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HEADQUARTERS
JOINT TASK FORCE SEVEN
APO 187 (HOW), c/o Postmaster
San Francisco, California

12 April 1954

MEMORANDUM FOR RECORD

SUBJECT: BRAVO Shot, Operation CASTLE

1. PURPOSE: To make a matter of record operational aspects that were considered prior to BRAVO event of Operation CASTLE and to analyze the resultant situation in light of available pre-shot and post-shot information.

2. GENERAL INFORMATION: Operation CASTLE is planned to consist of a series of seven detonations at the Pacific Proving Grounds, which encompasses Eniwetok and Bikini Atolls. BRAVO is the code name that was given the firing of the first device, SHRIMP, at 0645 M on 1 March 1954, off Namu Island, Bikini Atoll.

Subsequent to BRAVO detonation radioactive debris fell on certain inhabited atolls of the northern Marshall Islands. Radiation intensities rose to levels sufficient to warrant evacuation of four atolls and all personnel were removed from these atolls to Kwajalein in accordance with the operational emergency plan of JTF SEVEN. Areas evacuated and gamma dosages received are indicated below:

ATOLL	POPULATION	DISTANCE FROM GROUND ZERO	DOSES RECEIVED
Ailinginae	17	79 NM	80 R (computed)
Rongelap	82	100 NM	100-130 R (computed)
Rongerik	28 #	133 NM	40 - 98 R (film badge)
Utirik	154	270 NM	17 R (computed)

(#) 28 American Service personnel; 25 USAF Weather Detachment plus 3 USA Signal Corps personnel.

All evacuees are under competent medical care.

3. PREVIOUS EXPERIENCE AND CHARACTERISTICS OF NUCLEAR DETONATIONS: Radioactive debris is an inherent characteristic of all nuclear detonations. It originates from fission fragments

[redacted]

[redacted]

[redacted]

which are the residue of bomb elements and surface materials, soil and water, made radioactive by accompanying radiation fields. Debris is sucked high into the atmosphere by after winds of the explosion. Where this radioactive debris will fall is a major pre-shot consideration and primarily influences the decision to detonate a nuclear explosion at a certain time.

The area over which radioactive debris is spread and the intensity of fall-out on the ground are determined by the yield of the explosion as well as by wind pattern since the larger the yield, the more surface materials are sucked up into the cloud and the more fission fragments are available. The relationship between yield and fall-out is known only qualitatively.

4. PRE-SHOT INFORMATION: The operational aspects of the BRAVO experience were planned and conceived in the light of experience gained from previous operations. These factors were considered:

a. The basis for forecasting where fallout will go is experience gained from overseas test operations CROSSROADS, SANDSTONE, GREENHOUSE and IVY and to a certain extent from tests at the Nevada Proving Ground. Prior to the firing of BRAVO, only one megaton yield device (IVY-MIKE) had been detonated. Although conscientious efforts were made to document the fall-out from MIKE, only about 5% of the total debris could ever be accounted for.

The technique used for forecasting fallout patterns is to consider the cloud as a small area source (about a 15 mile radius); then add vectorially forecast winds from the surface to approximately 100,000 feet. The next step is to outline an area on the ground where fallout is expected. This area is computed by taking into consideration particle size, diffusion into the atmosphere, wind pattern, yield and source radius. Such patterns have been largely confirmed by experience in Nevada as well as by the meager data available here.

b. The most probable value of the yield from [redacted] was predicted to be three to five megatons or one half the value of the IVY-MIKE yield. The upper limit of [redacted] yield was considered to be of the order of eight megatons.

c. The surface radex was plotted, with an insurance factor added, i.e., smaller particles than previous experience indicated necessary were considered. This doubled distances from ground zero where fallout was predicted to occur.

d. The upwind intensity of radiation levels at various distances was considered to be of the same order of magnitude as for IVY-MIKE. Radiation versus distance lines were transposed to Bikini Atoll.

[redacted]

[redacted]

e. A critical problem in predicting fall-out involves forecasting the stability or lack of stability of the wind pattern after shot time. Since radioactive particle travel is determined primarily by the winds at each level, it is required that winds must be from favorable directions or varying within the outer limits on favorable directions during the time of fallout. The critical fallout period was considered to be on the order of twelve to eighteen hours for significant fallout to occur. The variation in time arises from considerations of wind shear, with more diffuse and less significant intensities at a given time associated with large angular and speed shear. For this reason, it was required that actual wind observations and forecasts immediately before shot time and throughout shot day be continuously considered in their relation with the forecast conditions for the first twenty-four hours after the shot.

5. PRE-SHOT BRIEFINGS: The following were presented at the pre-shot command briefings:

a. Weather

Weather conditions during the five days prior to BRAVO indicated a favorable trend for BRAVO day with easterly winds below 15,000 feet and winds of a southerly component above. The situation presented at H-6 hours for the subsequent 24 hour period (18 hours after shot time) was satisfactory. The 24 hour period to begin 18 hours after shot time was predicted to give an unfavorable trend as northwest winds were forecast for the 10,000 to 20,000 foot levels.

b. RadSafe

(1) Resultant wind diagrams including latest observed winds and forecast winds for H Hour and the 72 hour cloud trajectories, which gave a fallout pattern in a narrow sector to the east northeast and a wide (140°) sector to the south with very slow resultant winds. (See Figure 1).

(2) Surface radex, H to H plus 6 hours. (See Figure 2).

(3) Outlooks for:

(a) Bikini: Unfavorable; Eniwetok: Favorable; Ujelang: Favorable, and the native populated atolls in southeast quadrant from ground zero favorable, since resultant winds in the direction of these areas were considered too slow to move significant fallout to the atolls involved.

(b) Task Force fleet: Favorable, provided ships moved out at least 50 miles.

[redacted]

[redacted]

[redacted]

(c) Air routes through Wake and Kwajalein: favorable.

(d) Surface routing inside 500 miles considered in its relation to all known transient shipping: favorable.

c. Scientific

(1) High altitude sampling operations - favorable.

(2) Light transmission for scientific experiments - favorable.

6. CONCLUSIONS:

a. Lack of fallout information from previous shots of comparable yield was a serious handicap.

b. The yield of [redacted] was three times the most probable value and twice the probable upper limit with the result that more debris was carried up and diffused over a much larger area than was thought possible.

c. The original source cannot be considered as a point or a relatively small area but must be considered to be an area of about a hundred miles in diameter. This diameter also depends on yield.

d. The radioactivity of the debris can be considered proportional to yield. Radioactive material in the SHRIMP cloud was thus two to three times was was expected.

e. An appreciable fraction of the observed fallout can only be accounted for by assuming that it originated in the stratosphere. For such particles to reach the ground at observed times, their diameter must have been in excess of 100 microns.

f. Forecast for shot time winds at shot time was essentially correct. Variation from forecast trajectories was approximately 10 degrees in significant upper levels; unfortunately, the variation was in the wrong direction (See Figure 3). The small variations observed at lower levels were also in an unfavorable direction. Nevertheless, the accuracy of the winds aloft forecast approached the limits of accuracy of the wind observations themselves and were well within the normal forecast error.

g. The fallout pattern extended from the Bikini Atoll to the east northeast. Considerable widening of the pattern took place due to diffusion. The intensity of the

[redacted]

[redacted]

[redacted]

pattern on the ground was due primarily to superposition of mushroom cloud fallout on the stem cloud pattern; and the superposition can be attributed to the narrow cone within which the winds were acting. The theory that a significant fallout does not come from the stratosphere is not substantiated by the facts of BRAVO.

h. For future high yield shots, the forecast and observed winds for the first twenty-four hour post-shot period should receive as much emphasis as analyses made for shot time.

7. EVACUATION: Evacuation took place in accordance with operational emergency plan and without incident. Evacuation was not effected prior to detonation because no significant fallout was expected on inhabited areas.

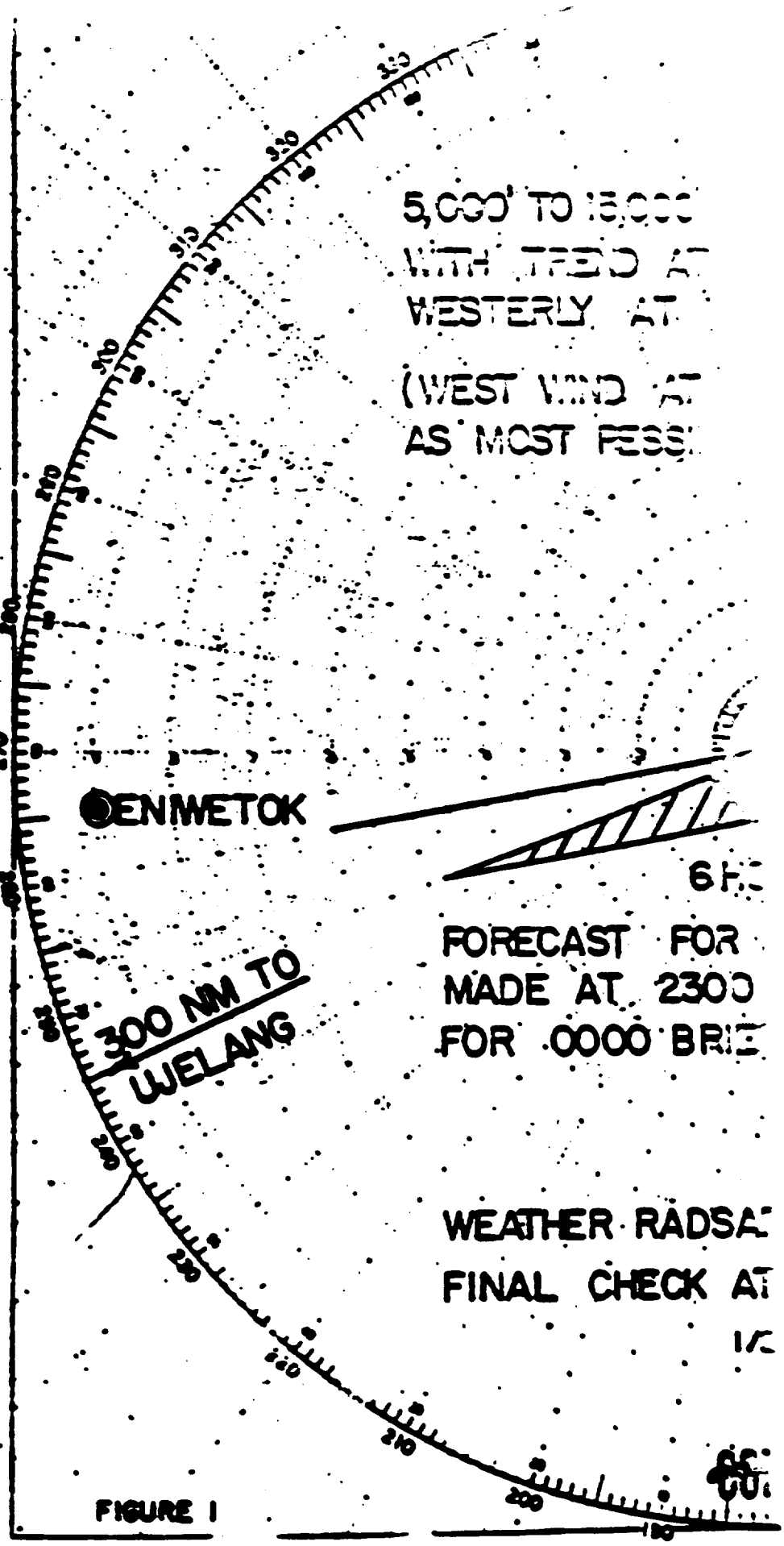
ALVIN C. GRAVES
Scientific Director

P. W. CLARKSON
Major General, U.S. Army
Commander

6 Incls
1. Figure 1
2. Figure 2
3. Figure 3
4. Tab "A" - Weather
5. Tab "B" - RadSafe, Narrative Sequence of Events
6. Tab "C" - Medical (plus addendum)

[redacted]

[redacted]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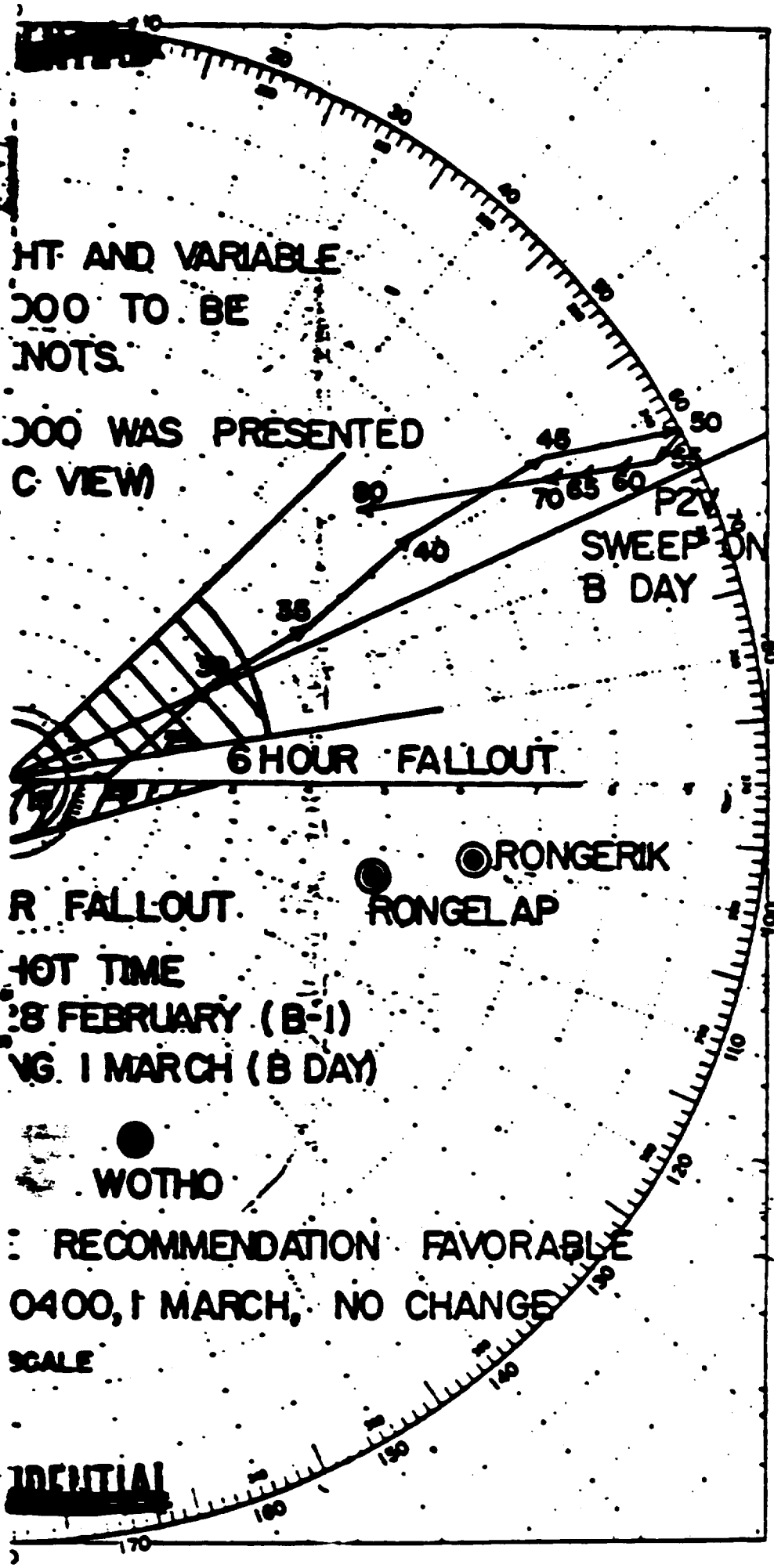
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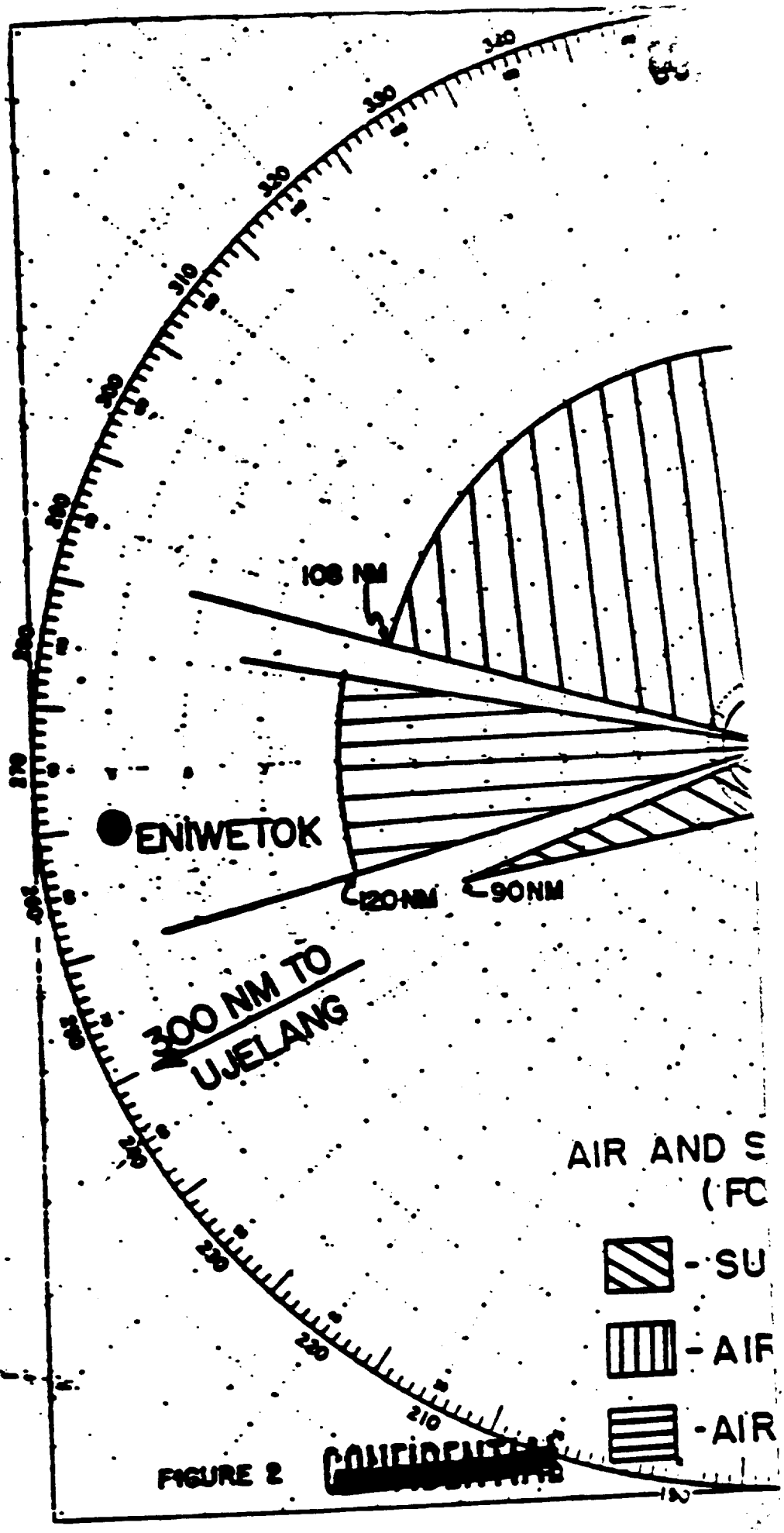
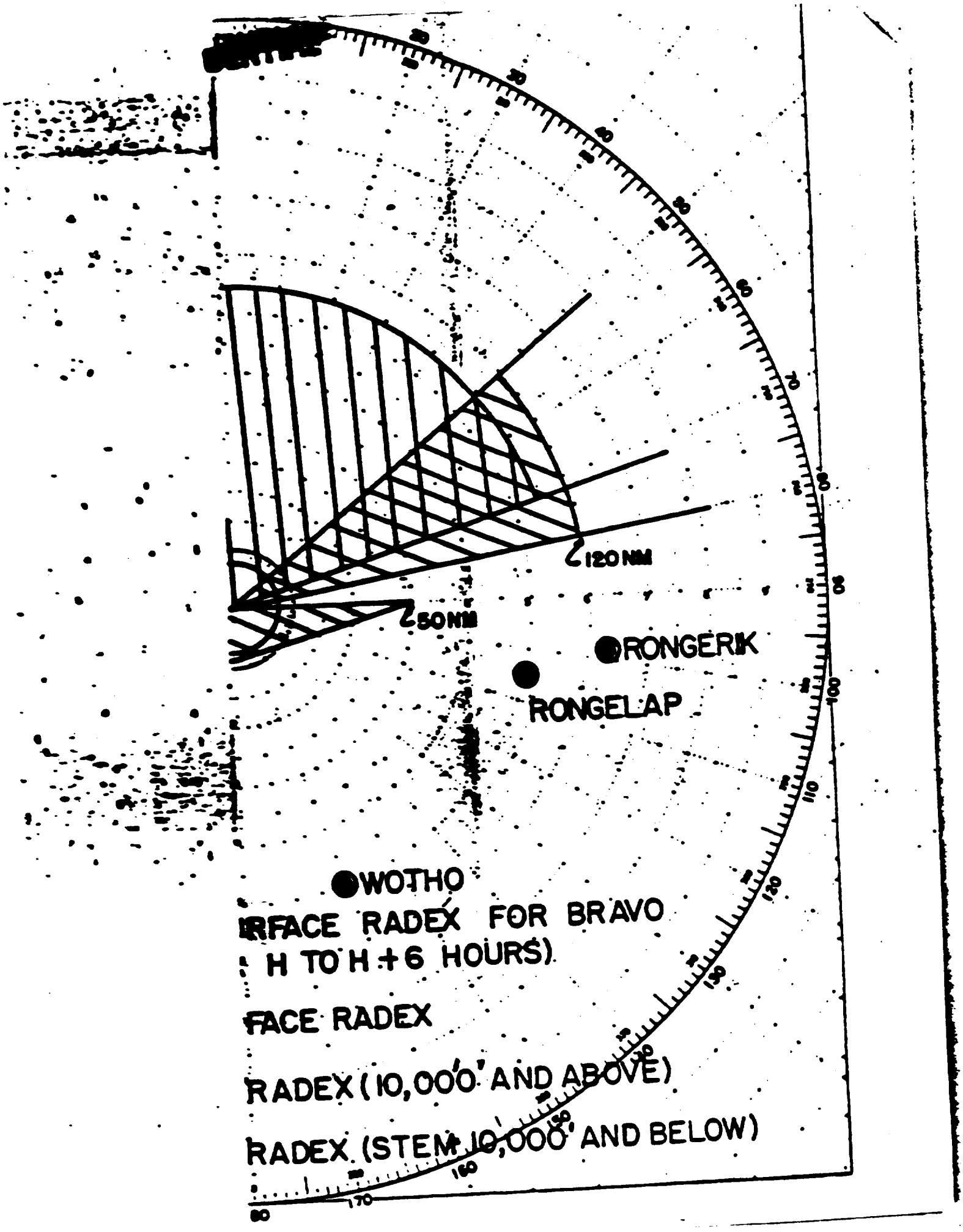


FIGURE 2 [redacted]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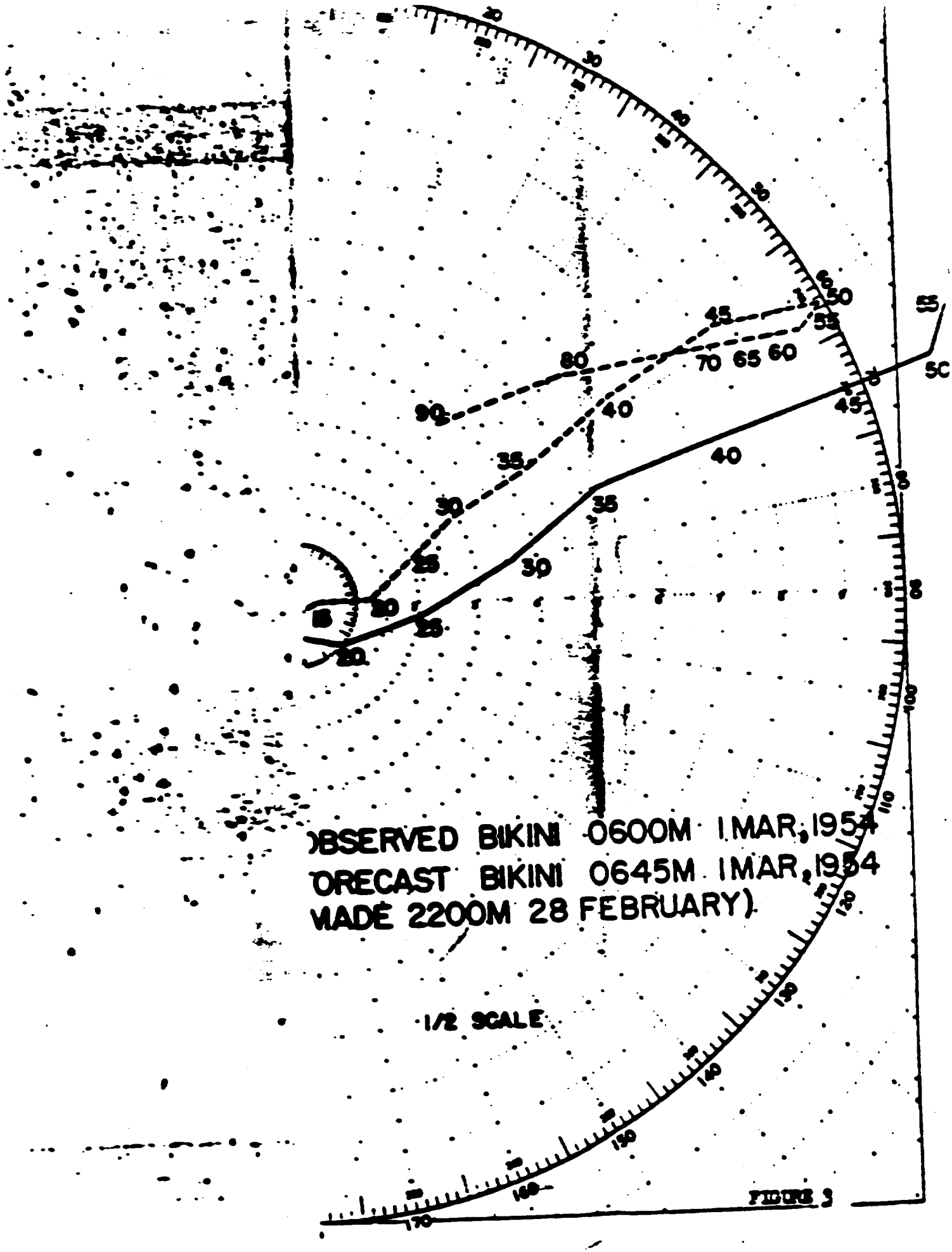
OBSERVED BIKINI 0600M 1MAR, 1954
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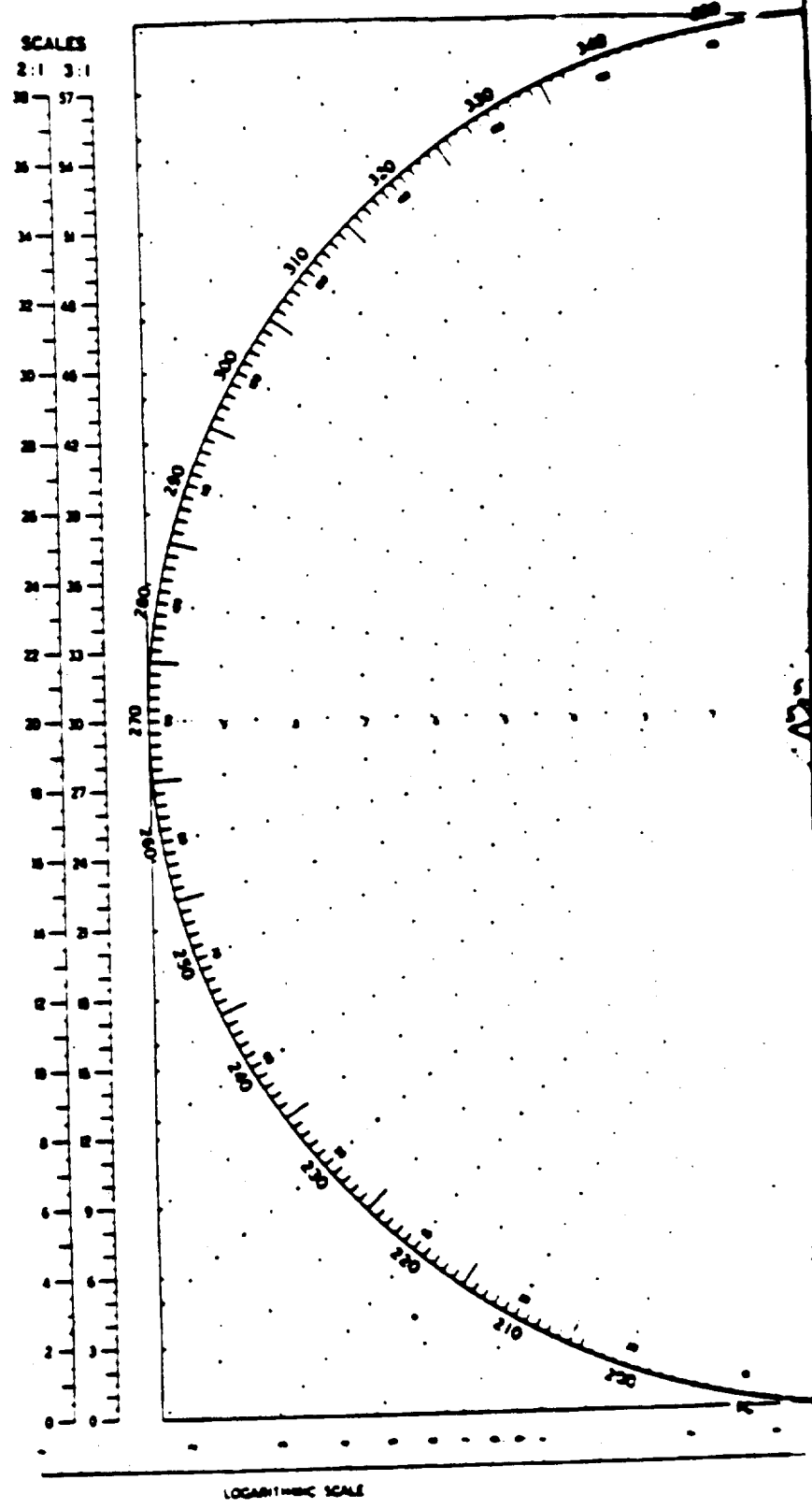
FIGURE 3



MANEUVERING BOARD

[redacted]

1 March 1954

MEMORANDUM FOR RECORD:

SUBJECT: Command Briefing, 1100, 28 February 1954

Members present: Gen Clarkson, Gen McGinley, Dr. Graves, Adm Bruton, Col Cowart, Lt Col Harbour (in lieu of CTG 7.4) Capt Maynard, Lt Col Bonnot, and Lt Col House.

1. In general, the hodograph gave a forecast surface radex in the low levels (zero to 15,000 feet) at about 50 miles in 6 hours, generally orientated to the west south west in approximately a 30 degree sector. In the high levels, the radex gave a 6 hour pattern centered on approximately 65 degrees in a narrow cone approximately 20 degrees wide.

2. The 72-hour cloud trajectories indicated all levels in a narrow band generally 65 degrees true from ground zero except the 10,000 foot level moving generally east through north to west and a 60,000 foot level moving southwest and then west.

3. RadSafe outlooks were given as follows:

a. Bikini atoll: Favorable.

b. Eniwetok atoll: Favorable.

c. Ujelang atoll: Very favorable.

d. Native atolls in southeast quadrant: Very favorable.

e. Control DDE: It was recommended that the Control DDE be moved from a position 90 miles West of Ground Zero to a position 230 degrees True, 90 miles from Ground Zero.

f. ATF and the YAGS: The plot of the YAGS and ATF courses from about E minus 24 hours to E plus 2 hours was indicated. In general, from about E minus 5 to about E minus 3 hours the ATFs and YAGs courses run approximately 15 to 20 miles from the armed device and the ATF departs from a position on the edge of the low altitude radex at about E minus 1½ hours to a position approximately 35 miles south of ground zero at E plus 2. The movements of the YAGs and ATF were presented for whatever consideration was necessary in view of their close proximity to the device and the radex.

[redacted]

[redacted]

g. No closure was recommended on air and surface routes through Wake and Kwajalein.

h. No transient shipping was reported within 500 miles of Ground Zero. It was pointed out that B minus 2 and B minus 1 P2V sweep had been sent out on headings of 300 degrees and 330 degrees respectively. This was based on earlier forecasts. Since the winds shifted around to a narrow band to the ENE, it was recommended that a B day P2V sweep along a bearing line approximately 65 degrees be laid on.

i. It was recommended that CINCPAC be advised of the following:

(1) 72 hours trajectories.

(2) Very favorable outlook for native populations.

(3) No interference on the air and surface routes.

j. It was recommended that no change be made in the position of the task force ships.

4. In summary, it was recommended that RadSafe conditions be considered very favorable on all points, but only favorable at Bikini shot atoll.

R. A. HOUSE
Lt Col., USAF
RadSafe Officer

[redacted]

SECRET

1 March 1954

MEMORANDUM FOR RECORD:

SUBJECT: Command Briefing, 1800, 28 February 1954.

Members present: Gen. P.W. Clarkson, Dr. A.C. Graves, Dr. Ogle, Dr. D. Sewell, Gen. E. McGinley, Mr. J. Reeves, Col. Cowart, Capt Maynard, Lt Col Bonnot, Lt Col House.

1. In general, the 1100, 28 February 1954 briefing was confirmed except indications were presented that conditions were getting less favorable.

2. It was agreed to let the execute decision remain firm until the midnight briefing.

R. A. HOUSE
Lt Col., USAF
Bad Safe Officer

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[redacted]

1 March 1954

MEMORANDUM FOR RECORD:

SUBJECT: Command Briefing, 0000, 1 March 1954

Members present: Gen. P.W. Clarkson, Gen. B. McGinley, Gen. H. Estes, Dr. A.C. Graves, Dr. W. Ogle, Mr. J. Reeves, Dr. D. Sewell , Capt. W.L. Knickerbocker, Col. W.S. Cowart, Capt. R. M. Maynard, Lt Col C.D. Bonnot, Lt Col R.A. House.

1. In general, the forecast presented at the midnight briefing was confirmed, except that in the levels between 5 and 15 thousand feet the forecast was light and variable. In an attempt to delineate direction to these winds, it was determined that the best forecast that could be given was for the 10 thousand foot level. This was forecast to be westerly at 10 knots as the most pessimistic situation. Consequently, the hodograph plot was made using the 10 thousand foot westerly wind in order to present the most pessimistic situation which would occur. This picture gave resultant winds in the direction of Rongelap and Rongerik, however, it was considered that the distance to Rongelap and Rongerik compared to the resultant wind speeds were such that no fall-out should reach those atolls. From the forecast hodograph the time of travel to Rongelap would have been about 12 to 15 hours. The hodograph plot did however show that certainly TARE site would be heavily contaminated, and most likely NAN. The hodograph gave two general fall-out areas. The lower level running from 260 degrees around through south to 90 degrees with a six hour fall-out line in the direction of the populated atolls in the southeast quadrant about 15 to 20 miles out from ground zero. The high level radex ran from about 45 degrees to 80 degrees with a six hour fall-out line to 70 miles. (Since the 6 hour fall-out lines were computed on about 100 micron particle size, it was recommended that the distance be doubled for safety. This amounted to considering particle sizes down to about 70 microns).

2. No change in the 72 hour cloud trajectories.

3. Radsafe Outlooks were modified as follows:

a. Bikini atoll was changed from favorable to unfavorable.

b. Eniwetok atoll remained very favorable.

c. Ujelang atoll remained very favorable.

[redacted]

[redacted]

d. Native atolls in the southeast quadrant were discussed at this point and elsewhere in the briefing. The net result of the forecast was that these atolls should remain favorable due to the forecast long time of travel for fall-out to these places. Specifically, Wotho and Rongelap were considered by name and position, these being the closest native populated atolls in the vicinity of ground zero.

e. Control DDR: No change recommended over the change made at the 1100, 28 February briefing.

f. ATF: It was recommended that the ATFs H/2 hour position be changed from 35 miles outh of GZ to at least 50 miles south of GZ.

g. No closure was recommended on air and surface routes through Wake and Kwajalein.

h. No further shipping was reported within 500 miles of GZ.

i. An advisory to CINCPACFLT and CINCPAC was recommended in conformance with the above.

j. Task Force Ships: It was recommended that, due to the close proximity of Task Force ships to the outer edge of the six hour fall-out, these ships be moved further out on a radial line to at least 50 miles.

4. In summary, it was recommended that RadSafe conditions be considered favorable on all points, and unfavorable for Bikini shot atoll.

R. A. HOUSE
Lt Col., USAF
RadSafe Officer

[redacted]

[redacted]

1 March 1954

MEMORANDUM FOR RECORD

SUBJECT: Final Weather and RadSafe Check, 0430, 1 March 1954

Members present: Gen P. W. Clarkson, Gen O. P. Weyland, Dr. A. C. Graves, Gen. H. Estes, Dr. W. Ogle, Dr. D. Sewell, Mr. J. Reeves, Col W. S. Cowart, Capt R. H. Maynard, Lt Col C. D. Bonnet, and Lt Col R. A. House.

1. The original forecast made at midnight (both weather and radsafe) was considered the best available condition for shot time.

2. The general recommendation for this briefing was one of minimizing the effects of the low level northerly and westerly winds. The recommendations as given at the midnight briefing were restated.

R. A. HOUSE
Lt Col USAF
RadSafe Officer

[redacted]

DISCUSSION OF OFF-SITE FALLOUT

Fallout off-site followed the pattern immediately established at and adjacent to the proving ground where the cloud in general moved east north easterly with prevailing winds. Task force ships southeast of NAN received the first fallout, being on the southern edge of the main strip of contamination. Fallout on the ships ranged from intensities of 1500 milliroentgens per hour on the BAIROKO which was closest to the center of the fallout path to a few milliroentgens per hour on vessels farther south.

Fallout began at Rongerik Atoll at 1348 hours, 1 March as shown by a self-recording radiation detection station placed there by the NYOO AEC and operated by personnel of the Air Weather Station. This instrument went off scale at 100 mr per hour at 1418 hrs 1 March. Based upon query from air weather personnel a monitor was dispatched with the supply PBM on the morning of 2 March. A ground reading of 2000 mr/hr was obtained at 1115 by the monitor who evacuated 8 of the personnel on his own initiation and recommended evacuation of the remainder as soon as possible based upon the high radiation levels. This was concurred in and the remaining 20 were evacuated by PBM at 1645, 2 March. Calculations estimating the dose received indicated that personnel evacuated at 1115 would have received 85 r and the remainder 95 r. This was in fair agreement with readings of film badges on personnel. Maximum film badge reading was 98r representing 3 men, 52r for 1, 44r for 1, 40r for 9. Average dose for all personnel, 54 roentgens.

Inasmuch as the data from Rongerik is the only data showing exact time the fallout occurred at any location east of the proving ground and adjacent to populated islands affected by substantial radiation, its importance is such that calculation of dosages received by native populations are based upon it for time of fallout in those locations. A detailed analysis of this data is therefore appended in the medical tab.

Survey of Rongelap was made by Pattern ABLE of Security Patrol Squadron (Patron 29) with NYOO Scintameters aboard on 2 March and found an estimated reading of 6750 mr/hr. (Later calibration for aerial survey equipment revised this to 1350). Based on this and its proximity to Rongerik it was decided that it would probably be necessary to evacuate the atoll. Consequently, the PHILIP, DDE 498, was dispatched to reach Rongelap on the morning of 3 March. In the meantime a PBM was sent to ground survey the atoll and at 1830 hours, 2 March, their ground survey showed a reading of 1400 milliroentgens per hour. Calculation of dosage to 3 March indicated about 110 roentgens so the order to evacuate was given. The destroyer PHILIP evacuated the natives by 0935 to 1025, 3 March. Calculation of the total dose indicated that 130 roentgens were received. Detailed calculations are appended in the medical tab. A total of 65 natives were removed, 16 natives (the old and sickest) by PBM and 49 by DDE.

Inasmuch as some natives of Rongelap were reported to be on Ailinginae, the atoll was surveyed, 17 natives located, and an intensity of 445 mr/hr was found. Evacuation was complete by 1400, 3 March. The dose computed for this group is 80r and details are appended.

Aerial survey of Utirik by ASLE Pattern indicated 620 mr/hr at 1651 hrs, 2 March (later re-calibrated to 240 mr/hr). On 3 March 1345 ground survey indicated 160 mr/hr. Decision to evacuate based upon fact that estimated dose at time of earliest evacuation would be 13r. Evacuation complete 1245 hrs, 4 March. Estimate of dose to actual evacuation time was 17r. 154 natives were evacuated. Calculations appended in the medical tab.

The only other populated atoll which received fallout of any consequence at all was Ailuk. ASLE Pattern indicated 95 mr per hour at 1845 hrs, 2 March. Based upon the best estimate of fallout time it was calculated that a dose to infinite time would reach approximately 20 roentgens. Balancing the effort required to move the 400 inhabitants against the fact that such a dose would not be a medical problem it was decided not to evacuate the atoll.

Indications from aerial surveys indicated substantial fallout occurred on the unpopulated islands of Bikar and Taka.

Very minor fallout occurred in a southwesterly and westerly direction on Eniwetok and Ujelang Atolls but levels did not exceed 10mr per hour at Eniwetok nor 3mr per hour at Ujelang. This was apparently very fine particulate matter carried by the low trade wind component.

A detailed plan was made to make ground surveys of all islands which had fallout in excess of 10mr per hour at estimated fallout time to provide information as to decay rate and verification of estimation of doses. Water and soil samples from these surveys were shipped by air to HASL, NY Operations Office, Attention: Mr. Merril Eisenbud, for detailed analysis.

R. A. HOUSE
Lt Colonel, USAF
Ch. Tech. Br., J-3

CLOUD TRACKING OPERATIONS FOR BRAVO

8 March 1954

1. SUMMARY:

The BRAVO Air Rad Safe Operations were conducted essentially as planned. No hazardous air contaminations were encountered by aircraft other than the samplers. Several aircraft and crews were exposed but the levels encountered appear acceptable from both a health and a decontamination aspect. Communication and control difficulties made it difficult if not impossible to forecast the fallout in the Rongerik/Rongelap areas. Steps have been taken to remedy the defects which became apparent during BRAVO operations.

2. GENERAL:

Cloud tracking information for BRAVO was derived from five sources. The manner in which each of these functioned during BRAVO will be discussed individually in subsequent paragraphs. These sources were as follows:

Sampling aircraft reports.
Sweet-sour reports.
Special Cloud tracking flights.
Weather reconnaissance flights.
AFOAT-1 flights.

3. SAMPLING AIRCRAFT REPORTS:

These reports were monitored and recorded by Rad Safe personnel aboard BOUNDARY TARE from plus two thru plus seven hours. Information derived from these reports indicated the sampling aircraft were working the South and Southeast edge of the cloud and therefore stayed in the immediate vicinity of Ground Zero. Because of the altitude of the sampling operations (30,000 - 45,000 ft) there is little relation between the operation of these aircraft and subsequent air or ground contamination. This data, however, does assist the Air Rad Safe Officer in obtaining an overall picture of the dispersal of radioactive material. No reports of cloud movement were received from the control B-36 aircraft.

4. SWEET-SOUR REPORTS:

These reports are submitted by any aircraft encountering radioactive contamination and not reporting by other means. No such reports were received during BRAVO. This is not surprising since aircraft other than the samplers and trackers (reporting by other means) seek to avoid areas in which contamination is suspected.

5. SPECIAL CLOUD TRACKING (WILSON) FLIGHTS:

a. The first of these flights, Wilson 2, was directed by Rad Safe to pre-planned post-shot search. This required the aircraft to remain in a holding pattern track approximately 50 miles West of Ground Zero from plus two to plus five hours. This portion of the track was designed for the purpose of detecting radioactive cloud movements toward Eniwetok Atoll. On BRAVO the maximum activity encountered was less than 15 mr/hr. Through a misunderstanding of control procedures, Wilson 2 overstayed in the holding pattern. When Rad Safe realized this fact, CIC was requested to order him into the previously designated search sector at once. The delay, however, resulted in this aircraft being well behind and to the North of the cloud segments that must have caused fallout on Rongerik and Rongelap. At 1550Z the aircraft reported its maximum reading during this flight. This was reported as being between 500 and 1000 mr/hr approximately 150 nautical miles from Ground Zero at a bearing of 60 degrees. This and the subsequent data appeared to verify the forecast cloud trajectories which indicated the upper cloud segments would leave the PPG on an approximate bearing of 70 degrees, thus avoiding the populated atolls. Wilson 2 subsequently reported in-flight difficulty with the instruments used.

b. On the basis of the results of the Wilson 2 flight the second tracker, Wilson 3, was instructed to search the same general area but to proceed further East to define the rate of cloud movement. At approximately 2000Z information was received indicating the possibility of some contamination in the Rongerik/Rongelap area. A message was immediately dispatched to TG 7.4 requesting Wilson 3 to alter his search area in such a manner as to cover the populated area to the East. Communication delays prevented Wilson 3 from complying with the request. This plus the fact that no exact instrument readings (instead a range of readings) were reported made interpretation of cloud tracking data difficult.

c. Subsequent Wilson flights (for plus one day) were cancelled when it appeared that no air contamination problem existed at that time.

6. WEATHE RECONNAISSANCE FLIGHTS:

Two Petrol Juliet weather reconnaissance flights were flown on plus one day. These flights were flown to the South and to the Southeast and indicated essentially zero air contamination.

7. AFOAT-1 FLIGHTS:

AFOAT-1 sponsored flights from Hawaii indicated a maximum air contamination of less than 1 mr/hr in that area, (3 March(. Similar flights from Guam reported tenths of an mr/hr as a maximum reading. This was encountered 4 March, 100 nautical miles west of Ponape at 5000 ft.

8. INFLIGHT EXPOSURES:

As expected, several aircraft, including samplers, cloud trackers, evacuation aircraft and P2V security sweep aircraft, encountered areas of air contamination. In all cases it appears that the exposures were well under task force limitations for a health point of view. Standard decontamination procedures are expected to be effective so that all aircraft should be returned to service well prior to the next shot. The P2V security sweep sectors will be modified on future shots to reduce the possibility of contaminating these aircraft.

9. CONCLUSIONS:

a. The Air Rad Safe operations for BRAVO were generally successful but several changes in procedures are being made (see below) to provide more timely and accurate data.

b. No hazardous areas of air contamination were encountered although fallout in the Rongerik/Rongelap area would make it probable that such contamination did exist for a short period of those atolls.

c. Improved monitoring, data reporting and communications facilities are required.

d. Lower search altitudes may improve the ability to correlate air contamination with subsequent fallout.

e. No hazardous fallout appears likely in the Hawaii, Ponape or Guam areas.

f. In flight exposures of Task Force personnel appear well within established limits.

10. RECOMMENDATIONS:

a. A CW contact is required between BOUNDARY CAPE and WILSON aircraft to insure better data reporting and control. (This has been requested).

b. A TIB radiac instrument should be carried on all WILSON aircraft and exact radiation reading should be reported. (Has been arranged).

[redacted]

c. Lower altitudes should be employed in tracking operations. Will be specified in future vector messages.

Paul H. Wignall

PAUL H. WIGNALL
Colonel, USAF
Air Rad Safe Officer

[redacted]

10 March 1954

MEMORANDUM FOR RECORD

SUBJECT: Protection of Transient Shipping During Operation CASTLE

1. In order to provide protection for transient shipping in the region immediately outside the Eniwetok/Bikini Danger Area during Operation CASTLE planning factors were established and a plan of action placed in effect as follows:

a. Planning factors:

(1) CASTLE clouds more than 24 hours old should not be hazardous.

(2) 24 hour travel of a CASTLE cloud should be approximately 500 nautical miles.

b. Plan:

(1) The Commander in Chief, Pacific Fleet was requested to make advance diversions of shipping outside a sector area from southwest clockwise through north to east to 500 nautical miles from ground zero from H to H plus 24 hours.

(2) P2V aircraft were planned to sweep the significant forecast sector of cloud travel, using visual and search radar methods of sightings out to 800 nautical miles on D-2 days, out to 600 nautical miles on D-1 day and, if necessary, in front of the cloud on D day. P2V aircraft crews were directed to effect diversion on all ships sighted in the sector area on D-1 and D day.

(3) WB-29 aircraft on routine weather reconnaissance missions were directed to report all sightings of surface shipping encountered. All sightings were to be relayed to the Radar center (CIC USS BAIROKO) in the TG 7.3 fleet.

(4) P2V aircraft and destroyer security sweeps were directed for the Eniwetok/Bikini Danger Area. Information from these sweeps was channeled to the Radar center (CIC USS BAIROKO).

2-7

MEMORANDUM FOR RECORD (Cont'd)
SUBJECT: Protection of Transient Shipping During Operation CASTLE

(5) Information from all the above sources was channeled into the task force headquarters for evaluation and consideration at the Weather/Radsafe Command Briefings.

2. The results of the above efforts for BRAVO were as follows:

a. All known transient shipping was diverted outside the hazardous fall-out area. The Patapsco (AOG-1) was sailed from Eniwetok to be out of the hazardous area by shot time. The Trust Territory ship M/V Roque was operating outside the designated sector (from Kwajalein to Utirik), arriving at Utirik on the morning of 2 March 1954 and departing Utirik on 3 March 1954. The Roque was subsequently located and monitored at Majuro and found to have insignificant levels of radiation. The Merapi was enroute from Honolulu to Eniwetok but well outside the designated sector area at shot time. The Merapi was monitored upon arrival at Eniwetok and found not contaminated.

b. Based on the forecast significant cloud travel (forecast made on the night of B-3 days) the P2V sweep for B-2 days was directed along true bearing 300 degrees from ground zero. No ships were sighted on this sweep. Based on the B-2 day shot time forecast, the P2V sweep for B-1 day was directed along true bearing 330 degrees to a distance of 375 nautical miles. The reduction in distance was based on forecast reduction in resultant wind speeds. This sweep contacted the USS General Patrick at 17-31N, 162-03E on course 266 degrees, speed 16 knots, at 1204M, 28 February 1954. As she would clear the designated sector by shot time, she was not diverted by the patrol aircraft. Based on a re-forecast (made on B-1 day) of the significant cloud movement for B day, it was decided to search in advance of the cloud along bearing 65 degrees true from ground zero out to 600 nautical miles. Two P2V's were used. The first of these became contaminated early in its mission and was forced to return to base. The second was directed to pick up the search in the approximate location of the previous abort and carry it out to the 600 miles. The only contact reported by these aircraft was the Patapsco (AOG-1) sighted at 12-31N, 170-42E, at 1935M, 1 March 1954, course 30 degrees, speed 10 knots. The Patapsco was turned to an easterly heading at 2030M, 1 March 1954. The Commander in Chief, Pacific Fleet was advised later to have the Patapsco monitored upon arrival at Honolulu in the event a check enroute could not be accomplished.

MEMORANDUM FOR RECORD (Cont'd)
SUBJECT: Protection of Transient Shipping During Operation CASTLE

c. Between 26 February and 1 March 1954, WB-29 aircraft performed weather and cloud tracking missions in all four quadrants from ground zero. No surface shipping was sighted on these missions, three of which were flown to the east northeast of ground zero, one on 27 February and two on 1 March 1954.

d. The P2V and destroyer search of the Eniwetok/Bikini Danger Area made no contacts. As a matter of interest, a destroyer security sweep on 17 Feburary 1954 encountered one Japanese fishing vessel, the Miyagikenajinoiokompirasaru, 26 nautical miles on true bearing of 40 degrees from Eniwetok Island. This ship was escorted toward the northern edge of the Danger Area and left on course 315 degrees, 9 knots with the recommendation that air patrol observe its subsequent movements. No further contacts with this ship were reported.

e. As a summary, the CIC BAIROKO was contacted periodically pre-shot and reported no transient shipping in the area.

R. A. HOUSE
Lt Col, USAF
Chief, Tech Branch, J-3

PATTERN OF FALL-OUT FOLLOWING BRAVO EVENT
(Combined Analyses - Immediate and One Week after BRAVO)

1. General. The pattern of ultimate fall-out of radioactive particles has been established utilizing in the cases of the most critical area (i.e. bearing about 050° True, clockwise to 120° True from Ground Zero) the following:

a. Aerial survey by P2V employing NYOO-AEC survey equipment, with readings in mr/hr extrapolated to ground level.

b. Known ground readings taken at some atolls (early and later) used with their time and intensity (actual observations) to get a feeling for the overall situation.

c. Resultant wind pattern to establish best wind for period from H minus 1 hour (USS CURTISS Observation - BIKINI) to H plus 8 hours (Rongerik sounding) together with the H minus 3½ hours (Rongerik 0300Z) to piece together the wind pattern above the tropopause.

d. Since the Rongerik (NYOO-AEC) survey meter trace established initial time of arrival of fall-out, this time was used in coordination with resultant wind at the cloud level which passed over Rongerik. This level was 25,000 feet vector. Its average speed from Ground Zero calculated from resultant wind plot was 10.4 miles/hr. At first, there was considerable difficulty in making fall-out arrive from the stem of the atomic cloud (0-55,000 feet-tropopause) at Rongerik in 8 hours. The 10.4 miles/hr above would make cloud arrive at Rongerik at about H plus 12 hours. However, by the method of plotting the entire cloud height (which is believed to be about 100,000 feet) for which there were available winds to 95,000 feet, and with the assumptions listed below in constructing shadows (fall-out) of stem and mushroom, there are obtained 2 areas - elliptical in shape, generally east of Ground Zero and superimposed on each other (Appendix I). The suggested fall-out area (blue) for the stem is oriented about 070° True from point SE of Ground Zero, distant 35 miles and with a 200-mile major axis, 100-mile minor axis with a series of extremely hot elliptical envelopes emanating from Ground Zero out to about 110 miles. Superimposed on this area (red) is the suggested mushroom fall-out pattern which is an ellipse oriented 080° True, 40 miles from Ground Zero, major axis at least 180 miles, minor axis 45-90 miles. It is assumed that the cloud diameter in the mushroom for the period in question was at least 70-100 miles. This shows therefore, that the early fall-out at Rongerik could come easily from the mushroom - large particles by H plus 8 hours, and since the superimposed fall-outs from stem and mushroom cross the northern half of Rongelap Atoll, one would expect these islands to be exceedingly high with their radiation levels. This might be likened to scavenging of the hot stem material by large particles from the tropopause and above. However, the major hot fall-out element must come from the stem debris.

The assumptions used in the rough construction of the ellipse for the whole cloud are: (LtCol Lulejian report on Fall-out - ARDC, SECRET, RD):

(1) If wind shear is $< 10^{\circ}$ for the levels in question, minor axis is 1/8 to 1/4 of the major axis (which is the entire vector for levels looked at). (This is case of 0-5,000 feet winds and 5-20,000 feet winds.)

(2) If wind shear is $> 10^{\circ}$ but $< 120^{\circ}$, minor axis is $\frac{1}{2}$ of major axis. This is case for 20,000 feet winds to tropopause, and somewhat less for 65,000 to 95,000 feet winds.

(3) If shear at levels making up vector under study is $> 120^{\circ}$ draw circle with diameter = to entire resultant vector.

CONCLUSIONS:

1. From overall fall-out picture, it is concluded that fall-out may have reached Rongelap Island and Ailinginae later than the pessimistic time of H plus 5 and H plus 4 hours, respectively.

2. From initial land survey reports on Rongelap Atoll with levels at Eripp Island (NE part of Atoll) still at 2.8 to 3.5 r/hr on H plus 7 days, the picture for heaviest fall-out patterns north of this area is established. The relatively light fall-out at Utirik (ESE of the hot area), higher levels of intensity at Bikar (East and downwind of the hot area, i.e..6 r/hr at H plus 33 hours almost in downwind line with the superimposed ellipses or hot areas but definitely beyond the hot shadow), confirm the belief in the assumed area of hot fall-out pattern above. Rothe (SSE of the area and from Ground Zero) received practically nothing because resultant vector wind speed from the stem and, perhaps some of the mushroom fringe, was so low in velocity through the SE to South from Ground Zero. Rongerik received at about H plus 11 hours a build up to about 10 mr/hr for a period of about five hours.

3. This type of analysis gives a feeling only for pattern of fall-out because it does not tell exactly when the fall-out arrives. However, it is apparent that the 200-300 plus roentgens lifetime dosage line passed on or close to Ailinginae, Rongelap Island and Rongerik which are at 80-100 miles in cases of Ailinginae and Rongelap and 130 miles to Rongerik from Ground Zero. The 1,000 plus roentgens lifetime dosage lines are exceeded as one goes north from Rongelap Island to northern islands of that atoll. This analysis is based on: (1) logical use of wind patterns existing during shot time to fall-out, (2) multiple shot (tower or ground) fall-out pattern data from Nevada Proving Grounds over last 3 years, and (3) experience and data from IVY-MIKE (limited cross-wind and upwind) and CASTLE-BRAVO itself.

4. Rongerik radiation intensity levels are known at onset and evacuation time; calculated roentgen dosage agrees with actual observations from film badges at this site

5. The heaviest fall-out pattern was expected to pass north of [redacted] and east northeast from Ground Zero.

6. The levels of radiation intensity at the distances of Rongelap and Rongerik were much higher than expected, and sooner than expected since necessary information in this range of yield for surface shots today is the result of some scaling, up from much lesser yields, interpretation of upper wind field patterns, coupled with forecast changes and experience of individuals with such limited data as IVY-[redacted], GREENHOUSE-DOG, EASY, [redacted] and ITEM.

7. After seeing BRAVO cloud project pictures (taken from an airplane) with large quantities of visible particulate matter falling through the cirrus deck above the camera plane from tropopause and above, wind data to great heights (i.e. up to at least 100,000 feet) is a must for shot time since the fall-out problem for surface or near shots of large yields can be a definite function of the mushroom as well as the very hot stem of the cloud.

R. H. MAYNARD
CAPT, USN

Appendix:

I - Plot of General Fall-out Pattern.
II - Forecast and Observed Hodographs, B-2 to B+7 days.
III - Tabulation of Time of Arrival Data
IV - Hodograph Trend Data

[redacted]

[redacted]

6. The levels of radiation intensity at the distances of Rongelap and Rongerik were much higher than expected, and sooner than expected since necessary information in this range of yield for surface shots today is the result of some scaling, up from much lesser yields, interpretation of upper wind field patterns, coupled with forecast changes and experience of individuals with such limited data as IVY-MIKE, GREENHOUSE-DOG, EASY, CHEROKEE and ITEM.

7. After seeing BRAVO cloud project pictures (taken from an airplane) with large quantities of visible particulate matter falling through the cirrus deck above the camera plane from tropopause and above, wind data to great heights (i.e. up to at least 100,000 feet) is a must for shot time since the fall-out problem for surface or near shots of large yields can be a definite function of the mushroom as well as the very hot stem of the cloud.

R. H. MAYNARD
CAPT, USN

Appendixs

I - Plot of General Fall-out Pattern.
II - Forecast and Observed Hodographs, B-2 to B+7 days.
III - Tabulation of Time of Arrival Data
IV - Hodograph Trend Data

[redacted]

[redacted]

200
180
160
140
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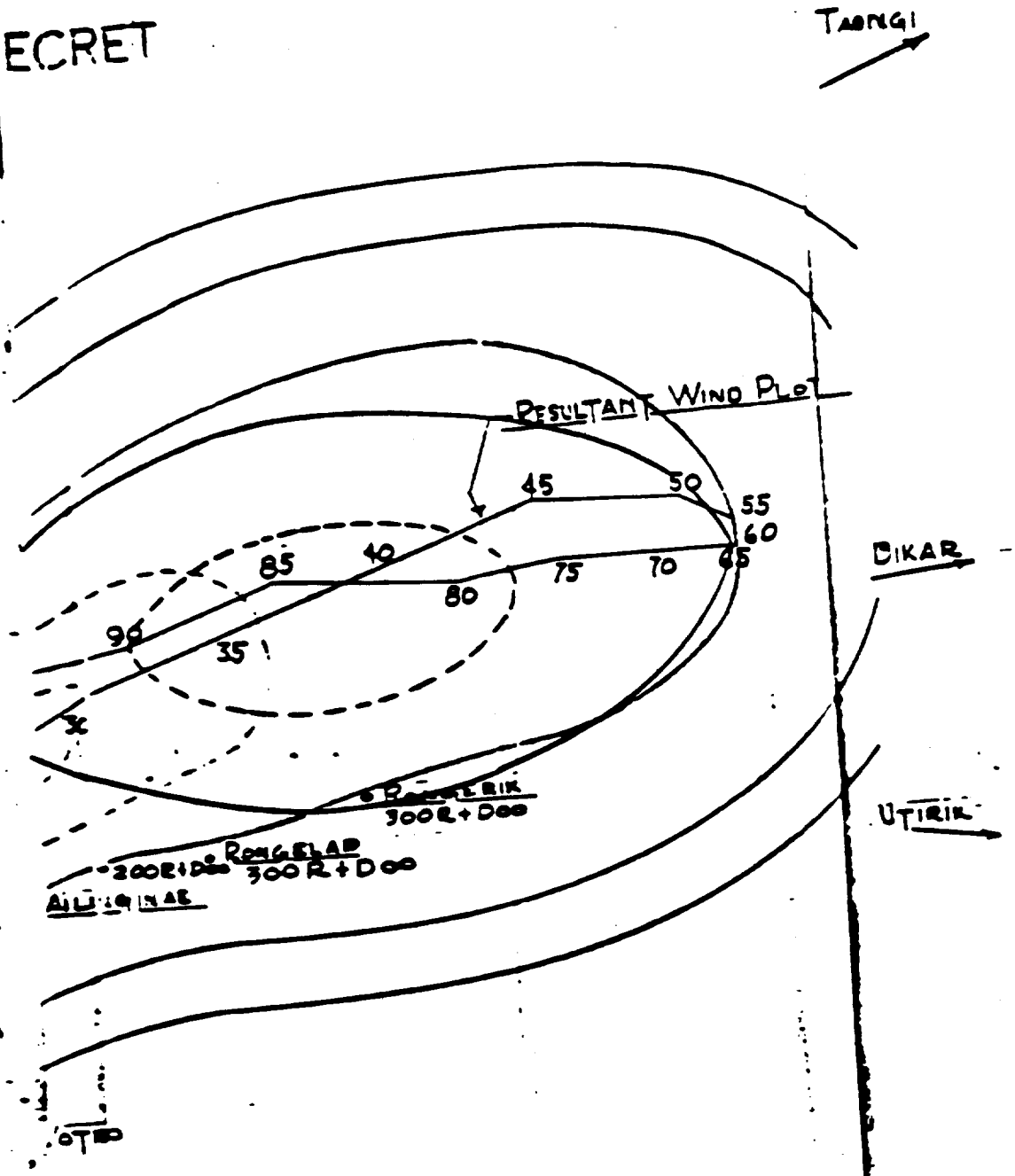
80
60
40
NM From GZ
PARRY
ENIWITOK
10 MR/HR
@ H+12
NAN

ECRET



RED
MUSHROOM SHADOW
BLUE
STEM SHADOW
GREEN
LOWER STEM SHADOW
TASK FORCE SHIPS

BRAVO EVENT

[redacted]

R H. WATSON

APPENDIX I

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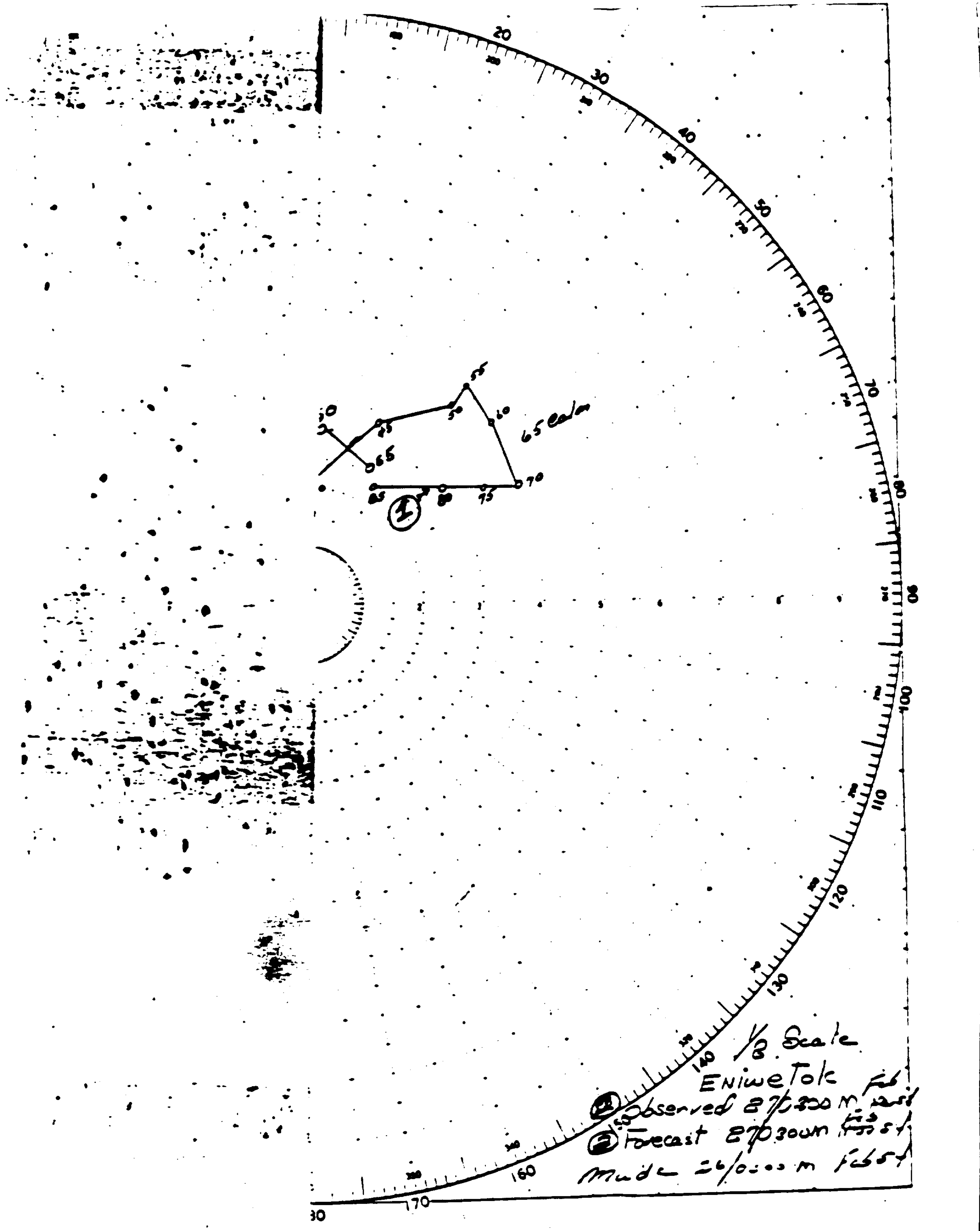

65 calm
1/8 Scale
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Observed
Forecast 27/0300M
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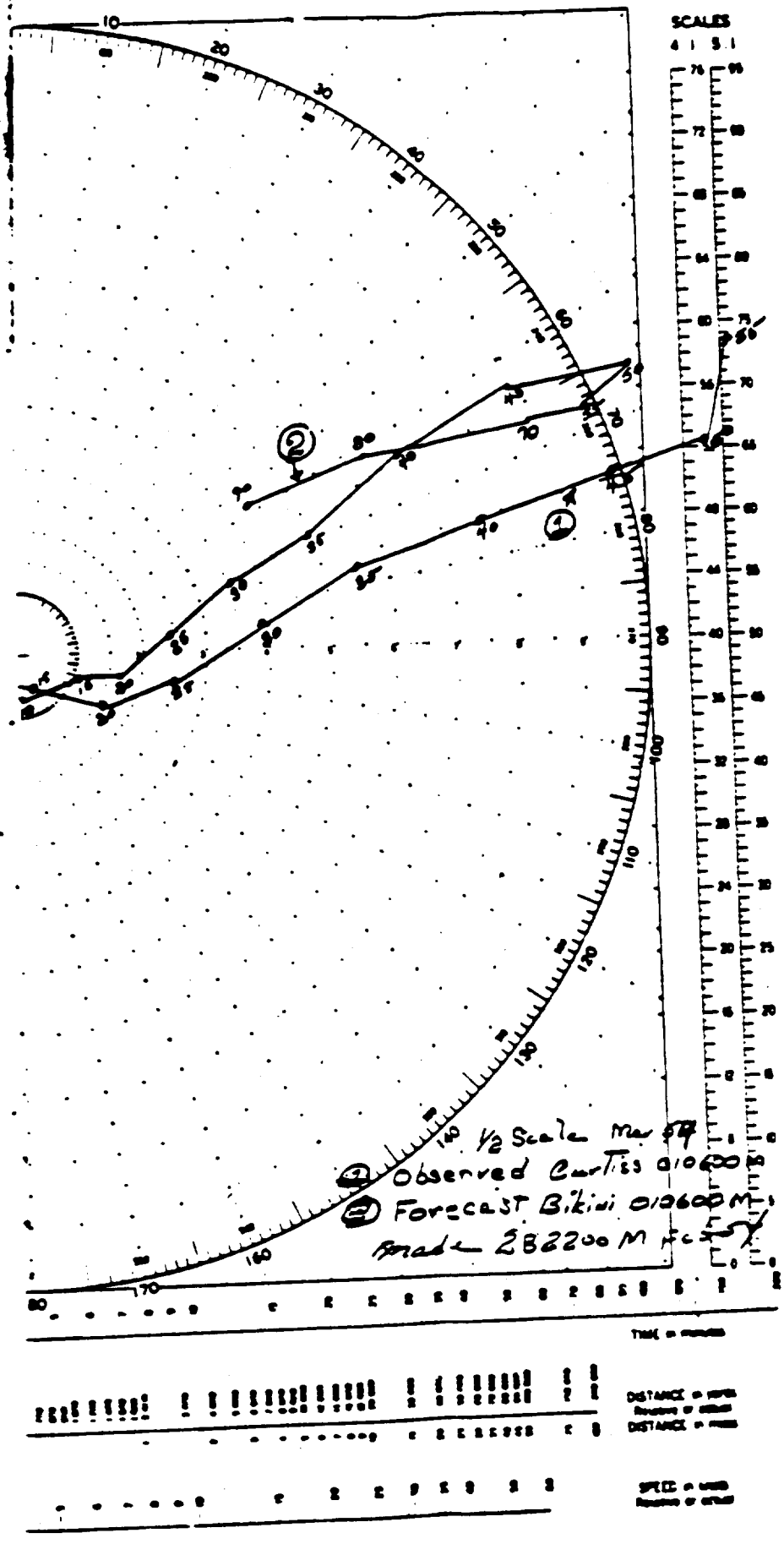
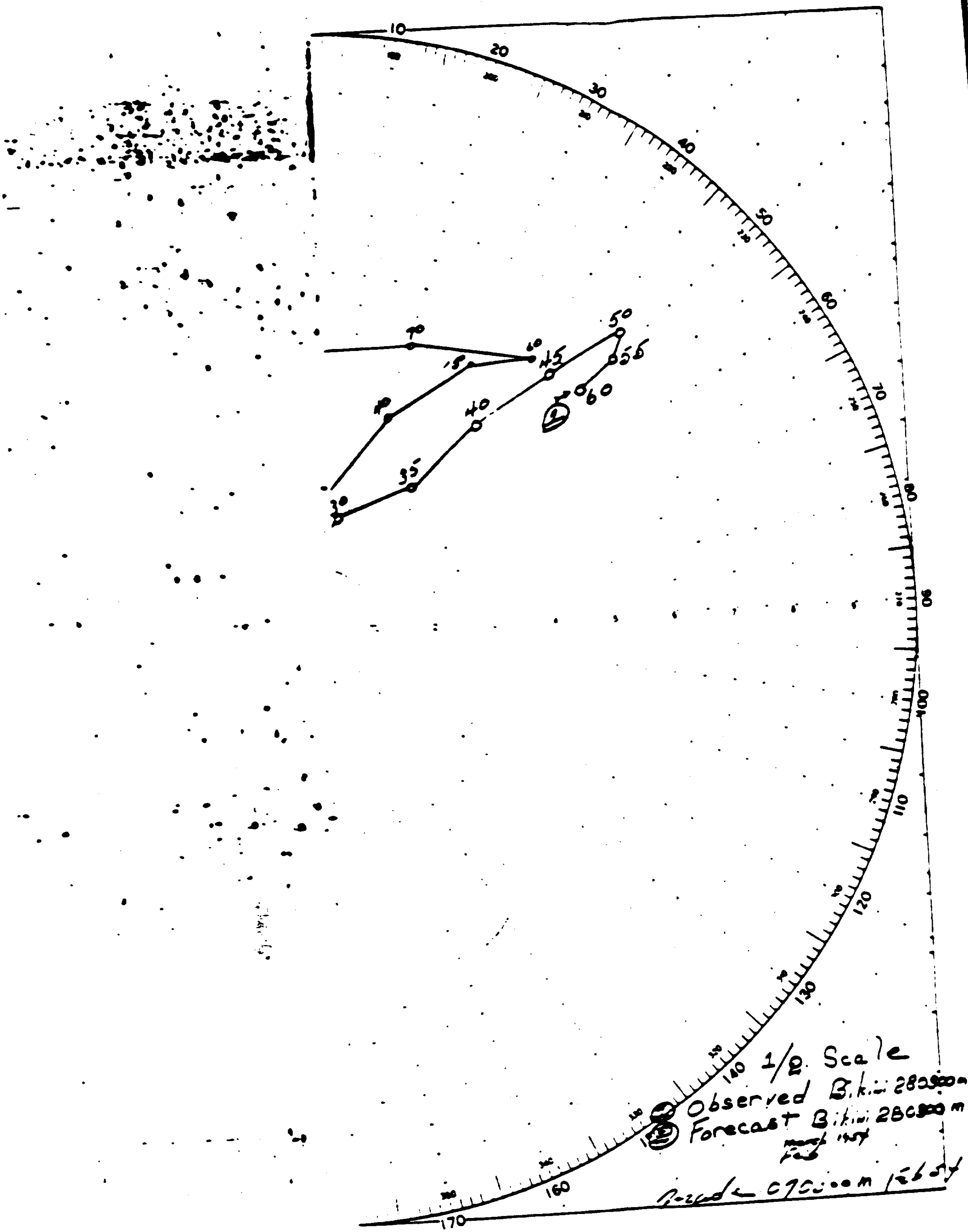

SCALES
1/2 Scale Mar 57
② Observed Curtiss 0/0600
③ Forecast Bikini 0/0600 M
Made 2B2200 M
TIME
DISTANCE
DISTANCE
SPEED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Observed Bikini
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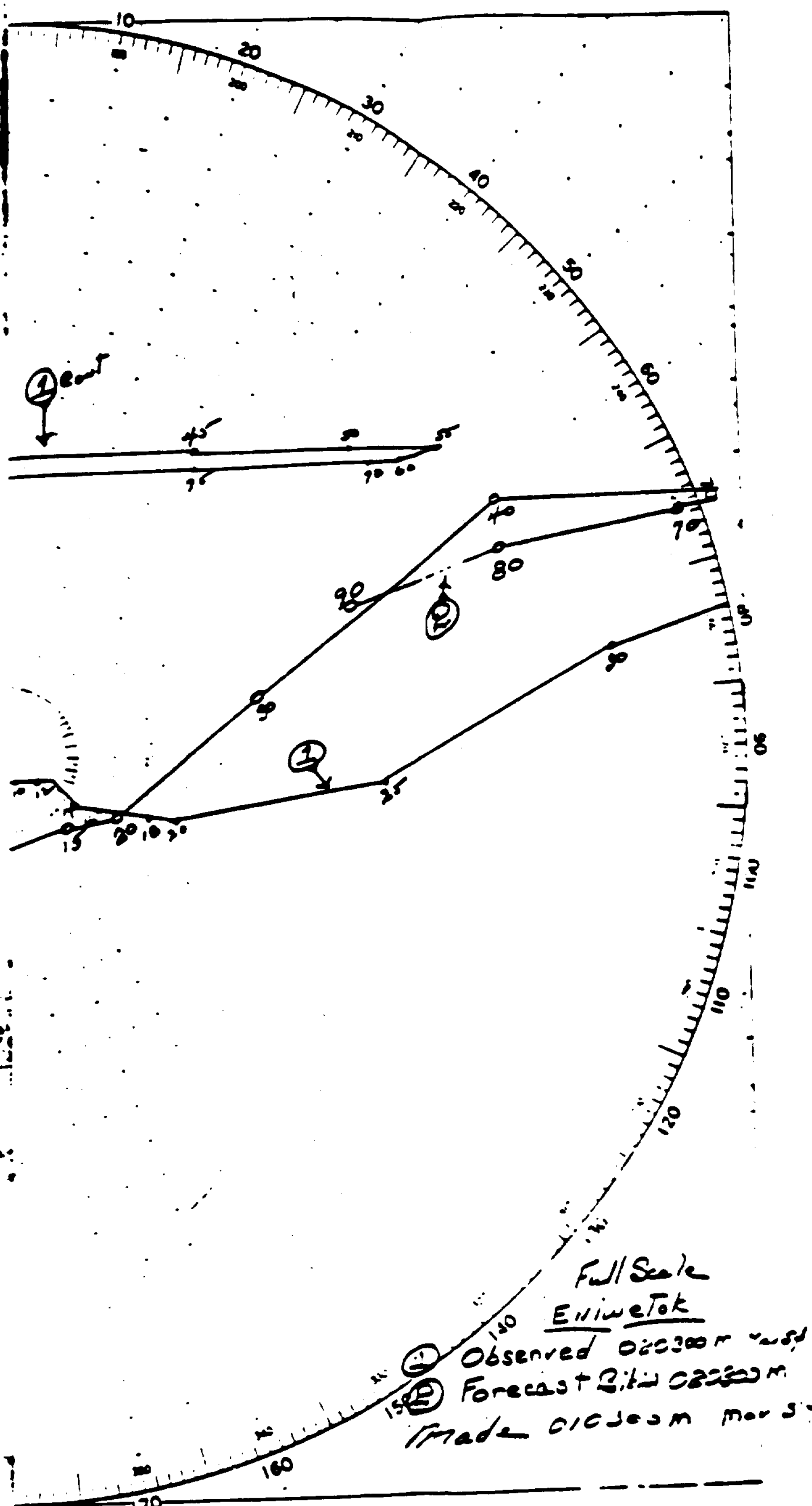
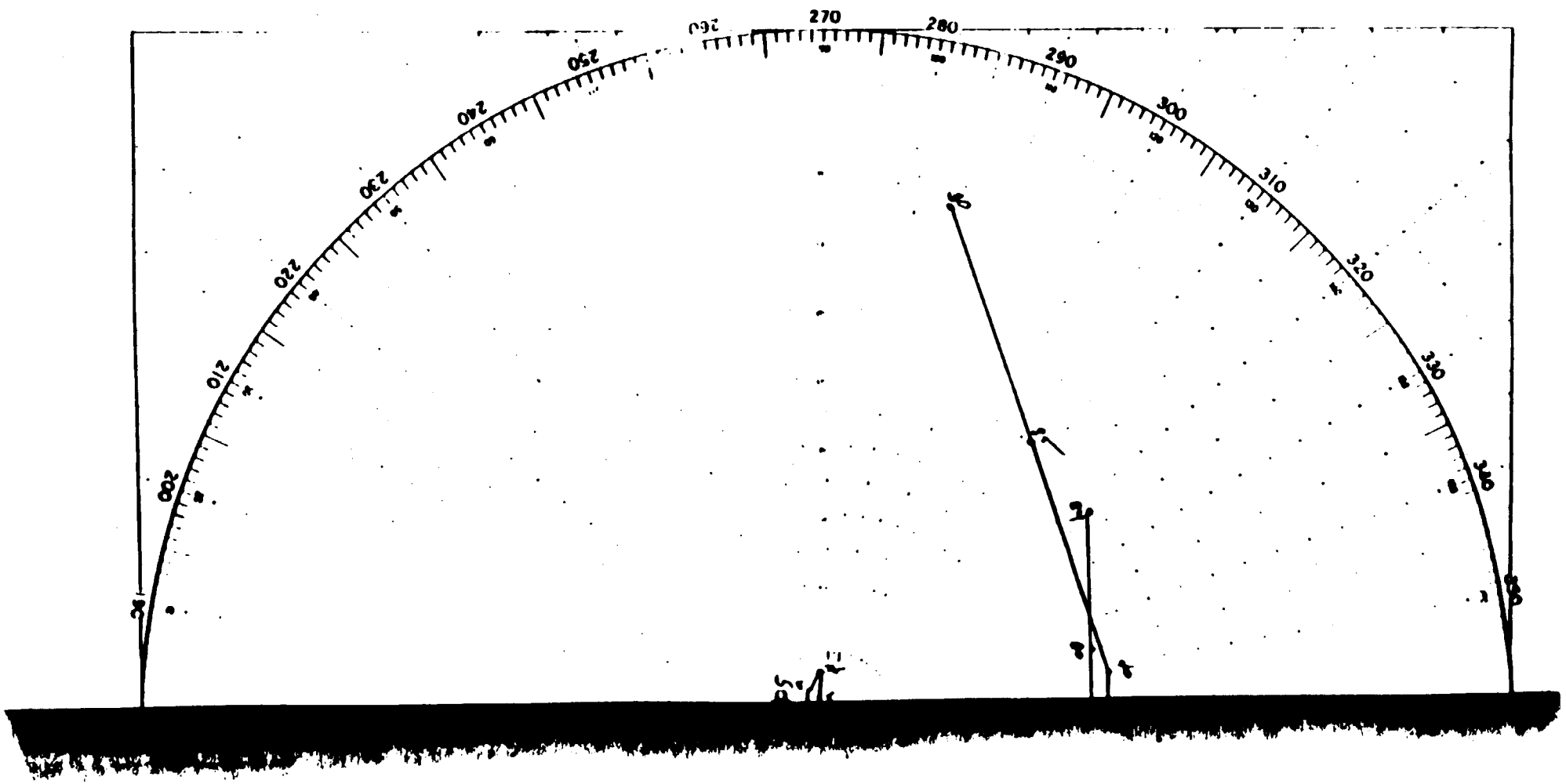

Full Scale
Eniwetok
① Observed
② Forecast
Made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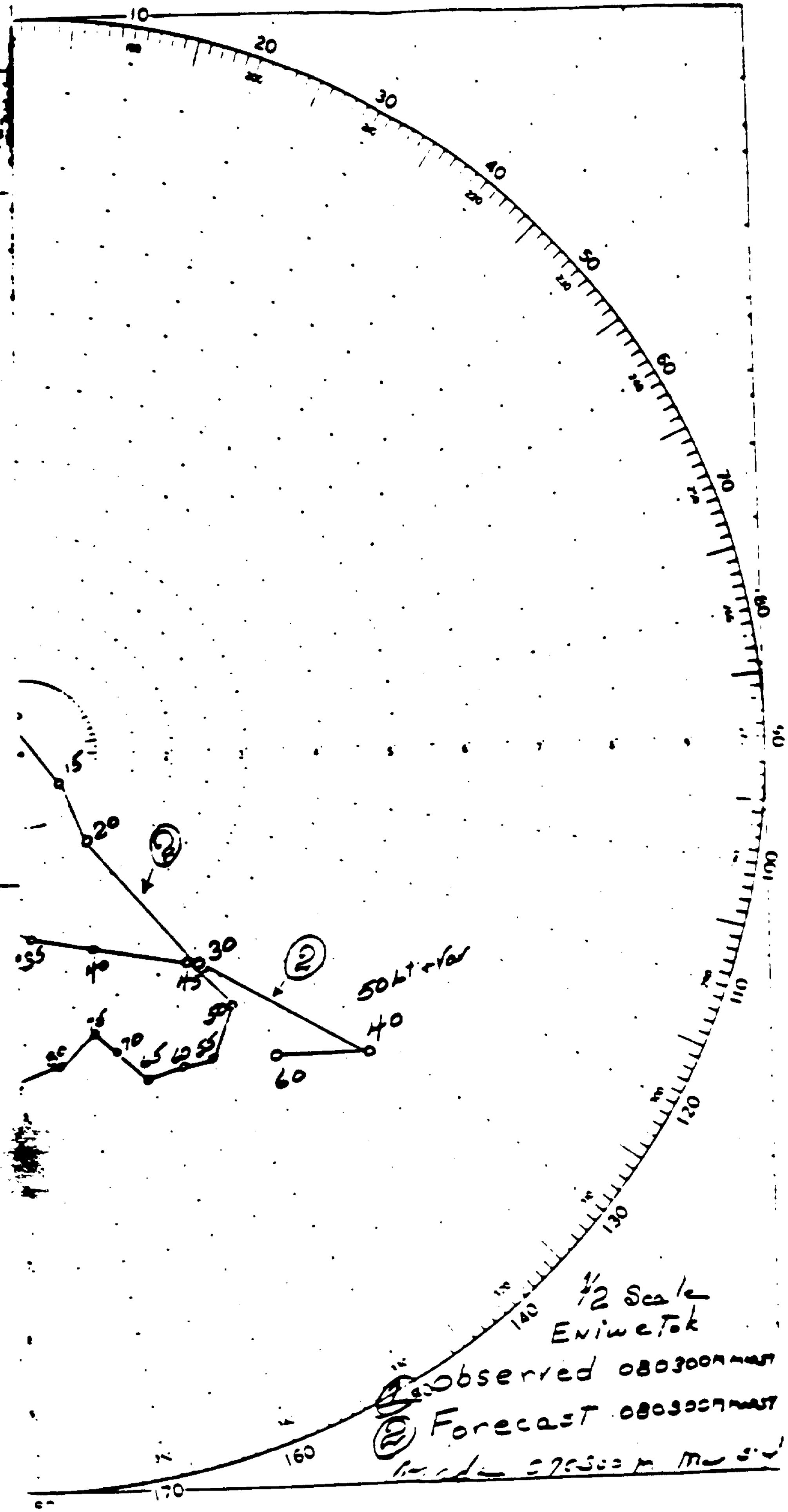
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Eniwetok
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Forecast
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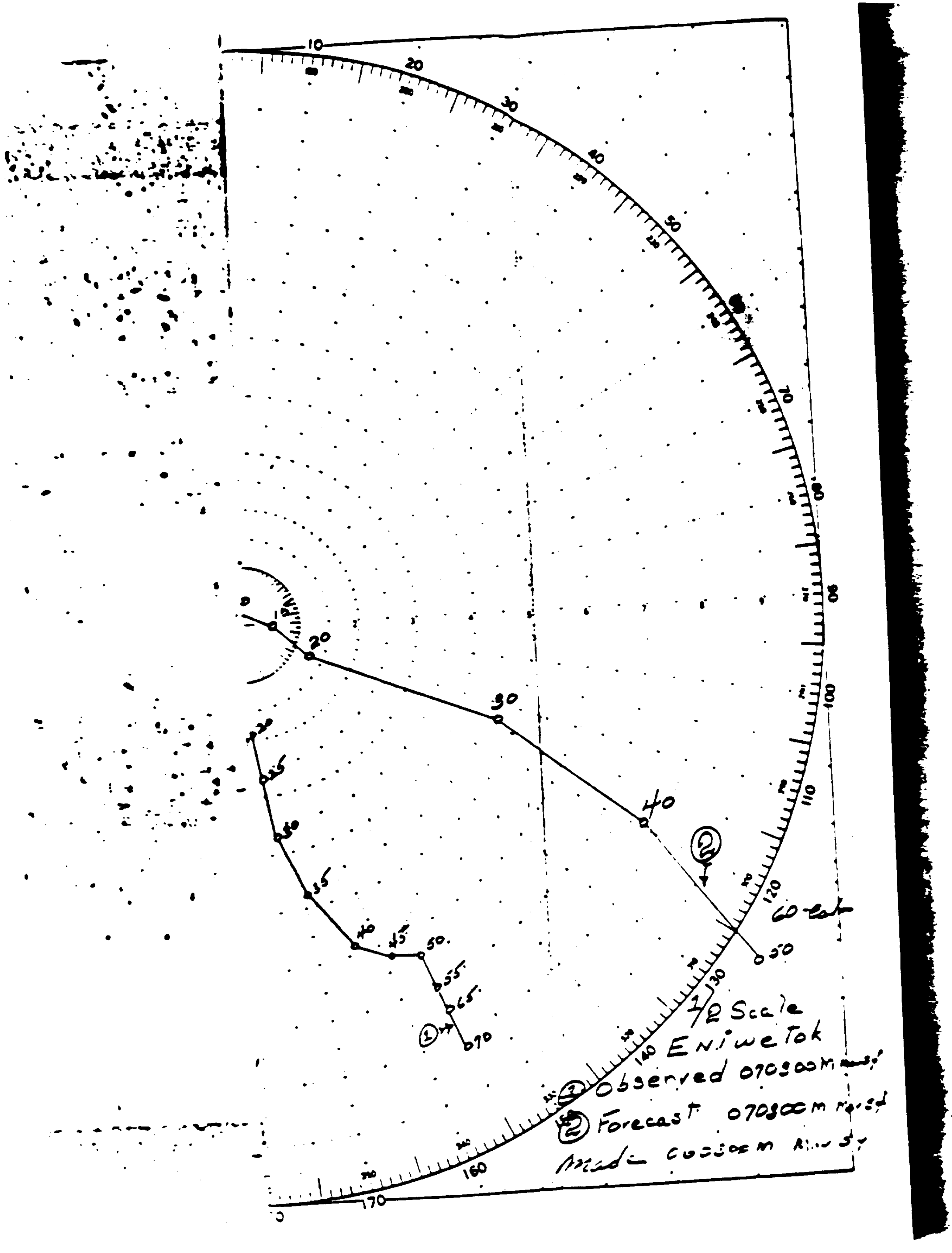
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(1) Observed 070300M
(2) Forecast 070300M

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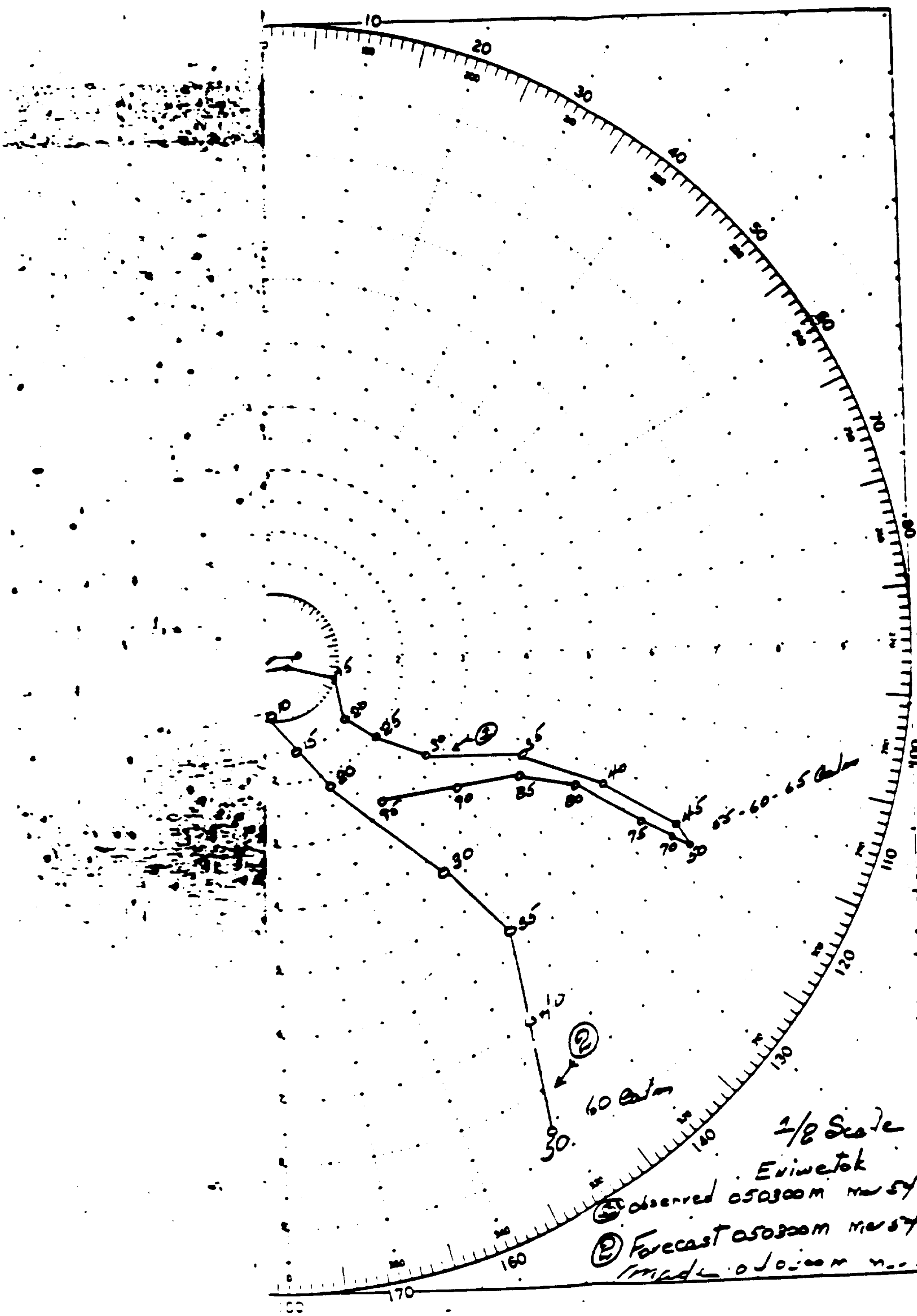

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170
65-60-65 Calm
60 Calm
2/8 Scale
Eniwetok
observed 050300M Mar 54
Forecast 050300M Mar 54

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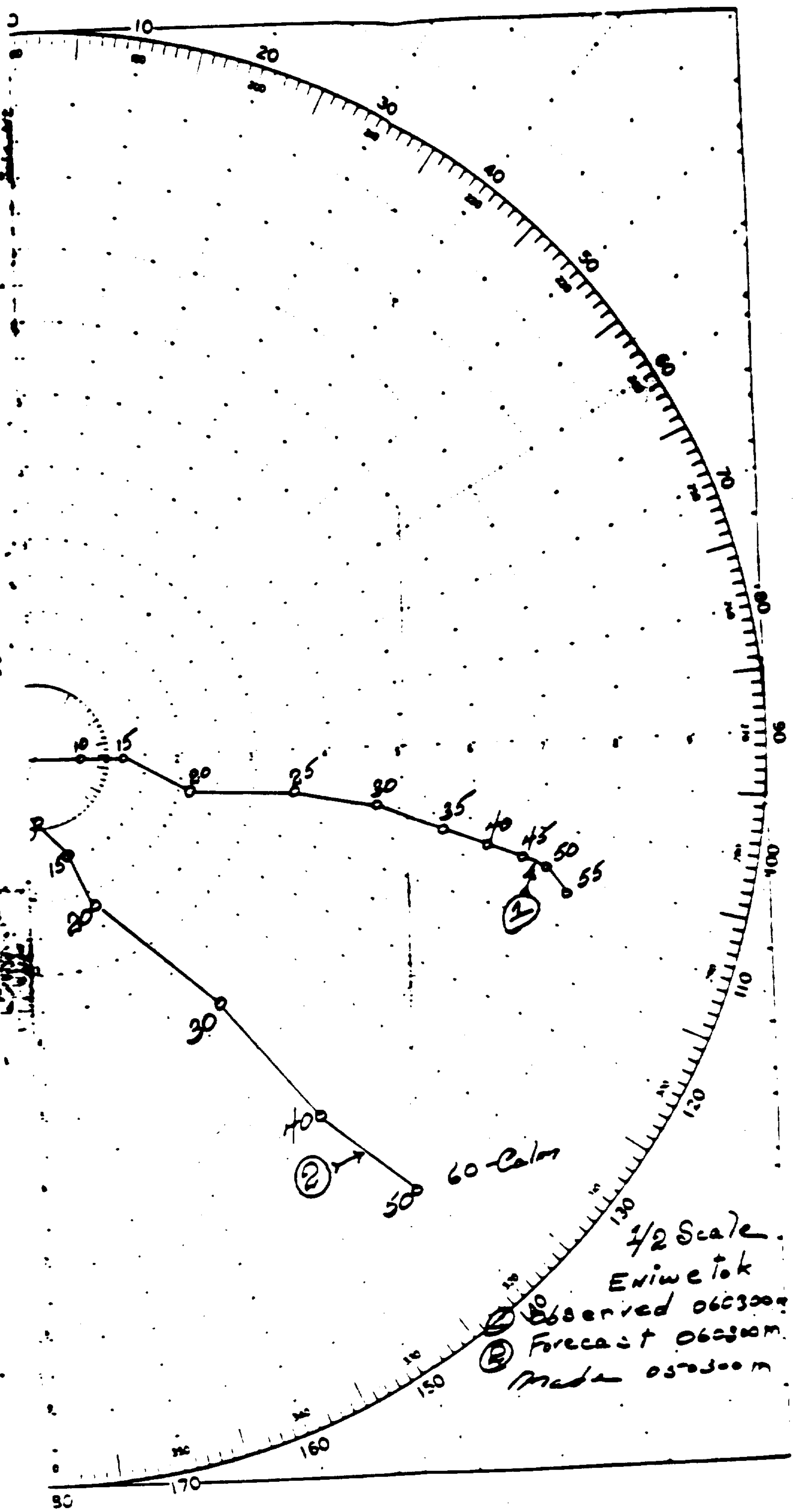

60-Calm
1/2 Scale
Eniwetok
Observed
Forecast
Made

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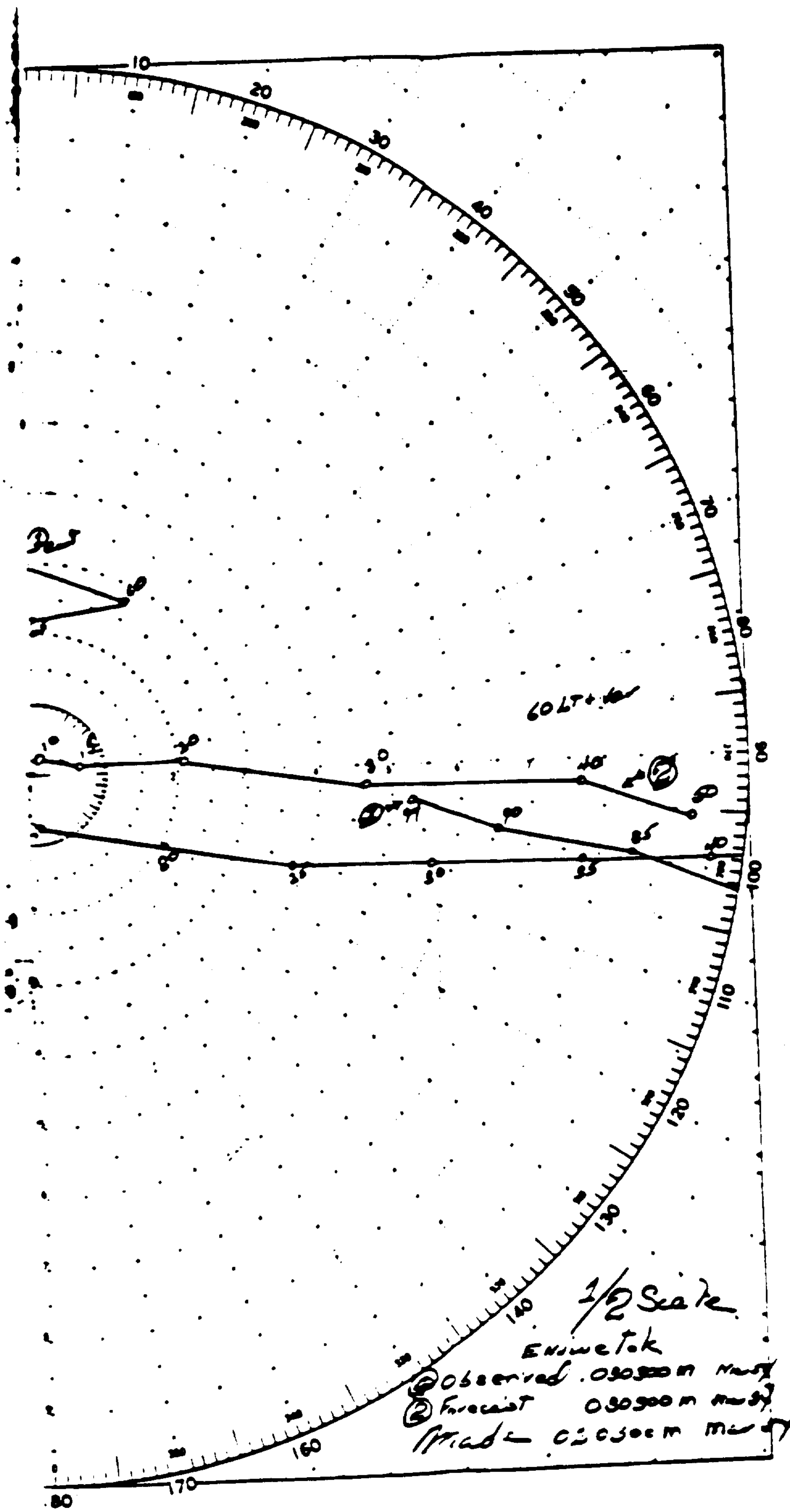
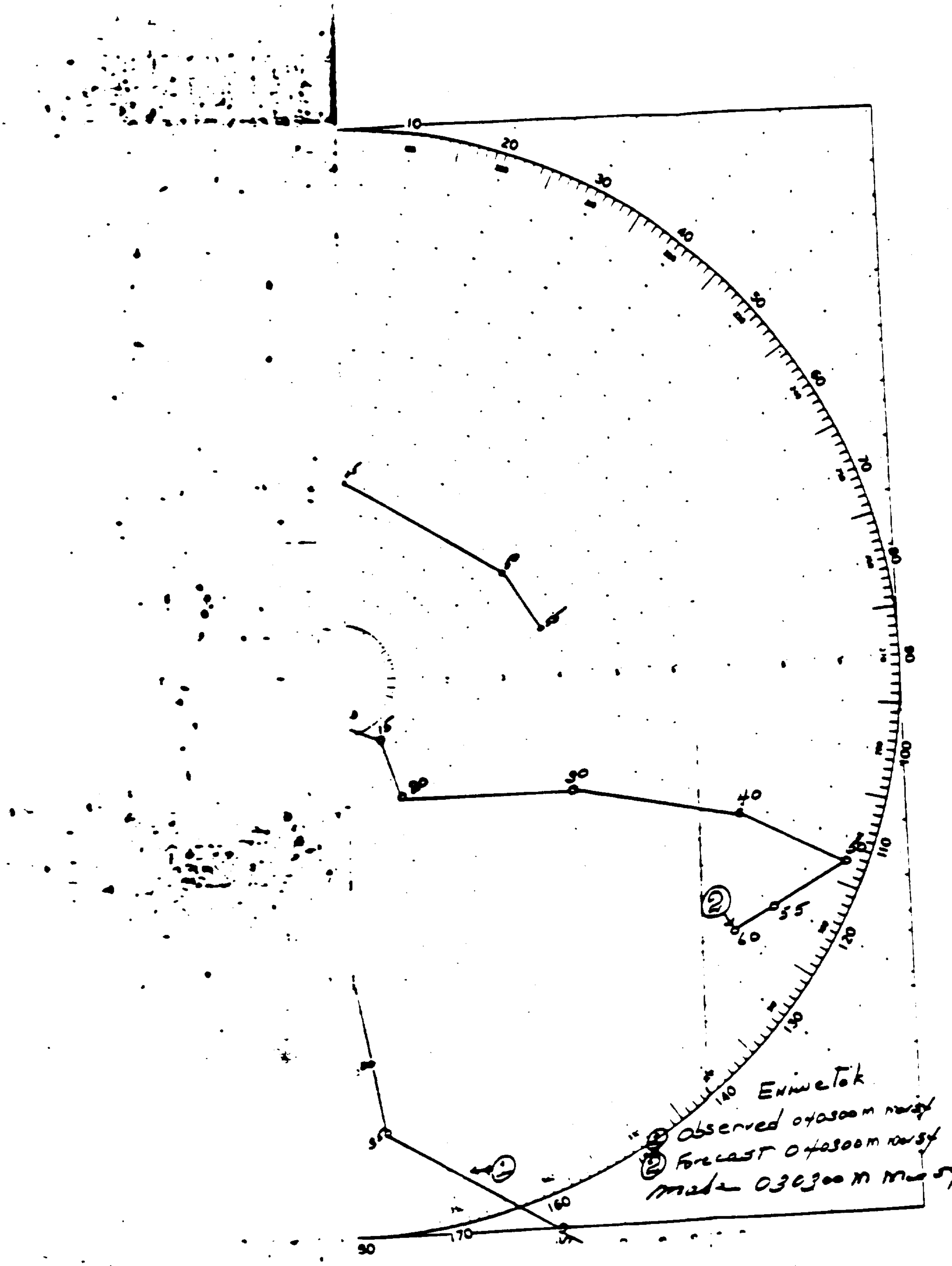


1/2 Scale
Eniwetok
Observed 030300 M
Forecast 030300 M
Made 020300 M


Eniwetok
① Observed 040300M Nov 54
② Forecast 040300M Nov 54
Made 030300M Nov 54

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BRAVO

PLACE	TIME BEARING	DISTANCE NAUT. MI.	TIME FALLOUT ARRIVED	INTENSITY MR/HR	DOSE ROENTGENS	INTENSITY MR/HR	TIME HRS	INTENSITY MR/HR	TIME HRS/DAS	AVERAGE RESULTANT WIND SPEED TO TROPOPAUSE
Lae	160	174	∠34hrs			.08				3.2
Ujae	170	148	∠37			0.1				3.2
Wotho	154	100	∠13.2	2.3	.17	1.0				3.8
Ailinginae	115	79	3.6	12,000	220	445	∠58	400	∠29.7	8.1
Rongelap	109	100	5.6	9,800	350	*1400	∠36	1350	30.9	8.9
Enlaetok	105	98.5	5.4	46,800	4,200	*3000	∠53.2			8.9
Rongerik	098	133	* 8	9,000	350	2000	∠28.5			10.4
Taongi	052	280				1.4	32.6	Fringe effect only		
Bikar	084	285	16.3	1,400	120	600	33.0			14.4
Utirik	096	270	21.6	450	48	160	∠55	53/10	∠6.3das	10.2
Taka	097	261	20.3	290		160	∠34			10.4
Mejit	104	340	30.2							9.6
Ailuk	107	291	27.1	110	13	76	34.8			8.9
Jemo	110	268	24.8			18	34.7			8.8
Likiep	115	262	26.2			6	34.9			8.1
Namu	142	265				.016	48.5			4.2
Ailinglapap	142	338				.08	48.9			4.8
Arno	127	464				0.6	51.6			5.3
Majuro	128	441				2.0	51.4			5.5
Aur	122	400				.36	50.9			5.9
Maloelap	117	387	42.3			3.6	50.6			7.1
Erikub	119	321	40.0			4.0	50.2			6.8
Wotje	114	321	39.0			20.0	50.0			6.0
Kusaie	200	225				.5	54.4			
Ponape	235	503								
Ujelang	245	286				2.0	49.5			
Pingelap	220	426								

* Reading on ground.

WINDS ALOFT

	RONGERIK	27 FEB 54	DIKINI 28 FEB 54	RONGERIK 28 FEB 54	CURTISS 28 FEB 54	CURTISS 28 FEB 54	RONGERIK 28 FEB 54	RONGERIK 28 FEB 54	CURTISS 28 FEB 54	CURTISS 28 FEB 54	CURTISS 01 MAR 54	CURTISS 01 MAR 54	CURTISS 01 MAR 54	CURTISS 01 MAR 54	
120															
115															
110															
105															
100				10 33											
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90				10 33											
85					08 34										
80				09 36	08 21	07 33									
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70				07 13	03 21	06 16									
65				09 09	06 13	12 02									
60				14 03	01 05	12 07					29 06				
55	28 07			30 12	03 21	01 05		27 40				20 16			
50	28 10			26 26	30 23	20 45	28 25	26 33		24 37		25 31			
45	24 24	19	26	39 25	32 22	33 25	24 24	44				25 45			
40	24 24	24	28 25	32 24	38 27	40 25	38 25	42 22	44 24			25 46			
35	25 23	23	36 23	31 25	35 27	39 24	43 24	30 25	37 23	43		23 35			
30	27 13	23	18 23	17 22	14 24	26 24	26 25	27 24	30 23	24		24 35	23	31	
25	24 16	23	14 23	17 25	16 21	19 22	16 22	22 18	30 21	22		25 26	21	22	
20	11 08	21	07 13	03 31	10 26	19 26	16 31	18 27	16 28	22 27	28 26	23 29	23		
18															
16															
15	16 12	24	05 24	08 26	11 27	11 27	11 26	12 29	15 26	10 26	15 29	14 34			
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10	08 05	08	06 34	03 17	08 25	07 30	05 26	03 33	10 32	15 33	12 30	07	13	27	
9															
8	10 05	16	06 09	08 26	05 32	09 05	05 33	09 28	06 33	11 02	05 31	05	30	06	
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6	09 26	08	13 09	23 12	07 07	18 09	06 02	04 09	05 09	05 07	07 12	04	08	21	
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4	09 28		08	18 07	18 07	27 07	22 07	18 08	14 08	15 08	15 08	14	09	20	
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SFC	07 22	07	20 07	23 07	29 08	18 07	22 08	24 07	24 05	18 03	21	06	12	07	25

0900Z	0300Z	0400Z	1200Z	1800Z	1500Z	1800Z	2100Z	0000Z	0300Z	0600Z	0900Z	2
DATE				DATE				DATE				

STATION STA. NO.

APPENDIX IV

	RONGERIK 01 MAR 54	RONGERIK 01 MAR 54				RONGERIK 01 MAR 54								
120														120
115														115
110														110
105														105
100														100
95						08 45								95
90						07 39								90
85						09 37								85
80						08 22								80
75														75
70						09 18								70
65						05 03								65
60						35 04								60
55	35 11	28 15	TROPOPAUSE			30 13								55
50	27 30	28 36				27 36								50
45	26 44	27 57				25 40								45
40	25 44	23 41				25 41								40
35	26 47	25 34				25 33								35
30	25 29	27 64				24 29								30
25	25 24	28 27				23 27								25
20	29 17	30 24	↑SIGNIFICANT LEVELS			30 20								20
18														18
16														16
15		27 11				31 11								
14														14
12														12
10	30 10	28 09				31 06								10
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SFC	13 08	07 11												SFC
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DATE | DATE | DATE

STATION | STA. NO.

APPENDIX IV

MEDICAL ASPECTS OF FALL-OUT FROM BRAVO

1. Medical evaluation of personnel exposed to the radiation from fall-out in case of BRAVO depends to a great extent upon the accuracy with which dosage can be computed. Based upon extrapolation of fall-out time from Rongerik data where the fall-out time was precisely determined by automatic recording instruments, it seems plausible to conclude, after making allowance for factors giving maxima values of time and intensity, that personnel were not exposed to dosages much higher than calculated. This is particularly true inasmuch as Rongerik calculations were in good agreement with observed film badge data on personnel there.

2. The association of symptoms with a given dosage may lead to erroneous conclusions since such tabular relationships have been devised only for whole body penetrating radiation given over a period of a few minutes. It is now generally believed that the symptoms in these tabulations will appear with a smaller dose than indicated. These personnel may develop signs or symptoms out of proportion to what would have previously been expected but could be somewhat tempered by the relatively slow dose rate characteristic of fall-out.

3. With respect to natives, due to the language difficulty, it was extremely doubtful that information obtained by questioning would be reliable.

4. We may draw certain conclusions, however, which seem to be sound concerning immediate prognosis based upon the doses believed to have been received.

5. Considering the personnel involved in exposure to radiation they can be grouped according to location:

a. Rongerik -

Twenty-eight Americans were exposed showing film badge readings ranging from 40 to 98 roentgens during a period of 28.5 to 35 hours. They were evacuated to Kwajalein. It was not expected that any of these men would develop any subjective symptoms. One admitted to feeling badly until reassured after which he admitted that his feeling was probably psychological. First blood counts taken on D plus 1 showed a normal distribution. Generalized loss of hair which usually occurs after 10 days with sufficient dosage was not expected and has not occurred to date. Levels of personnel contamination were not exceedingly high and inasmuch as decontamination was performed on D plus 1, beta burns are unlikely.

b. Rongelap -

Sixty-five natives were evacuated to Kwajalein and may have received doses as high as 130 roentgens in a period of 51 hours. In this case, the level of radiation is about the level which might cause some symptoms such as nausea, vomiting, fatiguability and loss of hair for acute doses. Allowing for the reduced effect from low dose rate it may happen that symptoms as above will occur in individuals who were already ill or in generally poor physical condition. Readings of skin and hair contamination were such that for this exposure time spotty distribution of beta burns could occur within several days. If this occurs, ulcerations might develop which may require several months to heal.

c. Ailinginae -

Seventeen natives on this island were exposed to approximately 80 roentgens in 58 hours. They were evacuated to Kwajalein. It was not expected that any subjective systemic symptoms would develop. However, personal contamination of this duration could conceivably cause beta burns in a spotty distribution with ulceration as described above.

d. Utirik -

154 natives were evacuated to Kwajalein after receiving a dose of 17 roentgens in 78 hours. No subjective systemic symptoms or changes in blood count were expected. Beta burns are unlikely but are possible statistically.

e. Ailuk with 401 natives was not evacuated and the total dose for a life time will be less than 20 roentgens. No medical problem from radiation should occur in the population.

f. Some other islands received fall-out exposing inhabitants to insignificant quantities of radiation.

g. Task Force personnel at or in the vicinity of Bikini Atoll -

Personnel in the concrete bunker on NAN island were evacuated to ships afloat receiving in general comparable dosage to those aboard ships all the time. Based on readings taken aboard the ships it was estimated that none of the ship's personnel would receive more than 10 roentgens whole body radiation. This dose would not cause any general symptoms of radiation sickness, however, decontamination personnel might have skin contact with concentrated radioactive deposits and possibly sustain mild beta burns.

6. All native evacuees were held at Kwajalein for observation and treatment should the need arise. The station medical complement took complete blood counts, made physical examinations and took histories. Captain E. H. Haight, (MC), USN, a radiological medical officer was sent to Kwajalein as consultant on radiation effects to the station surgeon. Daily observation was instituted in anticipation of the arrival of a medical group from the U. S. who were to investigate the patients.

7. The medical group arrived in Kwajalein on 8 March. It consisted of military and civilian medical officers and technicians from the Naval Medical Research Institute, the Armed Forces Special Weapons Project and the U. S. Naval Radiological Defense Laboratory and was established as Project 4.1, TU 13 of Task Group 7.1 with Commander E. P. Cronkite, MC, USN, as Project Officer. Drs. G. V. Leroy and C. L. Dunham represented the Division of Biology and Medicine, AEC, and were to act as advisors to Project 4.1. A systematic organization was set up with a view toward running a sick call, performing blood studies, taking histories, making physical examinations and documenting the cases by means of records and photography. Buildings were furnished for these purposes by COMNAVSTAKWAJ and his Station Surgeon, Commander W. J. Hall, worked closely with the group. The establishment of the investigating group of Project 4.1 was essential and desirable from several standpoints. All the medical personnel were experienced in the field of atomic medicine having been participants in previous testing using biological material as well as having had full time research projects along this line during interim periods. This allows for proper evaluation of human effects toward correlation with data on animals from which a great deal of our ideas on human effects have been extrapolated. Further, they constituted an augmentation medical group for treatment if necessary in conjunction with station medical facilities. An additional advantage was that almost all of the personnel had worked together as a unit on previous occasions.

8. None of the natives nor the Rongerik Americans had preliminary or early systemic symptoms consistent with radiation sickness from large dosage of external whole body irradiation. A reported case of vomiting and a few cases of loss of appetite were not significant considering the sudden change in environment and diet to which they were subjected. To relieve the load on the station medical facilities, not knowing of the early arrival of the medical group, the twenty eight Americans were returned to Ebwetok to remain as outpatients under the supervision of the Surgeon, Task Group 7.2. Blood counts were taken at approximately three day intervals. They remained asymptomatic although there began a depression of the white blood cells of mild degree. They were returned to Kwajalein on 17 March. During the early days of March all patients remained free of systemic symptoms attributable to irradiation but there was a definite decrease in the white blood cell count more marked in the Rongelap group. The blood pictures of the Ailinginae natives and the Rongerik Americans were quite similar which was reasonable considering they were exposed to the same order of magnitude of radiation. The Utirik group showed nothing particular from a medical standpoint and were considered as a virtually normal native population for comparison purposes pending time for obtaining base line data from non irradiated natives.

By the thirteenth and fourteenth day a tendency to epilate had become evident in the Rongelap natives involving mostly children but within a few days it had appeared in adults. The epilation was both patchy and diffuse, confined mostly to the head and particularly in children the scalp assumed a spotty appearance due to depigmentation of the skin.

At about the same time that epilation appeared in the Rongelap group, small skin lesions became noticeable on the folds of the neck, the forehead, shoulders, and arms. They appeared to be superficial and at first were hyperpigmented. As time went on, the lesions, which became blister like, began to peel leaving a whitish depigmented area in the center. The skin manifestations continued to appear throughout the month of March, all going through the same cycle and involving most of the natives. The most severe cases occurred on the feet with one exception - one man developed a deep ulcer behind one ear. By this time all of the skin lesions except the ear have virtually healed and it appears that repigmentation is taking place.

Similar findings but in a lower percentage and at a later date occurred in the Ailinginae group. One American developed what appeared to be superficial radiation lesions on the back. They were hyperpigmented and behaved as the others.

Throughout, there have been no demonstrative systemic symptoms other than an epidemic of colds in the Rongelap group. A few cases of secondary infection from skin lesions and some unexplained high fever in children responded well to penicillin with no sensitization reaction.

The white blood counts reached a minimum during the latter part of March with a late depression in blood platelets becoming apparent. The level of the mean counts being well below normal mean counts. Lowest counts were about 30,000 compared to a normal mean of over 300,000 for the natives. There is a definite upswing in the entire blood picture of both the natives and Americans at the present time.

On about 20 March, several cases of radiation burns were reported aboard both the USS BAIROKO and the USS PHILIP. Examination showed that in almost all cases there were discrete areas around the belt line which corresponded well to some lesions seen on the natives. History indicated that these lesions developed sometime between 3 March and 15 March. All were in the process of healing with desquamation and mild depigmentation and were quite superficial. The whole body dose was less than 10R and there were no other symptoms.

Three M-boat operators from TG 7.3 presented film badges reading from 85 to 95R and were sent to Kwajalein to be observed by the medical team on 16 March. Since that time they have had no symptoms, no skin findings nor blood changes. It is likely some discrepancy in badging or wearing of badges must have taken place as careful examination of the badges by densitometer revealed nothing unusual in the radiation to which they were subjected.

It was decided at the outset to manage all cases in a conservative manner, treating symptoms as they arose, avoiding experimentation with treatment but being ready at any time to perform transfusions either of whole blood or platelets if indicated. Sick call was managed daily

where complaints were treated as though radiation had not been present. Skin lesions were kept clean by surgical soap with excellent results leading to a minimum of secondary infection and remarkably prompt healing. It is felt that this conservative regimen gave optimum results and that all patients are recovering satisfactorily.

Detailed reports will be rendered by Project 4.1 on all cases. Detailed statistical analyses will be required to properly evaluate the data derived. Urine samples which have been analyzed in the U. S. will be combined with this study. A detailed study of characteristics of the fallout samples, shielding properties of the measuring instruments, and weather analysis will be necessary before a more exact dose of external whole body radiation can be established. The study of all aspects should lead to a much clearer concept of dose versus effect. The picture of external gamma radiation with a broad spectral band, combined with external beta radiation, and internal hazard makes a very complicated problem in the final report.

As a corollary to immediate treatment of the personnel exposed to the radiation, evaluation of the hazard remaining upon rehabilitation must be investigated. To that end soil and water samples, animals, plants and other comestibles are being investigated with a view of determining if and when the natives may be returned to their home atolls.

All personnel who have been involved in large dose exposures and those whose dose was small but who may have to reside in an active area should be observed over a long period of time. The first year following the tests, re-examination should be at quarterly intervals. This has been discussed with the Director, Division of Biology and Medicine, AEC, who advises that it is the intention of his organization to maintain a periodic observation system.

In summary, natives from adjacent atolls and Americans from the Task Force were exposed to radiation in doses from a few roentgens to approximately 150 roentgens. Some of the more heavily irradiated may be considered to have been borderline from a standpoint of seriousness. All should recover from the effects of the exposure.

Clinton S. Maupin

CLINTON S. MAUPIN
Colonel, Medical Corps
Staff Surgeon

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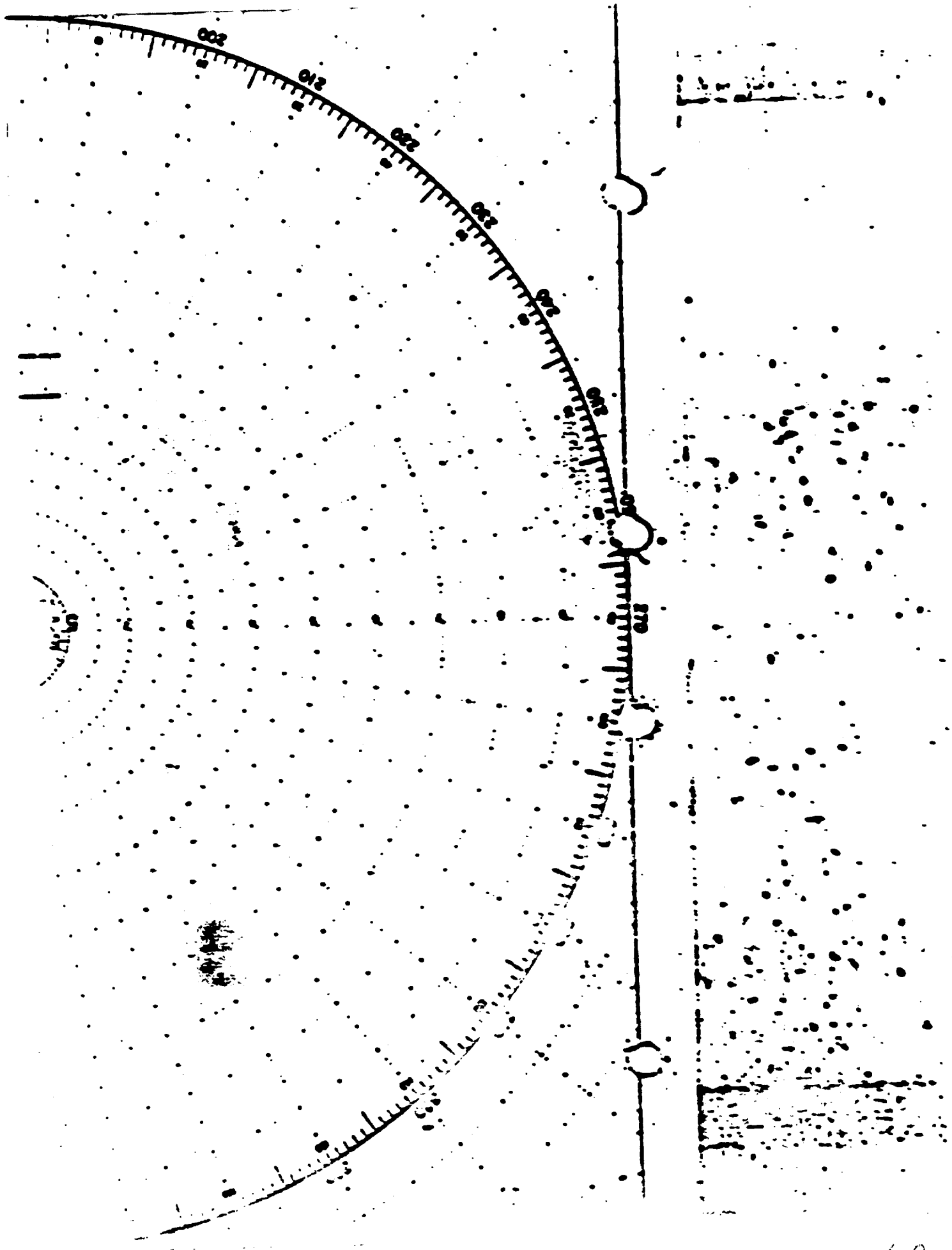


TAB A

SUMMARY OF WEATHER SITUATION FOR BRAVO SHOT

[redacted]

SUMMARY OF WEATHER SITUATION FOR BRAVO SHOT

1. GENERAL. This summary presents the weather situation as existed prior to, at, and just after BRAVO shot time, for the general area of the Marshall Islands, with specific reference to Bikini and the SHRIMP shot site.

2. PRE-SHOT WEATHER.

a. General Synoptic Situation

(1) SURFACE - The surface chart was dominated by a high pressure cell located at approximately 34 degrees north 171 degrees east with a central pressure of approximately 1030 MBS. A trough, oriented northeast - southwest lay just off the coast of Japan. Minimum pressures in low latitudes lay just along the equator. Flow over the Marshall Islands area was the east northeast trade flow, with no marked regions of convergence or divergence. (Chart No. 1). During the preceding several days the high pressure cell had been moving slowly eastward, with a slight increase in the central pressure.

(2) UPPER LEVEL CHARTS. From approximately 25,000 to 55,000 feet the flow pattern was dominated by a clockwise rotation centered near 5 degrees north 175 degrees east. This system was essentially vertical from 30,000 to 50,000 feet (Chart No. 4). The flow at these levels, under the influence of this dominant system was from the west southwest. At 20,000 feet the dominant clockwise rotation lay much further to the east, with a secondary center located south

[redacted]

of BIKINI and west of KWAJALEIN, giving westerlies at this level in the BIKINI area. To the east of BIKINI the flow was more northwesterly (Chart No. 3). At 10,000 feet the entire flow was broken up by a group of minor eddies, both clockwise and counter-clockwise, features approaching large scale turbulence in nature and showing quite erratic movements; however, there was a general west wind in the vicinity of BIKINI, with the wind speeds being very light (Chart No. 2).

b. Forecast for Shot-Time

(1) The following forecasts, based on the prognostic chart for shot time (Chart No. 5), were issued at the indicated times for BRAVO shot-time:

(a) H-48 Hrs: WEATHER: Scattered cumulus, scattered cirrus, widely scattered showers. WINDS: Surface easterly 10 to 15 knots - Ten thousand feet easterly at 15 to 25 knots - 50 thousand feet southwesterly at 10 to 20 knots - 60 thousand feet southerly at 5 to 15 knots.

(b) H-36 Hrs: WEATHER: Scattered cumulus bases 2000, scattered cirrus based at 35,000 feet, very widely scattered showers. WINDS: Surface 80 to 90 degrees at 15 to 20 knots - Ten thousand feet 80 to 90 degrees at 15 to 20 knots - 20 thousand feet 90 degrees at 10 to 15 knots - 30 thousand feet southerly at 5 to 10 knots - 40 thousand feet 220 to 250 degrees at 20 knots - 50 thousand feet southwesterly at 220 to 250 degrees at 20 knots - 60 thousand feet northerly at 10 to 15 knots.

(c) H-24 Hrs: WEATHER: 3/8 cumulus bases 2000 tops 5000, 3/8 cirrus bases near 38,000 widely scattered showers. WINDS: Surface 70 degrees at 20 knots 10 thousand feet at 14 knots - 20 thousand feet 230 degrees at 16 knots - 30 thousand 350 degrees at 14 knots - 35 thousand feet 260 degrees at 22 knots - 40 thousand feet 250 degrees at 24 knots - 45 thousand feet 240 degrees at 24 knots - 50 thousand feet 230 degrees at 14 knots - 55 thousand feet light and variable - 60 thousand feet 50 degrees at 10 knots - 70 thousand feet 70 degrees at 14 knots - 80 thousand feet 90 degrees at 12 knots - 90 thousand feet 100 degrees at 18 knots.

(d) H-13 Hrs: WEATHER: No change in H-24 forecast. WINDS: No change.

(e) H-8 Hrs: WEATHER: 2/8 cumulus bases 2000 tops 5000, 2/8 stratocumulus bases 6000 tops 7000, 4/8 cirrus bases near 38,000 widely scattered showers, contrail level 36,000 tropopause height 55,000 temperature of tropopause minus 78 degrees. WINDS: Surface 70 degrees at 20 knots - 5 thousand feet 70 degrees at 16 knots - 10 thousand feet light and variable with a westerly trend - 14 thousand feet 250 degrees at 18 knots - 20 thousand feet 270 degrees at 12 knots - 25 thousand feet 230 degrees at 20 knots - 30 thousand feet 230 degrees at 25 degrees - thirty five thousand feet 230 degrees at 38 knots - 40 thousand feet 240

degrees at 40 knots - 45 thousand feet 260 degrees at 38 knots - 50 thousand feet 80 degrees at 10 knots - 60 thousand feet lightly and variable - 70 thousand feet 80 degrees at 25 knots - 90 thousand feet 70 degrees at 20 knots.

(f) H-4 Hrs: WEATHER: No change in H-8 forecast. WINDS: No change.

(2) The air particle trajectory chart (Chart No. 6) was used to brief on the movement of the cloud after detonation for the several levels portrayed.

3. SITUATION AT H-HOUR

a. General Synoptic Situation

(1) SURFACE - The general synoptic patterns at this time differed from those earlier only by the continued eastward movement of the high pressure cell (Chart No. 7).

(2) UPPER LEVELS - The clockwise system had moved slightly to the east and south, with the winds at upper levels tending to become more westerly (Chart No. 10). At 20,000 feet the small clockwise circulation west of Kwajalein had expanded (Chart No. 9). At 10,000 feet the flow remained dominated by the minor eddies which had existed at 2303002 (Chart No. 8).

b. For the observed local conditions versus the forecast for that time, see paragraphs 5g, h and i below. A revised air particle trajectory forecast was issued at H/11 hours, based on data available through H/9 hours (Chart No. 11). The major change, which had not been forecast, was in the 20,000 foot trajectory.

4. POST-SHOT WEATHER:

a. The weather after shot time deteriorated rapidly due to induced local cloudiness. The winds aloft for Eniwetok and Rongerik were less favorable from a fallout point of view (Incl No. 1 and 2).

b. Chart No. 11 is the computed air particle trajectories for ERA70 day, based on data available through 1433 hours. Amplification of other levels than those presented is in order since the pattern from the surface to 25,000 feet was in a continual flux. The 25,000 foot trajectory was essentially the same for 30,000 feet. From 12,000 to 18,000 feet the trajectories lie between the 10,000 and 20,000 foot level patterns with the 18,000 foot most like the 20,000 foot trajectory and the 12,000 foot most like the 10,000 foot trajectory. In other words, between 10,000 and 20,000 feet there must have been considerable dispersion, with the 20,000 foot level having the most northerly component of motion. From 6,000 to 8,000 feet, the trajectories again start showing northerly components, with the 6,000 foot and below trajectories being generally from the east northeast.

5. DISCUSSION:

a. Briefings:

(1) The outlook on the morning of 27 February was very favorable from the radsafe point of view. The winds for shot time were forecast to be easterly from the surface through 20,000 feet, southeasterly at 30,000 feet, southerly at 40,000 feet, and southwesterly at 50,000 feet. The situation was changing slightly; 27 February would have been an ideal shot day (Incl No. 3).

(2). On the afternoon of 27 February, the weather outlook was still favorable from all considerations, especially radsafe. Easterly winds were forecast for shot time from the surface through 10,000 feet (080° to 090° at 15 to 20 knots), and southwesterly aloft (230° to 250° at 16 to 25 knots) up to the tropopause (55,000 feet) (Incl No. 4).

(3) The briefing at 1100M, 28 February, indicated a forecast for shot site at shot time as 3/8 cumulus, bases 2,000, tops 5,000; 3/8 cirrus at 39,000 feet and winds to be 070° at 20 knots at the surface (Incl 5).

(4) Later that afternoon, the trend at 10,000 feet became more southerly due to the shift of the high pressure cell at 10,000 feet to the north. The remaining winds were forecast to remain essentially as given at the 1100M briefing (Incl No. 6).

(5) The briefing given at midnight prior to the shot time at 0645, 1 March 1954, was as per the inclosed forecast (Incl No. 7).

(6) The briefing at 0400M, 1 March, was essentially as briefed at midnight. Winds aloft from the CURTISS for 2400M and 0300M were discussed (Incl No. 3). The levels 7,000 feet through 11,000 feet were under close scrutiny due to their variability. A tendency for a westerly direction at that level was forecast. (Incl No. 8).

b. Observed shot time winds and weather:

(1) The observed shot time winds (0600M, 1 March 1954) from the USS CURTISS, Eniwetok and Rongerik versus the forecast winds for shot time for the shot site are shown in Table I (next page).

SECRET

OBSERVED 0600Z, 1 MARCH

	FORECAST FOR BIKINI 0645Z, 1 Mar	USS CURTISS (AT BIKINI)	[illegible]	[illegible]
Surface	070/20	060/12	070/17	080/17
1000		070/17	080/20	070/15
2000		080/18	080/20	060/14
3000		090/17	080/19	080/10
4000		090/14	080/17	090/18
5000	070/16	100/09	080/13	080/16
6000		120/04	Calm	070/12
7000		310/04	310/09	060/05
8000		310/05	310/11	020/03
9000		320/07	360/11	330/06
10000	Light & Variable (westerly trend)	310/10	290/11	310/08
12000		300/07	260/10	290/09
14000		290/14	240/07	320/13
15000	250/18			
16000		290/13	260/13	310/15
18000		280/13	280/17	290/11
20000	270/12	280/23	280/17	300/19
25000	230/20	250/26	240/25	250/24
30000	230/26	240/35	250/28	250/29
35000	240/28	230/35	240/37	240/41
40000	230/38	250/44	240/42	240/48
45000	240/40	250/45	260/23	260/42
50000	260/38	250/31	270/19	260/31
55000	050/10	200/16	300/11	340/36
60000	Light & Variable		330/04	220/03
70000	080/09		080/27	090/13
80000	080/25		080/30	
90000	070/20			

TABLE I

(2) The following was the forecast of clouds and weather for shot time over shot site: 2/8 cumulus, bases 2,000 feet, tops 5,000 feet; 2/8 stratocumulus, bases 6,000 feet, tops 7,000 feet; 4/8 thin cirrus at 35,000 feet; widely scattered light showers in the area, none over shot site at shot time; contrail formation level 35,000 feet; tropopause height, 55,000 feet with temperature of 72°C.

SECRET

(3) The following conditions were observed at shot time at Bikini (A consensus of shot time observations taken by 2C weather officers and aerographers mates) aboard the USS CURTISS: 4/8 cumulus at 2,000 feet, tops 4,000, 1/8 altostratus (barely discernable) and 5/8 to 6/8 cirrus, thin.

Sea Level Pressure	1006.1 mbs.
Temperature	80°F
Dew Point	72°F
Surface Wind	074° 15K
Height of Tropopause	54,350 ft (at H/3)

A B-36 over ground zero at approximately H minus 20 minutes reported scattered cumulus, scattered to broken cirrus with bases 38,000 to 39,000 feet and tops to 40,000 feet, and no showers.

(4) The 282100Z Feb wind observation from Rongerik which was received on board the ESTES was garbled in transmission and was in considerable error. It did not agree with the winds received from Eniwetok and the CURTISS for that time, in that it showed southwesterly flow from 10,000 feet; the correct observation indicated light northwesterly flow, which was in agreement with the other observations.

(5) Local weather conditions began deteriorating shortly after the detonation. Multicloud layers developed at all levels. The winds aloft were forecast to be less desirable from a rain-fall consideration, and such was the case. Such a situation continued through 8 March 1954 (See Hodographs under Tab B).

c. Analysis of winds aloft:

(1) At 10,000 feet a belt of outdrafts across the Pacific, at approximately 25 to 30 degrees north, gave easterly flow generally throughout the northern Marshalls. There was an intense Kona storm in the vicinity of Hawaii. A number of weak short-duration circulations characterized by light and variable winds formed and dissipated between the equator and 20 degrees north. One clockwise circulation developed near Eniwetok on 28 February and drifted toward Kusaie, giving weak westerly flow over the shot area. This general situation persisted through BRAVO plus 3 days, with winds at all times less than 11 knots at Eniwetok. Analysis at this level was difficult and very changeable.

(2) At 20,000 feet, the major systems on BRAVO minus 5 days were a large outdraft 20 degrees north, 170 degrees east, and deep middle latitude troughs near 145 degrees east and 160 degrees west. This latter trough remained stationary while the western trough moved eastward, forcing the outdraft to 180 degrees east, thence southward and westward into the Marshalls. This trend resulted in shot site winds veering from east through south to west and continued after BRAVO day. Speeds were under 20 knots until BRAVO plus 1 day, then increased to approximately 30 knots on BRAVO plus 2 days.

(3) At 30,000 feet and 40,000 feet, a belt of clockwise circulations centered near 10 degrees north moved slowly southward with

individual cells drifting eastward. Movement of the cell near Eniwetok to a position southeast of Majuro gave strong southwesterly flow in the local area on 28 February and west southwest flow on 1 March, replacing the light variable winds which existed on 23 - 25 February. Continued southward motion and approach of following cell from west brought west to northwest flow on 2 and 3 March.

(4) At 50,000 feet, the slow movement of the clockwise circulation from a position northwest of Eniwetok to south of Majuro changed the flow gradually from north northwest to west southwest. After 1 March this circulation continued its movement to the southeast and weakened, with flow in the local area becoming west northwesterly.

(5) At 60,000 feet, no clearly defined trend was present. Winds were quite light and erratic at this level, with easterly flow at higher levels. These variable winds persisted through BRAVO plus 3 days.

d. Differences between forecast and observed winds: In regard to the differences between forecast and observed winds, reference is made to a report of Project 4.5, JTF THREE, by Palmer, Miller, and Stopinski. This report stated that studies of the observational errors in upper wind observations taken by GMD/1 equipment indicated that for wind speeds above 10 knots, approximately 15 per cent of the observations varied by more than 20 degrees, even when the observations were made by several different ground units, but with the same airborne unit. The differences between forecast

winds and observed winds during the period of BRAVO were within these observational limits. On the last specific wind forecast issued at H minus 8 hours, there were ten (10) winds forecast to be above 10 knots which can be compared with the observed winds taken from the CURTISS at BRAVO hour. Of these ten (10) winds, six (6) differed by 10 degrees, two (2) by 20 degrees, one (1) by 30 degrees and one (1) by 40 degrees. 80 per cent of the forecast winds which can be checked in the immediate locale were within observational limits imposed by the equipment itself. The errors of 30 degrees and 40 degrees were the forecasts for the levels immediately above and below 10,000 feet.

6. CONCLUSIONS:

a. Weather conditions during the five days prior to BRAVO day were indicative of a favorable trend for BRAVO, involving on an average, easterly winds below 15,000 feet, with winds of a southerly component above. BRAVO minus 2 and BRAVO minus 1 days were especially favorable from a fallout point of view. The weather situation presented at H minus 6 hours for a 24 hour period was satisfactory; however, an unfavorable trend was predicted to occur during the following 24 hours since northwest winds were forecast for the 10,000 to 20,000 foot levels. This trend was borne out by later observations.

b. The forecast wind directions were well within the normal forecast error, which must be anticipated. Forecasts of the same precision as those made in areas of dense observation networks cannot be expected in this area. The forecasts of winds aloft for BRAVO were, nevertheless, approaching the limits of human ability which the art at present allows.

C. D. Bennet
Lt. Colonel, USAF
Staff Weather Officer

21 Inclosures

1. Area Forecast Valid 011500Z to 021500Z March 1954.
2. Rongerik and Eniwetok Observed Winds Aloft for 012100Z March 1954.
3. Msg DTG 2820162 Feb 1954, to CJTF SEVEN, re: Weather Outlook for Shot Day.
4. Msg DTG 2705442 Feb 1954, to CJTF SEVEN, re: Weather Outlook for Shot Day.
5. Memo for Record, B-1, 1100Z Weather Briefing w/2 Incl.
6. Memo for Record, B-1, 1800Z Weather Briefing.
7. Memo for Record, B-1, 2400Z Weather Briefing w/2 Incl.
8. Memo for Record, 0400Z BRAVO Day Weather Briefing.
9. Symbols for Weather Distribution Chart.
10. Chart #1 - 1500 foot Streamlines and Weather Distribution Chart for 2800002 February 1954.
11. Chart #2 - 10,000 foot Streamlines for 2803002 February 1954.
12. Chart #3 - 20,000 foot Streamlines for 2803002 February 1954.
13. Chart #4 - 40,000 foot Streamlines for 2803002 February 1954.
14. Chart #5 - Prognostic 1500 foot Streamline and Weather Distribution valid for 0615Z, 1 March 1954.
15. Chart #6 - Air Particle Trajectories for H to H plus 72 hours, prepared at H minus 9 hours.
16. Chart #7 - 1500 foot Streamlines and Weather Distribution Chart for 2818002 February 1954.
17. Chart #8 - 10,000 foot Streamlines for 2818002 February 1954.
18. Chart #9 - 20,000 foot Streamlines for 2818002 February 1954.
19. Chart #10 - 40,000 foot Streamlines for 2818002 February 1954.
20. Chart #11 - Revised Air Particle Trajectories prepared at H plus 9 hours.
21. Chart #12 - Completed Air Particle Trajectories prepared at H plus 36 hours.

AREA FORECAST VALID 011500 TO 021500Z MARCH 1954

General Situation: Easterly flow extends to 7000 feet. Westerlies prevail to tropopause. Eniwetok Terminal: 18 sctd 180 sctd 380 brkn vsby 10 sfc wind 0715. Bikini Terminal: 18 brkn 180 brkn 380 brkn vsby 10 sfc wind 0715. Eniwetok winds and temps: 00715 20820 40822 60718 83604 03308 F11C 152611 P2C 202917 M7C 302830 M26C 402632 M50C 502628 603308 700718 800830 900740. Bikini Winds and Temps: 00715 208204 40822 60718 83604 93508 F11C 152612 P2C 202722 M7C 302628 M26C 402636 M50C 502730 60330 700718 800830 900740. Further outlook for Eniwetok and Bikini (Planning Only). Decreasing clouds Bikini area. Little change elsewhere. Eniwetok Clouds: 2/8 CU bases 18 tops 40 with sctd isolated tops to 60. 4/8 as bases 180 tops 200. 7/8 CI near 380. Bikini Clouds: 6/8 CU bases 180 tops 40 with sctd isolated tops to 60. 5/8 as bases 186 tops 200. 7/8 CI near 380. 2100Z 3/8 CU bases 18 tops 40 with sctd isolated tops to 60. 2/8 as bases 180 tops 200. 5/8 CI near 380 after 2100Z. Freezing level 170. Tropopause height 550 temp M 820. Height of contrail formation 350. Sea and swell 6 feet from ENE Eniwetok, Bikini. Kwajalein Terminal: 15 sctd vsby 10 sfc wind 0610 tempo 10 brkn vsby 5 sfc wind 0615 in lgt sctd showrs.

[redacted] OBSERVED WINDS ALOFT

1 March 1954, 2100Z

(Last observation made prior to evacuation)

00510 11013 21015 31012 41011 50711 60908 70508 81803 92706 99991 02809
23314 43212 62110 83007 99992 03014 52827 99993 02734 52534 99994 02932
52737 99995 02836 52815

[redacted] OBSERVED WINDS ALOFT

1 March 1954, 2100Z

00715 10914 21015 31013 41010 51010 61104 72805 82806 92810 99991 02820
22706 43305 63410 83315 99992 03030 52728 99993 02525 52526 99994 02536
52532 99995 02818 5 calm 99996 00906 52703 99997 0 calm 50920 99998 00928
50942 99999 00946 50946 70954

ENCL 2

CONFIDENTIAL

[illegible] FEB 54 CONFIDENTIAL

OPERATIONAL PRIORITY

GR

CJTF SEVEN

CJTF SEVEN (ADMIN)

ED RD

WEATHER OUTLOOK FOR SHOT DAY FOLLOWS CLN CLOUDS AND WEATHER CLN SCATTERED
CUMULUS CMA SCATTERED CIRRUS CMA WIDELY SCATTERED SHWRS PD WINDS CLN SUR-
FACE CMA EASTERLY ONE FIVE TO TWO ZERO KTS SMCLN ONE ZERO ZERO ZERO CMA
EASTERLY ONE ZERO TO ONE FIVE KTS SMCLN TWO ZERO ZERO ZERO ZERO CMA EAST-
ERLY ONE FIVE TO TWO ZERO KTS SMCLN THREE ZERO ZERO ZERO ZERO CMA SOUTH-
EASTERLY ONE FIVE TO TWO FIVE KTS SMCLN FOUR ZERO ZERO ZERO ZERO CMA
SOUTHERLY ONE FIVE TO TWO FIVE KTS SMCLN FIVE ZERO ZERO ZERO ZERO CMA
SOUTHEASTERLY ONE ZERO TO TWO ZERO KTS CMA SIX ZERO ZERO ZERO ZERO CMA
SOUTHEASTERLY FIVE TO ONE FIVE KTS PD RADSAFE OUTLOOK VERY FAVORABLE

LTCOL C. D. [illegible], USAF

CONFIDENTIAL

INCL 3

76

~~CONFIDENTIAL~~

270544Z FEB 54 CONFIDENTIAL
OPERATIONAL OPERATIONAL
IMMEDIATE IMMEDIATE
CM

FROM: CJTF SEVEN

TO: CJTF SEVEN ENIWETOK ATOLL MA MO
(ADMIN)

INFO: CTG 7.3

WEATHER OUTLOOK AS OF TWO SEVEN ZERO FIVE ZERO ZERO ZEBRA FOR BRAVO DAY FOREGOING CLR CLOUDS AND WEATHER CLR SCATTERED CUMULUS CLR SCATTERED CIRRUS CLR VERY WIDELY SCATTERED SHOWERS PD WINDS CLR SURFACE TO FIFTEEN THOUSAND FEET CLR EASTERLY ONE FIVE TO TWO ZERO KTS SMOLN FIFTEEN THOUSAND TO THIRTY FIVE THOUSAND FEET CLR EASTERLY ONE ZERO TO ONE FIVE KTS SMOLN TWENTY FIVE TO THIRTY THOUSAND FEET CLR SOUTHERLY FIVE TO ONE ZERO KTS SMOLN THIRTY THOUSAND TO FIFTY THOUSAND FEET CLR SOUTHWESTERLY TWO ZERO KTS SMOLN SIXTY THOUSAND FEET NORTHEASTERLY ONE ZERO TO ONE FIVE KTS PD RADSAFE OUTLOOK FOR ENIWETOK AND UJELANG VERY FAVORABLE SMOLN OUTLOOK FOR KWAJ FAVORABLE RD REQUEST YOU TAKE ACTION ON CONFIRMATION OF EXECUTE OTHER PARTS INCL THREE NIGHT CHECK LIST PARTS PD OGLE AND GRAVES AND EVANS RECOMMEND CONFIRMATION PD BRUTON INTERPOSES NO OBJECTION

LTCOL C. D. BOSCOT, USAF

~~CONFIDENTIAL~~

HML 4

77

28 February 1954

MEMORANDUM FOR RECORD

SUBJECT: B-1,1100Z Command Briefing

1. Persons present at the B-1, 1100Z Command Briefing were:

Major General Clarkson
Dr. Graves
Brigadier General McGinley
Rear Admiral Bruton
Mr. Reeves
Mr. Gibbons
Colonel Cowart
Lt. Colonel Harbour
Lt. Commander Madden

The briefing was conducted by:

Lt. Colonel Bonnot
Captain Maynard, USN
Lt. Colonel House

2. The 270000Z February Weather Distribution Chart, with the 270300Z February streamline - superimposed thereon was used for the present situation briefing. The undersigned mentioned the frontal system funnel just below Wake, the deep trough associated with it which was reflected through all levels to 60,000 feet; the present high aloft to the east of Bikini which was also remaining rather stationary. The undersigned further mentioned the easterly flow from the surface to 10,000 feet; the south easterly becoming southerly and south westerly below aloft associated with this deep high east of Bikini. Next presented at the briefing was the forecast for shot time: 3/8 cumulus bases 2,000 feet, top 5,000 feet: 3/8 cirrus 39,000 feet with widely scattered showers. The winds were given as per the attached forecast (Incl 1). Mentioned tropopause as. 55,000 feet also attached is the area forecast valid 280300Z February to 010300Z March (Incl 2). The undersigned described the air particle trajectory forecast stating that all of the trajectories were to the NE except the 10,000 feet one and the 60,000 ones which were westerly.

3. Colonel House at this point continued with the Radsafe portion of the briefing.

C. D. Bonnot
C. D. BONNOT
Lt Colonel, USAF
Staff Weather Officer

2 Incls
a. Wind forecast
b. Area forecast

SECRET

INCL 5

[redacted] - [redacted]

FORECAST CHARLIE 3/8 CU 2000 [redacted] TO 30,000 feet widely scattered showers.

[redacted]

SFC	[redacted]	30,000 I & T	
5000	[redacted]		
10,000	[redacted]	60,000	050/10
15,000	160/15		
20,000	230/13	70,000	070/14
25,000	240/15		
30,000	250/14	80,000	090/12
35,000	260/22	90,000	100/18
40,000	250/24		
45,000	240/20		
50,000	230/14		

271310Z FEB 54 UNCLASSIFIED
OPERATIONAL
PRIORITY
OM

FROM: TG 7.4 (AFLOAT)

TO: HEA CENT ENIWETOK NO NO

WCEP ESTES 031 FOR DISSEMINATION X AREA FORECAST 280300 TO 010300Z FEB 54 X GENERAL SITUATION X EDT TRADES PERSIST LOWER LEVELS X HIGHER LEVELS DOMINATED BY STRONG CLOCKWISE CIRCULATION EAST OF MAJURO X ENIWETOK TERMINAL X 20 SCTD 380 BKN VSBY 10 MI TEMPO 20 BKN VSBY 6 MI SFC WIND 0918 WITH GUSTS TO 30 KTS IN LGT SCTD SHWRS X BIKINI TERMINAL 20 SCTD 380 BKN VSBY 10 MI SFC WIND 0920 TEMPO 20 BKN VSBY 3 MI SFC WIND 0920 WITH GUSTS TO 30 KTS IN LGT SCTD SHWRS X ENIWETOK WINDS AND TEMPS 00918 20922 40924 60926 81020 01116 F15C 151414 F6C 202410 12C 202320 120C 402230 102C 502424 600414 700612 800714 900814 X FURTHER OUTLOOK FOR ENIWETOK AND BIKINI (PLANNING ONLY) X SLIGHT INCREASE IN SHOWER ACTIVITY X SOME DECREASE IN CIRRUS X ENIWETOK CLOUDS 3/8 CU BASES 20 TOPS 40 WITH SCTD ISOLATED TOPS TO 60 X 5/8 CI NEAR 380 X TEMPO 5/8 CU BASES 3 TOPS 60 WITH SCTD ISOLATED TOPS TO 70 X 2/8 AC BASES 120 TOPS 140 X 6/8 CI NEAR 380 X BIKINI CLOUDS SAME AS ENIWETOK X SIGNIFICANT CLOUD AREAS X PATCH SC EXISTS OVER EASTERN MARSHALLS X CIRRUS COVERS ENTIRE MARSHALL AND GILBERT ISLAND AREA X FREEZING LEVEL 175 X TROPOPAUSE HEIGHT 550 TEMP 124C HEIGHT OF CONTRAIL FORMATION 370 X SEA AND SWELL 8 FT FROM ENE AT ENIWETOK AND BIKINI X KWAJALEIN TERMINAL X 15 BKN VSBY 10 MI TEMPO 10 BKN VSBY 5 MI SFC WIND 0815 WITH GUSTS TO 25 KTS in LCD SHOWERS

HERSCHEL H SLATER, LTCOL, USAF

ENCL 5b

SECRET

28 February 1954

MEMORANDUM FOR RECORD

SUBJECT: D minus 1, 1800 Hour Weather Briefing

1. The following personnel were present for this briefing: Major General Clarkson, Brig. General McGinley, Dr. Graves, Dr. Ogle, Mr. Reeves, Dr. Duane Sewell, Colonel Cowart, Captain Maynard and Lt. Colonel House.

2. This was a very short briefing wherein mainly the light winds at 10,000 feet were mentioned as the only significant change to the 1100 hour briefing given this morning. It was pointed out that there was a tendency for southerly winds, which were very light, at 10,000 feet. Lt. Colonel House continued with the radsafe briefing.

C. D. BONNOT
Lt. Colonel, USAF
Staff Weather Officer

SECRET

ENCL 6

21

SECRET

1 March 1954

MEMORANDUM FOR RECORD

SUBJECT: 2400Z Weather Briefing Prior to BRAVO Shot (B-0645 hours)

1. The following personnel were present for this briefing: Major General Clarkson, Dr. Graves, Brig. General McGinley, Brig. General Estes, Dr. Ogle, Dr. Duane Sewell, Mr. Reeves, Capt. Knickerbocker, Col. Cowart, Capt. Maynard and Lt. Col. House.

2. The weather briefing was opened with a general statement on the synoptic situation over the Pacific area. It was mentioned that there was no significant change from the briefing this morning, and that the weather in general was holding up for shot time.

3. The attached forecast was presented (Incl a) which stated that at shot time there would be 2/8 of cumulus, bases 2,000 feet, tops 5,000 feet; 2/8 of stratocumulus, bases 6,000 feet, tops 7,000 feet; 4/8 thin cirrus at 35,000 feet; widely scattered light showers in the area, but none over shot site at shot time; and contrail formation level at 36,000 feet. The tropopause height was 55,000 feet; temperature -78°C. Mention was made of the 40 knot winds at 40,000 feet, and that the cirrus was caused by the flow around the high, located at 30 to 40 thousand feet over this area.

4. That there might be some locally induced weather caused by the detonation itself was mentioned, as well as the light and variable winds at 10,000 feet; that these winds would likely have a westerly component; and that the level from 7,000 feet through 14,000 feet was also very light and variable, the tendency being for a westerly component at all these levels.

5. The terminal forecast for Kwajalein and Wake was given next, stating that Wake had been quite poor, with low ceilings and frequent showers but would improve for shot time and would have broken cumulus and cirrus with scattered showers in the area. For Kwajalein it was stated that there would be continuous showers activity, and that they had been having broken to occasional overcast lower clouds with occasional showers. These showers reduced visibility to three miles. The latest winds aloft used in this briefing were the 2100Z winds from the USS CURTISS (Incl b). These winds, along with the discussion of the air particle trajectories completed the items discussed in the weather briefing.

6. Lt. Col. House followed this with the radsafe briefing. It was decided to have an additional look at the latest winds at 0400Z.

C. D. BIRNET
Lt. Colonel, USAF
Staff Weather Officer

2 Incls
a. Area forecast
b. Wind forecast

SECRET

ENCL 7

FROM: TG 7.4 (AFLOAT) UNCLASSIFIED

TO: WEA CENT KADENA

FORECAST FOR 0645Z, 1 MARCH 54. PREPARED 2200Z, 28 FEB 54.

ICAO ESTES 040 FCST EAST X 2/8 CU 2000 TOPS 5000 FT 2/8 SC BASE 6000 TOPS 7000 FT 4/8 THIN CIRRUS BASE NEAR 38000 WIDELY SCATTERED LIGHT SHOWERS X CONTRAIL LEVEL 36000 X TROPOPAUSE HEIGHT 55THSD 478C X WINDS 00720 50716 10L&V 152518 202712 252320 302326 402338 452440 502638 550510 60 L&V 700809 800825 900720

H. H. SLATER, LTCOL, USAF

INCL 7a

BIKINI OBSERVED WINDS ALOFT TAKEN ABOARD THE USS CURTISS

28 February 1954 - 2100M

00714 10722 20722 30814 40614 50608 60905 71302 82806 93011 99991 03311
20107 43117 62516 82714 99992 02716 52627 99993 01830 52430 99994 02537
52244

EOL 7b

1 March 1954

MEMORANDUM FOR RECORD

SUBJECT: Weather Briefing at 0400Z, H-170 Day

1. The following personnel were present for this briefing: General Weyland, Major General Clarkson, Dr. Graves, Brig. General McKinley, Brig. General Estes, Dr. Ogle, Dr. Duane Sewell, Mr. Reeves, Colonel Covert, Captain Maynard and Lt. Colonel House.

2. The CURTISS winds aloft for midnight and 0300M were discussed in view of the relationship to the shot site, the levels 7,000 feet through 11,000 feet being scrutinized the most (Incl a). The area forecast for shot day is also inclosed (Incl b).

3. Lt. Colonel House further discussed the radsafe situation after which it was decided to go ahead with the shot as scheduled.

C. D. BONNET
Lt. Colonel, USAF
Staff Weather Officer

2 Incls
a. CURTISS winds aloft for 0000M and 0300M 1 March 54.
b. Area Forecast for Shot Day

INCL 8

BIKINI OBSERVED WINDS [illegible] ABOARD THE USS [illegible]

1 March 1954 - 0000Z

00518 10726 20820 30819 40815 50903 60905 73503 83311 93215 99991 03215
22217 42809 62915 82916 99992 02822 52827 90993 02121 52324 99994 02343
52441 50 Missing 55 Missing 99996 02736

1 March 1954 - 0300Z

00921 10818 20719 30718 40815 50810 60707 70504 80205 93410 99991 03312
22514 42715 62415 82917 99992 02728 52224 99993 02231 52238 99994 02238
52538 99995 02631 53211 90221

DNL 8a

FROM: TG 7.4 (AFLOAT) 280440Z FEB 54 UNCLASSIFIED

TO: MEA CENT ENIWETOK

WCRP ESTES 041 FOR DISSEMINATION X AREA FORECAST VALID 010300Z TO 020300Z MAR 54 X GENERAL SITUATION X SHALLOW LAYER OF EASTERLIES EXTENDS TO 5000 FT OVER AREA X WESTERLY WINDS ALOFT PREVAIL X ENIWETOK TERMINAL X 20 BKN 380 SCTD VSBY 10 MI SFC WIND 0720 TEMPO 15 BKN VSBY 5 MI IN LGT WIDELY SCTD SHWRS X BIKINI TERMINAL X 20 SCTD 380 SCTD VSBY 10 MI X SFC WIND 0720 TEMPO 15 BKN VSBY 5 MI in LGT WIDELY SCTD SHWRS X ENIWETOK WINDS AND TEMPS X 00720 20723 40816 63012 83012 03212 F11C 152410 F9C,202314 M5C 302325 M26C 402335 M48C 502638 600413 700512 800725 900718 BIKINI WINDS AND TEMPS X 00720 20822 40818 63210 83210 03312 F11C 152518 F9C 202612 M5C 302325 M25C 402342 M48C 502735 60L&V 700809 800825 900718 X FURTHER OUTLOOK FOR ENIWETOK AND BIKINI (PLANNING ONLY) SLIGHT INCREASE IN LOW CLOUDINESS AND SHOWER ACTIVITY X ENIWETOK CLOUDS 2/8 CU BASES 20 TOPS 40 WITH SCTD ISOLATED TOPS TO 60 2/8 SC BASES 50 TOPS 60 4/8 CI NEAR 380 X BIKINI CLOUDS X 2/8 CU BASES 20 TOPS 40 WITH SCTD ISOLATED TOPS TO 60 2/8 SC BASES 50 TOPS 60 4/8 CINEAR 380 X SIGNIFICANT CLOUD AREAS X BROKEN CIRRUS SOUTH AND EAST EXTENSIVE SHEET OF MIDDLE AND LOW CLOUDS EXTENDING EASTWEST THROUGH NAKE X FREEZING LEVEL 170 X TROPOPAUSE HEIGHT 550 TEMP M78C HEIGHT OF CONTRAIL FORMATION 360 X SEA AND SWELL 6 FT FROM ENE AT ENIWETOK AND BIKINI X KWAJALEIN TERMINAL 18 BKN VSBY 10 MI SFC WIND 0520 TEMPO 12 BKN VSBY 5 MI SFC WIND 0522 WITH GUSTS TO 30 KTS IN LGT SCTD SHWRS X

H. H. SLATER, LTCOL, USAF

DISL 8b

LEGEND


5-8/8 HIGH CLOUDS


1-4/8 HIGH CLOUDS


5-8/8 MIDDLE CLOUDS


1-4/8 MIDDLE CLOUDS


7-8/8 STRATOCUMULUS


4-6/8 STRATOCUMULUS


1-3/8 STRATOCUMULUS


CUMULONIMBUS

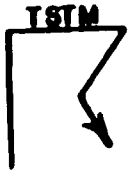

7-8/8 CUMULUS


4-6/8 CUMULUS


1-3/8 CUMULUS

SHOWERS

RAIN



THUNDERSTORM

INCLOSURE NO 9

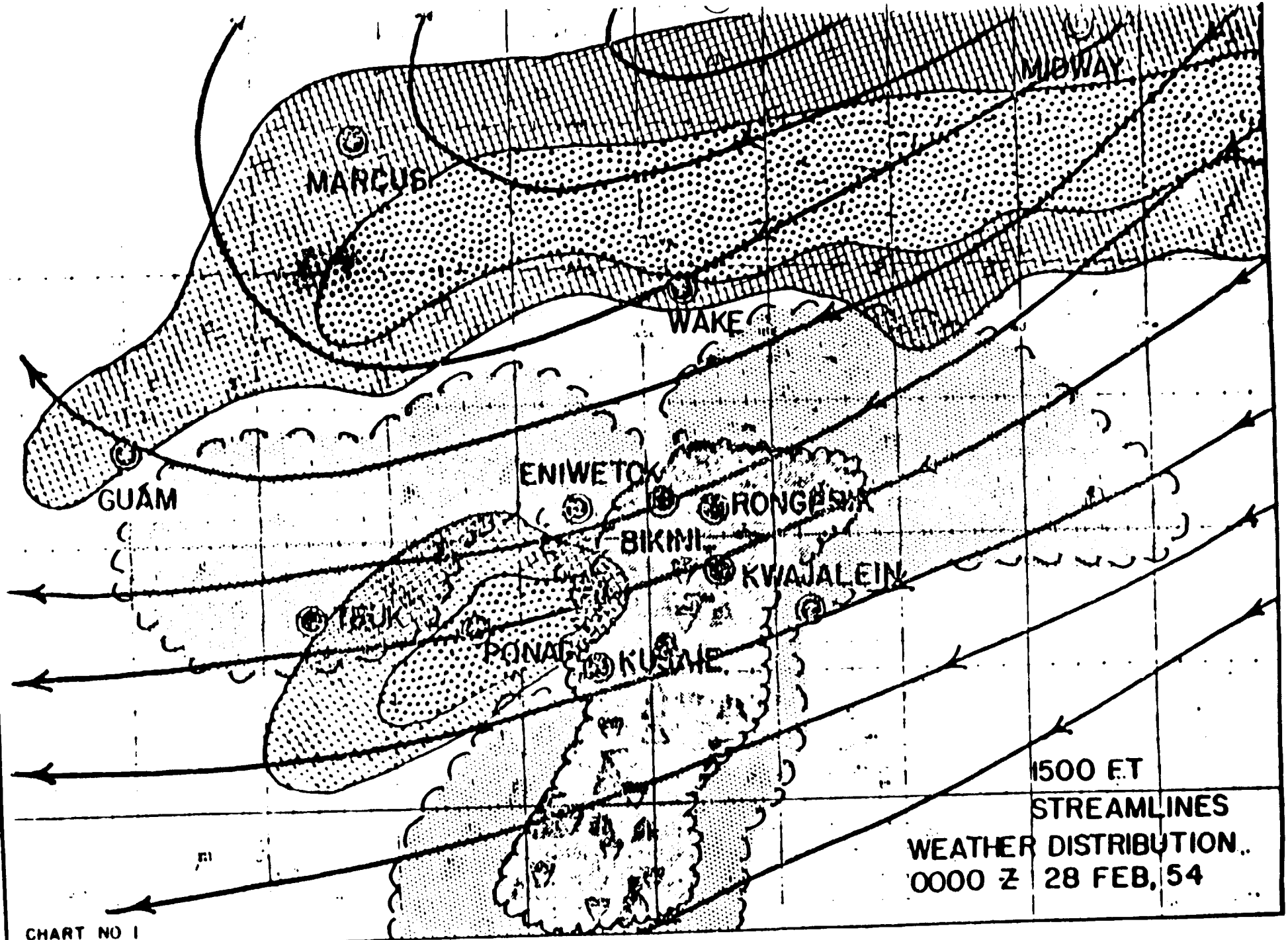
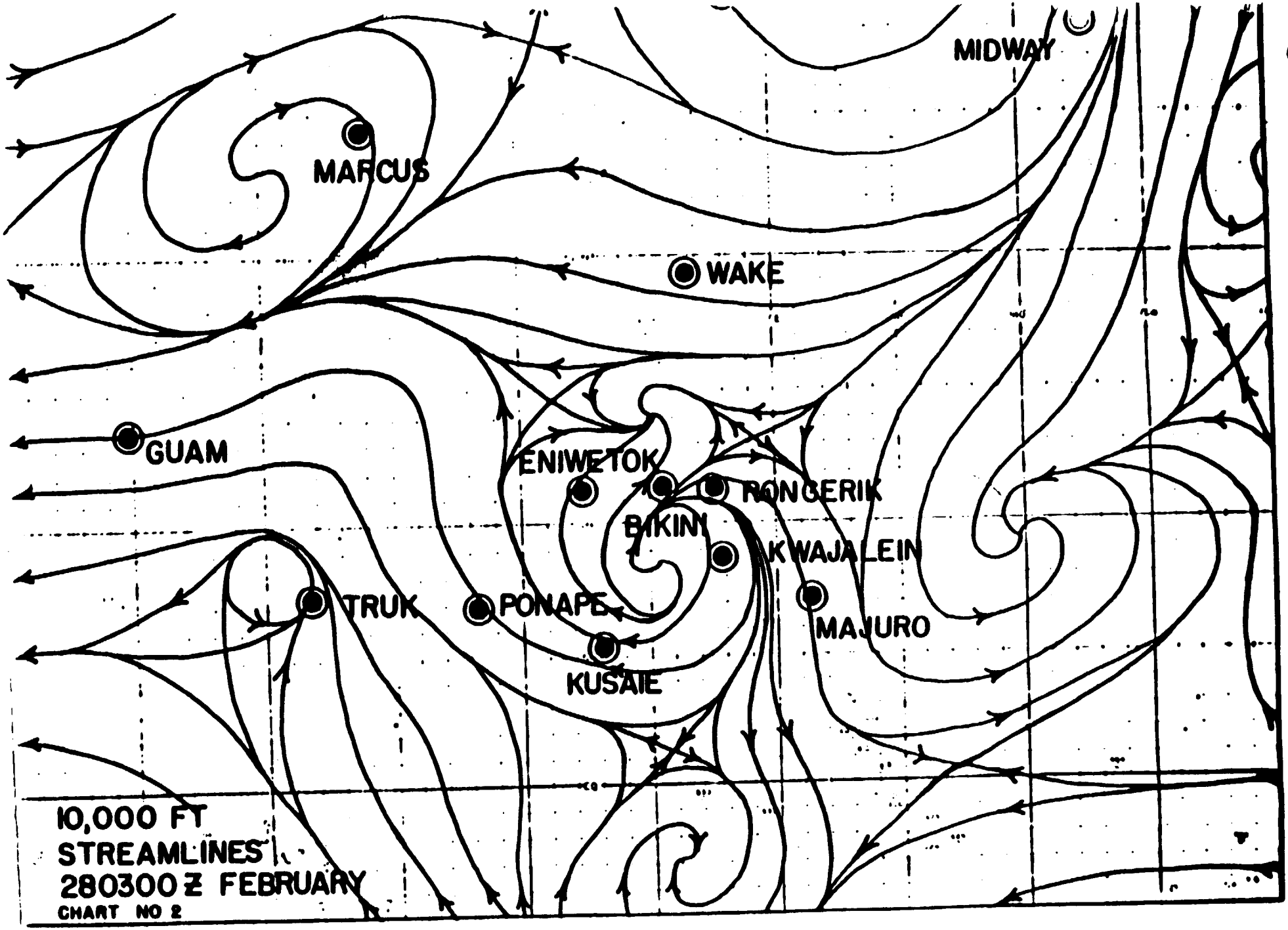
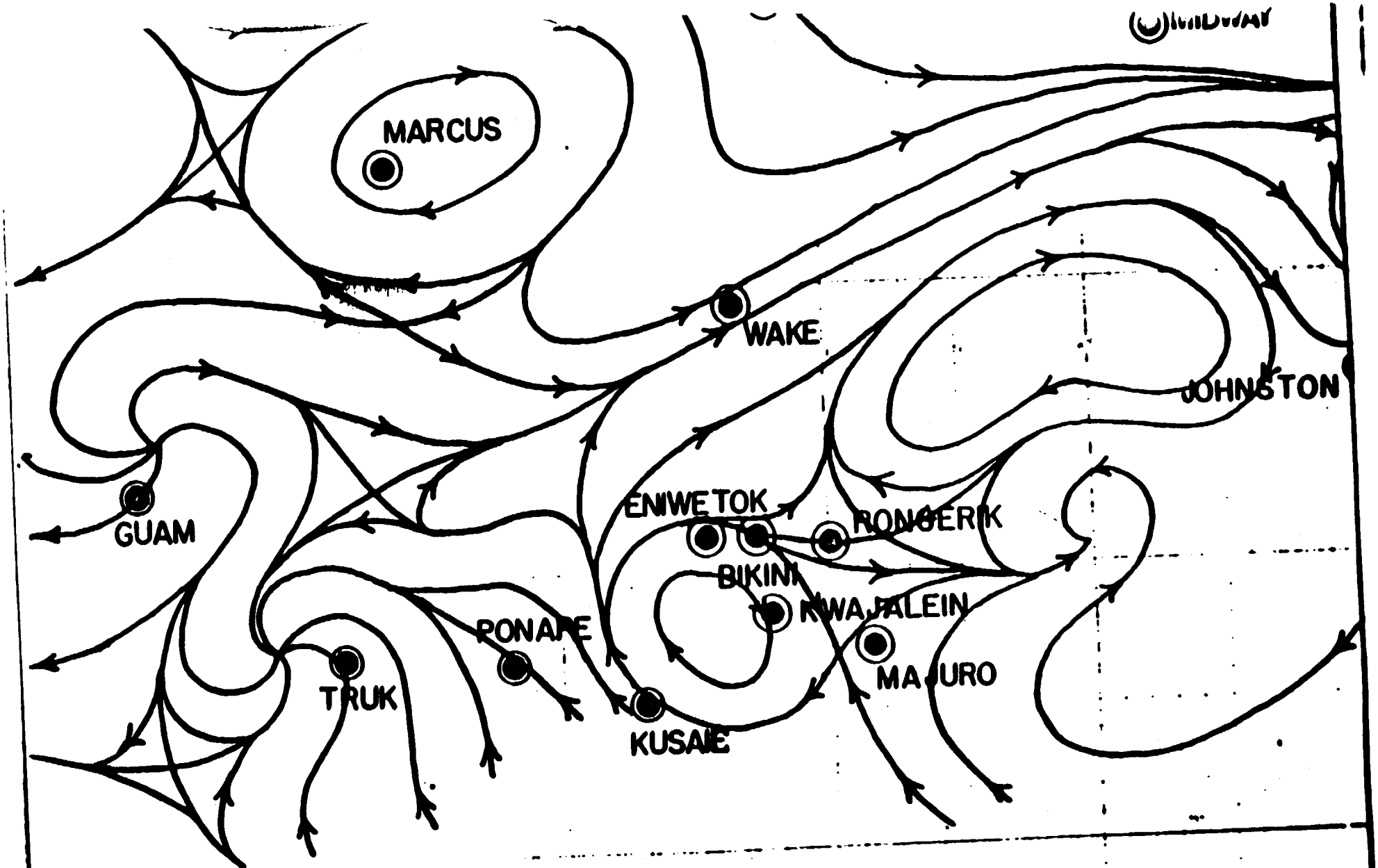

MIDWAY
MARCUS
WAKE
GUAM
ENIWETOK
RONGERIK
BIKINI
KWAJALEIN
TRUK
PONAPE
KUSAIE
1500 FT
STREAMLINES
WEATHER DISTRIBUTION..
0000 Z 28 FEB, 54

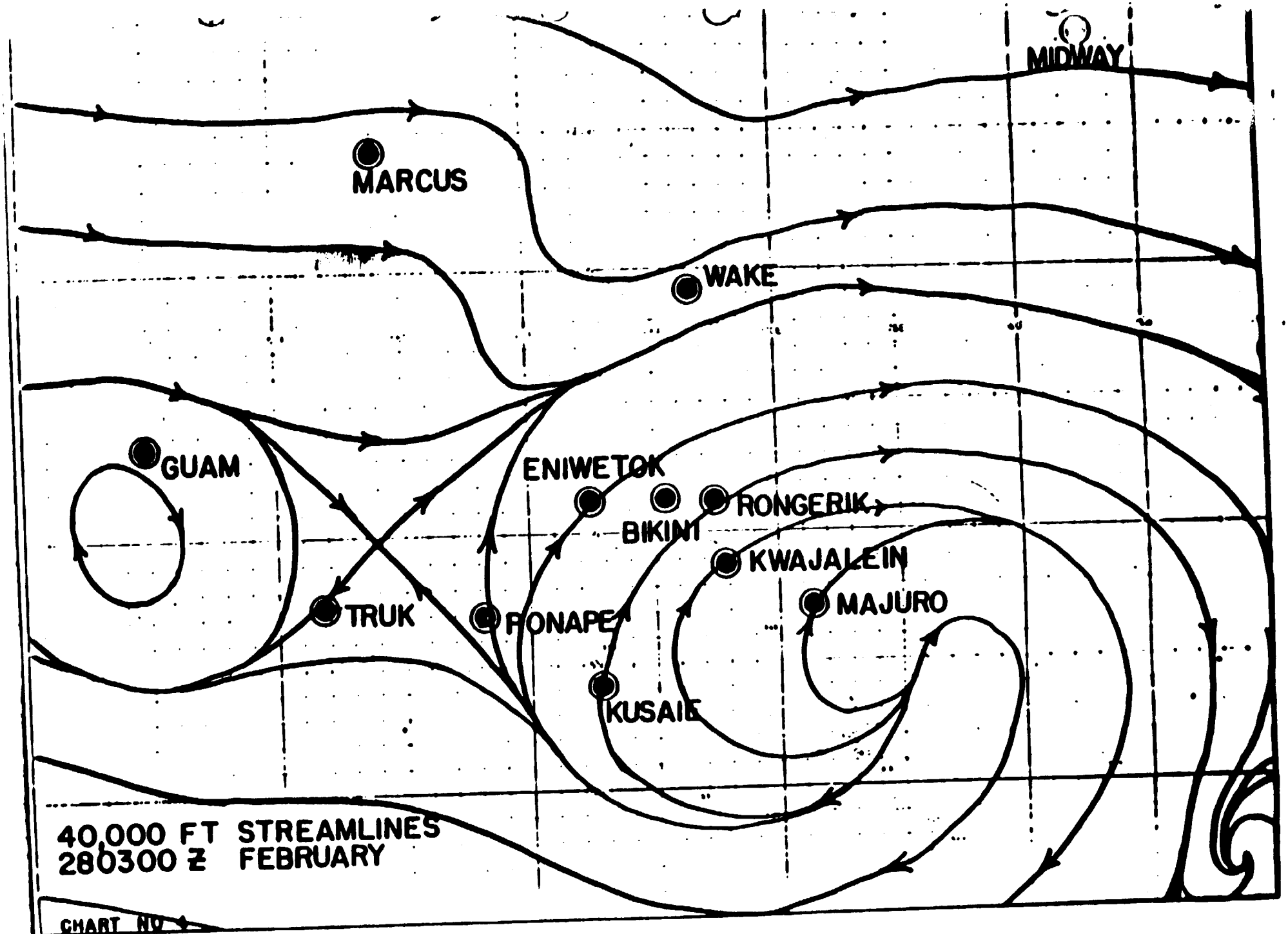
CHART NO 1

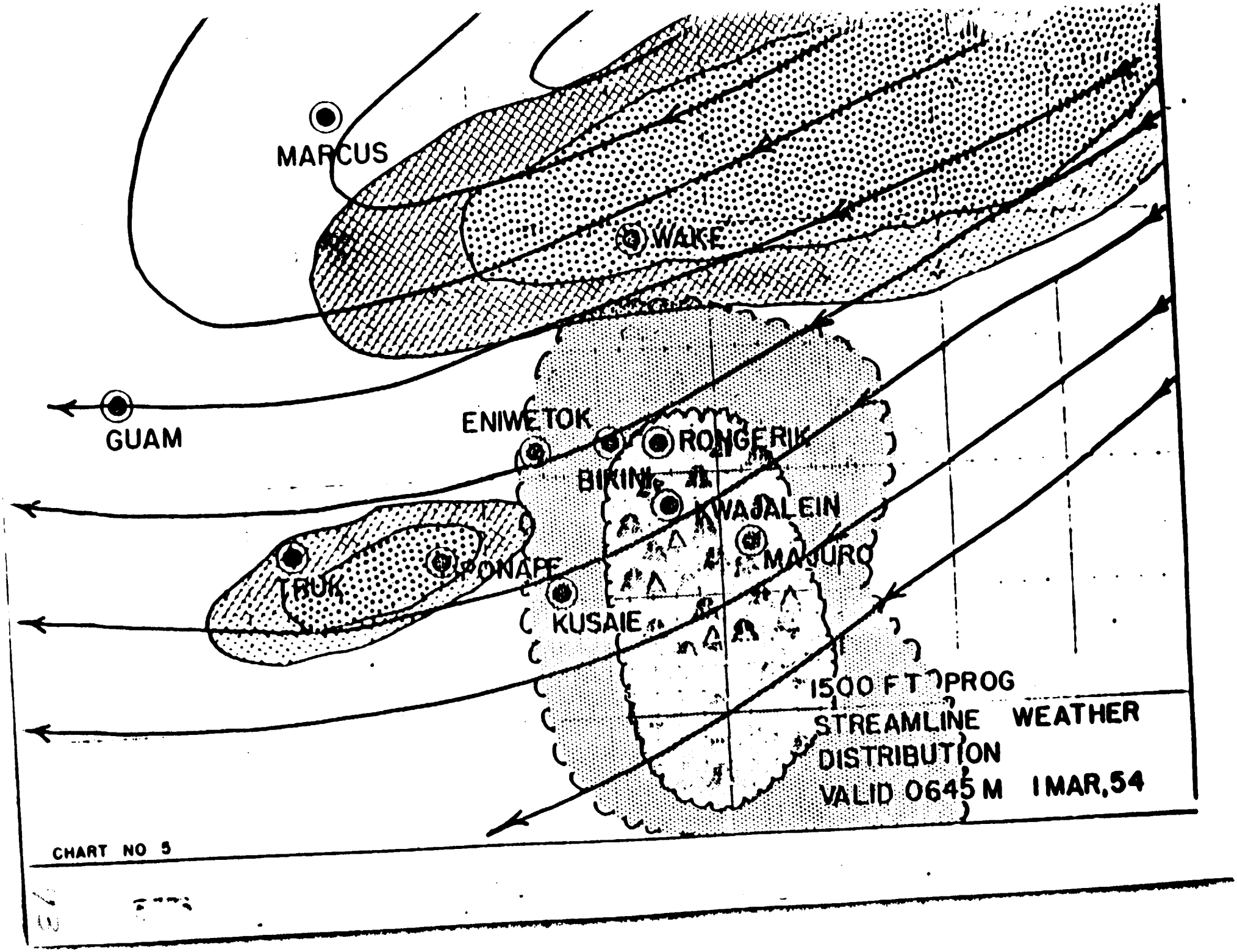

MIDWAY
MARCUS
WAKE
GUAM
ENIWETOK
RONGERIK
BIKINI
KWAJALEIN
TRUK
PONAPE
MAJURO
KUSAIE
10,000 FT
STREAMLINES
280300Z FEBRUARY
CHART NO 2



20,000 FT STREAMLINES
280300Z FEBRUARY

CHART NO 3


MIDWAY
MARCUS
WAKE
GUAM
ENIWETOK
BIKINI
RONGERIK
KWAJALEIN
MAJURO
TRUK
PONAPE
KUSAIE
40,000 FT STREAMLINES
280300 Z FEBRUARY
CHART NO


MARCUS
WAKE
GUAM
ENIWETOK
RONGERIK
BIKINI
KWAJALEIN
MAJURO
PONAPE
TRUK
KUSAIE
1500 FT PROG
STREAMLINE WEATHER
DISTRIBUTION
VALID 0645 M 1MAR,54
CHART NO 5

AIR PARTICLE TRAJECTORIES
H TO H + 72 HRS B DAY
PREPARED H − 9 HOURS

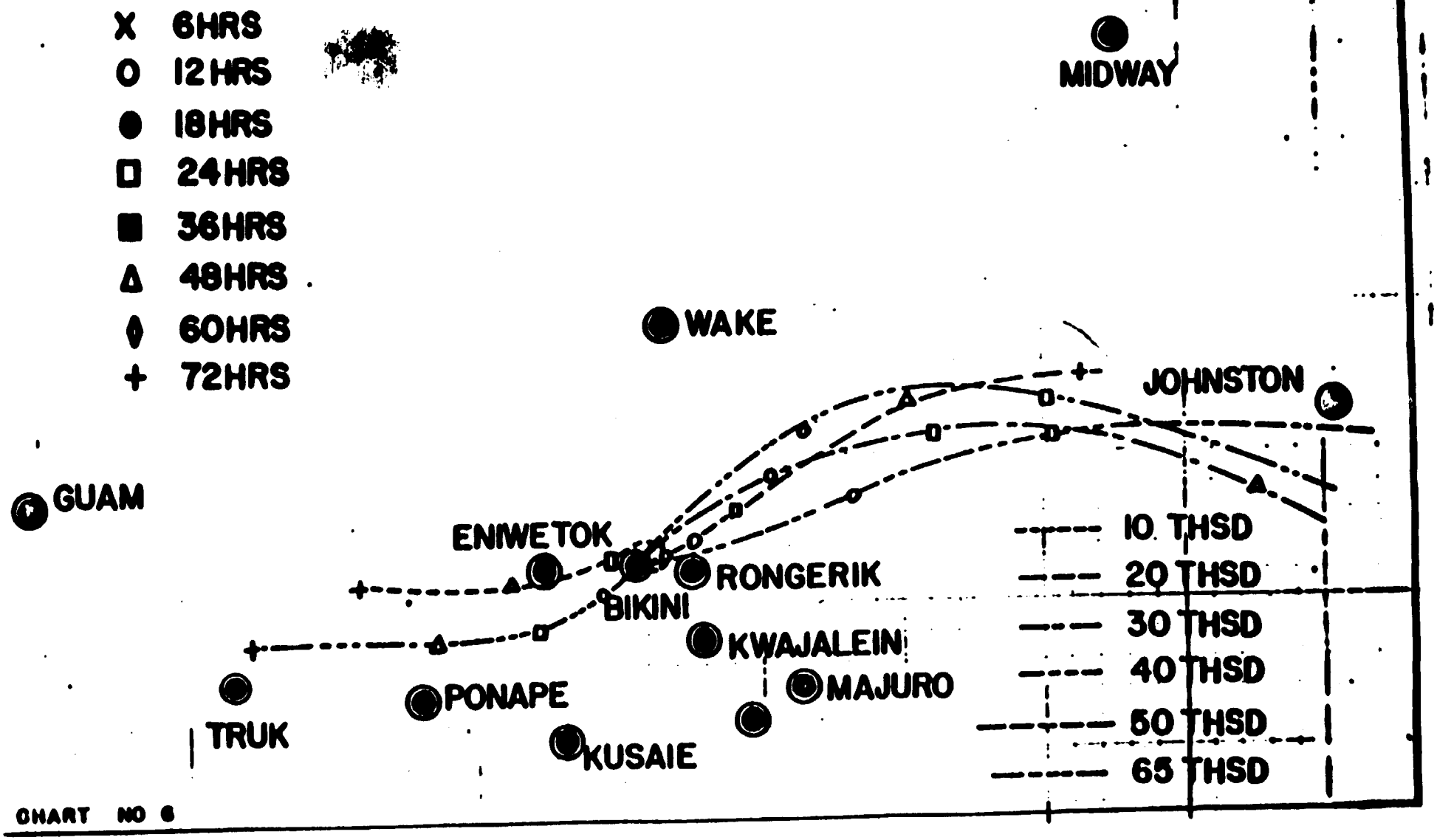
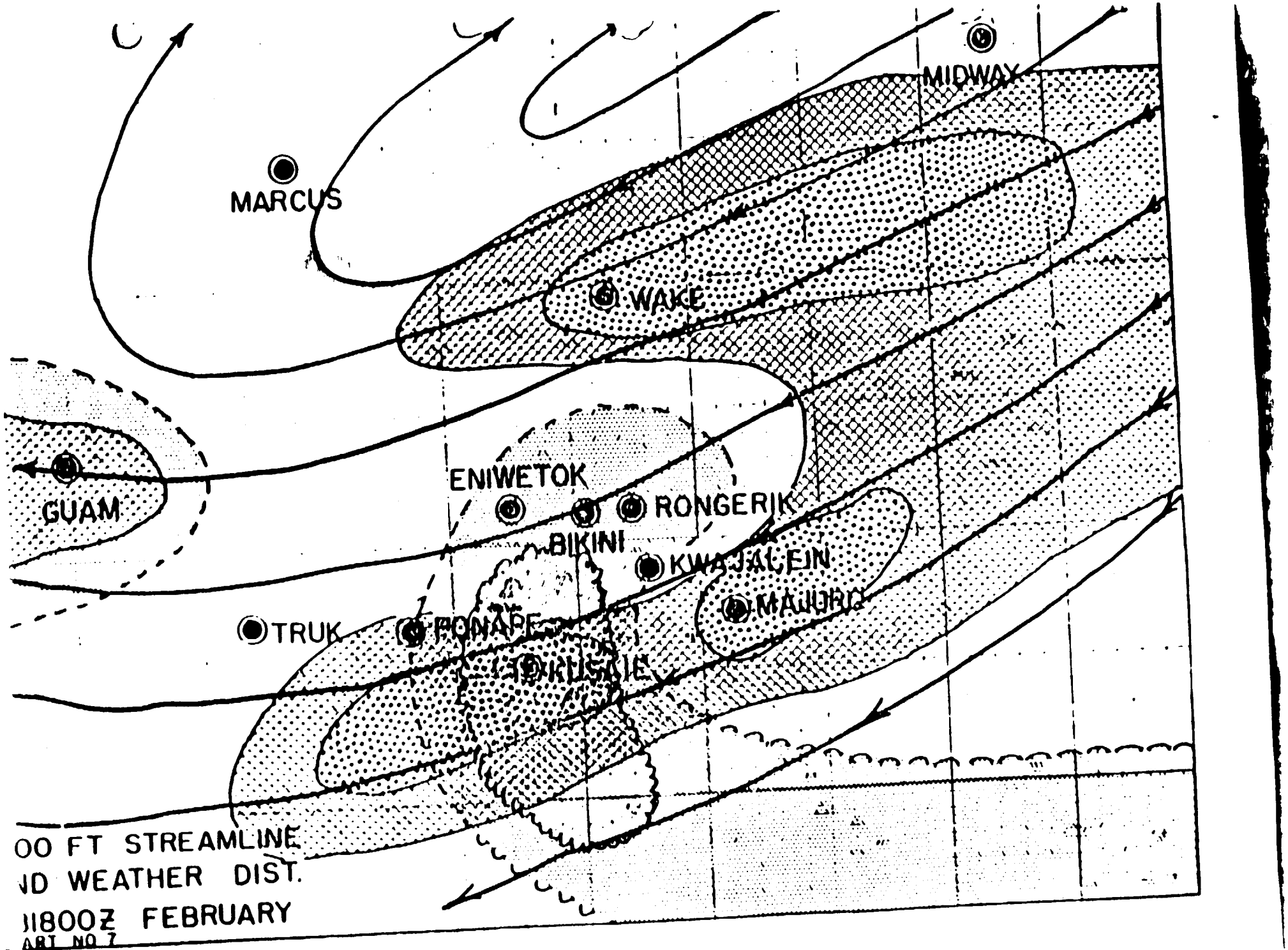
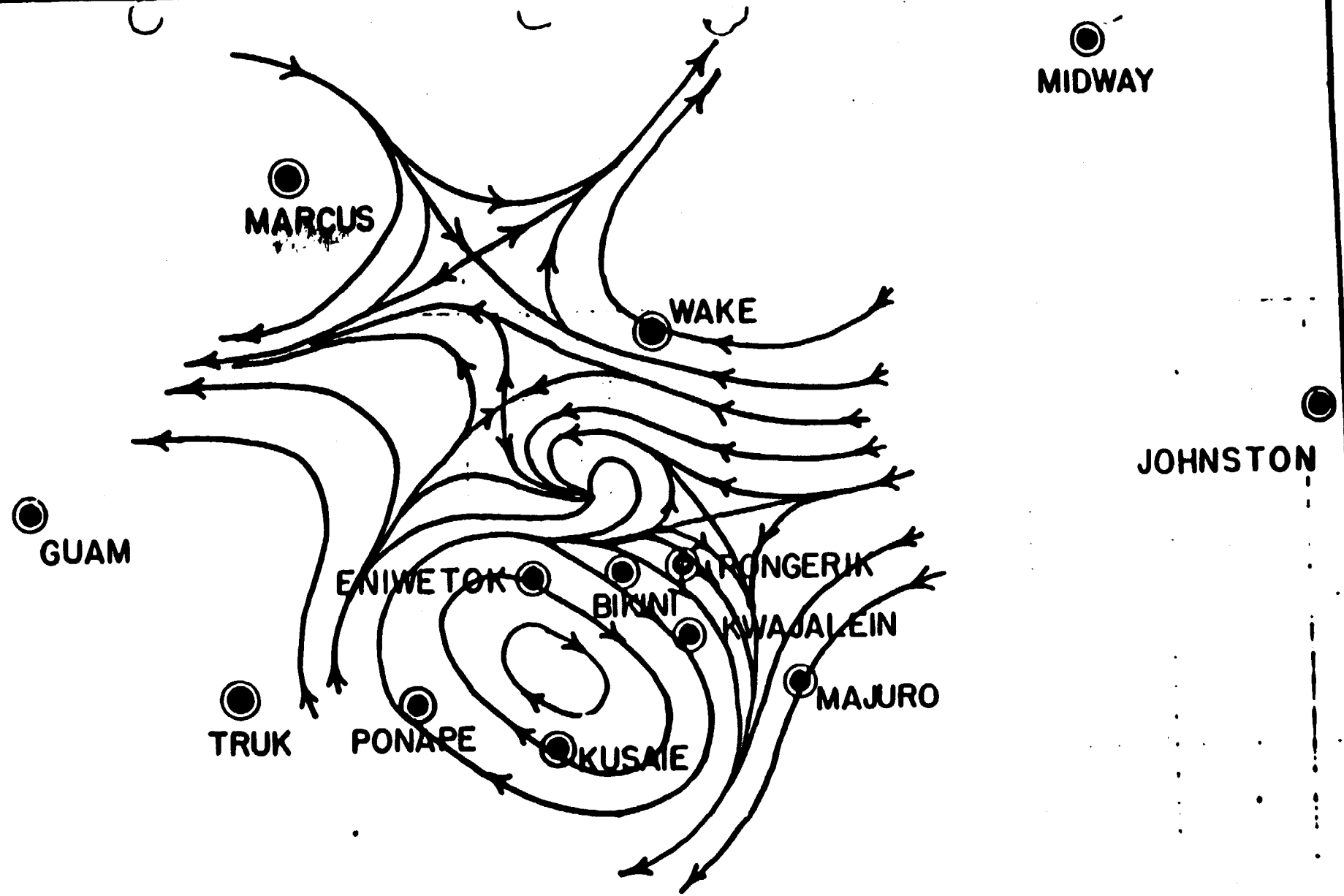


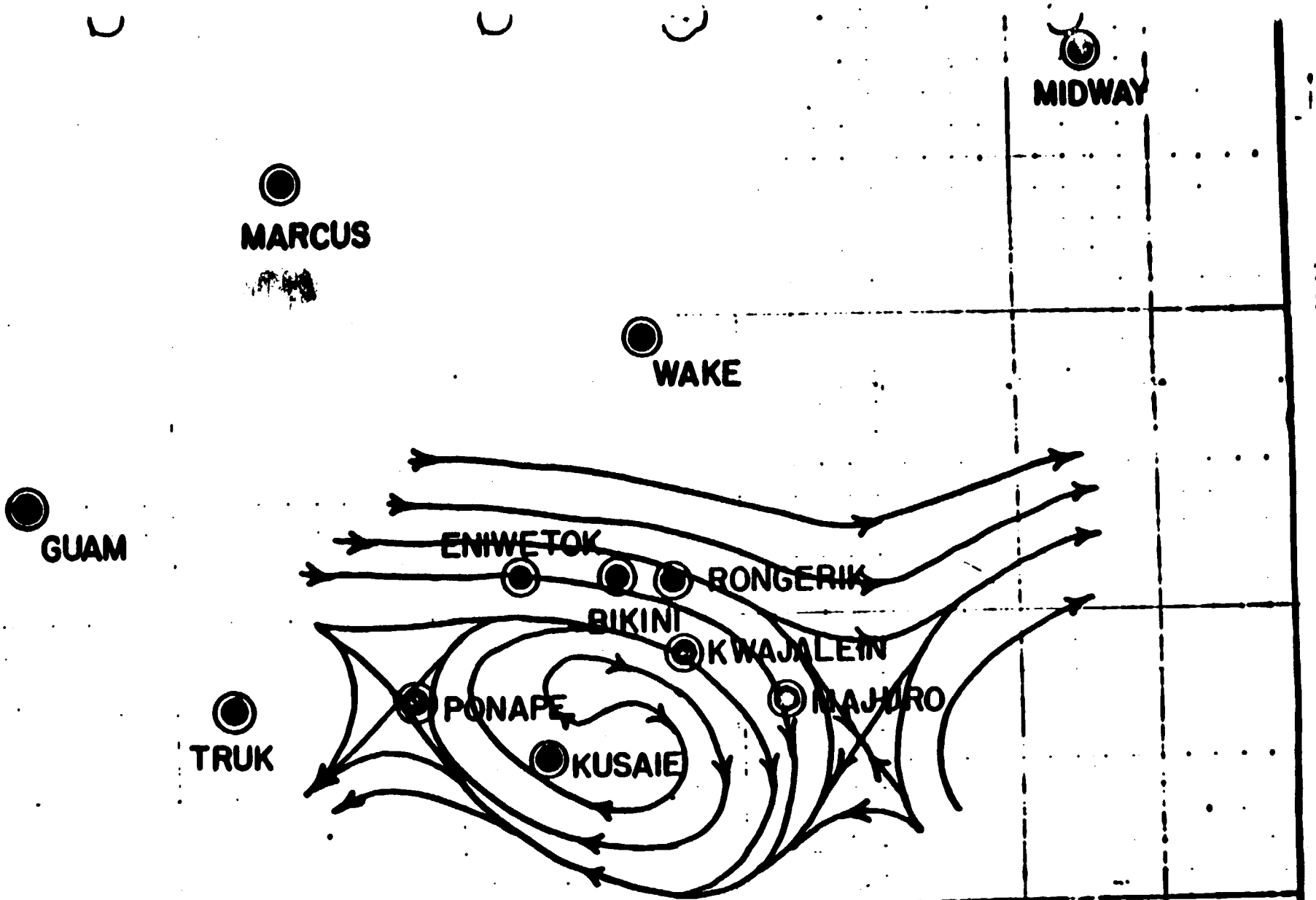
CHART NO 6


MIDWAY
MARCUS
WAKE
ENIWETOK
RONGERIK
GUAM
BIKINI
KWAJALEIN
MAJURO
TRUK
PONAPE
KUSAIE
00 FT STREAMLINE
ND WEATHER DIST.
1800Z FEBRUARY
ART NO 7



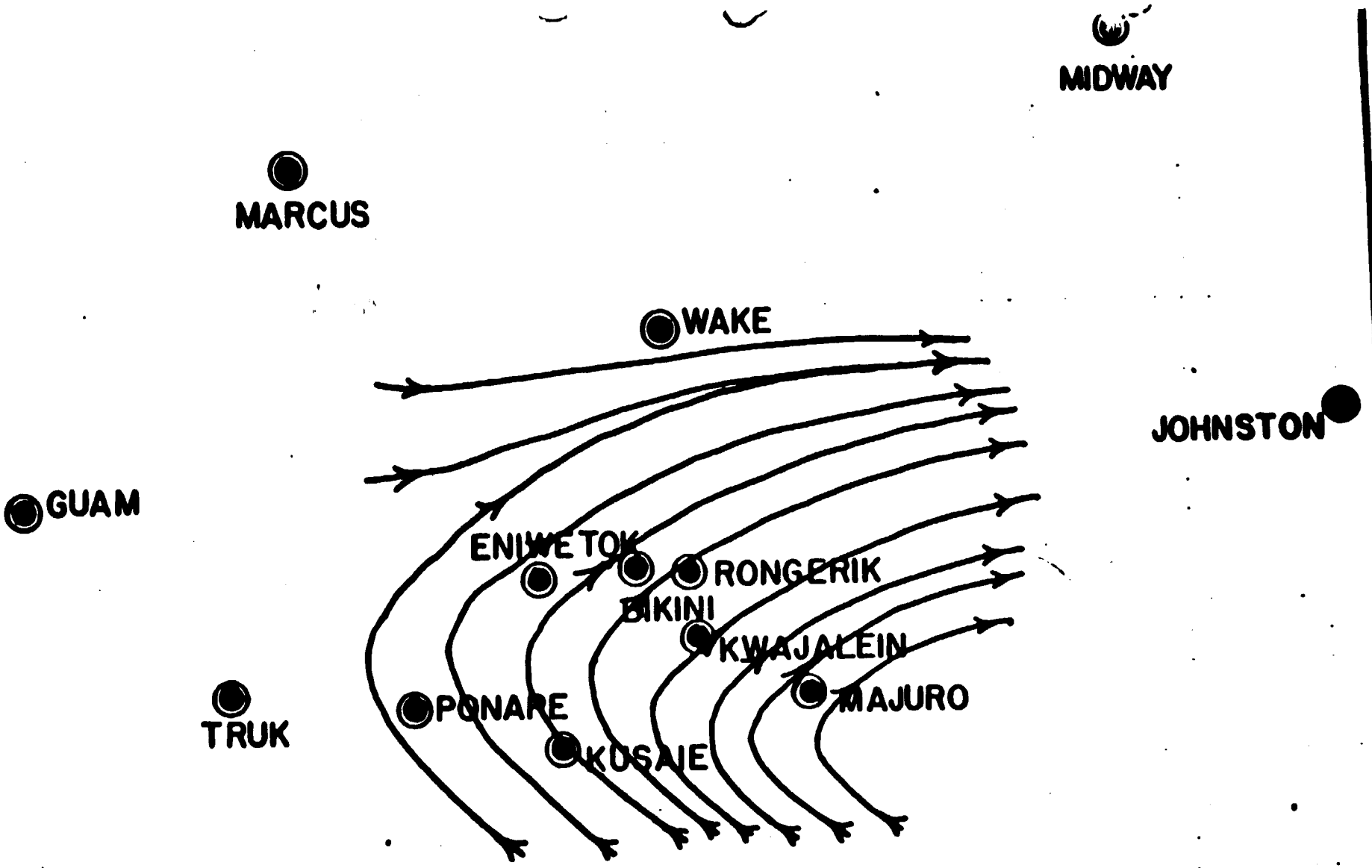
10,000 FT STREAMLINES
281800 Z FEBRUARY

CHART NO 8



20,000 FT STREAMLINES
281800 Z FEBURARY

CHART NO 9



40,000 FT STREAMLINES
281800Z FEBRUARY

CHART NO 10

REVISED TRAJECTORIES
H TO H + 72 HOURS B DAY
PREPARED H + 0900

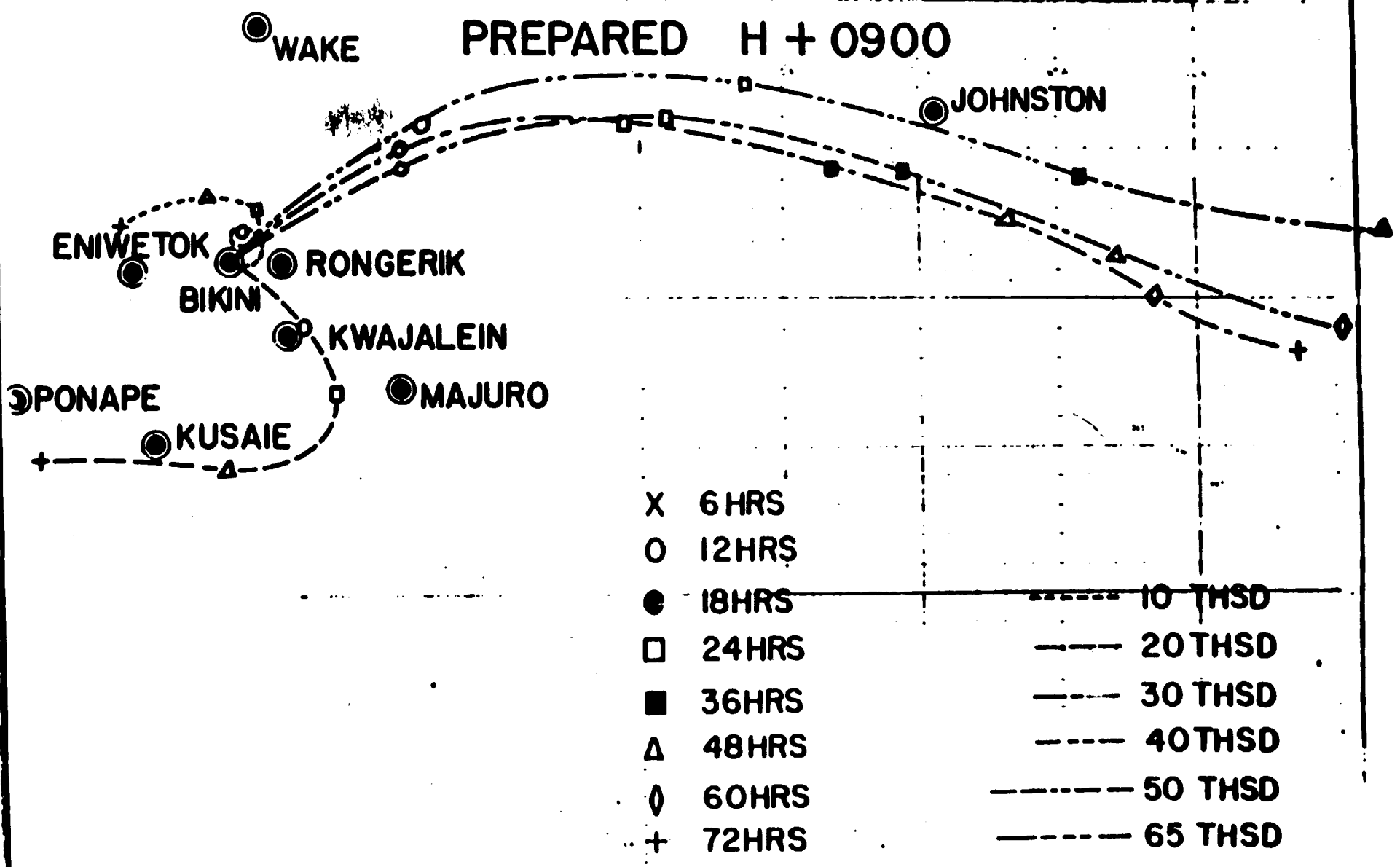
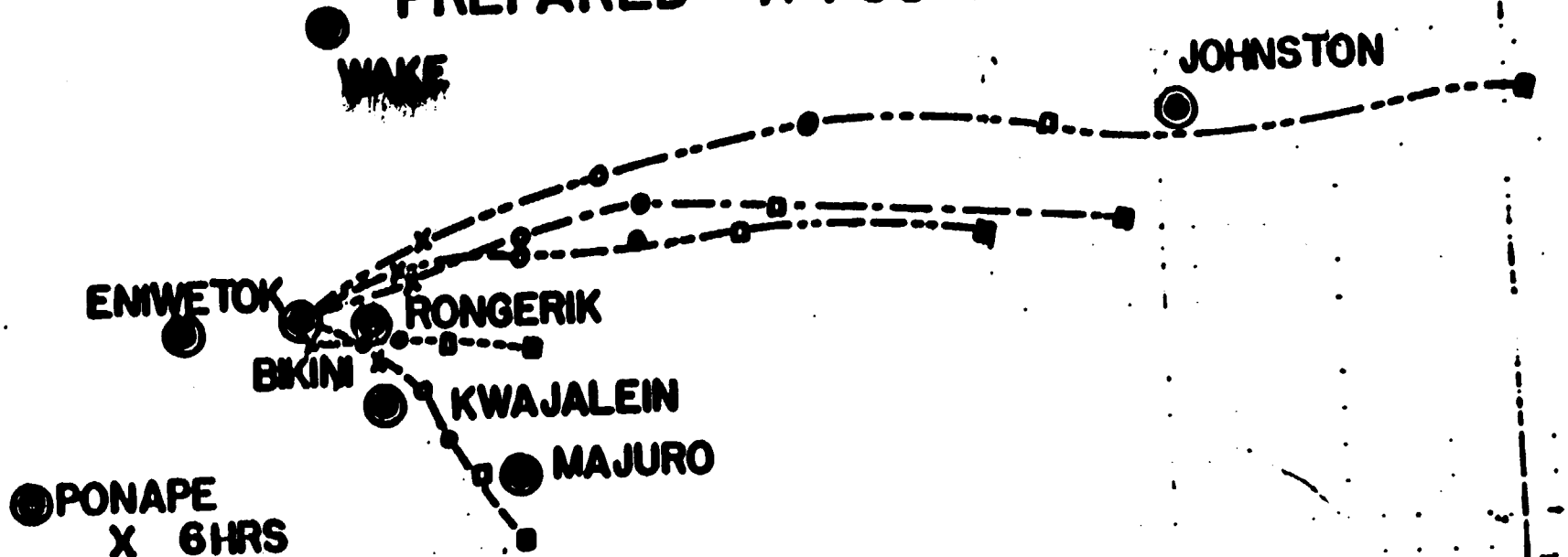


CHART NO 11

COMPUTED AIR PARTICLE TRAJECTORIES
H TO H + 72HRS B DAY
PREPARED H+38 HOURS



X 6HRS
O 12HRS
● 18HRS
□ 24HRS
■ 36HRS
△ 48HRS
◊ 60HRS
\+ 72HRS

----- 10 THSD
---- 20 THSD
--- 30 THSD
---- 40 THSD
------ 50 THSD
----- 65 THSD

CHART NO 18

TAB B

RADSAFE, NARRATIVE SEQUENCE OF EVENTS

TAB B

RADSAFE NARRATIVE SEQUENCE OF EVENTS

By the morning of B-1 day, the wind patterns (forecast and actual) were favorable but the trend of the observed resultant wind patterns was toward an unfavorable or marginal condition. No transient shipping was reported on the B-2 day P2V sweep centered on a significant forecast cloud movement on true bearing of 300° out to 800 miles from GZ. The B-1 day search by P2V out to 375 miles on a forecast significant cloud movement on a true bearing of 330° disclosed no transient shipping except the General Patrick, whose course and speed would take her outside the hazardous area by shot time. At the midnight briefing, the forecast offered a less favorable condition in the lower levels (10-25 thousand feet). Resultant winds at about 20,000 feet were forecast in the direction of Rongelap and Rongerik (Figure 1); however, it was considered that the speeds and altitudes did not warrant a conclusion that significant quantities and levels of debris would be carried out so far. TARE Site was forecast to be well in the fall-out area and NAN Site to be in a fairly high intensity area. Since the B-1 day forecasts gave winds tending significantly toward ENE, a decision was made at the midnight briefing to search on B day ahead of the cloud, i.e., centered on true bearing of 65° out to 600 NM and to warn ships out of the 450 NM minimum radius.

The routine B-18 hour advisory to CINCPACFLT indicated no significant fall-out forecast for populated Marshall Islands, and no safety problems on air or surface routes except surface routes between 275° clockwise to 80° out to a radius of 450 NM with possible significant fall-out in this area. No known shipping was in the forecast fall-out area. The surface radex was forecast for shot time to shot plus six hours to be oriented in a narrow sector to the northeast and a wide sector to the south, with an additional circular radex area around GZ of radius 15 miles (Figures 1 and 2). The sector pointing at Rongelap was considered insignificant due to the low altitudes from which fall-out could occur and due to the very light winds acting on the levels involved.

At the 0430, 1 March briefing, no significant change had been observed in the midnight winds received, however, a radsafe recommendation was made to move the task force ships radially further out from the minimum of 30 NM to a minimum of 50 NM in the SE quadrant. The low level cloud was forecast to overrun the TARE camp and move on to the east with a strong possibility of overrunning NAN. The resultant winds pointing at Rongerik and Rongelap were light and were not forecast to transport significant debris to these atolls.

At 0645 the BRAVO detonation was accomplished without hazard to task force personnel. The bunker firing party reported in safe, but by 0715 the radiation levels were reported rising at the bunker. These levels continued to rise to about 25 r/hr. The firing party was con-

sidered to be in a reasonably safe position since the personnel were able to get into a well protected area deep in the bunker, reading approximately 35 mr/hr.

The cloud tracking (by WB-29, Wilson 2) during the morning of B Day indicated no contamination of consequence moving toward Eniwetok or Ujelang at ten thousand feet. The afternoon upwind mission for Wilson 2 was a 30 degree sector out to 500 NM centered on true bearing of 70° from GZ. During the upwind portion of the cloud tracker's mission, readings were from 100 to 500 mr/hr at ten thousand feet. During the morning the B Day P2V sweep in front of the cloud encountered contamination early in his mission. This P2V was replaced by another, which completed the search out to 600 NM.

A report was received about 1500 on B Day that the AEC/NYOO instrument in the hands of the weather detachment on Rongerik had gone off scale. These instruments had a full scale reading of 100 mr/hr. The off-scale report was not viewed with concern since task force ships were experiencing readings (while steaming south) of more than 100 mr/hr (The BAIROKO going as high as 1.0 r/hr on the flight deck). Considering the distance (133 NM) and a cloud tracker at about 1945M, 1 March, reporting of zero contamination over Rongerik, it was generally believed that Rongerik and the task force ships were caught in a general pattern of finely divided (95% less than 5 micron by cascade impactor) particles over a wide area moving ENE to E. The weather detachment was advised of this condition. Nevertheless, the AEC/NYOO Kwajalein Flight ABLE was requested at midnight to be run the following morning. Kwajalein Flight ABLE pattern covers all Marshall Islands north of Kwajalein, and up to Taongi as the northern-most turning point. Aerial readings taken on the flight are extrapolated to the ground.

About 2000 the task force commander was briefed on the overall situation as was known at this time. This included the results of some initial damage and radsafe survey information taken about noon by helicopter, reports from the sampling aircraft (F-84, B-36 Featherweights and B-36 Control), the first twelve hour cloud tracking mission (Wilson 2) and the first few reports on the 8/12 to 8/24 hour cloud tracker (Wilson 3). The upwind mission for Wilson 3 was a 30 degree sector out to 500 NM centered on true bearing of 65 degrees from Rongerik, followed by a vectored mission to 17N 163E to base at Eniwetok. The task force commander was advised that fairly heavy contamination had been encountered by Wilson 2 in the sector portion of his flight and that one P2V aircraft had been contaminated in about the same region. The task force commander was advised that the readings taken at ten thousand feet by the cloud trackers were thought to be on the order of magnitude of that encountered by the task force ships. Since the only significant con-

tamination was found in regions which confirmed the forecast cloud trajectories, the requirement for H+24 through H+48 hour tracking coverage was cancelled.

As a result of the report from Rongerik, the advisory to CINCPACFLT at 2000 hours B Day included mention of fall-out at Rongerik plus minor fall-out at Rongelap and other northern Marshall Islands. The fall-out was attributed to an H+12 hour change in the forecast air particle trajectory for the twenty thousand foot level. This trajectory, formerly moving toward the ENE, was reforecast to move toward SE in a circular clockwise path through south to west. The CINCPACFLT advisory included no health hazard problem for surface and air routes, but that fall-out on Bikini Atoll, as well as damage to structures, would delay reentry several days.

During the trip back to Eniwetok on the night of B Day, the fleet encountered a wide area of finely divided (apparently less than 5 micron) particles which caused top-side intensities as high as 350 mr/hr. Appropriate measures were instituted by the Navy Task Group Commander to the affect that all personnel not essential to open deck duties would remain indoors. Ship's weather doors were closed and the washdown systems operated intermittently to hold down the levels.

Based on the advisory from the weather detachment that their instrument was off-scale, the Air Task Group, on the morning of H+1 day, sent a monitor by amphibian aircraft to check the Rongerik situation. This monitor upon arriving over Rongerik, reported the atoll contaminated and requested permission to start evacuation of personnel. At about 1300 the monitor reported readings on Rongerik of 240 mr/hr at 250 feet and 3.2 r/hr one inch off the ground. The Rongerik evacuation was completed in two segments, the first group (8 people) coming out by H+30 hours and the second group (20 people) by H+35 hours.

The special AEC/NYOO Kwajalein Flight ABLE, requested the previous night, had been instructed to make an in-flight report upon reaching Taongi. (A preliminary Flight ABLE report indicated 1350 mr/hr on the ground at Rongelap, 445 mr/hr on the ground at Ailinginae and zero for Rothe.) Accordingly, it was decided to start a destroyer on the way to Rongelap immediately and to set up a SA-16 amphibian with monitors to check the surface conditions at Rongelap before dark. The destroyer was directed to be off Rongelap ready to start evacuation at dawn the following day. A Trust Territory representative with interpreter was requested to move by PBY from Kwajalein to arrive at Rongelap at the same time. The SA-16 was set up, two responsible monitors were especially briefed to make readings at waist height, use several meters of the same type for comparison and to use different types for cross-check. An average reading of 1.4 r/hr made in the living area of Rongelap Island by these monitors was used in the decision the same night to order the destroyer to commence evacuation operations at dawn. Evacuation operations began about 0730, 3 March and

and were completed by 1030 the same date. Interrogation of natives disclosed that all were present except 17 who were fishing at Ailinginae. Following the Rongelap operation, the destroyer proceeded to Ailinginae, removed the remaining 17 and proceeded to Kwajalein. A total of 17 males, 20 females, 15 boys and 14 girls were removed by destroyer and disembarked at Kwajalein. 16 old and sick were moved at about 0930 by PBM to Kwajalein. Decontamination of all natives was accomplished during the trip to Kwajalein.

The full report from AEC/NYOO Flight ABLE indicated Utirik ground contamination at 240 mr/hr at 1651M, 2 March and 76 mr/hr at about 1716M, 2 March at Ailuk, the nearest populated island to the south. Bikar, the nearest island to the north was determined to be unpopulated and contaminated to about 750 mr/hr at about 1600M, 2 March. Taongi, the next nearest island to north was 1.5 mr/hr and unpopulated. Based on these facts a decision was made to start another destroyer to Utirik to anticipate an order to start evacuation at dawn on 4 March. In the meantime a PBM was set up to ground survey Utirik on 3 March while the destroyer was on the way. The infinity dose of the Utirik natives was computed at 58 r. The decision to evacuate was made and the destroyer ordered to start evacuation the following morning, 4 March. A total of 47 males, 55 females, 26 boys and 26 girls were removed, decontaminated on the destroyer enroute to Kwajalein and disembarked on 5 March. Questioning of natives disclosed that all had been removed. The destroyers which evacuated Rongelap and Utirik were directed to obtain drinking water samples from these atolls. A check of the water samples indicated from 2 to 28 times the task force standard for full time usage.

With the decision to evacuate Utirik made and the machinery set in motion to accomplish this operation, the status of Ailuk was put up for consideration. This atoll has a population of 401. The infinity dose was determined at less than 20 r, i.e., less than the minimum standard used by the task force for its sampling aircraft crews. This was the major factor in the decision not to evacuate Ailuk.

During the afternoon of 2 March a directive was issued to execute Kwajalein NYOO Flights BAKER and CHARLIE. These flights cover all Marshall Islands south of Kwajalein. The flights were set up on the assumption that the twenty thousand foot trajectory could have brought contamination around to the south and west and contaminated some of the southern Marshalls. The flights were executed on 3 March. No significant ground contamination was found. An additional NYOO type flight was performed over the Gilbert Islands for the same reasons. No significant contamination was found.

On the basis of Flights ABLE, BAKER and CHARLIE, it was determined that no further atolls would need to be evacuated. The effort was there-

fore concentrated on those populated atolls indicating more than 10 mr/hr at H plus 24 hours and which were not evacuated. For this purpose a special survey was set up under the technical direction of Dr. Thomas N. White, H Div, LASL, assisted by Major Robert Crea, Hq JTF SEVEN, to start from Kwajalein on 5 March by PBM.

Following the survey under Dr. White and Major Crea, the next effort was directed toward acquiring data on the evacuated atolls in order that the effects of the radiation could be better evaluated. The investigation included ground monitoring and the taking of soil and water samples from living areas. Secondary purposes were efforts to reduce the adverse impact on real and personal property of the hasty departure, to determine radiation data of scientific interest and to evaluate the time of reoccupancy by the former inhabitants. This effort was assigned to a destroyer in order that working parties would have a floating base for operations ashore and decontamination facilities afloat. The technical direction of the effort was placed under the supervision of Dr. Herbert Scoville, Technical Director, Armed Forces Special Weapons Project, assisted by representatives of CASTLE Project 2.5a. The rehabilitation portion of the effort was placed under the supervision of the commanding officer of the destroyer. The party with equipment departed 7 March for Kwajalein to join with the Trust Territory representative in a PBM rendezvous with the destroyer at Rongelap early morning of 8 March.

Arrangements were made to air ship soil and water samples to Health and Safety Laboratory, AEC, New York Operations Office, Attention Mr. Merril Eisenbud. Mr. Eisenbud was requested to provide the task force with decay information and activity per unit area on the soil samples and activity per unit volume on the water samples. He was also requested to make such other analysis as he thought necessary considering the unusual circumstances and interest in BRAVO Event.

Detailed reports by Dr. White, Dr. Scoville and Major Crea have been distributed separately to interested agencies. Continuing surveys of the evacuated atolls have been made for picking up of animals for medical studies, rehabilitation and for studies of marine life. Reports on these activities will be included in the above distribution as they become available.

Richard A. House

RICHARD A. HOUSE
Lt Colonel, USAF
Chief, Tech Ops Branch, J-3

6 Incl
1. RadSafe factors Considered at the Wea RadSafe Command Briefing.
2. Memo for Record: with 6 Incl covering RadSafe Briefing material as presented at Cmd Briefings for BRAVO.
3. Discussion of Off-Site Fall-out.
4. Cloud Tracking Operations.
5. MR: Protection of Transient Shipping During Operation CASTLE.
6. Analysis of Fall-out Following BRAVO Event with 4 Incls

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RADSAFE FACTORS CONSIDERED AT THE WEATHER/RADSAFE COMMAND BRIEFINGS

1. Resultant wind diagram, forecast winds for HOW Hour.

2. Surface RADEX: H to H plus 6 hours, bearings, radius, hot areas, cool areas.

3. 72 hour cloud trajectories given by WX Officer to advise British and CINCPACFLT. Sampling area and BU sampling area; need for penetration authority.

4. Air RADEX: Not used at briefing unless requested. Air RADEX plotted and displayed in RadSafe Office. Does not basically affect decision. Sampling region given by hodograph or 72 hour trajectories.

5. Outlooks: (Based on).

   a. Bikini (hodograph)

   b. Eniwetok (hodograph)

   c. Ujelang (hodograph)

   d. Native atolls in SE quad (hodograph)

   e. Control destroyer (hodograph)

   f. ATF for YAGs (hodograph)

   g. Air Routes

      (1) Thru Wake (72 hour trajectory)

      (2) Thru Kwajalein (72 hour trajectory)

   h. Surface routes inside 500 miles (approx 1 day cloud travel). Plot of transient ship chart at briefing (hodograph)

   i. CINCPAC advisory (72 hour trajectory), native outlook; air and surface routes.

   ALL ABOVE INCLUDED IN CLOUD TRACKING PLAN

6. Summary: Evaluation as (very favorable) (Favorable) (Favorable except) (Unfavorable) RadSafe condition for shot time.

[redacted]

[redacted]

5 March 1954

MEMORANDUM FOR RECORD:

SUBJECT: RadSafe Material Presented at Weather/RadSafe Command Briefings for BRAVO

Attached hereto are copies of material presented to CJTF SEVEN during the period H minus 48 hours through H minus 2 hours for BRAVO Event.

R. A. HOUSE
Lt Col., USAF
RadSafe Officer

6 Incls:
1. M/R: H-48 hrs TWX Briefing for CJTF SEVEN
2. M/R: H-36 hrs TWX Briefing for CJTF SEVEN
3. M/R: Command Briefing, 1100M, 28 Feb. 1954.
4. M/R: Command Briefing, 1800M, 28 Feb. 1954.
5. M/R: Command Briefing, 0000M, 1 March 1954.
6. M/R: Final Weather and RadSafe Check, 0430M, 1 March 1954.

[redacted]

[redacted]

1 March 1954

MEMORANDUM FOR RECORD:

SUBJECT: H-48 Hour TWX Briefing for CJTF SEVEN

CJTF SEVEN

262016Z FEB 54 [redacted]

OP[redacted]-PRIORITY

CJTF SEVEN (ADMIN)

X

X X

Weather outlook for slot day follows: Clouds and weather: Scattered cumulus, scattered cirrus, widely scattered showers. Winds: Surface, easterly 15 to 20 knots; 10,000, easterly 10 to 15 knots; 20,000, easterly 15 to 20 knots; 30,000, southeasterly 15 to 25 knots; 40,000, southerly 15 to 25 knots; 50,000, southwesterly 10 to 20 knots, 60,000, southeasterly 5 to 15 knots. RadSafe outlook very favorable

[redacted]

[redacted] 1 1

t Col Bonnot Lt Col C.D. Bonnot

M/R: Compiled by Bonnot, House and Maynard.

CERTIFIED TRUE COPY:

/s/ R.A. House

/T/ R.A. HOUSE
Lt Col. USAF

[redacted]

[redacted]

1 March 1954

MEMORANDUM FOR RECORD:

SUBJECT: H-36 Hour TWX Briefing for CJTF SEVEN

	270544Z FEB 54	[redacted]
CJTF SEVEN	OPERATIONAL IMMEDIATE	OPERATIONAL IMMEDIATE
		CM
	MA	MO

CJTF SEVEN ENIWETOK ATOLL (ADMIN)

CTG 7.3

Weather outlook as of 270500Z for Bravo day follows: Clouds and weather: Scattered cumulus, scattered cirrus, very widely scattered showers. Winds: Surface to 15,000 feet, easterly 15 to 20 knots; 15,000 to 25,000 feet, easterly 10 to 15 knots; 25,000 to 30,000 feet, southerly 5 to 10 knots; 30,000 to 50,000 feet, southwesterly 20 knots; 60,000 feet northeasterly 10 to 15 knots. Radsafe outlook for Eniwetok and Ujelang very favorable; outlook for Bikini favorable. Request you take action on confirmation of execute order (Item 38 Checklist). Ogle and Graves and Reeves recommend confirmation. Bruton interposes no objection.

[redacted] 1 1

LT COL C D BONNOT

LTCOL BONNOT

CERTIFIED TRUE COPY:

R.A. Bouse
Lt Col., USAF

M/R: Members present: Graves, Ogle, Reeves, Bonnot, Bouse, Maynard.
Dr. Graves called Adm Bruton. RAH

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