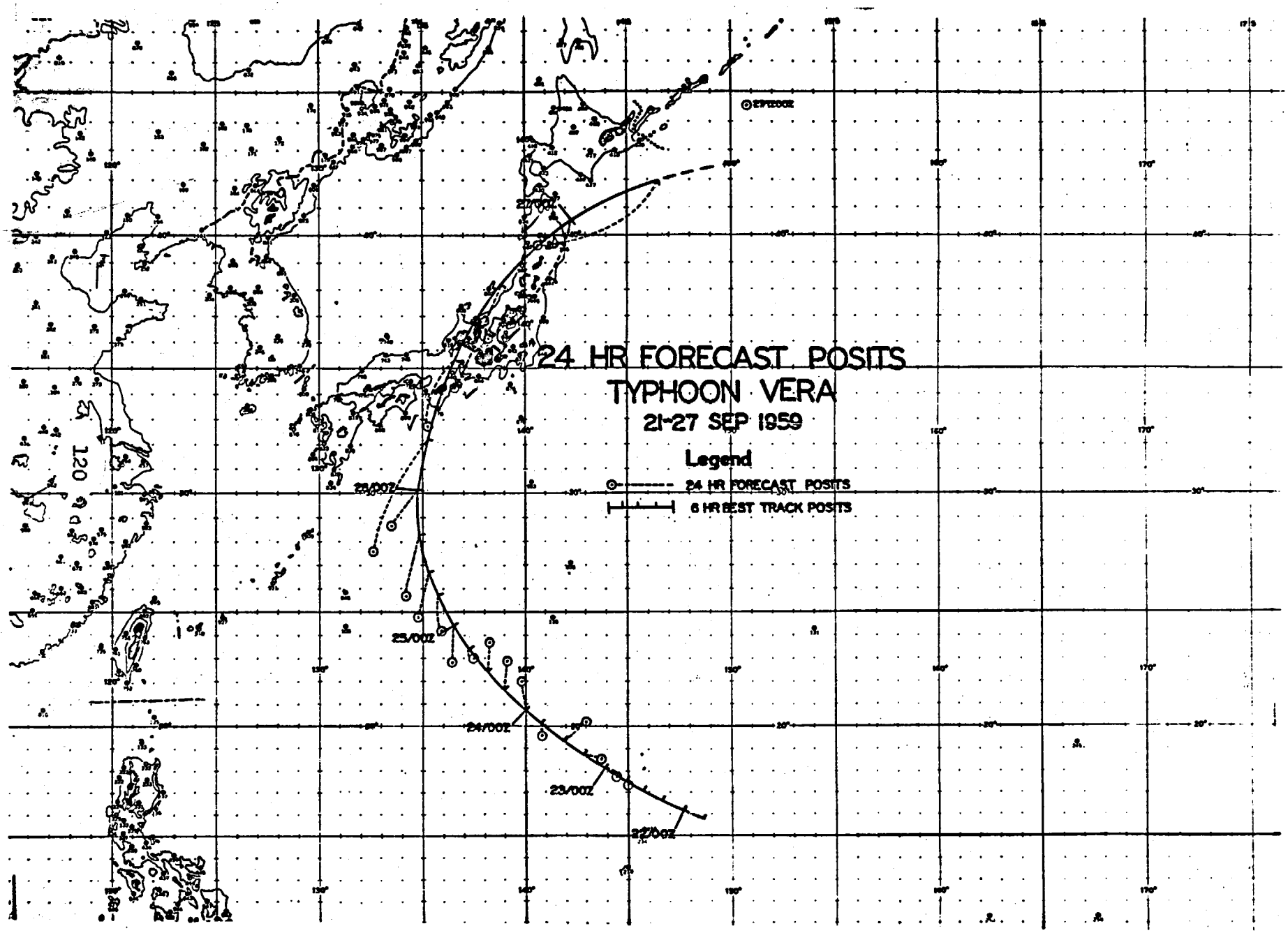
TYPHOON VERA 21 - 27 SEPT. 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
211800Z	15.8N	148.5E	- - - -		- - - -	
220000Z	16.2N	147.6E	- - - -		- - - -	
220600Z	16.6N	146.7E	239	25	- - - -	
221200Z	17.1N	145.8E	212	15	- - - -	
221800Z	17.5N	144.9E	305	06	161	17
230000Z	18.2N	143.9E	042	34	121	37
230600Z	18.8N	142.9E	180	39	107	48
231200Z	19.5N	142.0E	327	38	060	70
231800Z	20.2N	141.0E	360	36	205	31
240000Z	20.8N	140.0E	220	29	360	56
240600Z	21.6N	139.0E	090	10	076	75
241200Z	22.4N	138.1E	175	35	004	75
241800Z	23.4N	137.2E	322	37	156	27
250000Z	24.4N	136.4E	175	57	360	92
250600Z	25.6N	135.7E	175	77	172	87
251200Z	26.8N	135.7E	209	20	190	118
251800Z	28.3N	134.9E	196	132	194	166
260000Z	30.1N	134.9E	238	65	223	105
260600Z	32.2N	135.3E	202	67	207	305
261200Z	35.3N	136.6E	- - - -		- - - -	
261800Z	38.3N	138.9E	- - - -		- - - -	
270000Z	40.6N	142.2E	- - - -		- - - -	
270600Z	40.2N	146.5E	- - - -		- - - -	

AVERAGE 12 HOUR ERROR 42.5 NM
AVERAGE 24 HOUR ERROR 87.3 NM


BEST. TRACK
TYPHOON VERA
21-27 SEP 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
118
26/00Z
25/00Z
24/00Z
23/00Z
22/00Z
21/00Z


12 HR FORECAST POSITS
TYPHOON VERA
21-27 SEP 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
25/00Z
25/00Z
24/00Z
23/00Z
22/00Z
119


24 HR FORECAST POSITS
TYPHOON VERA
21-27 SEP 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
27/00Z
26/00Z
25/00Z
24/00Z
23/00Z
22/00Z

L. TYPHOON AMY (3-7 OCTOBER 1959)

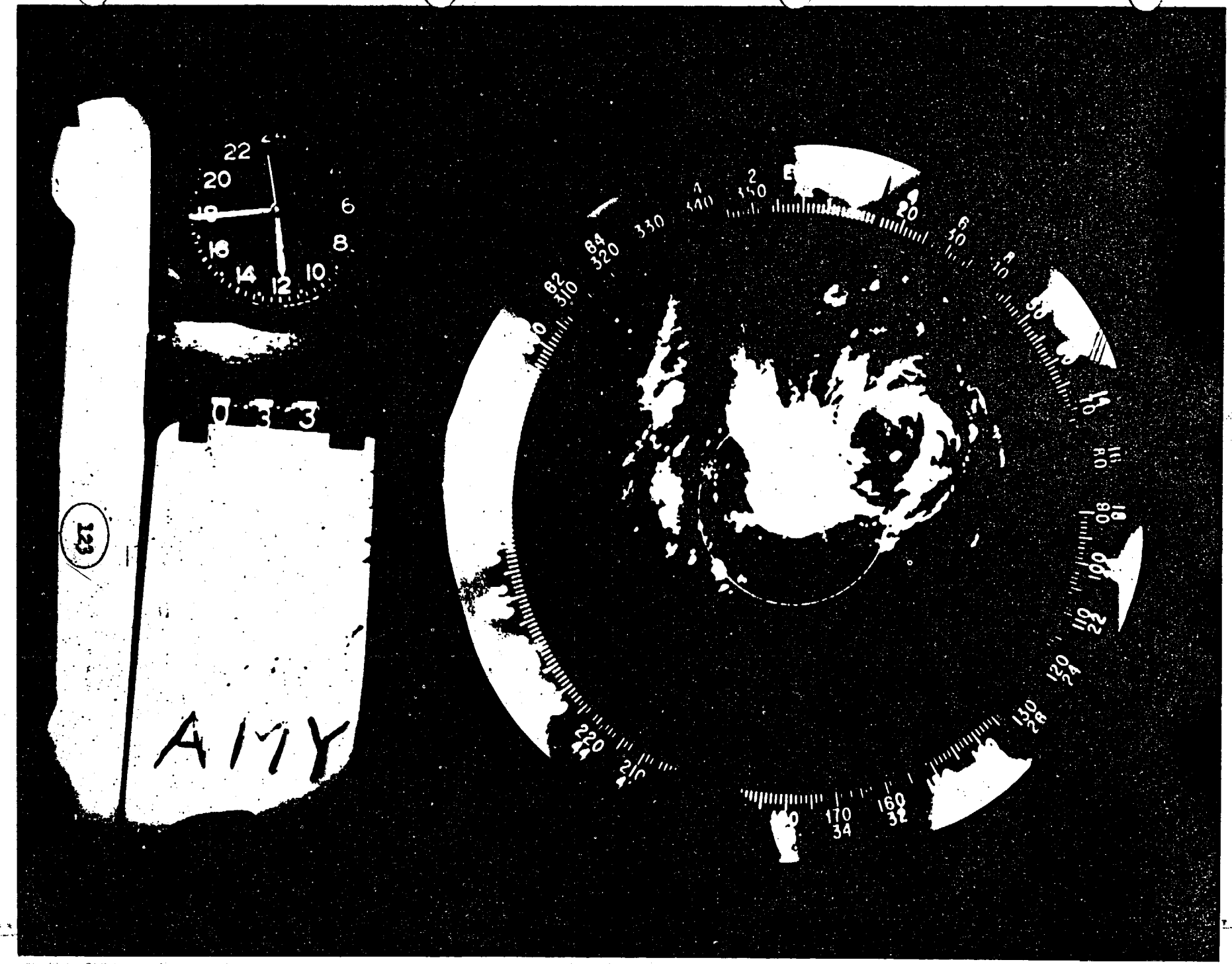
On 1 October, a weak cyclonic circulation on the Intertropical Convergence Zone was observed to the east of the Philippines. Subsequent analyses indicated that this circulation was almost stationary and that pressures in the area were gradually decreasing. Reconnaissance was therefore requested and at 030900Z a weak diffuse center, with maximum surface winds of 30 knots, was located in the vicinity of 17.5N - 125.0E. Based on this information JTWC issued warning number one on Tropical Depression AMY.

For the first 30 hours AMY moved to the north-northeast at an average speed of 6 knots. Thereafter, AMY accelerated quite rapidly, and when she passed slightly east of Kadena Air Force Base, Okinawa early on the 6th, her speed was 28 knots. During this period AMY had been upgraded to a tropical storm at 031800Z, had reached typhoon intensity at 050000Z, and had then weakened and again becoming a tropical storm at 060000Z. By 070000Z, over central Honshu, AMY had weakened further and was rapidly becoming extra-tropical. A final warning was issued at 070600Z.

AMY was somewhat unusual in that, throughout the life of the storm, the strongest surface and 700 millibar winds appeared to be confined to the eastern semicircle. As an example, when AMY passed approximately 35 miles to the east, Kadena Air Force Base reported maximum sustained winds of only 25 knots with gusts to 45 knots. However, approximately one hour later, a reconnaissance aircraft reported the surface wind to be 70 knots in AMY's southeast quadrant. A radar photograph of AMY, taken by the Kadena Weather Detachment as

AMY passed abeam of Okinawa, is included as page 123. The photograph, taken at 060245Z, clearly shows well developed wall clouds in all quadrants. The photograph therefore sheds no light as to why the winds in the east semicircle were invariably reported by reconnaissance as being 20 to 30 knots higher than those in the west semicircle. AMY also had an unusual track and did not conform to October Climatology. However, Typhoon OPAL of 1955 showed a similar path and had similar characteristics. Seventeen warnings were issued covering a period of 5 days.

Though menacing Okinawa and Southern Japan, no damage due to Typhoon AMY was reported.



123

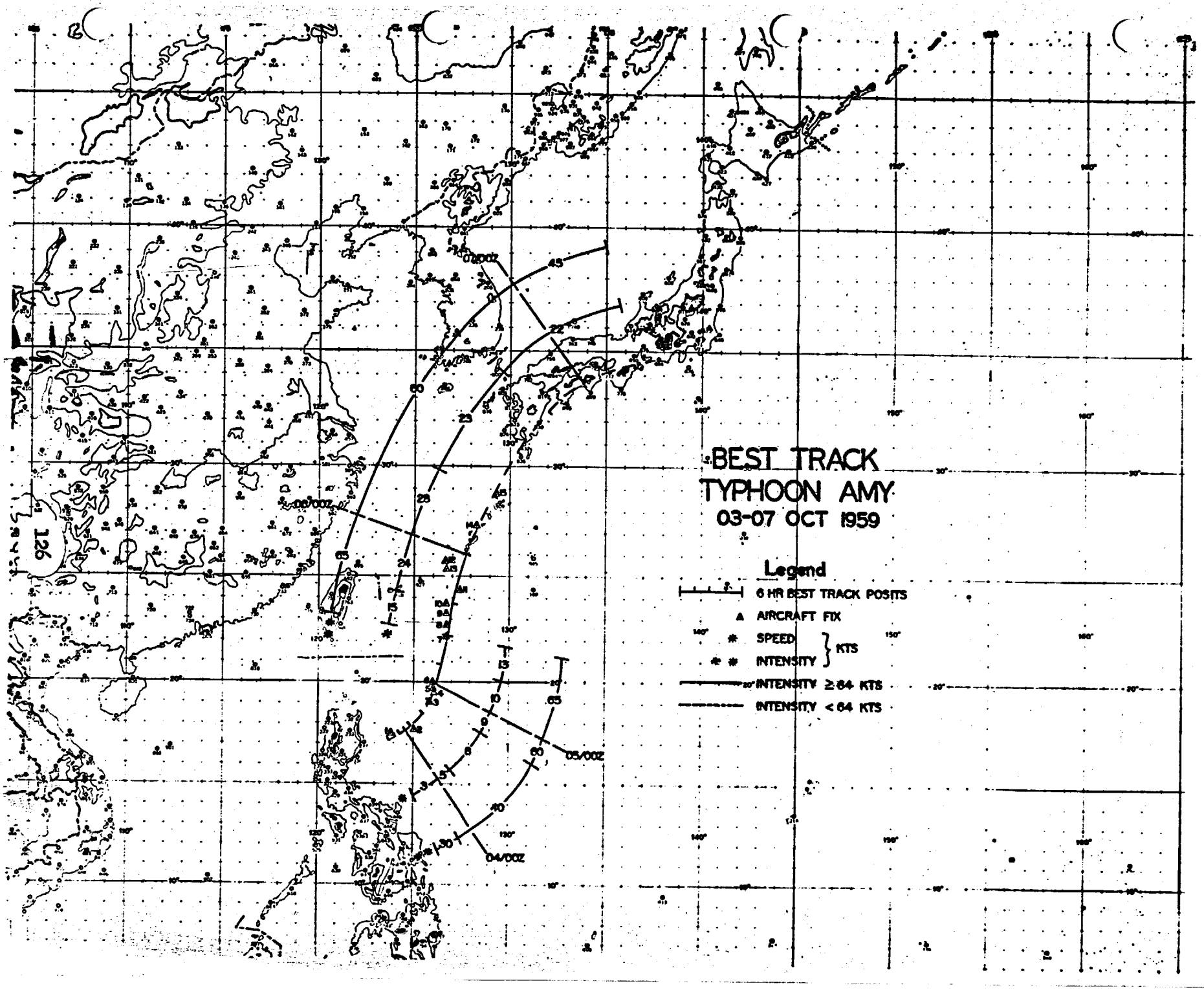
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON AMY

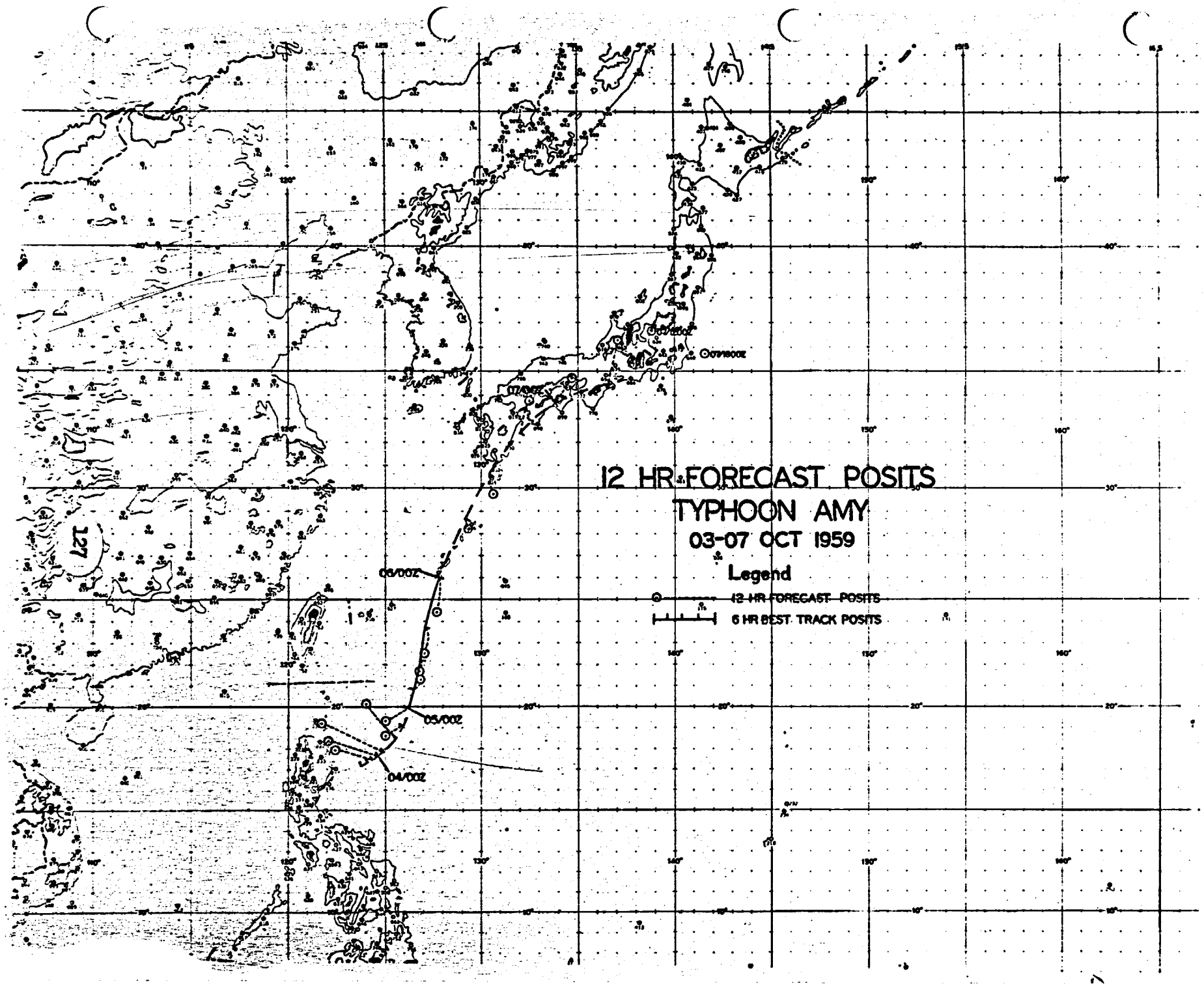
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	030900Z	17.5N	123.9E	54-P-10	1000	40	10000	30	11	08	CIRC ILL DEFINED
2	040600Z	17.7N	125.0E	54-P-10	993	- -	9980	25	10	10	NOT DEFINED
3	041744Z	19.0N	125.7E	54-P-5	- -	- -	10020	50	13	05	----------
4	042000Z	19.5N	126.0E	54-T-10	- -	- -	- -	- -	- -	- -	----------
5	042130Z	19.7N	126.0E	54-P-5	987	70	9910	50	17	04	ELLIP ILL DEFINED
6	050020Z	20.0N	126.0E	54-P-5	987	75	9870	50	15	06	ILL DEFINED
7	051145Z	22.1N	126.8E	54-R-5	- -	- -	- -	65	- -	- -	CIRC DIA 20 MI
8	051400Z	22.7N	126.8E	54-R-10	- -	- -	- -	70	- -	- -	CIRC DIA 20 MI
9	051530Z	23.2N	126.7E	54-R-10	- -	- -	9960	70	16	16	CIRC DIA 25 MI
10	051800Z	23.7N	126.8E	54-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 25 MI
11	052000Z	24.3N	127.4E	54-R—	- -	- -	- -	- -	- -	- -	----------
12	052130Z	25.8N	126.8E	54-P-10	1000	45	10020	60	08	07	EYE DIFFUSE
13	052237Z	25.3N	127.8E	12-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 20 MI
14	060345Z	27.2N	128.3E	54-P-1	990	70	9760	65	18	15	----------
15	060745Z	28.8N	129.2E	54-P-1	977	95	9670	85	17	13	CIRC DIA 40 MI

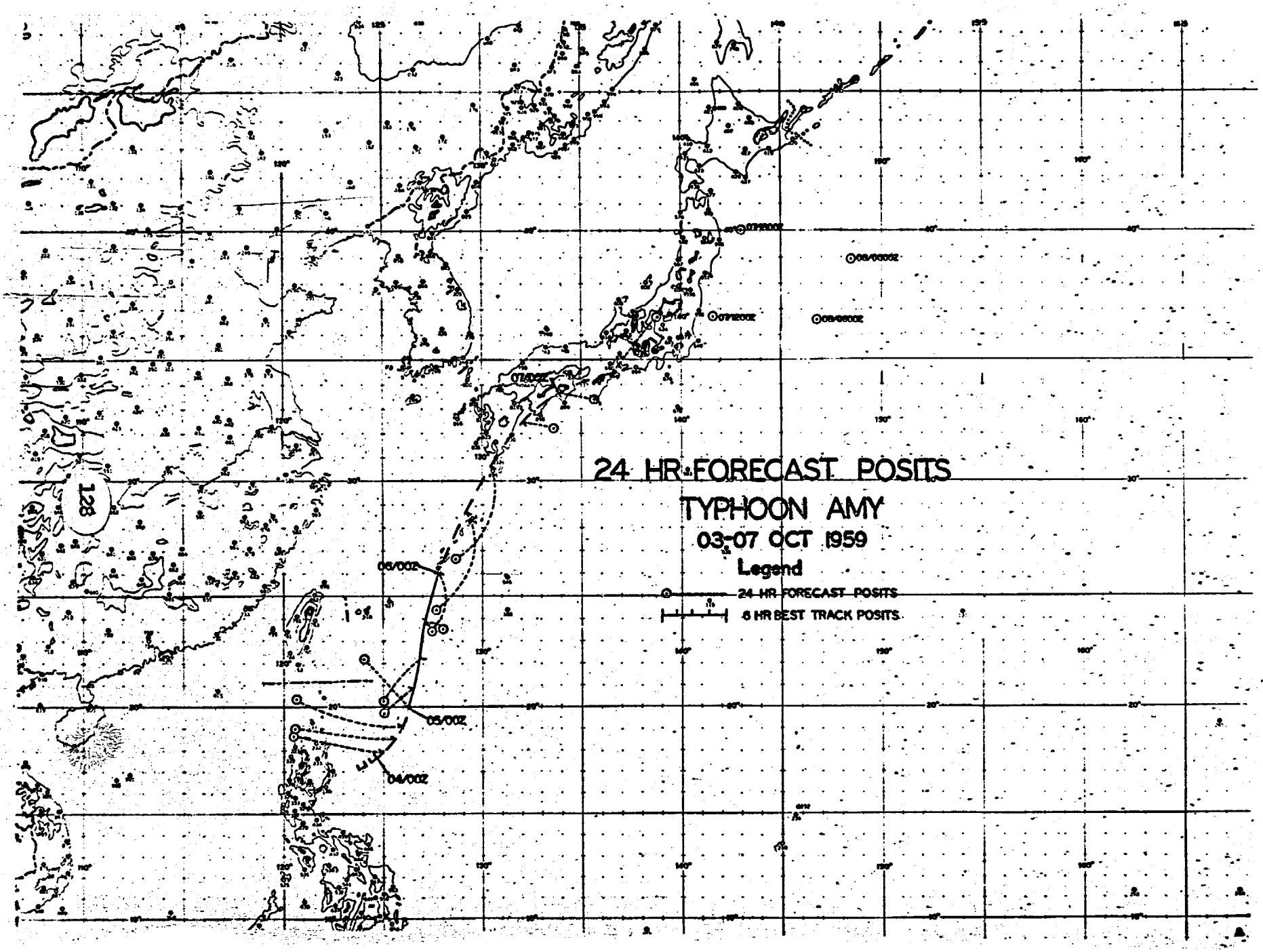
TYPHOON AMY 03 - 07 OCT 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
030600Z	17.2N	123.8E	- - - -		- - - -	
031200Z	17.3N	124.1E	- - - -		- - - -	
031800Z	17.4N	124.3E	- - - -		- - - -	
040000Z	17.6N	124.6E	- - - -		- - - -	
040600Z	17.8N	124.9E	296	193	- - - -	
041200Z	18.4N	125.4E	322	130	- - - -	
041800Z	19.1N	125.8E	247	50	284	302
050000Z	19.9N	126.2E	238	78	318	178
050600Z	20.9N	126.5E	038	35	231	106
051200Z	22.2N	126.8E	185	26	220	156
051800Z	23.8N	127.0E	180	70	100	57
060000Z	26.0N	127.9E	184	86	184	157
060600Z	28.6N	129.1E	166	30	195	278
061200Z	30.7N	130.4E	158	53	201	248
061800Z	32.4N	132.0E	197	84	273	196
070000Z	33.8N	133.9E	210	75	106	87
070600Z	34.4N	136.4E	198	105	223	180

AVERAGE 12 HOUR ERROR 78.1 NM
AVERAGE 24 HOUR ERROR 176.8 NM


BEST TRACK
TYPHOON AMY
03-07 OCT 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
02/00Z
03/00Z
04/00Z
05/00Z
126


12 HR FORECAST POSITS
TYPHOON AMY
03-07 OCT 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
03/00Z
04/00Z
05/00Z
07/18Z
07/00Z
127


24 HR FORECAST POSITS
TYPHOON AMY
03-07 OCT 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
128
06/00Z
05/00Z
04/00Z

M. TYPHOON CHARLOTTE (09-19 OCTOBER 1959)

As early as 4 October, surface map analyses indicated a diffuse area of low pressure extending along the Intertropical Convergence Zone from the general vicinity of the Palau Islands eastward. By 8 October, this low pressure area had deepened and contracted to the extent that surface map analyses indicated the possibility of a cyclone just to the southeast of the islands of Yap and Koror. Accordingly, a reconnaissance aircraft investigated the area late on the 8th and verified the existence of a closed circulation. This circulation was still quite weak but warranted further reconnaissance surveillance. Throughout the 9th, reconnaissance aircraft continued to track this cyclone. Finally on the 10th, as a result of an early morning penetration, Tropical Storm CHARLOTTE was named and the first warning was issued at 100600Z.

Throughout the 9th and 10th, CHARLOTTE moved northwestward at speeds varying from 6 to 9 knots. Steady intensification took place so that at 101800Z she was upgraded to a typhoon. On the 11th and 12th, CHARLOTTE intensified further and continued to move to the northwest at an average speed of 9 knots. On the 13th, as CHARLOTTE approached the western extremity of the semi-permanent Pacific High, recurvature and deceleration commenced. Also on the 13th, at 0800Z, CHARLOTTE appears to have reached her peak intensity. At this time a reconnaissance aircraft penetration reported a sea level pressure of 905 millibars and maximum surface winds of 145 knots. On the 14th CHARLOTTE reached the apex of her recurvature. She slowed to a speed

of 3-4 knots and began a movement toward the north-northeast. At approximately 161200Z, CHARLOTTE passed within 40 miles of the southern tip of Okinawa. At this time she was moving northeastward at a speed of about 9 knots. As a result of this comparatively slow speed, Okinawa experienced sustained winds of 45-55 knots for approximately 14 hours on the 16th. A peak gust of 105 knots was recorded by the Ryukyuan Weather Bureau, and 24 inches of rain caused considerable flooding. On the 18th, CHARLOTTE finally came under the influence of strong westerlies aloft and rapidly accelerated toward the northeast. An influx of colder air lying to the north and northwest caused steady weakening. At 190000Z, she was downgraded to a tropical storm and the final tropical warning was issued. Very shortly thereafter, CHARLOTTE was imbedded in the Polar Front as an extra-tropical low.

It is interesting to note the reconnaissance aircraft fixes on the 18th. At this time CHARLOTTE was rapidly proceeding northeastward off the southeastern tip of Honshu. These fixes would seem to indicate that CHARLOTTE's track was further north than that delineated by the best track. However, careful analysis of the reports from Hachijo Jima indicated that the primary center had passed close to this station. Apparently a secondary upper air center had developed on the 18th as CHARLOTTE became diffuse and cold air advection caused rapid weakening. It was this secondary center which was fixed at 181415Z and 182000Z by reconnaissance aircraft. Throughout her lifetime, CHARLOTTE's track conformed quite closely to the flow as indicated by the high level charts. The 200 millibar chart was

particularly helpful as a forecasting tool, and the 200 millibar level was undoubtedly the best steering level aloft. Thirty-six warnings were issued covering a period of 10 days.

For damage caused by Typhoon CHARLOTTE see section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON CHARLOTTE

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	090215Z	10.4N	137.3E	54-P-10	--	35	10120	35	09	09	EYE ILL DEFINED
2	090700Z	10.9N	136.6E	54-P-5	1006	40	10080	35	09	09	EYE FILLED WITH CLDS
3	092100Z	12.0N	135.0E	54-P-5	994	30	10130	30	11	08	EYE ILL DEFINED
4	100800Z	13.4N	133.9E	54-P-2	998	50	10100	35	13	07	CIRC DIA 30 MI
5	102000Z	13.4N	132.4E	54-R-15	--	--	--	--	--	--	WALL CLDS DIA 20 MI
6	102140Z	13.8N	132.7E	54-P-5	989	90	9910	--	16	05	TURBC SVR W QUAD
7	110140Z	14.3N	131.7E	54-P-5	989	100	9890	--	17	07	CIRC DIA 25 MI
8	110800Z	14.7N	131.0E	54-P-5	980	70	9630	70	18	12	CIRC DIA 15 MI
9	111400Z	14.8N	130.3E	54-R-10	--	--	--	--	--	--	----------
10	112000Z	15.4N	128.6E	54-T-40	--	--	--	60	--	--	TURBC LGT N&W QUADS
11	112200Z	15.5N	129.2E	54-P-15	972	80	9420	--	17	12	CIRC DIA 40 MI
12	120030Z	15.8N	129.0E	54-P-15	975	175	9480	--	16	13	WALL CLDS ALL QUADS
13	121422Z	16.9N	126.9E	12-R-10	--	--	--	--	--	--	WELL DEFINED EYE
14	122000Z	17.3N	126.2E	54-R-15	--	--	--	--	--	--	CIRC DIA 10 MI
15	122200Z	17.5N	126.0E	54-P-5	932	150	8180	--	17	15	WALL CLDS ALL QUADS
16	130200Z	17.9N	125.9E	54-P-5	916	125	7730	--	17	16	CIRC DIA 08 MI
17	130433Z	18.0N	125.7E	VW-R-5	--	--	--	--	--	--	CLOSED EYE 08 MI DIA
18	130800Z	18.3N	125.4E	54-P-5	905	145	7320	180	20	15	PERFECT EYE FORMATION
19	131605Z	18.7N	125.2E	54-R-5	--	--	--	--	--	--	DOUBLE WALL CLDS
20	132200Z	19.3N	124.9E	54-P-3	914	100	7630	110	17	15	WALL CLDS ALL QUADS
21	132316Z	19.5N	125.1E	12-R-5	--	--	--	--	--	--	WELL DEFINED CIRC EYE

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON CHARLOTTE (CONT'D)

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
22	140200Z	19.7N	124.8E	54-P-5	914	125	7620	- -	18	15	CIRC DIA 05 MI
23	140800Z	20.4N	124.6E	54-P-5	916	175	7640	- -	17	15	WALL CLDS ALL QUADS
24	141045Z	20.6N	124.4E	12-R-10	- -	- -	- -	- -	- -	- -	EYE DIA 09 MI
25	141400Z	21.1N	124.3E	54-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 12 MI
26	142200Z	21.5N	124.3E	54-P-2	932	150	8130	70	18	18	CIRC DIA 07 MI
27	150200Z	21.8N	124.4E	54-P-5	937	- -	8110	- -	17	13	EYE BREAKING UP
28	150357Z	22.1N	124.6E	12-R—	- -	- -	- -	- -	- -	- -	
29	150800Z	22.5N	124.7E	54-P-5	940	95	8280	70	17	15	EYE ELLIPTICAL
30	151359Z	23.2N	125.3E	12-R-5	- -	- -	- -	- -	- -	- -	DOUBLE WALL CLDS
31	151830Z	23.9N	125.7E	* *	- -	- -	- -	- -	- -	- -	
32	152200Z	24.3N	125.8E	54-P-5	956	85	8730	90	16	13	CIRC DIA 60 MI
33	160150Z	24.7N	126.6E	54-P—	955	- -	- -	- -	- -	- -	TWO CELLS
34	160522Z	25.0N	127.1E	54-P—	952	- -	9010	90	10	10	EYE OBLONG
35	161100Z	25.6N	128.0E	12-R-10	- -	- -	- -	- -	- -	- -	WALL CLD STRONG NE
36	161412Z	25.7N	128.3E	54-R-20	- -	- -	- -	- -	- -	- -	EYE ELLIP DIA INDEF
37	162000Z	26.3N	129.0E	54-R-25	- -	- -	- -	- -	- -	- -	EYE NOT WELL DEFINED
38	162115Z	26.2N	128.9E	54-P-10	962	60	9070	- -	17	14	EYE ILL DEFINED
39	170200Z	26.8N	129.4E	54-P-5	970	90	9220	70	16	16	CIRC DIA 60 MI
40	170800Z	27.2N	130.3E	54-P-3	965	75	9190	80	15	15	WALL CLDS ALL QUADS
41	171100Z	27.3N	130.8E	12-R-5	- -	- -	- -	- -	- -	- -	EYE ELLIPTICAL
42	171430Z	27.8N	131.3E	54-R-2	- -	- -	- -	- -	- -	- -	WALL CLDS ALL QUADS

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON CHARLOTTE (CONT'D)

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
43	172000Z	28.1N	131.5E	54-P-5	974	- -	9500	70	22	16	CIRC DIA 45 MI
44	172318Z	28.4N	133.1E	12-P-5	- -	- -	- -	- -	- -	- -	EYE POORLY DEFINED
45	180200Z	29.0N	132.9E	54-P-2	970	60	9570	60	16	10	WALL CLDS N, E&S QUADS
46	180800Z	30.2N	134.1E	54-P-2	970	90	9590	67	19	08	TURBC SVR N QUAD
47	181415Z	32.1N	136.5E	54-R-1	- -	- -	- -	75	- -	- -	EYE ELLIPTICAL
48	182000Z	34.8N	139.5E	54-R-15	- -	- -	- -	- -	- -	- -	CIRC, WALL CLDS TO N

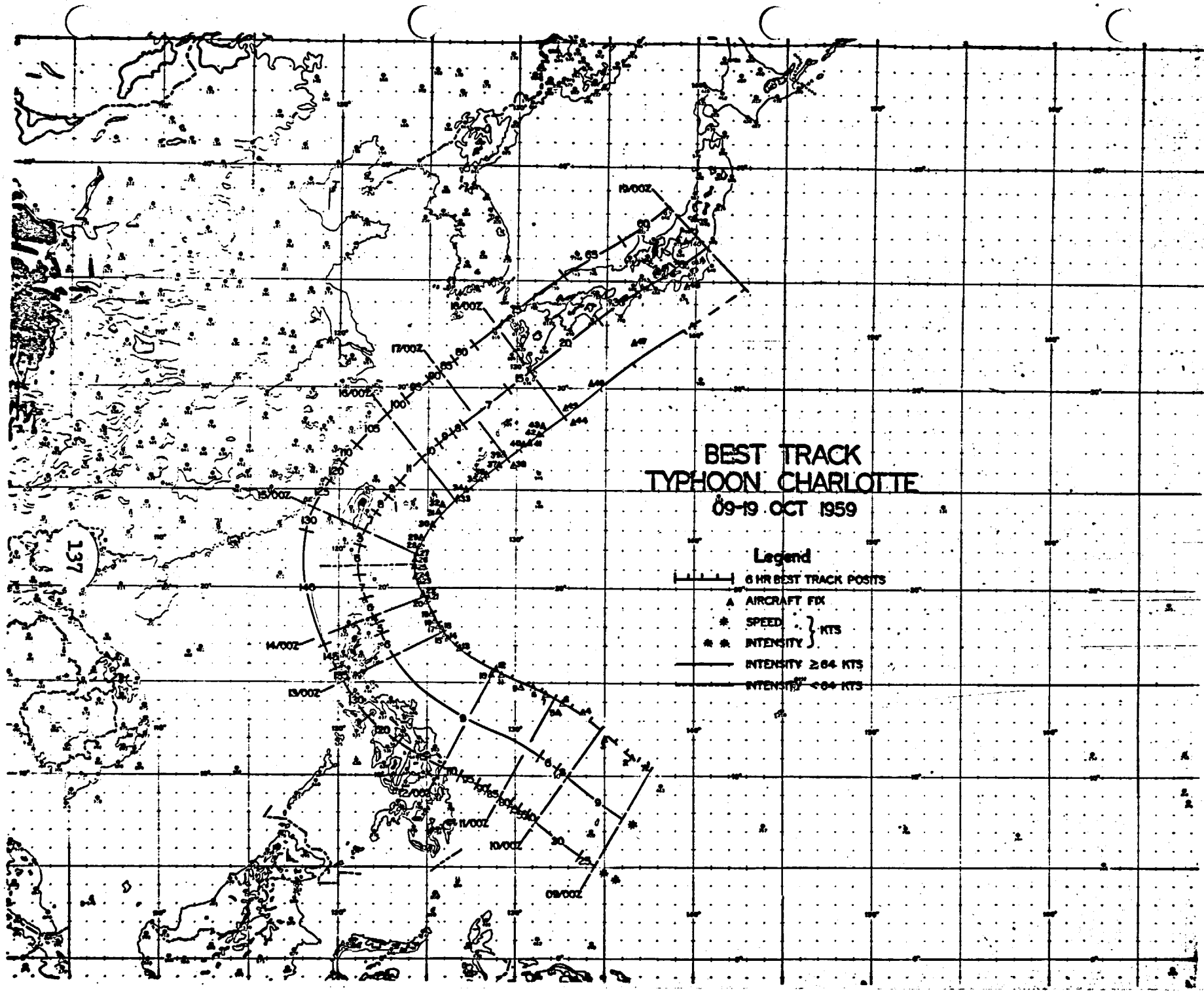
TYPHOON CHARLOTTE 09 - 19 OCT. 1959
POSITION AND FORECAST VERIFICATION DATA

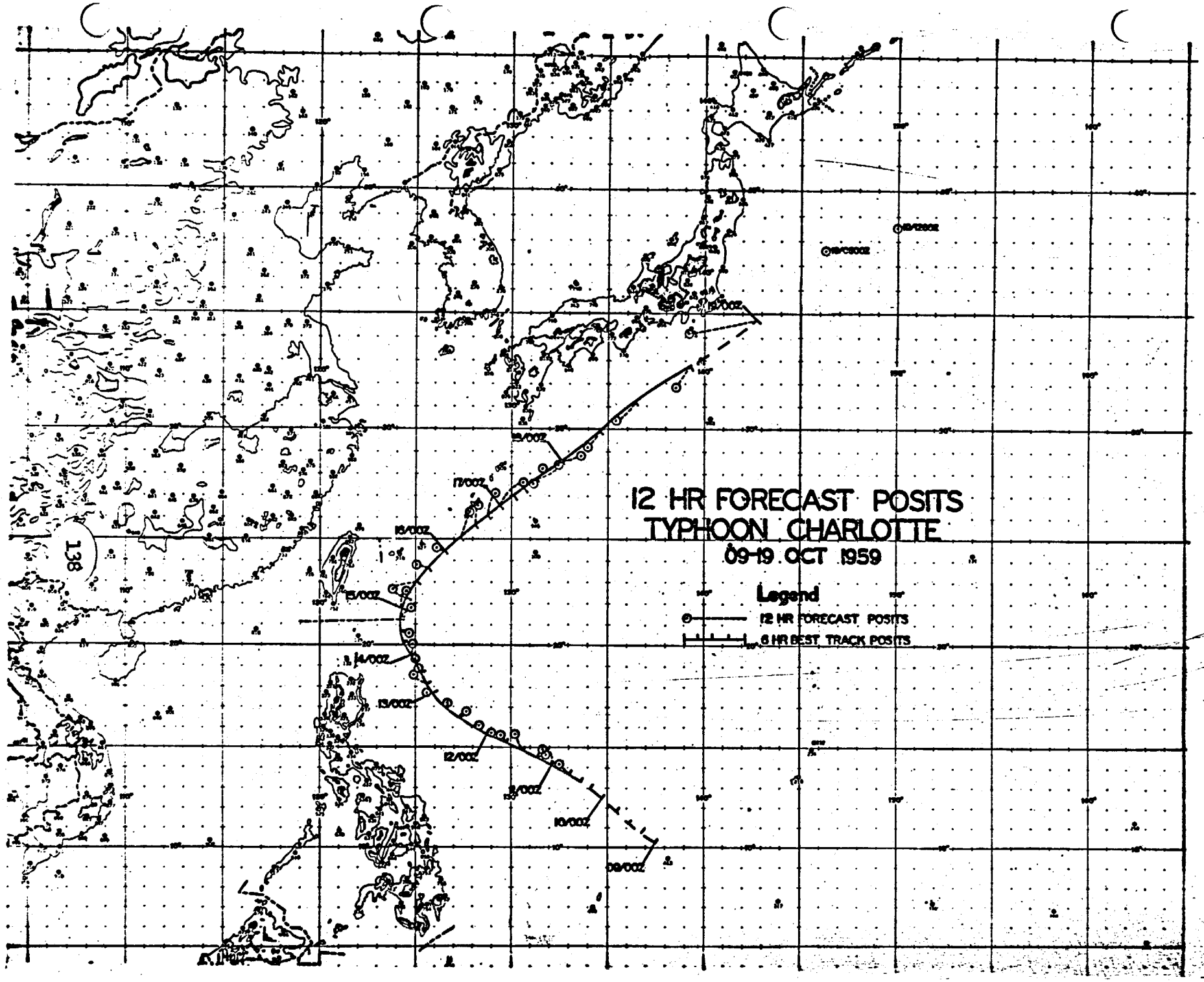
DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
090000Z	10.2N	137.6E	- - - -		- - - -	
090600Z	10.8N	136.9E	- - - -		- - - -	
091200Z	11.4N	136.2E	- - - -		- - - -	
091800Z	11.9N	135.5E	- - - -		- - - -	
100000Z	12.5N	134.8E	- - - -		- - - -	
100600Z	15.0N	134.1E	- - - -		- - - -	
101200Z	15.4N	133.6E	- - - -		- - - -	
101800Z	13.7N	133.1E	310	46	- - - -	
110000Z	14.2N	132.2E	325	57	- - - -	
110600Z	14.5N	131.4E	260	30	333	66
111200Z	14.9N	130.6E	334	48	338	85
111800Z	15.2N	129.8E	326	25	076	62
120000Z	15.6N	128.9E	043	07	343	82
120600Z	16.0N	128.1E	062	20	326	36
121200Z	16.5N	127.3E	051	29	255	20
121800Z	17.0N	126.6E	056	19	096	28
130000Z	17.7N	125.9E	270	18	050	07
130600Z	18.2N	125.6E	291	44	270	20
131200Z	18.7N	125.3E	325	14	269	65
131800Z	19.2N	125.0E	324	22	290	105
140000Z	19.5N	124.9E	003	36	339	58
140600Z	20.1N	124.6E	119	18	353	45
141200Z	20.7N	124.3E	135	20	043	80
141800Z	21.3N	124.3E	045	40	125	37
150000Z	21.7N	124.4E	009	53	052	36
150600Z	22.3N	124.7E	300	51	051	116
151200Z	23.0N	125.1E	259	75	003	90
151800Z	23.7N	125.7E	284	37	282	90
160000Z	24.5N	126.5E	284	23	283	148
160600Z	25.1N	127.4E	020	68	281	53
161200Z	25.6N	128.2E	016	55	351	46
161800Z	26.2N	128.8E	015	60	063	185
170000Z	26.5N	129.5E	048	85	056	167
170600Z	27.0N	130.1E	059	67	051	172
171200Z	27.4N	130.7E	047	70	062	240
171800Z	27.8N	131.4E	060	68	068	222

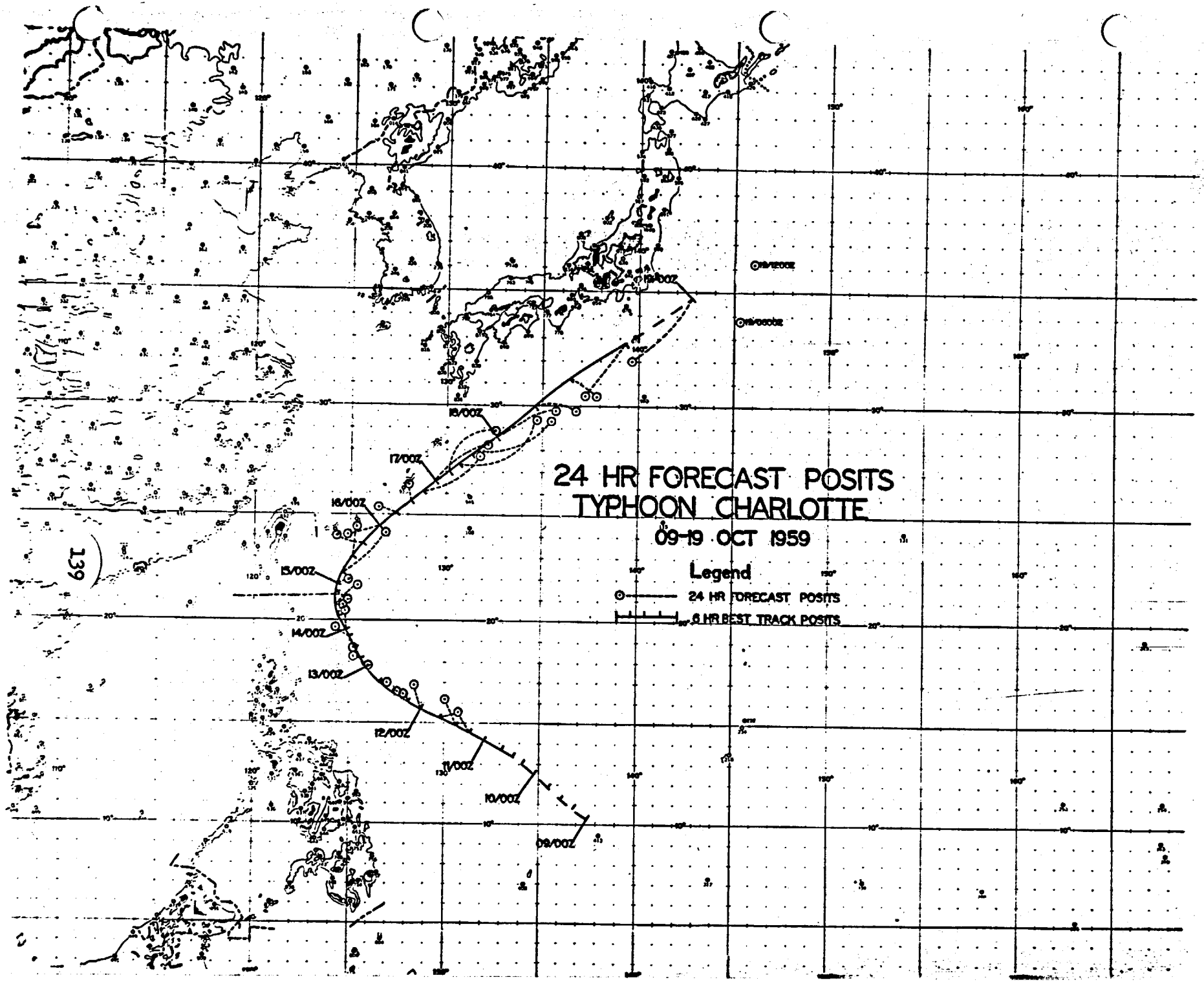
TYPHOON CHARLOTTE 09 - 19 OCT 1959
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
180000Z	28.7N	132.7E	086	46	069	172
180600Z	30.0N	134.6E	213	54	095	116
181200Z	31.2N	136.4E	227	76	124	93
181800Z	32.8N	139.3E	213	72	215	181
190000Z	34.8N	142.8E	258	180	224	232

AVERAGE 12 HOUR FORECAST ERROR 48.0 NM
AVERAGE 24 HOUR FORECAST ERROR 98.6 NM


BEST TRACK
TYPHOON CHARLOTTE
09-19 OCT 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
137
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z
12/00Z
11/00Z
10/00Z
09/00Z


12 HR FORECAST POSITS
TYPHOON CHARLOTTE
09-19 OCT 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
138
09/00Z
10/00Z
11/00Z
12/00Z
13/00Z
14/00Z
15/00Z
16/00Z
17/00Z
18/00Z


24 HR FORECAST POSITS
TYPHOON CHARLOTTE
09-19 OCT 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
09/12OOZ
19/06OOZ
19/OOZ
18/OOZ
17/OOZ
16/OOZ
15/OOZ
14/OOZ
13/OOZ
12/OOZ
11/OOZ
10/OOZ
09/OOZ
139

N. TYPHOON DINAH (14-21 OCTOBER 1959)

As previously mentioned in Section IV, forecasters of the JTWC have found the Stidd Diagram a valuable tool in first detecting tropical cyclones. The Stidd Diagram, included as page 30, shows the initial stages of development of Typhoon DINAH. DINAH first became a suspect area on 13 October in light of the higher than normal surface winds and multiple layers of clouds at Eniwetok, and the large 24-hour pressure falls at Ponape. As is evident from the Stidd Diagram, DINAH passed north of Ponape at approximately 1800Z on the 14th. Because of previous reconnaissance commitments on Typhoon CHARLOTTE, the first reconnaissance fix on DINAH was not made until 142230Z. The fix positioned DINAH approximately 600 miles southeast of Guam, and surface winds of 50 knots near the center were observed. Subsequent fixes indicated that DINAH was steadily intensifying, and at 151800Z DINAH was upgraded to a typhoon.

DINAH continued to intensify, and the maximum surface winds near the center were 125 knots as she passed 120 miles to the south of Agana, Guam at 161000Z. At that time, although intense, DINAH was still small area-wise. It was therefore not surprising that the maximum gust recorded on Nimitz Hill (the site of FWC/JTWC) was 42 knots. For the next 36 hours after passing Guam, DINAH moved to the west-northwest while gradually decelerating. Early on the 18th, at 15N - 135E, DINAH turned sharply northward and, at an average speed of 10 knots, moved almost due north until reaching

26 degrees north latitude. DINAH's abrupt turn to the north began just as Typhoon CHARLOTTE, moving northeastward, passed approximately 900 miles due north of DINAH. Upon reaching 26 degrees north on the 20th, DINAH began moving northeastward and accelerating. She also began to weaken and take on extratropical characteristics and at 211800Z when DINAH was 250 miles southeast of Tokyo, the final tropical warning was issued.

DINAH was characterized by her small eye averaging 20-25 miles. Over all her track followed late October climatology quite well. In the area south of Tokyo, the upper air center moved to the north as indicated by the 210800Z and 211400Z fixes, while surface and ship reports indicated the surface center to be moving in a northeasterly direction. This upper air center was caused by a slow moving trough aloft. Twenty nine warnings were issued on DINAH covering a period of eight days.

Typhoon DINAH expended her fury over the open ocean and no known damage has been reported.

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON DINAH

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	142230Z	09.7N	154.3E	54-P-10	997	50	10080	40	10	08	CIRC DIA 15 MI
2	150200Z	09.8N	153.7E	54-P-10	1000	60	10030	50	09	07	EYE DIFFUSE
3	150730Z	10.0N	152.5E	54-P-10	993	65	9920	50	11	09	CIRC DIA 30 MI
4	151620Z	10.1N	150.1E	54-R-8	- -	- -	- -	- -	- -	- -	CIRC DIA 40 MI
5	152000Z	10.2N	149.0E	54-P-8	981	95	9580	70	14	11	CIRC DIA 22 MI
6	160200Z	10.8N	146.9E	54-P-5	985	150	9480	75	13	07	CIRC DIA 15 MI
7	160645Z	11.0N	145.5E	54-P-2	- -	100	9180	85	13	12	CIRC DIA 15 MI
8	160800Z	11.1N	145.1E	54-P-2	958	150	9140	100	15	12	CIRC DIA 08 MI
9	161410Z	12.2N	142.7E	54-R-10	- -	- -	- -	120	- -	- -	CIRC DIA 10 MI
10	162100Z	12.7N	140.9E	54-P-5	947	150	8480	- -	15	11	CIRC DIA 08 MI
11	170200Z	13.1N	140.0E	54-T-15	- -	- -	- -	- -	- -	- -	
12	170800Z	13.4N	138.3E	54-P-5	938	180	8430	105	21	13	CIRC DIA 30 MI
13	171400Z	13.8N	136.7E	54-R-5	- -	- -	- -	90	- -	- -	CIRC DIA 30 MI
14	172340Z	14.6N	135.6E	54-P-5	947	150	8560	90	18	13	CIRC DIA 20 MI
15	180200Z	14.9N	135.4E	54-P-5	947	150	8580	90	19	14	CIRC DIA 20 MI
16	180800Z	15.7N	135.1E	54-P-2	944	185	8540	110	20	10	CIRC DIA 30 MI
17	181400Z	16.3N	134.8E	54-R-5	- -	- -	- -	90	- -	- -	CIRC DIA 12 MI
18	182100Z	17.1N	134.6E	54-P-10	945	125	8480	95	20	15	CIRC DIA 20 MI

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON DINAH (CONT'D)

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
19	190200Z	18.4N	134.6E	54-P-20	945	200	8660	- -	17	17	CIRC DIA 30 MI
20	190800Z	19.1N	135.0E	54-P-3	942	80	8350	- -	17	13	CIRC DIA 30 MI
21	191400Z	20.1N	134.9E	54-T—	- -	- -	- -	- -	- -	- -	CIRC DIA 25 MI
22	192030Z	21.1N	135.2E	54-P-2	918	- -	7710	125	18	13	CIRC DIA 30 MI
23	200400Z	23.3N	135.3E	54-P-10	913	- -	7600	130	18	13	CIRC DIA 25 MI
24	200800Z	23.8N	135.2E	54-P-1	914	- -	7660	140	18	14	EYE ELLIP DIA 20 MI
25	201230Z	24.5N	135.1E	54-R-1	- -	- -	- -	- -	- -	- -	EYE CIRCULAR
26	202115Z	27.8N	137.0E	54-P-10	934	175	8160	- -	19	15	EYE ELLIP 20X40 MI
27	210200Z	29.4N	138.6E	54-P-10	935	125	8440	- -	21	16	CIRC DIA 40 MI
28	210800Z	32.0N	139.5E	54-P-30	992	- -	9590	- -	10	10	EYE ILL DEFINED
29	212100Z	36.1N	145.8E	54-P-10	985	- -	9310	65	06	06	EYE ILL DEFINED

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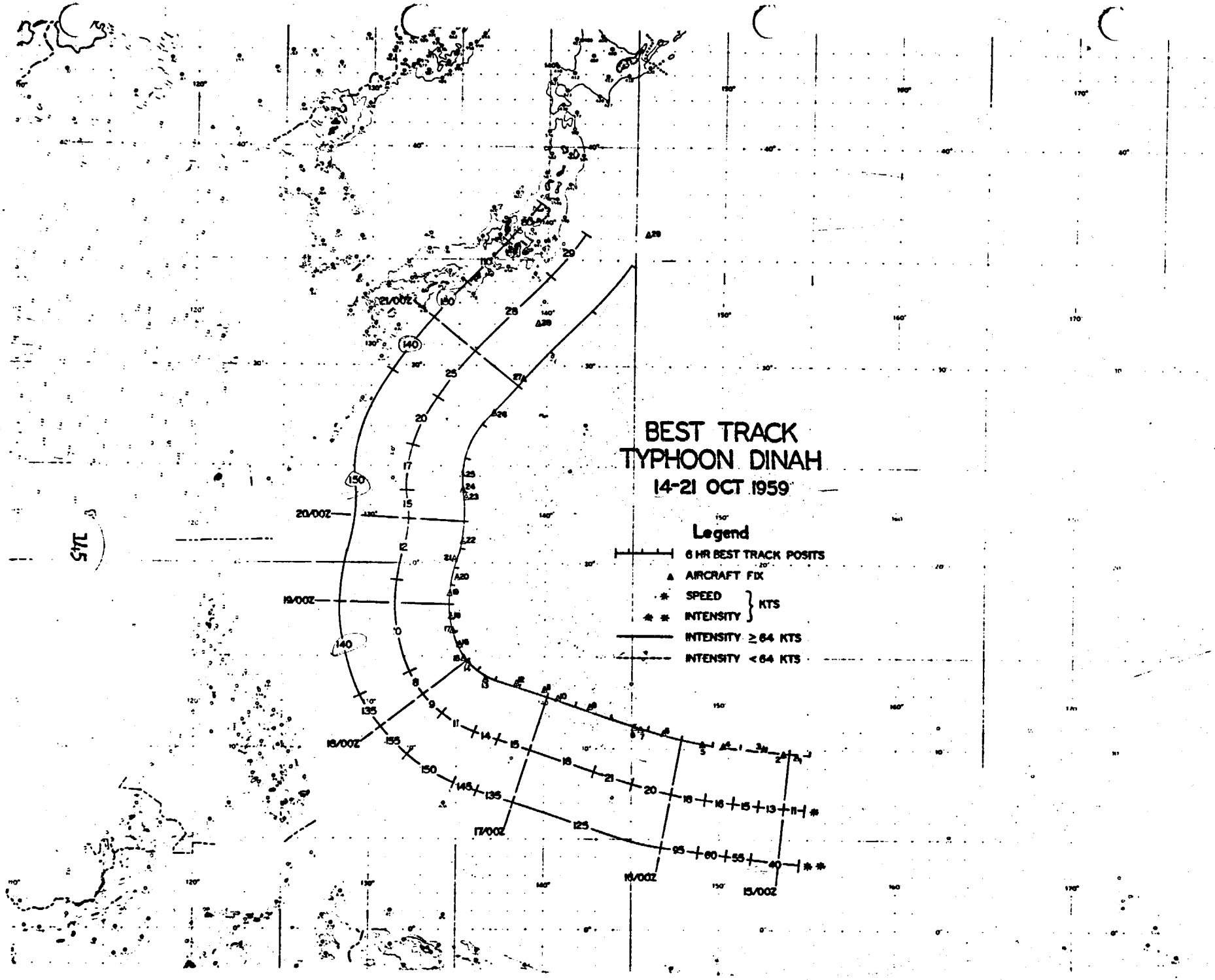
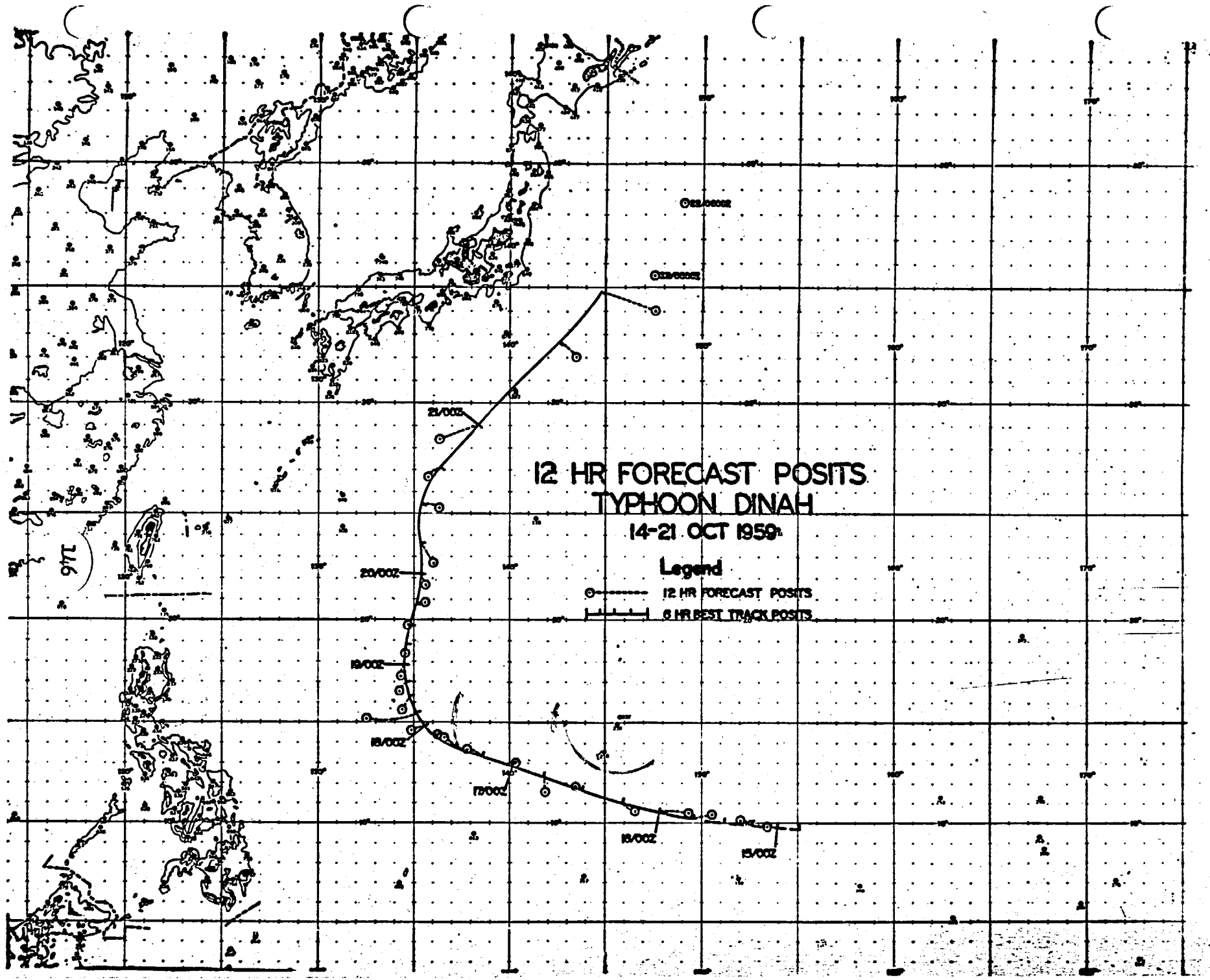
+57MB → IN 6HR?

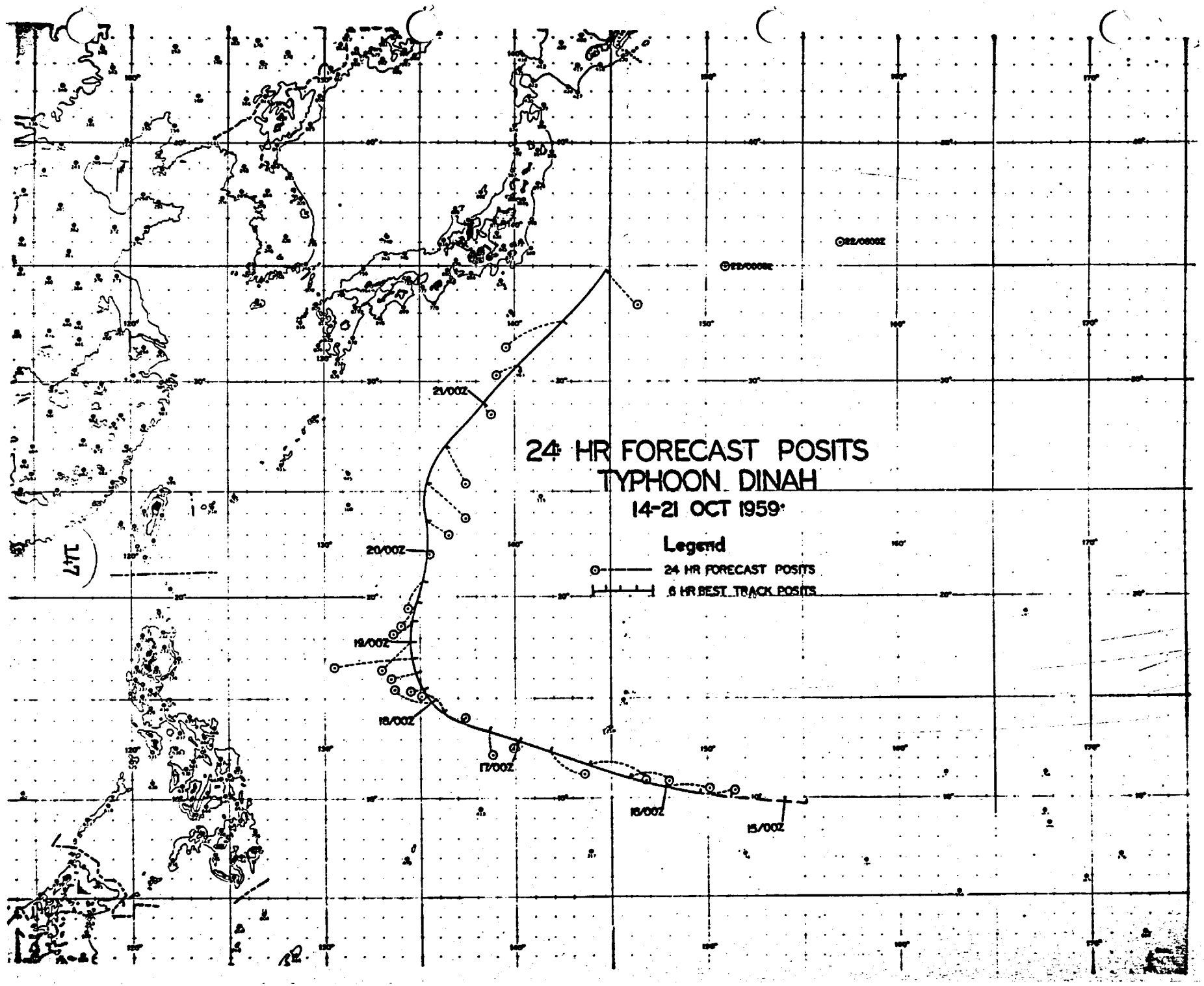
TYPHOON DINAH 14 - 21 OCT 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
141800Z	09.7N	155.1E	- - - -		- - - -	
150000Z	09.8N	154.0E	- - - -		- - - -	
150600Z	09.9N	152.7E	095	28	- - - -	
151200Z	10.0N	151.2E	080	45	- - - -	
151800Z	10.1N	149.6E	070	58	090	95
160000Z	10.5N	147.9E	085	80	090	127
160600Z	11.0N	145.9E	115	50	095	125
161200Z	11.7N	143.9E	285	33	115	174
161800Z	12.3N	141.8E	175	41	125	124
170000Z	12.8N	140.1E	030	10	260	12
170600Z	13.3N	138.6E	300	57	165	66
171200Z	13.7N	137.2E	300	59	180	19
171800Z	14.2N	136.2E	050	05	315	90
180000Z	14.7N	135.5E	270	36	270	102
180600Z	15.4N	135.1E	265	148	260	47
181200Z	16.2N	134.9E	220	51	265	94
181800Z	17.0N	134.8E	245	34	265	247
190000Z	17.8N	134.7E	220	41	230	128
190600Z	18.8N	134.8E	200	37	240	70
191200Z	19.8N	134.9E	270	13	220	83
191800Z	20.8N	135.1E	090	12	210	89
200000Z	22.1N	135.2E	120	31	085	19
200600Z	23.6N	135.2E	145	65	115	76
201200Z	25.3N	135.3E	100	48	130	131
201800Z	27.1N	136.3E	250	36	150	122
210000Z	29.0N	138.2E	250	113	125	50
210600Z	30.7N	140.1E	180	25	240	69
211200Z	32.7N	142.5E	130	63	065	162
211800Z	34.8N	144.8E	110	134	140	121

AVERAGE 12 HOUR ERROR 50.1 NM
AVERAGE 24 HOUR ERROR 97.7 NM


BEST TRACK
TYPHOON DINAH
14-21 OCT 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
21/00Z
20/00Z
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z


12 HR FORECAST POSITS
TYPHOON DINAH
14-21 OCT 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
21/00Z
20/00Z
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z


24 HR FORECAST POSITS
TYPHOON DINAH
14-21 OCT 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
21/00Z
20/00Z
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z
147

O. TYPHOON EMMA (05-13 NOVEMBER 1959)

As a suspect area, Typhoon EMMA was first detected south of Kwajalein on 30 October. EMMA, as a large area of squally weather, was tracked for the next 6 days by reconnaissance aircraft. Finally on the 7th day (November 5th) a reconnaissance aircraft reported a definite closed surface circulation with wall clouds developing and surface winds near the center of 30 knots. Based on this information the first warning on Tropical Depression EMMA was issued at 050600Z. Moving to the west-northwest at a speed of 9 to 10 knots, EMMA passed approximately 20 miles south of Guam on the 6th. The pressure at Guam dropped to 995 millibars, but the sustained winds reached only 30 knots. It was not until 10 October, or 12 days after EMMA was first detected as a suspect area, that she finally reached typhoon intensity, approximately 800 miles west of Guam.

As a full-blown typhoon EMMA recurved gradually to the north at an average speed of 11 knots. She apparently reached peak intensity on 11 November with maximum surface winds near the center of 110 knots and a sea level pressure of 962 millibars. As EMMA reached 23 degrees north she came under the influence of strong westerlies aloft, and accelerated rapidly to the northeast. At 121800Z EMMA passed within 35 miles of Okinawa and caused considerable damage on the island. Kadena Air Base reported maximum sustained winds of 55 knots with gusts to 85 knots, while the Ryukyu Weather Bureau station, located on a hill near Naha, reported a maximum gust of 106 knots. Following her passage to the south and east of Okinawa, EMMA continued to accelerate and began to weaken rapidly. The final tropical warning was

issued at 131800Z at which time EMMA was moving east-northeasterly at 35 knots.

One interesting fact concerning EMMA was the out-of-phase vertical slope which persisted for a considerable period of time i.e., from the time EMMA passed Guam on 6 October until she reached typhoon intensity on the 10th. During this period both the surface and 700 millibar centers were carefully tracked by reconnaissance, and it was observed that the 700 millibar center was consistently located about 45 miles to the west-southwest of the surface center. Although a November typhoon, EMMA followed late October climatology very closely. Thirty-five warnings were issued covering a period of 9 days.

For damage caused by Typhoon EMMA see Section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON EMMA

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	050730Z	12.1N	148.1E	54-P-5	1003	30	10090	30	12	10	EYE ILL DEFINED
2	060000Z	12.9N	145.8E	54-P-5	993	30	--	32	25	18	EYE ILL DEFINED
3	060200Z	12.7N	145.4E	54-P-1	993	30	9990	36	13	08	EYE WELL DEFINED
4	060800Z	13.0N	144.4E	54-P-5	993	30	9910	42	16	10	CIRC DIA 75 MI
5	061400Z	12.7N	142.3E	54-T-25	--	--	--	35	--	--	----------
6	070200Z	13.5N	140.9E	54-P-10	996	45	10010	35	13	07	EYE ILL DEFINED
7	070700Z	14.0N	139.7E	54-P-5	994	55	10010	30	10	08	EYE ILL DEFINED
8	071400Z	13.8N	138.1E	54-T-15	--	--	--	--	--	--	700MB WIND FIX
9	072130Z	14.3N	137.9E	54-P-5	994	55	10020	45	14	13	EYE ILL DEFINED
10	080200Z	14.5N	137.6E	54-P-5	995	40	10010	45	14	11	EYE ELLIP 75X40MI
11	080800Z	14.9N	137.5E	54-P-5	995	50	10000	42	16	12	EYE ILL DEFINED
12	082100Z	15.4N	134.5E	54-P-5	985	35	9980	30	14	00	EYE OPEN
13	090200Z	15.3N	133.3E	54-P-10	988	45	9930	30	14	04	EYE OPEN
14	090900Z	15.6N	131.9E	54-P-5	989	55	9860	48	14	10	EYE ILL DEFINED
15	092200Z	16.0N	129.9E	54-P-5	986	50	9730	--	12	12	EYE ELLIP 20X30 MI
16	100100Z	15.8N	129.1E	54-P-5	980	80	9640	65	15	14	CIRC DIA 20 MI
17	100800Z	16.4N	128.1E	54-P-15	983	75	9560	65	14	10	EYE ILL DEFINED
18	101125Z	16.6N	127.0E	12-R-10	--	--	--	--	--	--	CIRC DIA 65 MI
19	102000Z	17.6N	126.2E	54-R-10	--	--	--	70	--	--	EYE ELLIP 30X40 MI
20	102200Z	17.9N	125.6E	54-P-2	966	80	9210	100	15	11	CIRC DIA 60 MI

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON EMMA (CONT'D)

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
21	110200Z	18.2N	125.1E	54-P-2	970	75	9260	60	15	11	CIRC DIA 75 MI
22	110730Z	19.5N	125.2E	54-P-5	966	130	9180	105	15	13	CIRC DIA 60 MI
23	111125Z	19.8N	124.6E	12-R-25	- -	- -	- -	- -	- -	- -	CIRC DIA 25 MI
24	111415Z	20.8N	124.8E	54-T-35	- -	- -	- -	95	- -	- -	
25	112210Z	21.9N	124.0E	54-P-2	962	70	9040	110	17	13	CIRC DIA 60 MI
26	120100Z	22.3N	123.8E	54-P-2	959	75	8980	115	19	14	CIRC DIA 60 MI
27	120234Z	22.8N	124.4E	54-P-3	- -	- -	- -	- -	- -	- -	EYE ILL DEFINED
28	121048Z	24.2N	126.0E	12-R-0	- -	- -	- -	- -	- -	- -	CIRC DIA 60 MI
29	121400Z	24.5N	126.5E	54-R-10	- -	- -	- -	85	- -	- -	CIRC DIA 50 MI
30	122256Z	26.6N	129.7E	12-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 70 MI
31	130213Z	26.9N	131.5E	54-P-2	974	65	- -	- -	- -	- -	EYE ILL DEFINED
32	130842Z	28.1N	134.5E	54-R-5	986	- -	- -	- -	- -	- -	EYE ILL DEFINED

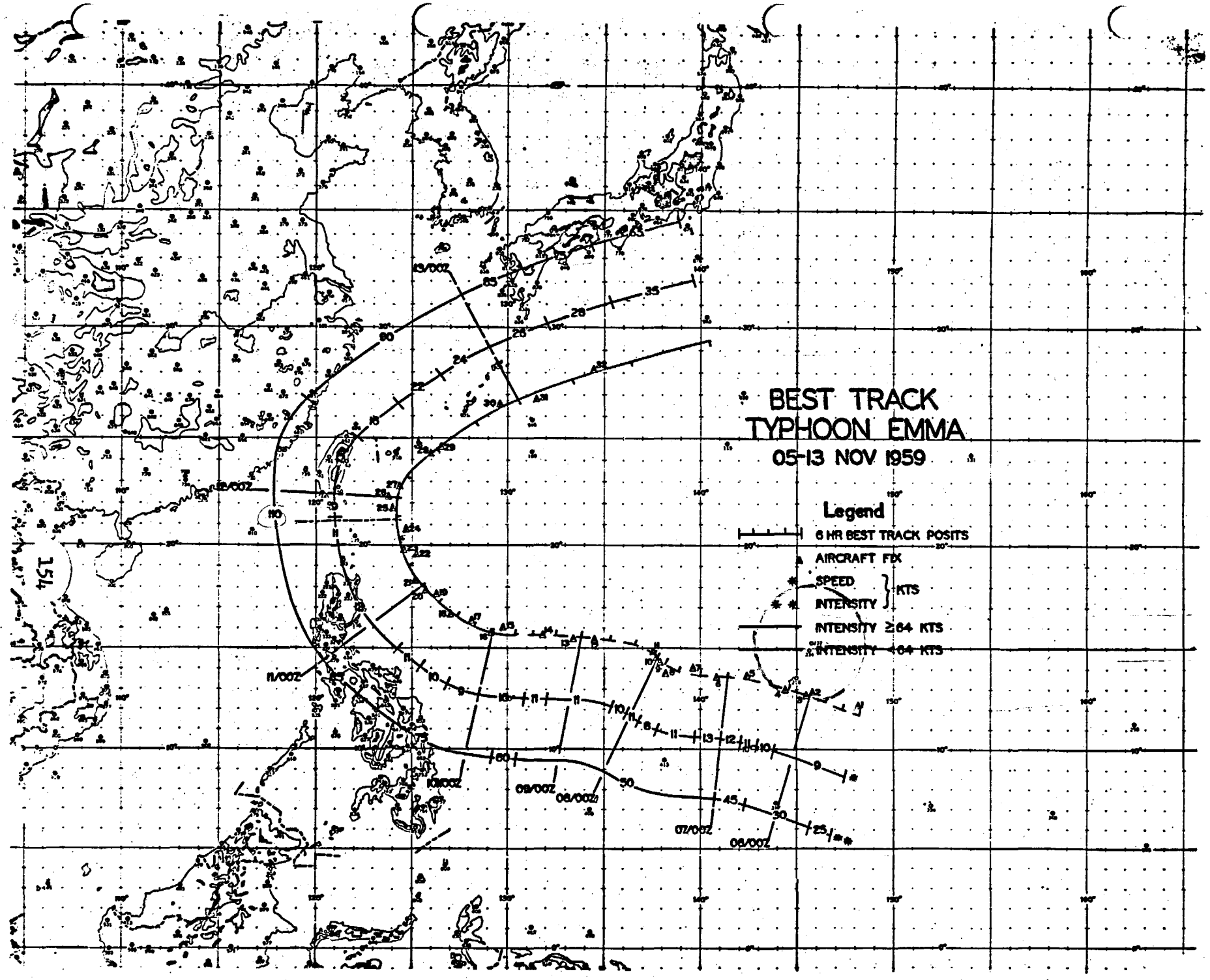
TYPHOON EMMA 05 - 13 NOV. 1959
POSITION AND FORECAST VERIFICATION DATA

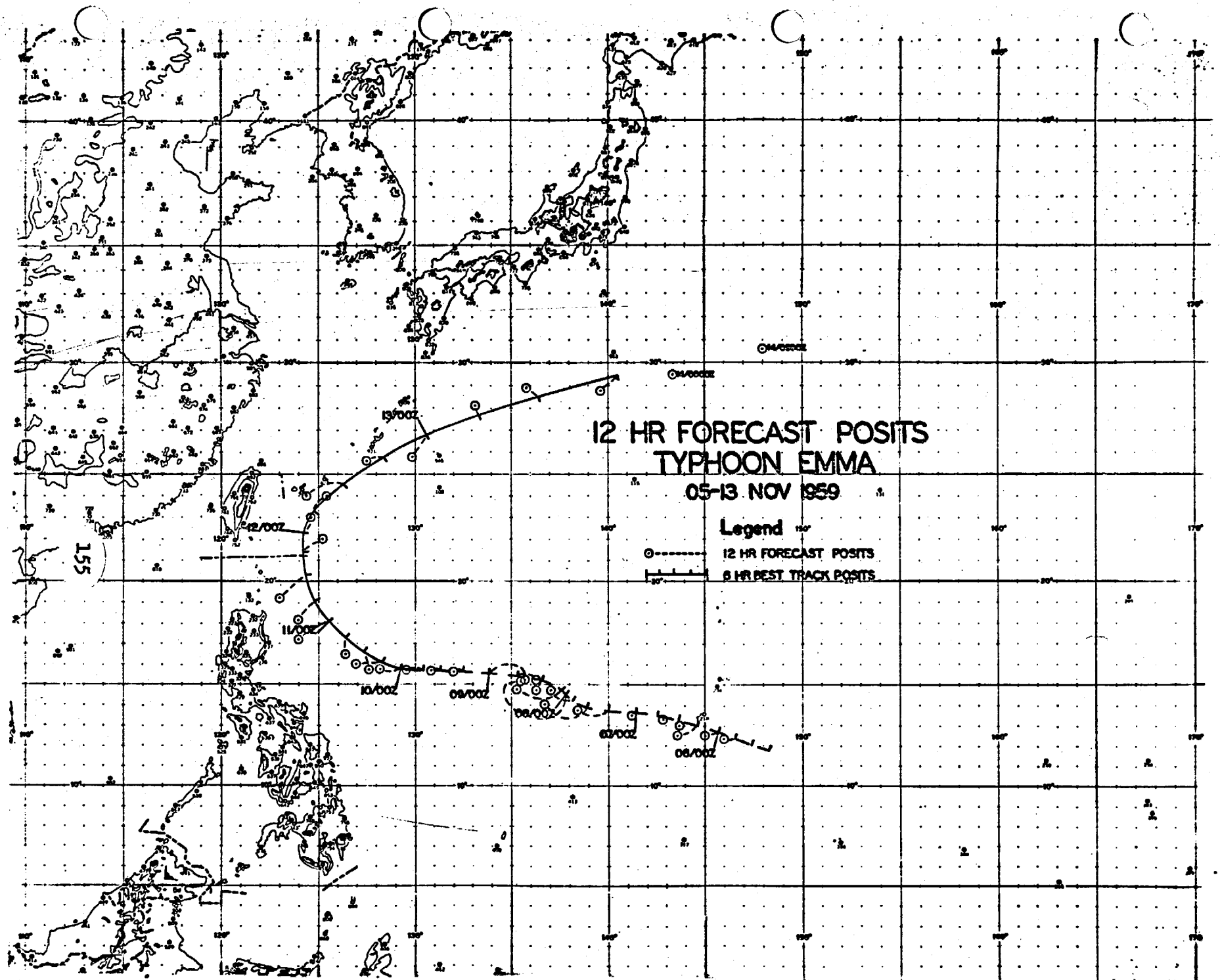
DTG	STORM POSITION LAT. LONG.	12 HR ERROR DEG. DISTANCE	24 HR ERROR DEG. DISTANCE
050600Z	11.8N 148.2E	- - - -	- - - -
051200Z	12.0N 147.3E	- - - -	- - - -
051800Z	12.3N 146.5E	- - - -	- - - -
060000Z	12.7N 145.6E	- - - -	- - - -
060600Z	12.9N 144.7E	- - - -	- - - -
061200Z	13.2N 143.7E	- - - -	- - - -
061800Z	13.4N 142.6E	- - - -	- - - -
070000Z	13.6N 141.3E	- - - -	- - - -
070600Z	13.7N 140.0E	273 - 101	- - - -
071200Z	13.9N 138.9E	273 - 121	- - - -
071800Z	14.2N 138.2E	298 - 75	272 - 162
080000Z	14.5N 137.8E	285 - 137	270 - 236
080600Z	14.7N 137.6E	273 - 135	282 - 211
081200Z	15.1N 136.6E	230 - 30	283 - 240
081800Z	15.3N 135.2E	103 - 61	272 - 144
090000Z	15.5N 133.9E	279 - 102	111 - 44
090600Z	15.5N 132.5E	275 - 30	274 - 146
091200Z	15.6N 131.3E	270 - 28	272 - 180
091800Z	15.7N 130.3E	275 - 47	292 - 87
100000Z	15.8N 129.2E	273 - 66	275 - 72
100600Z	16.1N 128.3E	276 - 78	268 - 98
101200Z	16.6N 127.4E	164 - 46	259 - 130
101800Z	17.2N 126.4E	195 - 40	247 - 147
110000Z	18.0N 125.5E	240 - 103	170 - 131
110600Z	19.0N 124.9E	224 - 74	197 - 134
111200Z	20.2N 124.4E	232 - 103	230 - 240
111800Z	21.2N 124.2E	049 - 70	228 - 185
120000Z	22.2N 124.2E	029 - 60	237 - 231
120600Z	23.3N 124.8E	036 - 48	042 - 126
121200Z	24.3N 126.2E	258 - 104	354 - 78
121800Z	25.7N 128.2E	260 - 38	353 - 73

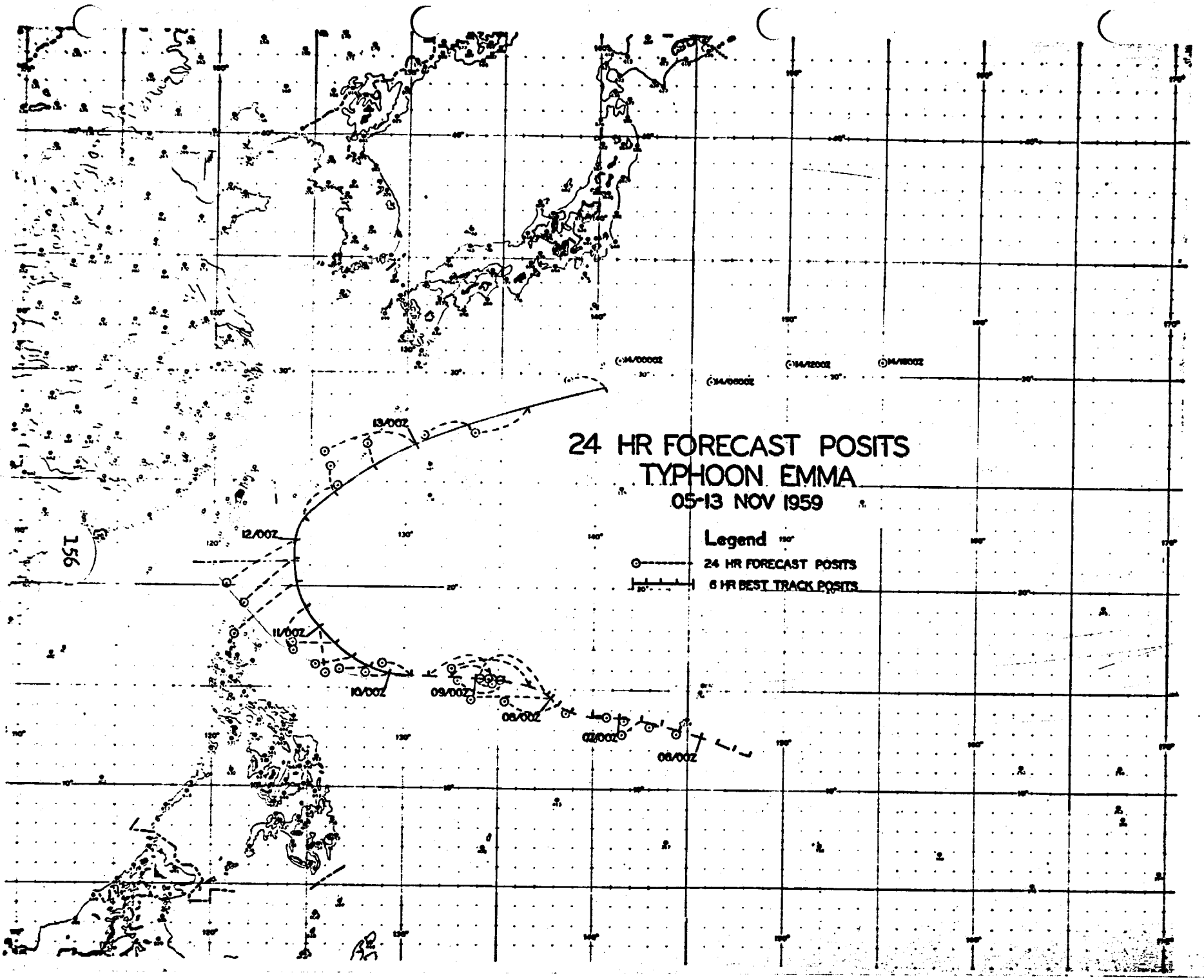
TYPHOON EMMA 05 - 13 NOV. 1959
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
130000Z	26.8N	130.5E	210	66	264	260
130600Z	27.7N	133.3E	340	29	256	125
131200Z	28.4N	136.3E	315	40	246	159
131800Z	29.4N	140.3E	228	42	288	95

AVERAGE 12 HOUR ERROR 69.4 NM
AVERAGE 24 HOUR ERROR 149.4 NM


BEST TRACK
TYPHOON EMMA
05-13 NOV 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥64 KTS
INTENSITY <64 KTS
154


12 HR FORECAST POSITS
TYPHOON EMMA
05-13 NOV 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
155
12/00Z
11/00Z
10/00Z
09/00Z
08/00Z
07/00Z
06/00Z
13/00Z


24 HR FORECAST POSITS
TYPHOON EMMA
05-13 NOV 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
156
14/00GZ
14/12GZ
14/18GZ
14/06GZ
13/00Z
12/00Z
11/00Z
10/00Z
09/00Z
08/00Z
07/00Z
06/00Z

P. TYPHOON FREDA (13-20 NOVEMBER 1959)

On 9 November, following in the wake of Typhoon EMMA, FREDA first became evident as a weak tropical low on the Intertropical Convergence Zone south of Ponape. This diffuse low pressure area drifted slowly to the west-northwest, and on the 12th was located near Ulithi with what appeared to be a double surface center. The lowest reported pressure at that time was 1004 millibars at Ulithi. All reconnaissance aircraft were committed to Typhoon EMMA, so the suspect area was watched very closely utilizing all available data. By 121800Z the pressure at both Yap and Ulithi had dropped to 1001 millibars, multiple layers of clouds prevailed at both stations, and the surface winds at Ulithi had increased to 25 knots from the east-southeast. It was now almost a certainty that what had formerly been only a diffuse tropical low was now a cyclone of perhaps storm intensity. Reconnaissance was urgently requested, and a fix was made by a B-50 of the 54th Weather Reconnaissance Squadron at 130120Z. Based upon the fix, which positioned the center 110 miles southwest of Yap, the first warning on Tropical Storm FREDA was issued.

Subsequent reconnaissance fixes indicated that FREDA had moved somewhat erratically during the first 12 hours. However, thereafter she curved gradually northwestward at a steady 10 to 12 knots. A report from the U.S. Coast Guard Loran Station on Catanduanes Island in the eastern Philippines, which was confirmed by a reconnaissance fix, showed that FREDA moved directly over the Island at 160200Z. The wind measuring gear at the Coast Guard Station was carried away at 130 knots, and the Coast Guard observers estimated the maximum

gusts to have been 165 knots. Shortly after passing over Catanduanes Island, FREDA gradually began to decelerate and weaken due to the proximity of land masses. Easterly flow aloft indicated that FREDA would move across Luzon into the South China Sea, passing just north of Clark Air Base. However, a polar high which moved into the South China Sea apparently blocked any pronounced westerly movement. As a result, FREDA passed just to the east of Baler, Luzon and moved over Luzon from southeast to northwest. The Manila area suffered only minor damage due to FREDA. The mountains of central Luzon further weakened FREDA, and she was downgraded to a tropical storm at 171800Z. The zonal westerlies extended as far south as 22 degrees north. Therefore, as FREDA passed across the extreme south tip of Taiwan, she recurved sharply. FREDA passed directly over Okinawa at approximately 190800Z with maximum gusts of 52 knots being reported at Kadena Air Base. Thereafter she weakened rapidly and the final tropical warning was issued at 200000Z.

In considering climatology, Typhoon FREDA was unusual in that she recurved. In mid-November, for typhoons which move as far west as the 130th meridian, the normal climatological track does not show recurvature, rather westward movement across the Philippines and into the South China Sea. Twenty-nine warnings were issued covering a period of 8 days.

For damage caused by Typhoon FREDA see Section VI "Destructive Effects of Typhoons".

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON FREDA

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	130120Z	08.0N	137.0E	54-P-5	996	70	10060	65	12	12	EYE ELLIP 50X30 MI
2	130900Z	09.8N	136.3E	54-P-5	999	50	9990	50	09	09	EYE ELLIP 15X20 MI
3	131147Z	09.6N	134.6E	54-P-5	993	- -	9900	40	10	08	SPIRAL BANDS SC
4	132115Z	09.9N	132.7E	54-P-8	986	65	9800	60	14	06	EYE ILL DEFINED
5	140200Z	09.8N	132.1E	54-P-10	985	75	9780	65	15	10	CIRC DIA 40 MI
6	140845Z	10.0N	131.2E	54-P-2	980	70	9530	75	14	11	CIRC DIA 30 MI
7	141221Z	10.1N	130.5E	54-R-20	- -	- -	- -	- -	- -	- -	CIRC DIA 40 MI
8	142030Z	10.8N	129.2E	54-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 35 MI
9	142130Z	11.0N	128.2E	54-P-5	973	80	9450	- -	16	11	CIRC DIA 35 MI
10	150000Z	11.3N	128.3E	54-P-5	978	100	9380	- -	16	12	CIRC DIA 40 MI
11	150800Z	11.8N	127.2E	54-P-5	968	90	9280	70	18	13	CIRC DIA 50 MI
12	151400Z	12.3N	126.3E	54-R-10	- -	- -	- -	90	- -	- -	CIRC DIA 40 MI
13	152200Z	13.2N	125.3E	54-P-2	944	125	8530	95	20	08	CIRC DIA 60 MI
14	160200Z	13.7N	124.3E	54-P-0	936	100	8590	- -	17	12	CIRC DIA 40 MI
15	160800Z	14.1N	123.6E	54-P-0	951	125	8680	- -	16	12	CIRC DIA 40 MI
16	170800Z	18.1N	121.9E	54-T-12	- -	75	- -	- -	- -	- -	FLT LVL CNTR W OF EYE
17	171400Z	18.9N	120.4E	54-T-5	- -	- -	- -	- -	- -	- -	
18	172000Z	19.8N	120.3E	54-P-1	- -	- -	9780	70	13	08	CIRC DIA 40 MI
19	172215Z	19.7N	120.3E	54-P-15	995	80	9800	75	13	07	CIRC DIA 75 MI

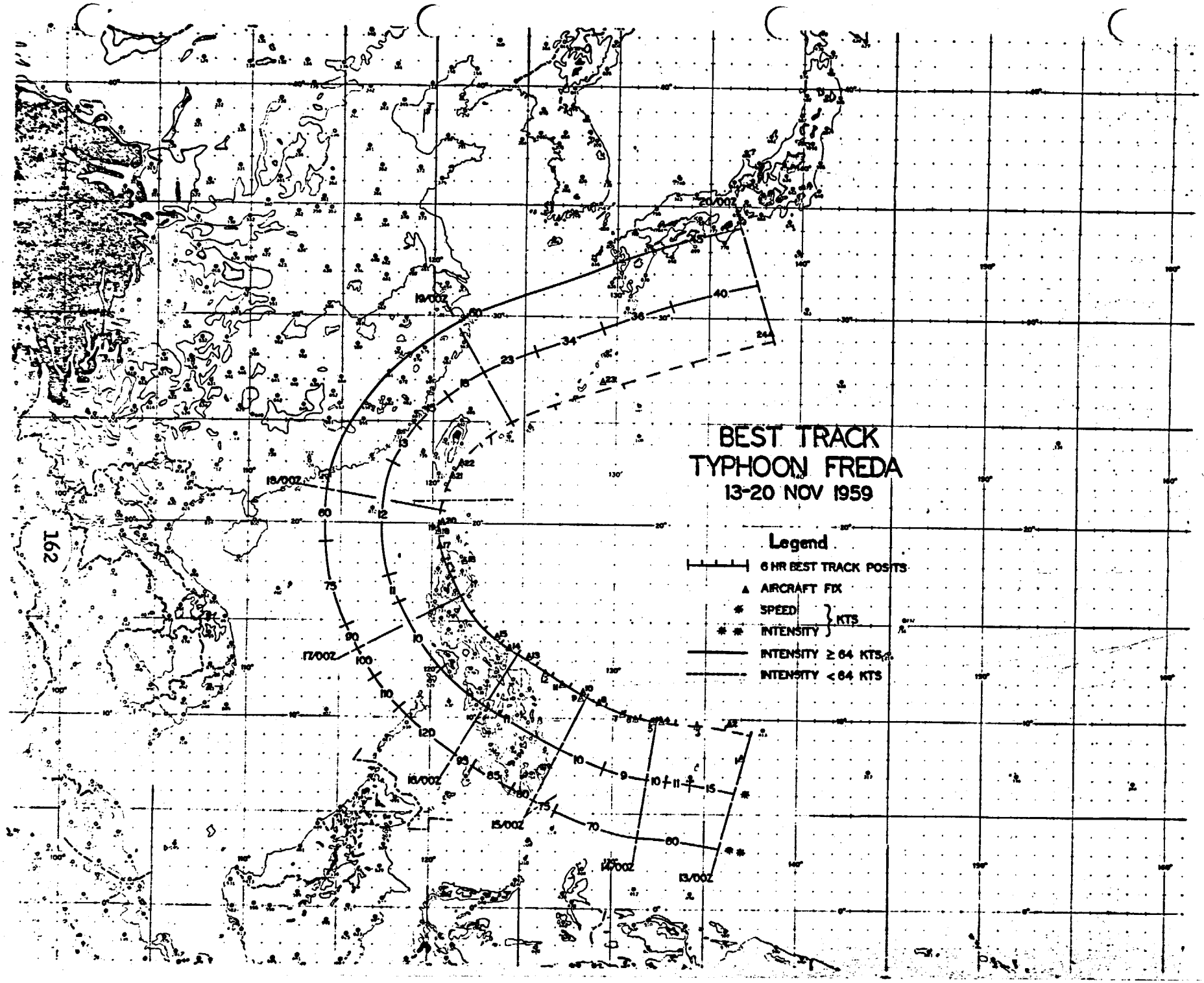
RECONNAISSANCE AIRCRAFT FIXES - TYPHOON FREDA (CONT'D)

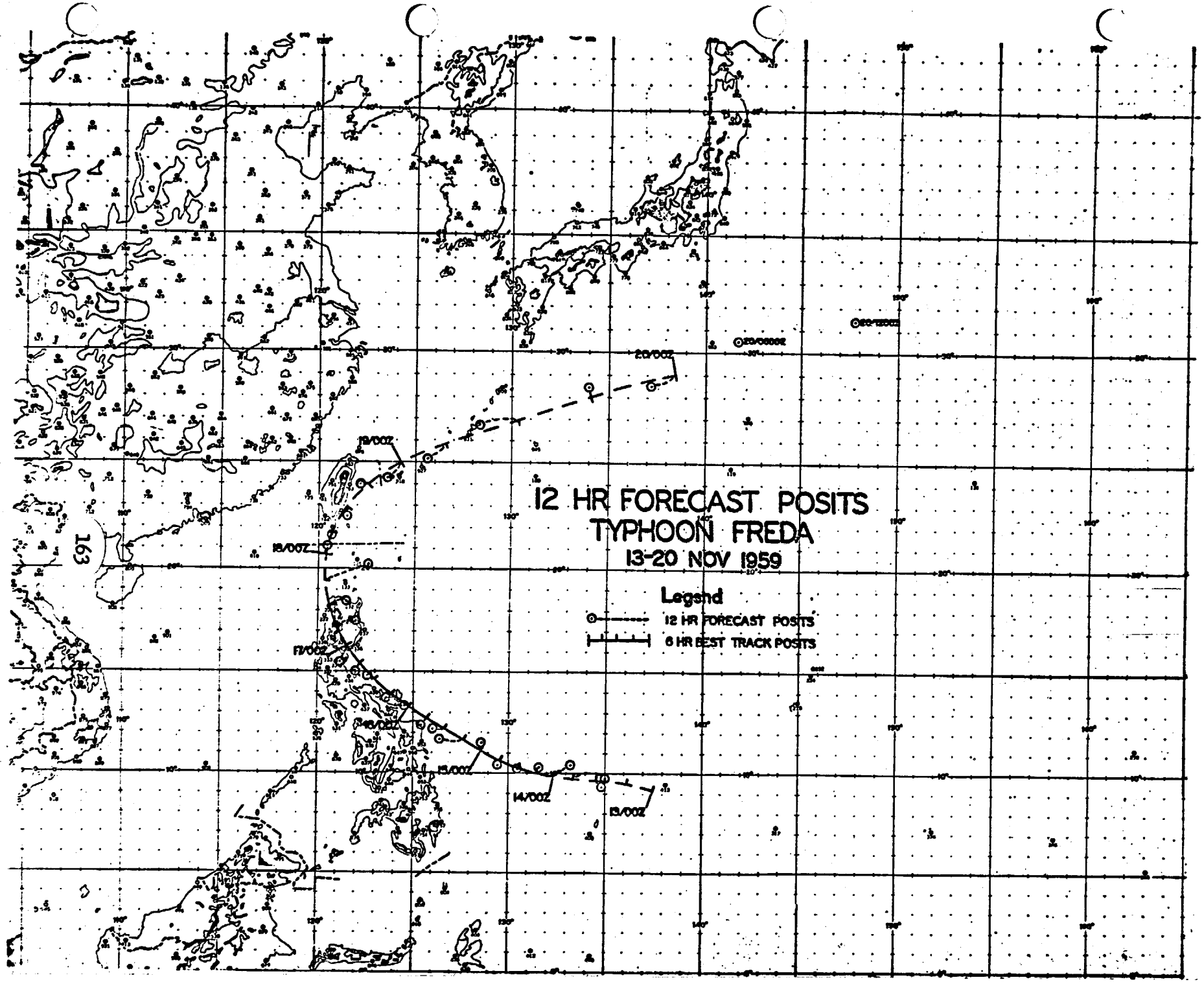
FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
20	180259Z	20.0N	120.6E	56-P-1	990	40	- -	- -	- -	- -	EYE ELLIP 40X20 MI
21	180900Z	22.4N	121.1E	54-P-1	991	55	9860	60	11	10	CIRC DIA 80 MI
22	181400Z	23.0N	121.7E	54-P-3	996	- -	9860	80	11	10	CIRC DIA 90 MI
23	191104Z	27.0N	129.2E	12-R-2	- -	- -	- -	- -	- -	- -	DIA 20MI N-S 15MI E-W
24	192125Z	29.3N	138.3E	12-P-10	993	25	10000	- -	06	03	EYE OPEN S-E

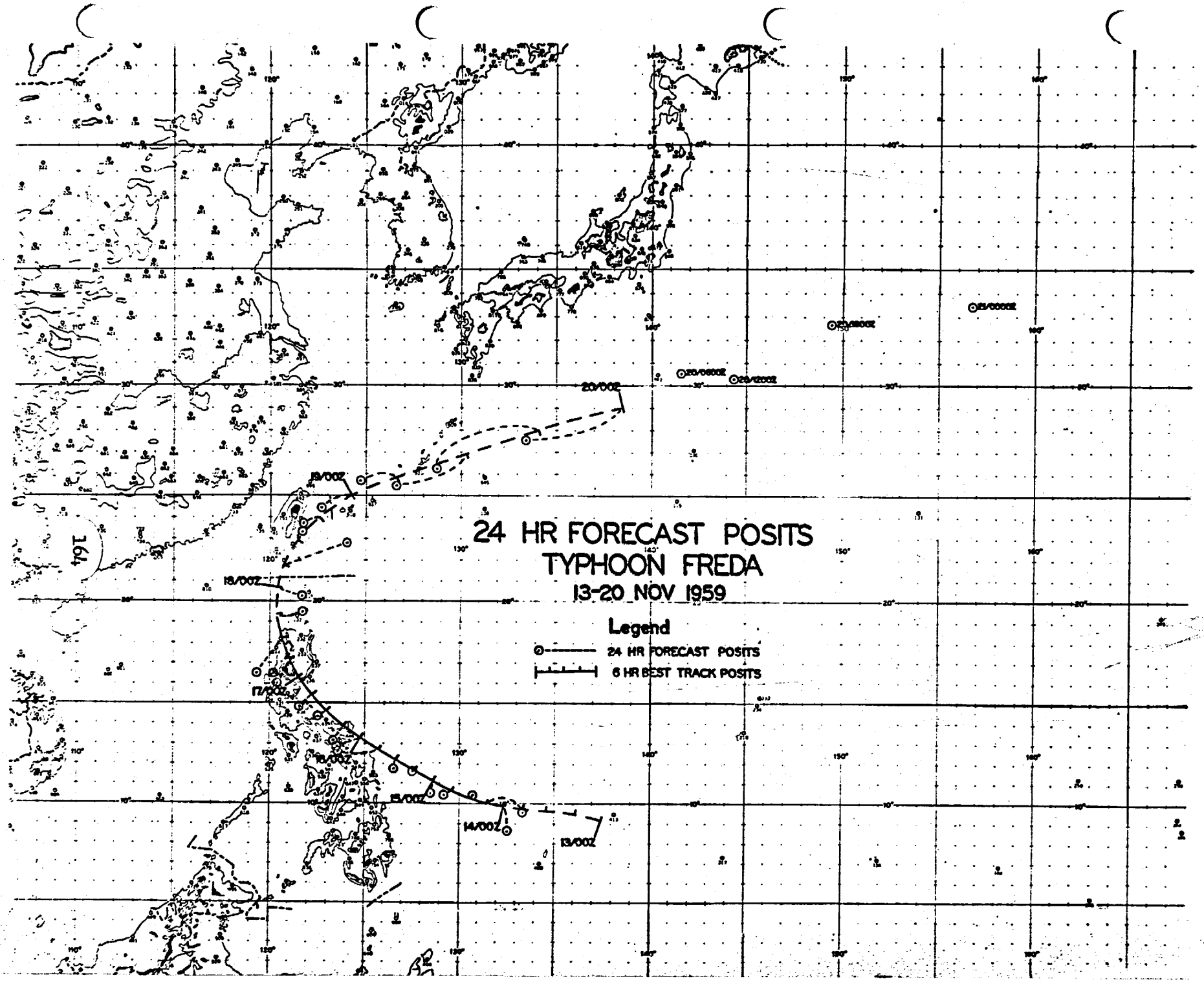
TYPHOON FREDA 13 - 20 NOV. 1959
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
130000Z	09.1N	137.5E	-	-	-	-
130600Z	09.4N	136.1E	-	-	-	-
131200Z	09.6N	134.6E	165	76	-	-
131800Z	09.7N	133.4E	085	90	-	-
140000Z	09.8N	132.4E	055	46	168	64
140600Z	10.0N	131.5E	010	13	095	112
141200Z	10.2N	130.6E	240	14	010	12
141800Z	10.6N	129.6E	200	20	246	35
150000Z	11.0N	128.7E	190	33	210	37
150600Z	11.6N	127.7E	220	37	191	52
151200Z	12.1N	126.7E	268	41	189	78
151800Z	12.7N	125.8E	225	37	214	74
160000Z	13.3N	124.8E	263	18	247	71
160600Z	13.9N	123.9E	245	18	217	66
161200Z	14.6N	123.0E	295	32	230	32
161800Z	15.4N	122.3E	210	30	233	49
170000Z	16.3N	121.7E	162	54	275	96
170600Z	17.2N	121.3E	070	47	220	95
171200Z	18.2N	120.8E	070	36	223	136
171800Z	19.4N	120.5E	060	131	078	70
180000Z	20.6N	120.4E	360	34	108	74
180600Z	21.8N	120.7E	190	14	250	193
181200Z	22.9N	121.5E	210	21	150	60
181800Z	24.0N	122.6E	270	23	230	57
190000Z	25.0N	124.3E	220	63	250	85
190600Z	25.9N	126.6E	230	70	265	96
191200Z	26.9N	130.2E	255	50	245	211
191800Z	28.0N	134.1E	340	15	250	309
200000Z	29.0N	138.5E	255	68	255	281

AVERAGE 12 HOUR ERROR 41.9 NM
AVERAGE 24 HOUR ERROR 97.8 NM


BEST TRACK
TYPHOON FREDA
13-20 NOV 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
20/00Z
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z
162


12 HR FORECAST POSITS
TYPHOON FREDA
13-20 NOV 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
163
20/00Z
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z


24 HR FORECAST POSITS
TYPHOON FREDA
13-20 NOV 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
20/00Z
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z
164

Q. TYPHOON GILDA (13-21 DECEMBER 1959)

On 10 December, surface and winds aloft reports from Truk indicated the possibility of a tropical cyclone developing to the southeast of the Island. Reconnaissance was requested, and at 110330Z a weak center was fixed approximately 400 miles south-southeast of Guam. The next fix, at 120152Z, indicated that the tropical low had remained almost stationary during the privious 24 hours and had intensified only slightly. On the following day, within less than three hours, two separate centers were fixed. One, with a central pressure of 1002 millibars, was centered just south of Ifalik Atoll. The other, located some 80 miles to the northwest of Ifalik, had a central pressure of 1000 millibars. Twelve hours later, at 132130Z, a fix confirmed the fact that the two lows had rapidly consolidated into a full-blown typhoon with a central pressure of 977 millibars. Warning number 1 on Typhoon GILDA was issued shortly after the receipt of the fix.

For the next three days GILDA moved to the west-northwest at an average speed of 11 knots while continuing to intensify. At the end of this three day period (approximately 161800Z) GILDA began to decelerate rapidly. At the same time a weak trough aloft in the westerlies moved into the Luzon Straits. This trough, coupled with the aforementioned deceleration, led to a forecast of recurvature. However, the trough did not deepen appreciably or extend far enough south to cause recurvature. Then, at approximately 180000Z, GILDA began moving almost due west and started to accelerate rapidly. Two

days later, at approximately 200000Z, GILDA began to decelerate rapidly and by 200600Z was moving at 12 knots toward Viet Nam on a track which was slightly south of west. The final warning, issued at 210000Z, contained a forecast for rapid dissipation over Viet Nam to the northeast of Saigon.

Typhoon GILDA was typical of December climatology. The path was very similar to that of Typhoon GLORIA in 1952. The abrupt westward movement on the 18th came unexpectedly and could not have been forecast from the sparse upper air data available. At approximately 190800Z GILDA passed directly over the U.S. Coast Guard Loran Station on Talampalan Island in the western Philippines. Coast Guard observers estimated the maximum sustained wind to have been 80 knots with gusts to 140 knots. Thirty warnings were issued covering a period of 9 days.

For damage caused by Typhoon GILDA see Section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON GILDA

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	110330Z	06.8N	146.0E	54-P—	- -	- -	- -	- -	- -	- -	————
2	120152Z	06.6N	145.9E	54-P-5	1001	25	10160	25	12	08	EYE ILL DEFINED
3	130024Z	07.6N	143.1E	54-R-2	1002	- -	10020	45	10	10	WALL CLDS NE QUAD
4	130314Z	07.6N	142.9E	54-P—	1000	50	- -	- -	- -	- -	————
5	132130Z	07.4N	140.8E	54-P-5	977	80	9660	75	13	09	CIRC DIA 10 MI
6	140200Z	07.4N	140.2E	54-P-5	980	80	9570	80	14	12	CIRC DIA 20 MI
7	140800Z	07.7N	139.2E	54-P-5	969	100	9210	70	17	12	CIRC DIA 20 MI
8	141400Z	08.0N	138.4E	54-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 10 MI
9	142135Z	08.0N	137.0E	54-P-5	945	100	8360	110	17	14	CIRC DIA 12 MI
10	150000Z	08.4N	136.6E	54-P-10	938	100	8300	110	17	14	CIRC DIA 12 MI
11	150800Z	08.4N	135.6E	54-P-8	932	150	8300	120	16	12	CIRC DIA 12 MI
12	151400Z	08.7N	134.7E	54-R-10	- -	- -	- -	- -	- -	- -	————
13	152200Z	09.3N	132.6E	54-P-20	933	125	8180	130	18	12	CIRC DIA 20 MI
14	160140Z	09.6N	132.4E	54-P-10	926	150	8120	125	20	13	CIRC DIA 20 MI
15	160800Z	10.1N	130.9E	54-P-15	914	150	7540	135	22	16	CIRC DIA 15 MI
16	161345Z	10.3N	129.8E	54-R-20	- -	- -	- -	- -	- -	- -	WIDE SPREAD RAIN
17	162200Z	11.3N	128.6E	54-P-10	920	135	7980	120	17	13	WALL CLDS ALL QUADS

RECONNAISANCE AIRCRAFT FIXES - TYPHOON GILDA (CONT'D)

FIX NO	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
18	170200Z	11.5N	128.2E	54-P-10	933	165	8030	110	17	14	CIRC DIA 17 MI
19	170800Z	11.5N	127.8E	54-P-5	- -	90	8280	115	15	15	CIRC DIA 15 MI
20	171130Z	11.5N	127.6E	54-R-10	- -	- -	- -	- -	- -	- -	----------
21	172000Z	12.2N	126.3E	54-R-15	- -	- -	- -	- -	- -	- -	----------
22	172300Z	12.2N	125.8E	54-P-10	939	150	8310	90	18	15	ELLIP DIA 15 MI
23	180810Z	12.0N	124.3E	54-P-2	- -	- -	- -	80	- -	- -	----------
24	182000Z	12.2N	122.1E	54-R-5	- -	- -	- -	- -	- -	- -	----------
25	182300Z	12.3N	121.3E	54-P-1	978	80	- -	60	- -	- -	CIRC DIA 25 MI
26	190100Z	12.2N	121.1E	54-P-1	- -	100	- -	30	- -	- -	CIRC DIA 25 MI
27	191945Z	12.7N	117.6E	54-RT-5	- -	- -	- -	- -	- -	- -	ELLIP DIA 22 MI
28	192300Z	12.6N	116.9E	54-P-5	984	150	9660	70	21	18	CIRC DIA 30 MI
29	200200Z	12.6N	116.3E	54-P-5	985	150	9680	70	18	15	ELLIP DIA 30 MI

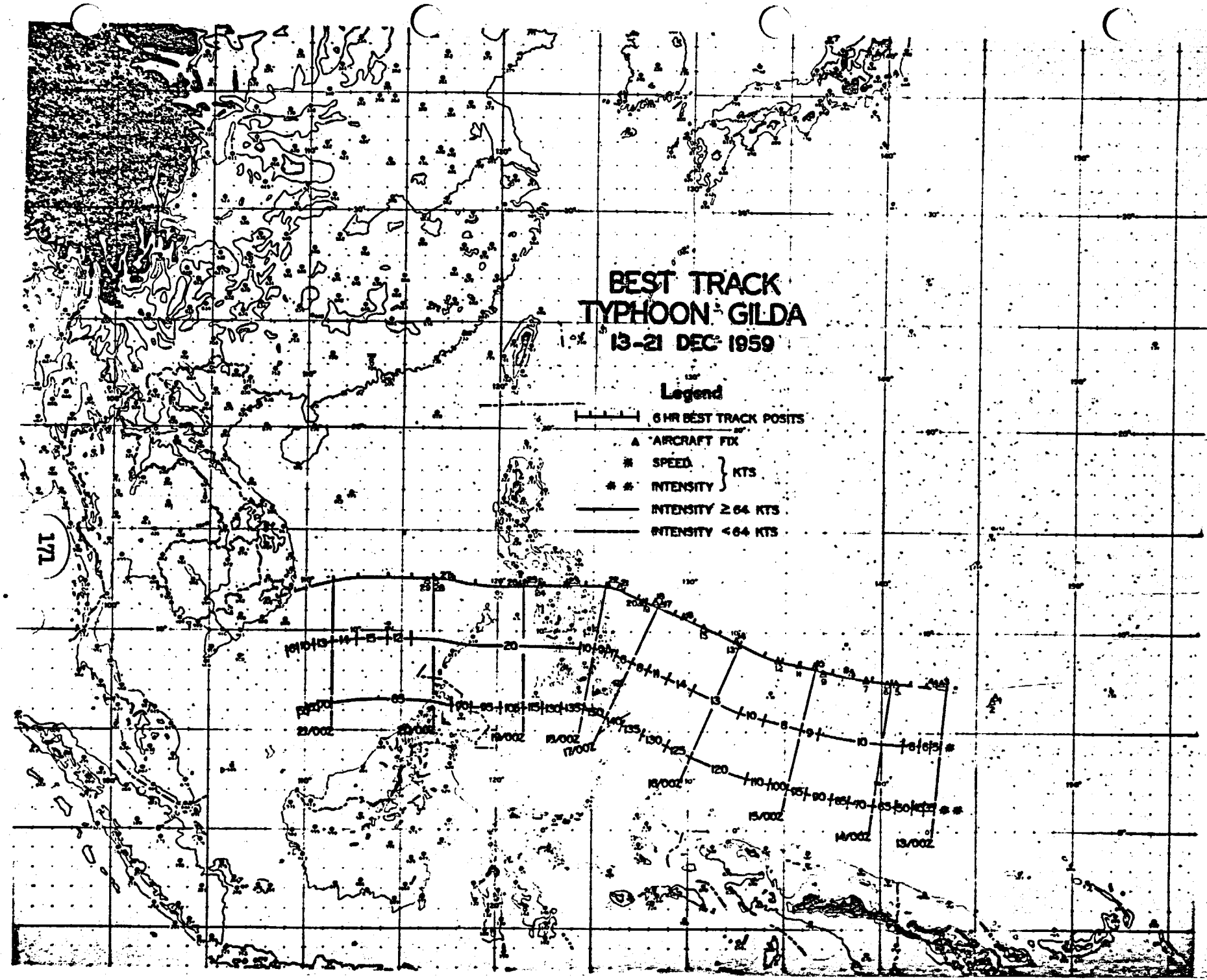
TYPHOON GILDA 13 - 21 DEC. 1959
POSITION AND FORECAST VERIFICATION DATA

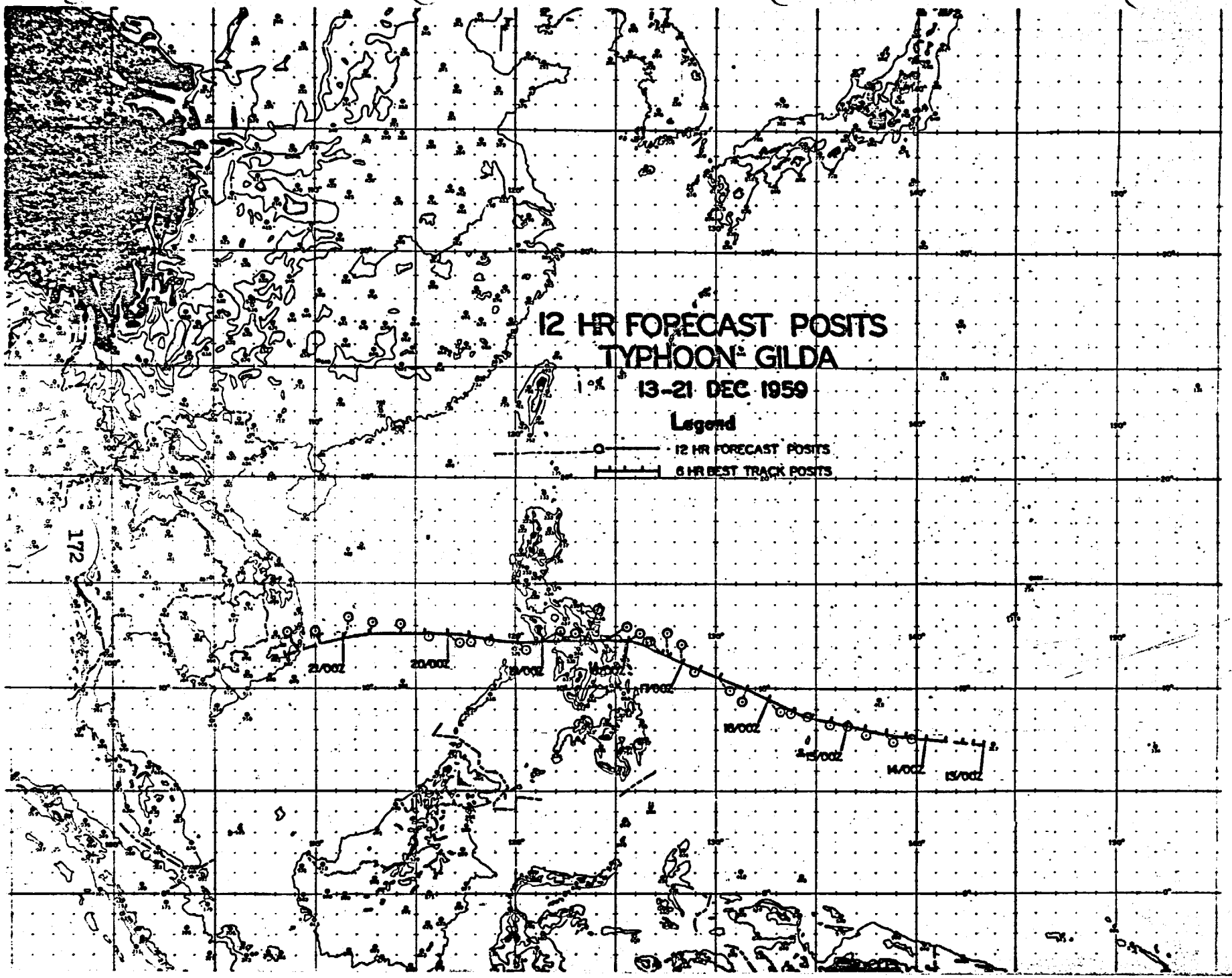
DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
130000Z	07.1N	143.4E	- - - -		- - - -	
130600Z	07.2N	142.9E	- - - -		- - - -	
131200Z	07.3N	142.3E	- - - -		- - - -	
131800Z	07.3N	141.5E	- - - -		- - - -	
140000Z	07.4N	140.5E	- - - -		- - - -	
140600Z	07.6N	139.5E	108	23	- - - -	
141200Z	07.8N	138.5E	137	34	- - - -	
141800Z	08.0N	137.5E	180	12	110	56
150000Z	08.1N	136.6E	360	06	135	61
150600Z	08.3N	135.8E	270	06	225	25
151200Z	08.5N	134.9E	292	21	270	19
151800Z	08.8N	133.9E	270	06	230	16
160000Z	09.3N	132.7E	131	36	195	20
160600Z	09.9N	131.5E	201	26	148	45
161200Z	10.4N	130.2E	135	43	135	102
161800Z	10.9N	129.2E	256	11	193	64
170000Z	11.2N	128.4E	351	55	155	47
170600Z	11.5N	127.8E	350	86	282	64
171200Z	11.7N	127.3E	327	47	343	136
171800Z	12.0N	126.6E	020	12	348	137
180000Z	12.2N	125.7E	047	38	003	56
180600Z	12.2N	124.7E	045	68	062	80
181200Z	12.2N	123.5E	036	55	050	119
181800Z	12.2N	122.4E	049	49	055	167
190000Z	12.2N	121.2E	057	74	045	121
190600Z	12.2N	120.1E	121	32	055	99
191200Z	12.3N	118.9E	245	11	060	136
191800Z	12.5N	117.8E	165	15	143	55
200000Z	12.6N	116.7E	248	36	115	46
200600Z	12.6N	115.5E	123	12	165	25
201200Z	12.6N	114.3E	355	31	115	60
201800Z	12.6N	112.8E	013	33	070	24

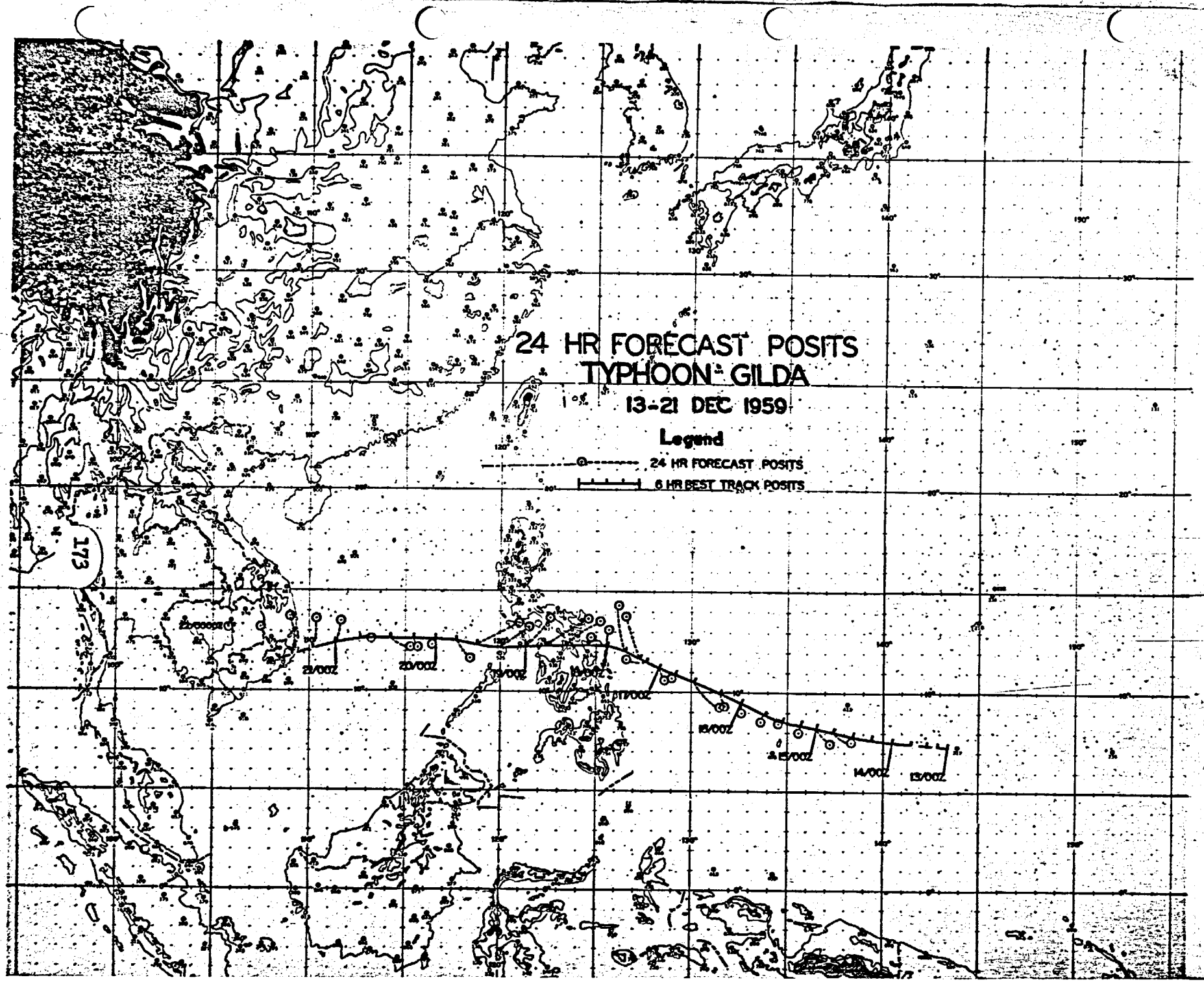
TYPHOON GILDA 13 - 21 DEC. 1959
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
210000Z	12.4N	111.4E	010	60	010	70
210600Z	12.1N	110.1E	354	43	004	64
211200Z	11.8N	109.1E	338	72	357	124
211800Z	11.6N	108.5E	- - - -		325	108

AVERAGE 12 HOUR ERROR 35.1 NM
AVERAGE 24 HOUR ERROR 74.0 NM


BEST TRACK
TYPHOON GILDA
13-21 DEC 1959
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
17N


12 HR FORECAST POSITS
TYPHOON GILDA
13-21 DEC 1959
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
172
21/00Z
20/00Z
19/00Z
18/00Z
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z


24 HR FORECAST POSITS
TYPHOON GILDA
13-21 DEC 1959
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
175
23/00Z
20/00Z
19/00Z
17/00Z
16/00Z
15/00Z
14/00Z
13/00Z

R. TYPHOON HARRIET (24 DECEMBER 1959 - 02 JANUARY 1960)

On 22 December a 1002 millibar tropical low was evident to the southeast of Truk. Reconnaissance aircraft were sent to investigate, and throughout the 23rd reported increasing precipitation and wall clouds forming around the center. The next day at 0215Z a definite eye was located approximately 300 miles southeast of Truk and based on this fix, JTWC issued warning number 1 on Tropical Storm HARRIET.

Movement was erratic until 250000Z when HARRIET was upgraded to a typhoon. She then started moving toward the northwest at the steady speed of 10 knots. This track moved HARRIET to a point 200 miles south of Guam, at which time Guam's upper winds backed to the east. As a result, Typhoon HARRIET turned abruptly westward, gradually veering 6 hours later to a west-northwesterly course at 17 knots. On 28 December HARRIET appeared to be coming under the influence of a trough in the westerlies. However, the trough was not strong enough to produce recurvature and once again HARRIET turned abruptly toward the west. At 281800Z, some 500 miles east of Catanduanes Island, HARRIET reached her maximum intensity with surface winds of 130 knots near the center. At the same time a 1062 millibar high centered over Siberia was gradually spreading southward over the Philippines, and this blocked the typhoon from any northward movement. Slow deceleration then commenced and the cold air associated with the high gradually weakened HARRIET. Steering rapidly dropped to the 500 millibar level and a west-southwesterly

movement began. At approximately 312130Z the typhoon passed directly over Catanduanes Island with winds well in excess of 100 knots. Movement over the Philippines further weakened HARRIET, steering dropped to the 700 millibar level, and at 010000Z she was downgraded to a tropical storm. By 020000Z January 1960, HARRIET was dissipating rapidly over the South China Sea and JTWC issued the final warning.

Typhoon HARRIET was one of those rare December storms extending into the New Year. Her early path followed December climatology quite closely, but the southwesterly movement was unusual. No similar climatological path has been recorded in the past 10 years. HARRIET was also characterized by her comparatively small eye, averaging only 25 miles. Thirty-seven warnings were issued covering a period of 10 days.

For damage caused by Typhoon HARRIET see Section VI, "Destructive Effects of Typhoons."

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON HARRIET

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
1	230520Z	03.2N	153.5E	54-P-15	994	40	9860	—	25	25	CIRC DIA 30 MI
2	240215Z	02.8N	153.8E	54-P-5	993	65	9910	30	14	11	CIRC DIA 25 MI
3	240630Z	03.6N	153.3E	54-P-5	993	70	9920	40	15	12	CIRC DIA 25 MI
4	242030Z	04.5N	152.2E	54-P-5	984	60	9820	50	16	13	CIRC DIA 35 MI
5	250200Z	04.9N	151.4E	54-P-5	982	85	9720	50	14	12	CIRC DIA 10 MI
6	250345Z	05.1N	151.2E	54-P-5	979	55	9670	50	15	14	CIRC DIA 15 MI
7	252045Z	06.7N	148.4E	54-P-5	975	85	9480	50	18	14	CIRC DIA 25 MI
8	260315Z	07.8N	148.0E	54-P-5	975	85	9540	50	18	14	CIRC DIA 20 MI
9	260700Z	08.4N	147.2E	54-P-5	981	100	9640	60	18	15	CIRC DIA 20 MI
10	261400Z	09.8N	145.7E	54-R-5	- -	- -	- -	- -	- -	- -	CIRC DIA 50 MI
11	262045Z	10.3N	143.6E	54-P-10	978	65	9460	60	18	10	CIRC DIA 20 MI
12	270215Z	10.7N	142.3E	54-P-5	983	50	9630	- -	17	12	NOT WELL DEFINED
13	270800Z	11.4N	140.7E	54-P-2	976	65	9410	90	15	08	CIRC DIA 25 MI
14	281400Z	12.1N	139.0E	54-R-10	- -	- -	- -	- -	- -	- -	ELLIP NNE/SSW 25MI
15	280030Z	13.0N	136.4E	54-P-5	950	120	8750	80	18	16	ELLIP 15X20 MI
16	280200Z	13.1N	135.9E	54-P-5	936	120	8590	120	18	16	ELLIP 15X20 MI
17	280800Z	13.4N	134.4E	54-P-5	926	150	8140	90	21	18	CIRC DIA 12 MI
18	281615Z	13.8N	132.9E	54-R—	- -	- -	- -	- -	- -	- -	ELLIP N/S 20X15 MI
19	282200Z	14.6N	131.3E	54-P-15	930	- -	8800	95	19	19	ELLIP N/S 25X15 MI

RECONNAISSANCE AIRCRAFT FIXES - TYPHOON HARRIET (CONT'D)

FIX NO.	TIME	LAT.	LONG.	*UNIT METHOD & ACCY	MIN SLP MBS	MAX SFC WND	MIN 700MB HGT	MAX FLT LVL WND	700MB TEMP (°C)	700MB DEWPT (°C)	EYE CHARACTERISTICS
20	290200Z	14.5N	130.3E	54-P-2	956	100	8940	80	19	16	ELLIP N/S 20X15 MIL
21	290915Z	14.4N	129.4E	54-P-1	940	150	8500	112	17	12	CIRC DIA 20 MIL
22	291400Z	13.8N	128.4E	54-R-25	- -	- -	- -	- -	- -	- -	CIRC DIA 25 MIL
23	292000Z	14.5N	128.0E	54-T-30	- -	- -	- -	- -	- -	- -	----------
24	292200Z	14.3N	127.8E	54-P-10	946	150	8530	110	17	14	CIRC DIA 25 MIL
25	300200Z	14.2N	127.5E	54-P-10	965	150	8680	110	16	16	CIRC DIA 25 MIL
26	301100Z	14.0N	126.3E	54-R-10	- -	- -	- -	- -	- -	- -	CONTIN RAIN TURBLC LGT
27	301615Z	13.6N	125.1E	54-R-1	- -	- -	- -	- -	- -	- -	CIRC DIA 35 MIL
28	302000Z	13.7N	124.7E	54-R-15	- -	- -	- -	- -	- -	- -	CIRC DIA 45 MIL
29	310000Z	13.8N	124.1E	54-P-1	955	- -	- -	90	- -	- -	EYE DIFFUSE
30	311529Z	13.5N	121.8E	VW-R-3	- -	- -	- -	- -	- -	- -	CIRC DIA 15 MIL
31	312315Z	13.0N	121.1E	54-P-	- -	80	- -	45	- -	- -	----------
32	010800Z	12.0N	119.8E	54-P-3	- -	60	- -	50	12	10	EYE DIFFUSE
33	012000Z	11.0N	118.2E	54-R-10	- -	- -	- -	- -	- -	- -	CIRC DIA 30 MIL
34	020020Z	10.3N	117.2E	54-P-10	- -	40	10200	- -	14	10	CIRC DIA 30 MIL

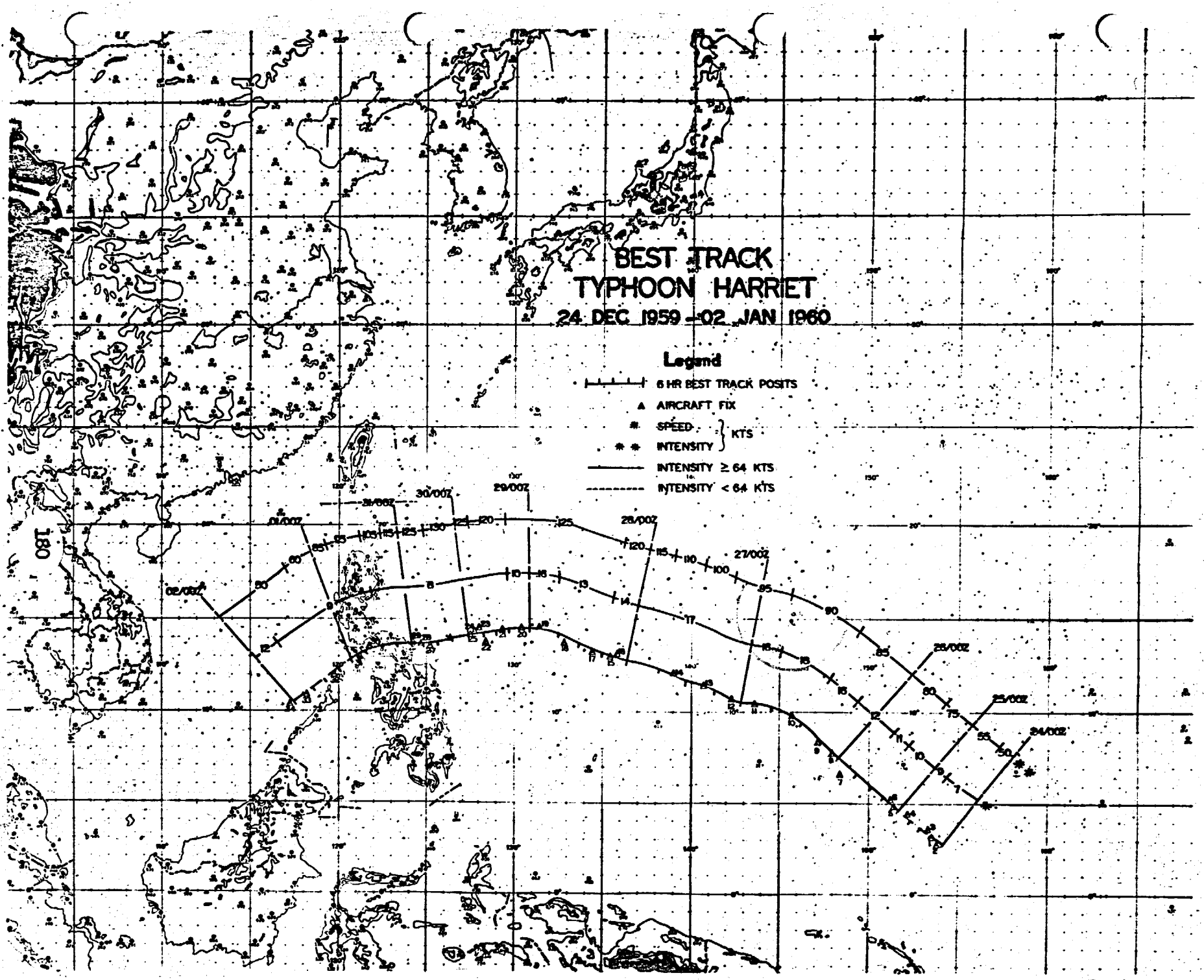
TYPHOON HARRIET 24 DEC - 02 JAN 1959 - 60
POSITION AND FORCAST VERIFICATION DATA

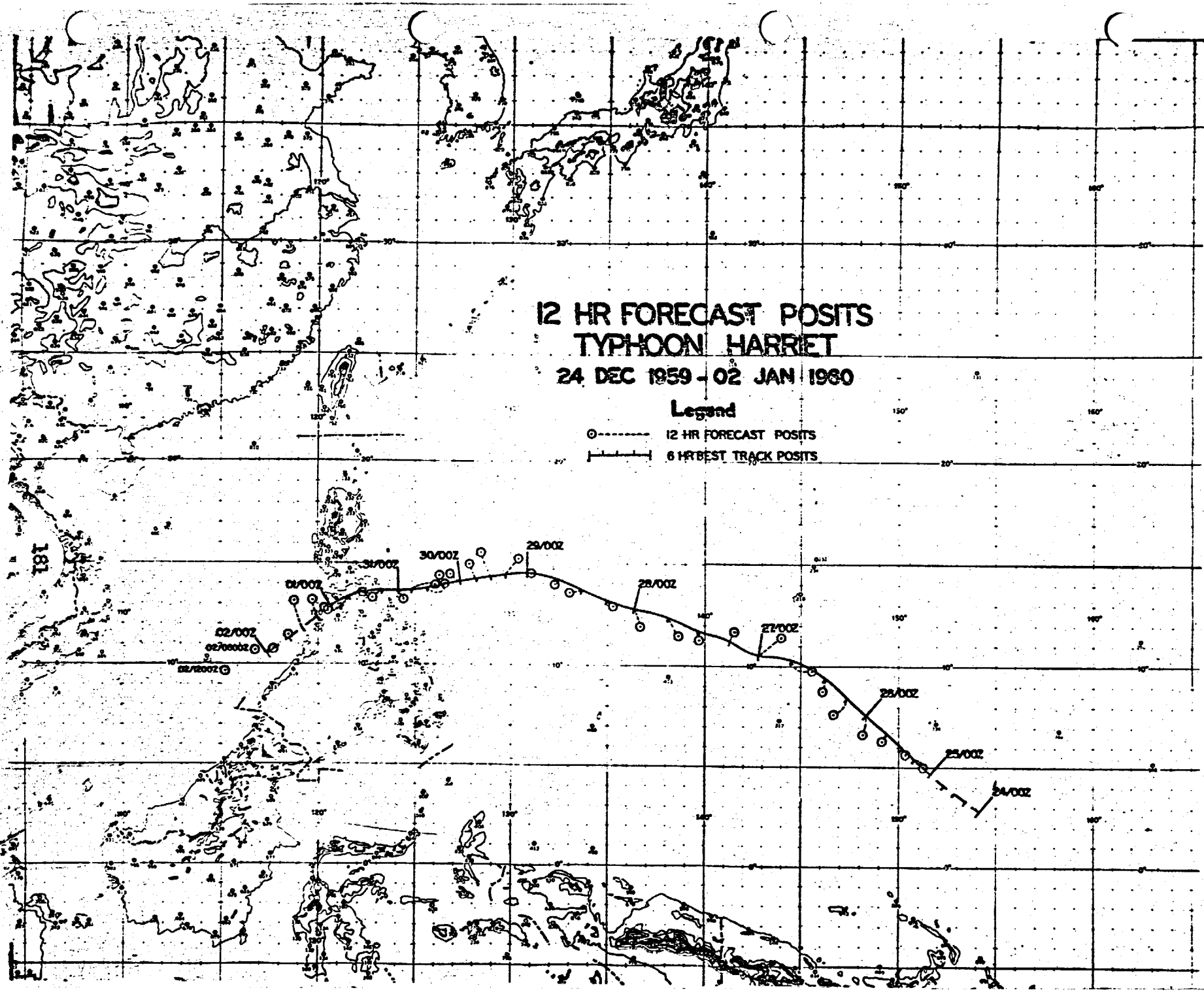
DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
240000Z	02.9N	154.1E	- - - -		- - - -	
240600Z	03.3N	153.5E	- - - -		- - - -	
241200Z	03.6N	152.9E	122	85	- - - -	
241800Z	04.1N	152.4E	127	85	- - - -	
250000Z	04.7N	151.7E	129	96	127	180
250600Z	05.4N	150.9E	134	33	128	201
251200Z	06.0N	150.2E	153	29	130	218
251800Z	06.7N	149.3E	199	28	138	91
260000Z	07.5N	148.3E	189	57	155	76
260600Z	08.3N	147.4E	218	55	186	67
261200Z	09.3N	146.2E	185	27	171	111
261800Z	10.2N	144.6E	110	61	175	85
270000Z	10.5N	142.9E	049	80	096	86
270600Z	11.2N	141.3E	193	45	078	146
271200Z	11.8N	139.8E	178	40	050	193
271800Z	12.4N	138.1E	150	66	036	102
280000Z	12.9N	136.4E	157	62	145	88
280600Z	13.3N	135.0E	156	21	146	107
281200Z	13.8N	133.8E	090	44	178	105
281800Z	14.2N	132.5E	240	20	176	44
290000Z	14.5N	130.9E	090	08	308	25
290600Z	14.5N	129.8E	040	54	007	43
291200Z	14.4N	129.0E	331	71	345	76
291800Z	14.3N	128.2E	343	45	049	125
300000Z	14.2N	127.4E	306	32	354	162
300600Z	14.0N	126.5E	326	35	001	127
301200Z	13.9N	125.7E	084	48	310	55
301800Z	13.9N	124.9E	082	70	319	52
310000Z	13.8N	124.1E	153	34	084	64
310600Z	13.7N	123.3E	222	34	090	104
311200Z	13.6N	122.5E	270	08	170	45
311800Z	13.3N	121.6E	232	75	243	94

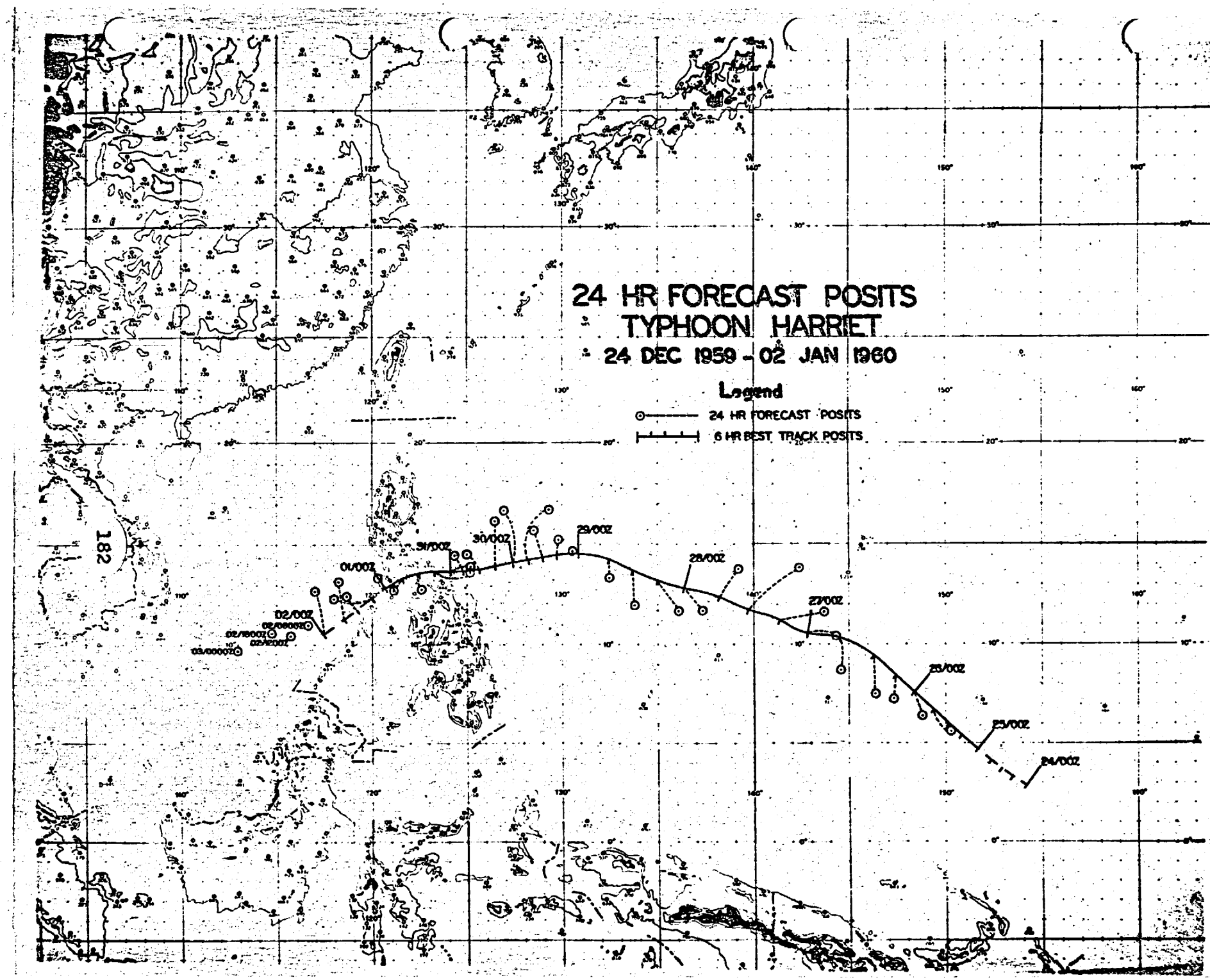
TYPHOON HARRIET 24 DEC - 02 JAN 1959 - 60
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	12 HR ERROR DEG.	DISTANCE	24 HR ERROR DEG.	DISTANCE
010000Z	12.9N	120.7E	242	16	335	35
010600Z	12.4N	120.0E	352	49	261	114
011200Z	11.8N	119.2E	347	81	314	51
011800Z	11.2N	118.5E	360	10	351	119
020000Z	10.5N	117.4E	067	22	349	139

AVERAGE 12 HOUR ERROR 46.5 NM
AVERAGE 24 HOUR ERROR 100.9 NM


BEST TRACK
TYPHOON HARRIET
24 DEC 1959 – 02 JAN 1960
Legend
6 HR BEST TRACK POSITS
AIRCRAFT FIX
SPEED
INTENSITY
KTS
INTENSITY ≥ 64 KTS
INTENSITY < 64 KTS
180
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z
25/00Z
24/00Z
02/00Z


12 HR FORECAST POSITS
TYPHOON HARRIET
24 DEC 1959 - 02 JAN 1960
Legend
12 HR FORECAST POSITS
6 HR BEST TRACK POSITS
181
31/00Z
30/00Z
29/00Z
01/00Z
28/00Z
02/00Z
27/00Z
26/00Z
25/00Z
24/00Z


24 HR FORECAST POSITS
TYPHOON HARRIET
24 DEC 1959 - 02 JAN 1960
Legend
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
182
01/00Z
30/00Z
29/00Z
28/00Z
27/00Z
25/00Z
24/00Z