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DEPARTMENT OF THE AIR FORCE
16AF ADVON
APO NEW YORK 09283

RS 3415

REPLY TO
ATTN OF: C

13 FEB 1966

SUBJECT: Search Operations, Palomares, Spain

UNIQUE DOCUMENT # SAC20011865000O

TO: SAC (Gen John D. Ryan)
USAF (Maj Gen Woodrow P. Swancutt)

1. The attached study was prepared by the Systems Analysis Team which functioned at the accident site from 30 Jan 66 to 8 Feb 66. The team was composed of representatives from Sandia Corporation; SMC, Wright-Patterson AFB; and DAD, Eglin AFB. This team was assisted by USAF, AEC, and Los Alamos Scientific Laboratory personnel at the site plus XX organizations that furnished computer computations and theoretical studies.

2. The postulated solution number 1, page 17, and the conclusions on page 25 and 26 are the primary basis for the present ground search. The probable point of impact for the secondary is a circle of 5000 ft. radius, whose center lies at 37 degrees 14.65' N latitude and 1 degree 34.[illegible]' W longitude. For ground search activity, the area has been enlarged to a square configuration measuring 10,000 ft. on each side using the probable impact position above as the center.

3. I propose to cover this area at least three times with searchers coordinated at arms length. Successive searches will be made perpendicular to the previous sweep. The search team varies between 150 - 200 personnel. PAC 1S monitors accompany the searchers. String is used to guide the searchers and prevent gaps in the area to be covered. The searchers are instructed to mark with flags any crater, hole, or suspicious depression for further investigation. The investigation is made by a team composed of USAF, AEC, Los Alamos Scientific Laboratory, and Sandia Corporation people using choppers to follow up the line of ground searchers.

4. Copies of this letter and the report have been forwarded for information to the addresses shown on pages 33 and 34.

DELMAR E. WILSON, Maj Gen, USAF
Commander

1 Atch
Staff Study of Search Operations

THIS DOCUMENT CONSISTS OF 1 PAGE

RESTRICTED DATA
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DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW

1ST REVIEW - DATE: 5/97
AUTHORITY: ☐ ADC ☒ ADC ☒ ADD
NAME: [illegible]

2ND REVIEW - DATE: 1/11/99
AUTHORITY: ADD
NAME: [illegible]

DETERMINATION [CIRCLE NUMBER(S)]
1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO: S-RD
3. CONTAINS NO DOE CLASSIFIED INFO
4. ~~COORDINATE WITH: DOD AF~~ - COMPLETED
5. CLASSIFICATION CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY): Pr HAD NO DELETIONS

1) Attach is "Bottom Sediments and Currents...", not the one listed

per Tonya 5/11/99

Attd 27.

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CSA-66-09

97SA20C000190

BOTTOM SEDIMENTS AND CURRENTS

AIRCRAFT SALVOPS MED

REPORT TO CTF-65

BY

NAVOCEANO OCEANOGRAPHIC SUPPORT TEAM

F. M. DAUGHERTY, JR., SENIOR SCIENTIST
CHARLES OSTERICHER
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JOHN S. WOODSON
JAMES W. UNDERWOOD
HAROLD E. GRIMM

SUBMARINE SOIL MECHANICS

The purpose of this investigation is to provide engineering and geologic information as required by CTF-65 for submarine search operations. Sediment cores were obtained off Villaricos Tower and seaward to a depth of 318 fathoms. Available bathymetry data and standard shipboard navigation resulted in poor agreement between sample positions and depth; however, the samples are considered as representative of the search area. Soils engineering tests were performed at the U.S. Navy Fuel Annex, Cartagena, Spain. USNCEL has lead responsibility for bottom analysis and will provide additional information based on these data.

The sediments in the search area are of two general types; coarse sand and silt-size materials that occur near shore, and fine clay-size materials that occur offshore. The boundry between these two sediment types is in the vicinity of the 100-130 fathom contours. Although this distribution represents the general sediment coverage of the search area, intermediate zones of silt as well as clay and sand can be expected. Deep Jeep operators noted numbrous rocks scattered along the sea-floor as well as a prominant canyon-like feature, although not clearly delineated by the bathymetry. The canyon wall was described as exposed consolidated bedrock in numberous locations. Topographic highs with slopes of about 45° and covered with clay-size materials were also noted by these operators. The presence of this type of topography as well as the high adhesive characteristics of some of the sediments indicate that further submersible travel be undertaken with caution.

The load-carrying ability of the sediment samples is relatively high. Shear strength values range from 0.2 lbs/in^2 (cores 11 and 12) to 3.3 lbs/in^2 (core 13). The average shear strength for the near shore sediments is 2.0 lbs/in^2 (cores 5 and 13) and the offshore sediments 0.6 lbs/in^2 (cores 8, 11, and 12). All of the offshore samples show an increase in strength in the sediment core (Fig. 1). This probably indicates a normally consolidated sediments, those that have never been subjected to loads greater than their present overburden. This type of deposition is gernerally indicative of a slow rate of accumulation and rather constant and stable sea-floor conditions. Maximum bottom currents of 0.15 knot tend to support this conclusion. The ephemeral stream located in the vicinity of the Villaricos Tower probably provides the major dynamic influence on the sediment distribution, and this presumably operates only seasonally.

The corer weighing 250 pounds had a freefall of 10 feet. Measurements of corer penetration substantiate shear strengths as determined in the laboratory (Table I). Other engineering properties measured support the high shear strength data. High bulk density values (104 to 115 lbs/ft^3 as well as low water content values (36 to 68% dry wt.) were found. The sensitivity of these sediments (see definition of terms) ranged from 2 to 4. The majority of the sensitivities were in the low sensitivity range or 2. A sensitivity value of 2 indicates that about 50 percent of the undisturbed strength is lost due to remolding the sample. Cannon balls found by Deep Jeep operators support the strength data determined in the laboratory.

FIGURE 14 Strength Profiles

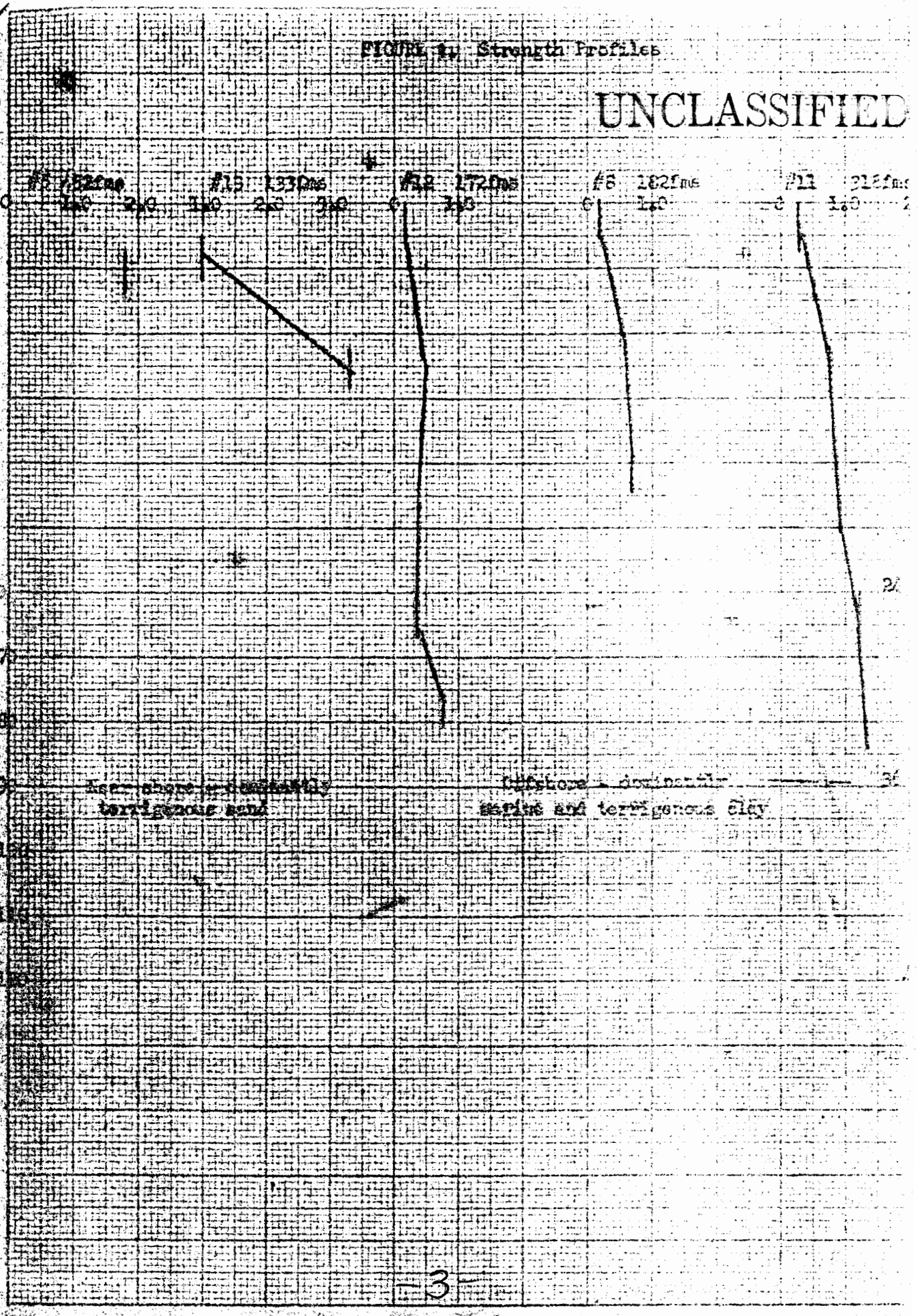

TABLE I

ENGINEERING DATA * *

Core No.	Shear Strength psi	Bulk Density pcf	Water Content % dry wt.	Description
1-4/	In vicinity of 37°13'40"N., 1°45'00"W.			35 fms. poor if any penetration some sand on core catcher
5/	1.8	114	39	37°13'25"N., 1°45'[illegible]"W. 32 fms dominantly sand, some penetration
6/	No recovery 37°13'07"N., 1°44'08"W. 108 fms.			
7/			36	5 cm recovery, bottom [illegible] sand 37°13'1[illegible]"N., [illegible]°[illegible]'[illegible]"W. [illegible] fms.
13/				
5-12*	1.0	110	51	0-10 cm silty [illegible]
22-29*	3.3	115	42	10-25cm graded silt and sand at bottom 25-26cm clayey silt 56cm penetration 37°14'23"N., 1°[illegible]'[illegible]"W. 133 fms.
12/				
0-7*	0.2	104	68	0-20cm homogeneous silty clay
20-27*	0.5	110	51	20-28cm clayey silt
43-50*	0.4	108	56	60-94cm graded silt and sand layers
60-67*	0.4	110	55	
73-80*	0.8	112	39	37°12'43"N., 1°44'[illegible]"W. 172fms.
8/				
0-7*	0.2	106	58	0-26cm homogeneous silty clay
19-26*	0.6	107	52	26-36cm stratified sand and shell
36-43*	0.7	107	57	36-53cm homogeneous silty clay
53-61*	-	-	58	61 cm penetration 37°12'48"N., 1°[illegible]'[illegible]"W. 182 fms.

* Depth in core in cm.

** See definition of terms on following page

TABLE I (continued)

Core No.	Shear Strength psf	Bulk Density pcf	Water Content % dry wt.	Description
9/	10cm penetration, no engineering tests, mostly clayey [illegible] 37°12'07"N., 1°43'03"W.			
10/	25cm penetration, core barrel collapsed, no engineering [illegible] clayey silt. 37°12'04"N., 1°42'40"W.			
11/				
0-7*	0.3	104	69	Homogeneous silty [illegible]
22-29*	0.8	106	59	core.
43-50*	0.9	107	58	37°12'01"N., [illegible]
60-67*	1.2	109	56	
77-84*	1.3	110	52	107cm core penetration

DEFINITION OF TERMS

The basic shear strength equation is: $s=c+n \tan \phi$

where s is the shear strength, c is the cohesion, n is the effective stress on the shear plane, and ϕ is the angle of shearing resistance. For this investigation the angle of shearing resistance is assumed to be zero and the shear strength is equal to the cohesion. The changes in effective stress are ignored due to the low permeability of the fine-grained and saturated sediments. Cohesion (undisturbed and remolded samples) was measured directly with a laboratory vane shear device and is expressed in pounds per square inch units.

Bulk density or wet unit weight is defined as the weight of the solids plus pore water per unit of total volume and expressed in pounds per cubic feet units.

Water content is defined as the ratio of the weight of water in a given sediment mass to the dry weight of the solid matter. Values reported are in terms of percent dry weight.

Sensitivity is defined as the ratio of the undistrubed strength to the strength of the same sample at the same water content but in a remolded state, and represents the effects of remolding on the consistency of a cohesive material.

NOTE: Object penetration graphics are addended to this report. These represents are method of presenting penetration information and are only included as general guidelines.

Figure 2

Figure 3

The predominent current at all depths sampled was a flow to the southwest which was only slightly modified, in speed and direction, by currents of tidal origin. A net current of 0.23 knot (at 210°) was measured at 550 feet. The net flow decreased regularly with depth to 0.07 knot (at 235°) at 1700 feet, 20 feet above the bottom.

Although the tidal currents are weak and were difficult to define precisely in the observed data, the average currents as related to the tides at Malaga (36°43'N, 4°25IW) and shown in the attached figures can be used with a reasonable degree of accuracy for predicting subsurface currents in the near future.

550 feet. Non-tital flow dominant, net flow to southwest at 0.23 knot. Tidal influence shown by reduced flow to southwest or a very weak east-northeast current 1-2 hours after high water at Malaga. Up to 2 hours after low water at Malaga the tidal currents enforce the southwesterly flow. The maximum observed current was 0.5 knot south. 50% of the observed currents were 0.25 knot or greater and were all south or southwest.

900 feet. Non-tidal flow predominates with a net flow of 0.13 knot to the southwest. The maximum observed current was to the south-southwest at 0.25 knot. Less than 20% of the observed currents were 0.20 knot or greater and [redacted] were all to the south-southwest.

1200 feet. The net flow was to the southwest at 0.10 knot. The tidal currents caused a minimum southwest or westerly flow at highwater + 4 hours at Malaga. At low-water + 3.5 hours a maximum flow to the south or southwest was observed. The maximum observed current was 0.20 knot. Currents greater than 0.15 knot were observed 20% of the time. 16% of the observation were 0.

1500 feet. The net flow was southwest at 0.09 knot. The maximum observed current was 0.19 knot. Currents greater than 0.15 knot were observed 24% of the time and all were to the southwest. Tidal influence at this sample depth was very weak.

1650 feet. The net flow was southwest at 0.08 knot. The tidal effects were apparent in a weakening of the southwesterly flow 2 to 4 hours after high-water at Malaga. The strongest currents occurred 3-4 hours after low-water at Malaga. The maximum observed current was 0.16 knot flowing southwest. Currents greater than 0.10 knot were observed 35% of the time. Their directions varied from south to west.

1702 feet. The tidal effects at this depth were obscure. The net flow was 0.07 knot to the southwest. The maximum current observed was 0.15 knot. Currents greater than 0.10 knot were observed 25% of the time and were all to the south or southwest except one observation to the northeast.
Slack water occurred 15% of the time.

These data should be applicable throughout the search area at the indicated depths. Near bottom currents in water depths greater than 1700 feet should not differ appreciably from the measured 20 feet above the bottom. Prominent bottom topographic features can be expected to alter current directions and speeds. As an example a submarine canyon will confine the current flow to a direction parallel to the axix of the depressive and cause an increase in the average speed, perhaps to a maximum of 25%.

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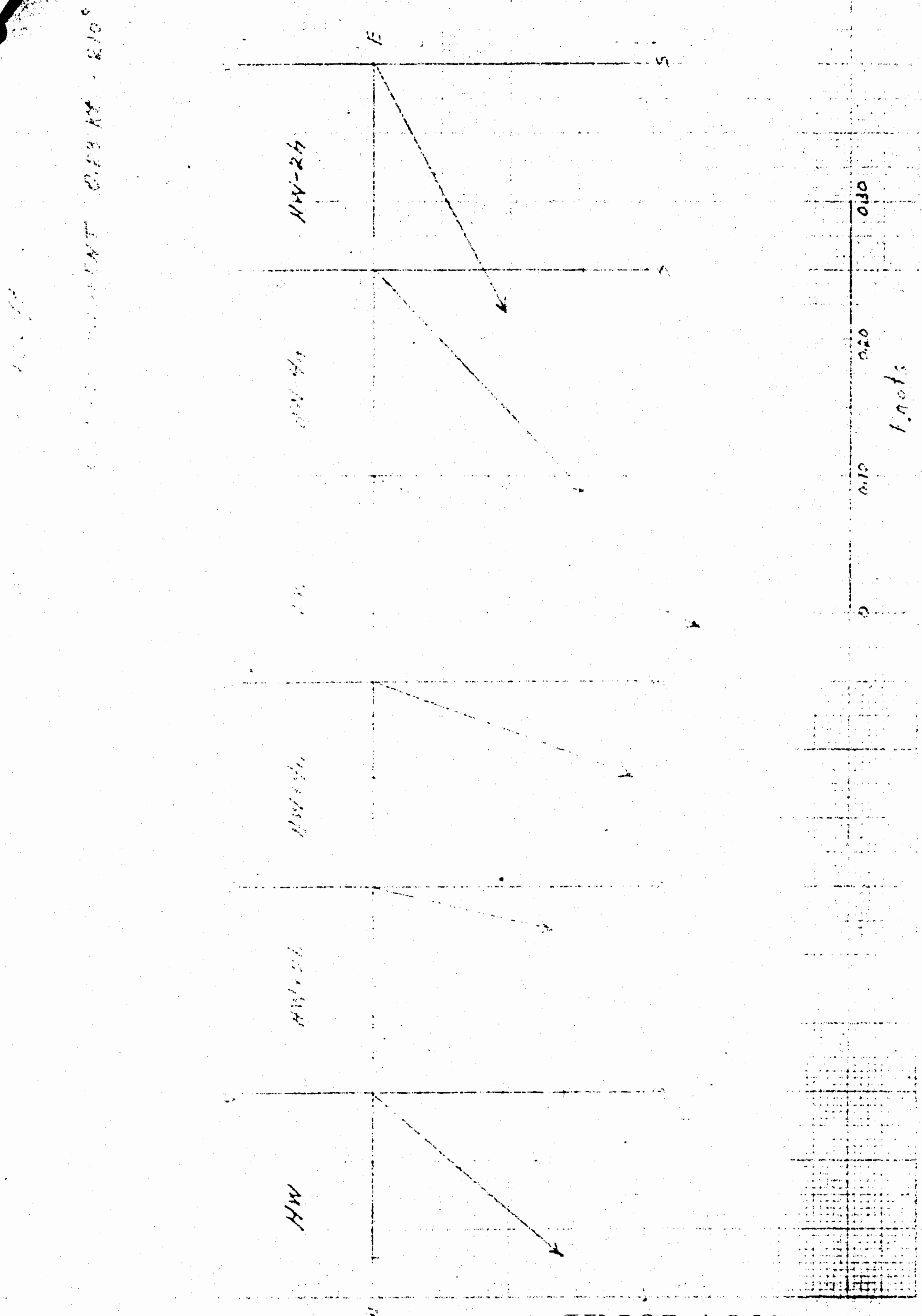

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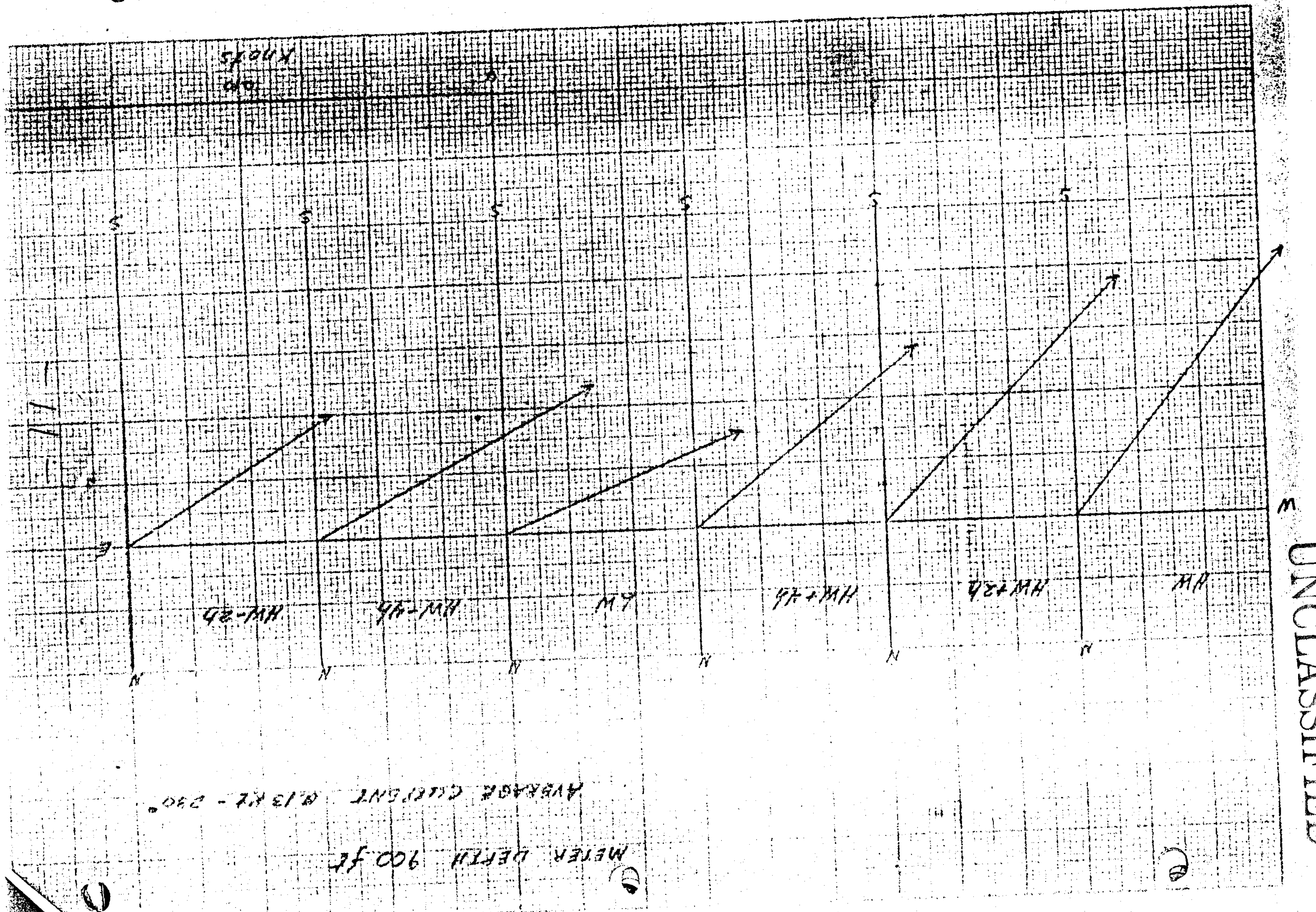

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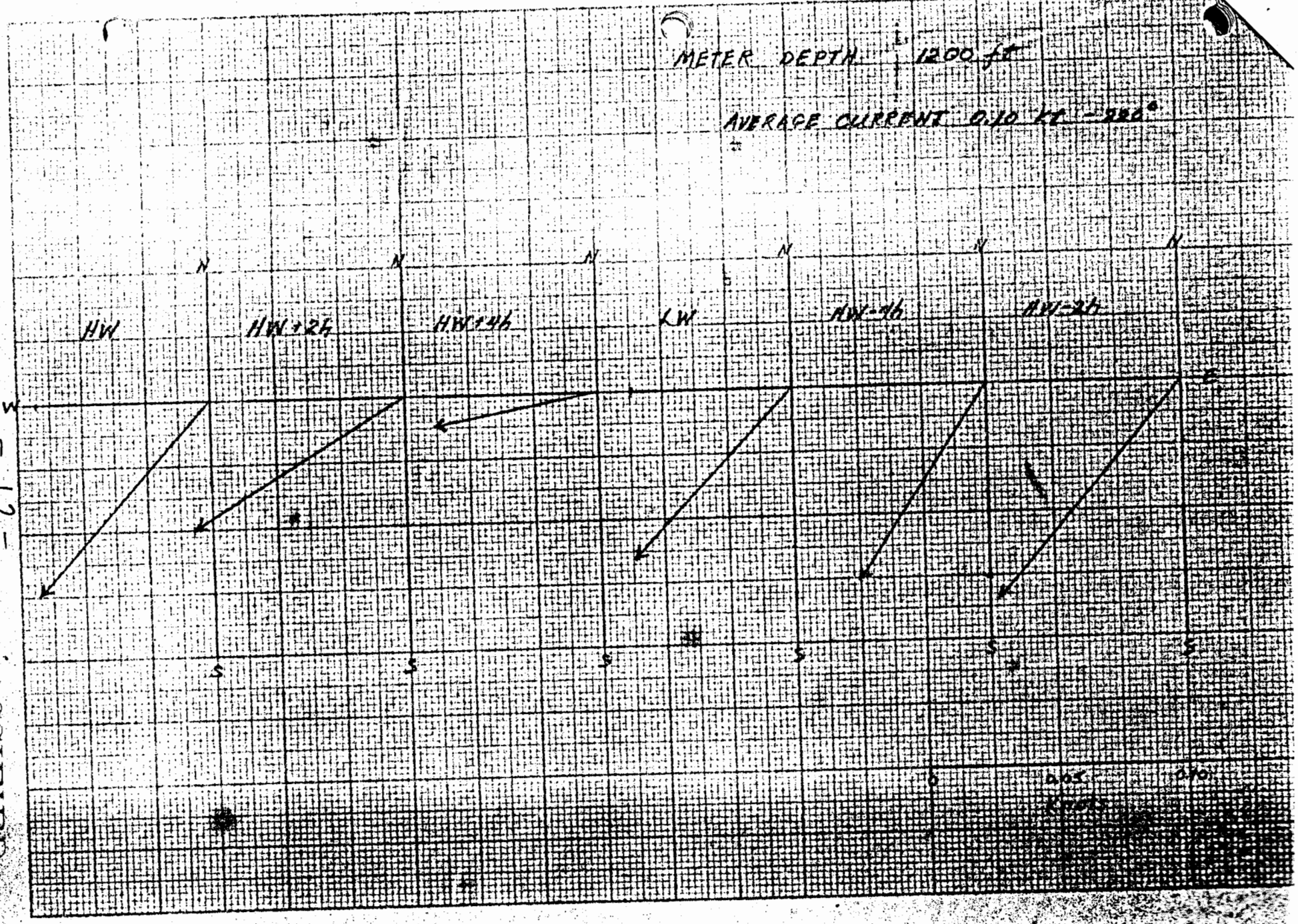
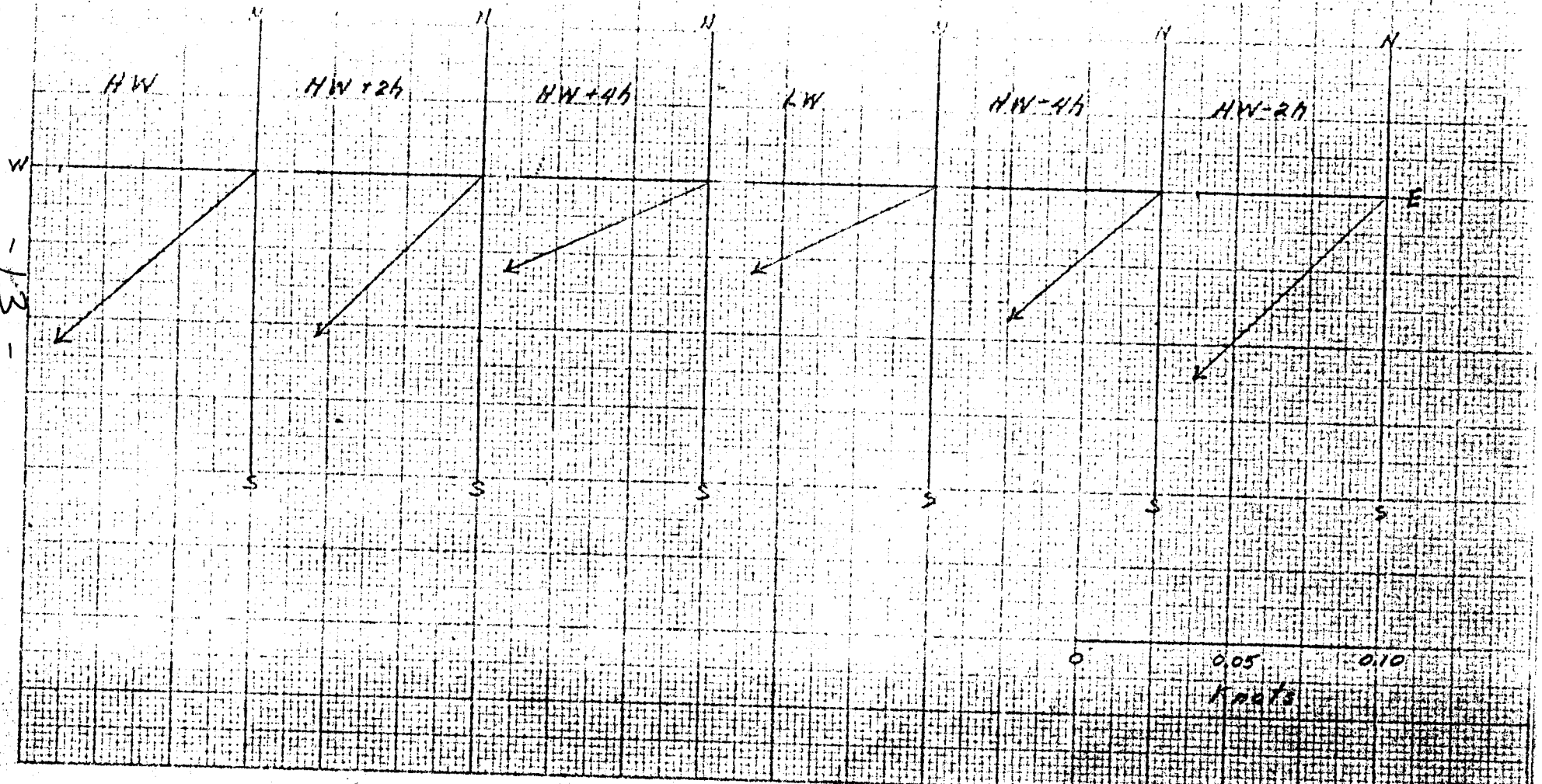
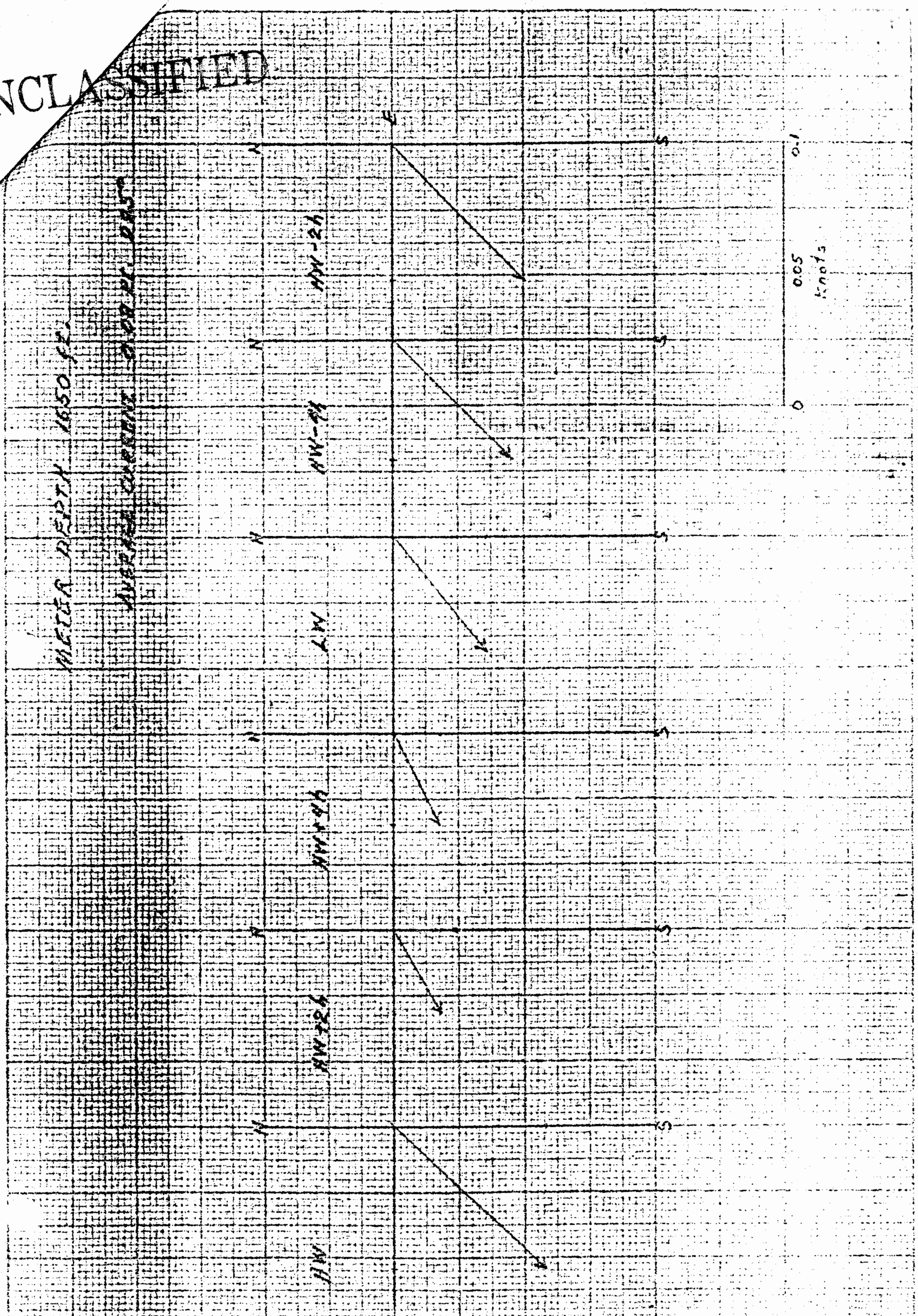

METER DEPTH 1200 ft
AVERAGE CURRENT 0.10 kt - 220°
HW
HW+2h
HW+4h
LW
HW-4h
HW-2h
N
S
E
W
0
0.05
0.10

METER DEPTH 1500 ft

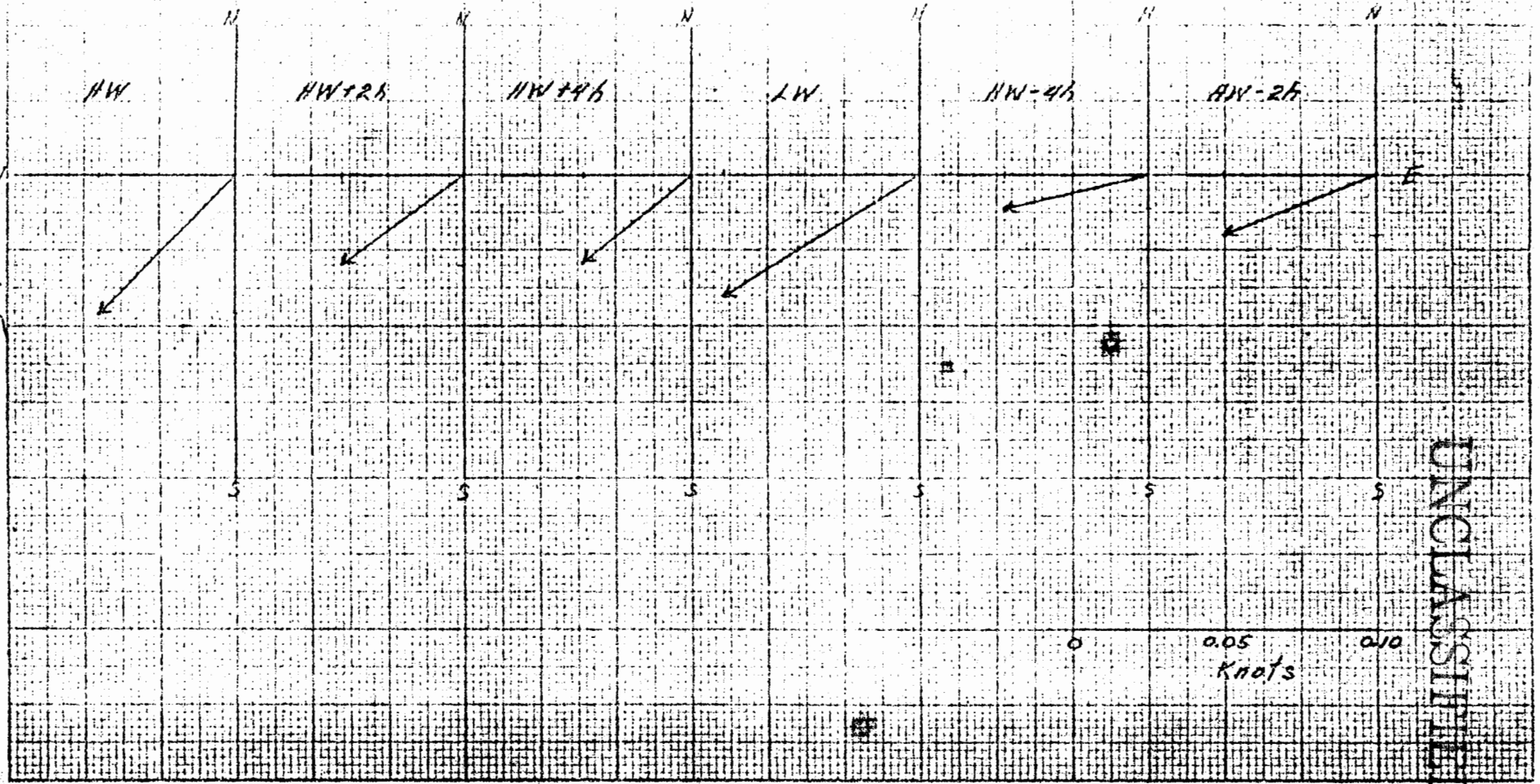
AVERAGE CURRENT 0.09 kt 290°





JEK DEPTH 1702 ft

AVERAGE CURRENT 0.07 kt -295°



ON THE DAY OF THE ACCIDENT THE SPANISH OCEANOGRAPHIC SHIP B/H JUAN DE LA COSA WAS NEAR THE FISHING VILLAGE OF CARBONERAS. AFTER OBSERVING THREE RED FLARES AND SMOKE ON A BEARING OF 245°. THEY PROCEEDED TO THE AREA. A MESSAGE, FROM THE SHIP CABO S. VICENTE INDICATING THAT THEY SAW A LARGE WHOLE PARACHUTE FALLING TO THE WATER, THE APPROXIMATE LOCATION WAS 37° 10' N 01° 42' W. ADDITIONAL MESSAGES FROM OTHER SHIPS IN AREA ALSO CONFIRMED THESE SIGHTINGS.