

SUBJECT: FISH Notes
TO : CO, SSA, War Dept.

1. Enclosed is copy of Sixta non-Morse report for week ending 19 October 1944. This is sent pursuant to request contained in SSA 4906. I will continue to send these reports weekly.

2. Enclosed is copy of report prepared by one of the U.S. Navy liaison officers here as to procedure and operations at Knockholt. After reading this it seems to me that paragraph 7 of my Report #F-67 (IL 3642) is quite inaccurate. I was apparently confused by the multiplicity of tapes involved. Paragraph 7 makes sense if "perforated tape" is substituted for "teletype tape" and "teletype tape" for "hand".

3. Enclosed is Mr. Small's memorandum with reference to some trivial errors in his Report #G-1, IL 3918.

4. Enclosed is supplemental list of captured machines. The T52b seems to be like the machine at Knockholt except that an auto-key switch has been added. Efforts are being made to construct a single working model from the battered remains of several of the captured machines.

5. The auto-key arrangement in the T52d differs from what it was at first thought to be (as mentioned in Report #F-101, IL 3892). When the KTF switch is thrown on the motor relations are as follows:-

Wheel	Driven by
47	71 dots, 73 crosses
53	73 dots, 47 crosses
59	47 dots, 53 crosses
61	53 dots, 59 dots
64	59 crosses, 61 crosses
65	61 dots, 64 crosses
67	64 dots, 65 dots
69	65 crosses, 67 dots
71	67 crosses, 69 dots
73	69 crosses, 71 crosses

It will be observed that these relations are the same as without the KTF (Report #F-46, IL 3501), paragraph 18, except that the 69, 71 and 73 wheels are now driven independently. The third impulse of the plain text enters into the motor picture. When P₃ is a dot motion is compelled in the 71 and 73 wheels; when it is a cross motion is compelled in the 64 and 65 wheels. From a mechanical viewpoint the motor arrangements (both with and without KTF) are the exact converse of what has been described. Each wheel normally moves with the encipherment of every letter but is prevented from moving if the requisite impulses are received from two other wheels. Thus the 59 wheel is prevented if there is a cross in the 47 and a dot in the 53. From a cryptographic viewpoint the original description is, of course, of equal validity. The actual connections of the KTF mechanism are not to the wheels mentioned above. A dot in P₃ is transmitted to the 69 wheel and prevents it from preventing motion in the 71 and 73. Similarly a cross in P₃ is transmitted to the 61 wheel.

SECRET

IL 36-A
F-105
Page 2

6. The additional plugs and plug-boards for Dragon have arrived. There have been two changes made in the machine. The plug-board has been re-arranged so that all impulses of a single letter appear together, the purpose being to facilitate checking of the plugging. The other change was referred to in Report #F 101, IL 3892. A panel of 5 switches has been added and any one Baud, or more than one, can be eliminated so that testing takes place only on 4, or less, impulses. It will probably not be found practicable to work with less than 4 impulses. Another change which will probably be made shortly will enable steps to be recorded automatically. A typed copy of the dechi will be placed in an electromatic typewriter which will step along in synchrony with the tape. A symbol will be typed on the dechi whenever there is a hit but the machine will go right ahead thus saving a great deal of time. Settings will not be recorded or noted but these are easily found when handtesting. All of these changes were (or will be) quite simple to make. Dragon has been out of order for the past day or two and the reason is not yet known. Up until the time trouble developed it had broken 35 transmissions.

Walter J. Fried
Capt. Signal Corps

Encls. A, B, C, D.

SECRET

DECLASSIFIED
Authority NND 963016

SECRET

IL 3957-A
P-105
Page 3

AMNAVDEL
Station X, England.
16 October, 1944

From: Ensign Milton Gaschk USN
TO : Op-20-G

Subj: Non-morse operating procedure, report on.

1. Two copies of this report are enclosed.
2. It is difficult to grasp or see all the fine points, or learn "trade secrets" of this procedure when there is no background in this type of intercept work. More definite information could be gathered if questions accumulated from similar work could be presented to the experienced operators, and ideas exchanged.
3. AMNAVDEL invites and encourages definite questions to be put forth concerning this activity.
4. Mr. Mason, Mr. Janes, and all supervisors were most obliging in giving the information contained in this report, and offered all assistance in any future requests.
5. It was strongly suggested that if any near future non-morse intercept activity is contemplated, training should not be delayed too long. Experience here has shown that all radiomen are not necessarily adaptable to this work, and the process of elimination does not take place until some weeks from the commencement of training. Four or five months should be allowed to build up a reserve of partially trained operators. This applies equally to women being trained in slip reading.

SECRET

DECLASSIFIED
Authority NWD 963016

NON-MORSE OPERATING PROCEDUREReceiving Room

The main type of intercept work confronting this activity is that of covering non-morse point-to-point transmissions. Two stations compose a "link" or "network" which are independent of all other circuits. The two stations concerned on any one "link" operate on independent frequencies - thus, one frequency carries only one station. To cover each station, two receivers, diversity fed, are employed.

For operating convenience, the two receiving positions, covering each end of a "link" are adjacent. In addition to the receiving equipment, each position consists of one teleprinter and one perforator. An extra operator is required for the latter two instruments. Therefore, four persons are necessary for each "link".

Recording Traffic

The manner in which traffic is recorded depends on existing conditions. These can be classified as follows:

1. If reception is good, with no interference, atmospherics, or fading, the teleprinter and perforator are cut in, giving three versions of the transmission:

- (a) Undulator tape.
- (b) Teleprinter tape.
- (c) Perforated tape.

The teleprinter tape, recorded in groups of five (five letters to a group) is affixed to a W/T form. All three (a, b, and c) when complete are given an identical station serial number and passed to the Slip Reading Room.

2. When slight QRM or fading is present, no perforated copy is made, only the teleprint and undulator tapes are produced.

3. When conditions are such that too many corrections would be required on the teleprint tape, then only the undulator tape is recorded. These corrections will be covered later in this report.

Operating Procedure

Each link has its own peculiarities. Normally, the practice is somewhat similar to C.W. interception. Accurate logs must be maintained. It is at this phase where close cooperation and physical proximity between the two operators of the same "link" is important. Messages are infrequently sent singly. The German operator when in the process of constructing the perforated tape for automatic transmission, punches three or four messages in series, and as these are sent enciphered, no breaks, separations, or space signs are apparent to the intercept man. Each message of the series carries its own in-

te

SECRET

SECRET

IL 391 A
F-105
Page 5

internal serial number. This tape is then introduced to the transmitting head and sent complete as one transmission. In addition, each tape contains an external serial number preceded by the "Q" signal "QEP", which is sent "enclair" prior to the switching of the machine to "cipher" position.

Once the tape has started on its way through the transmitting head, with the machine set at "cipher", there is no indication to the intercept operator on his undulator tape, of where one message ends and the next begins. Now, however, intercept man number two, straddling the German receiving station on the other frequency comes into the picture. Let us assume Berlin is transmitting two tapes, each containing three messages, to Sofia. Internal serial numbers 60, 61, 62, 63, 64, 65. External numbers, QEP 40 for the first tape, QEP 66 for the second. The Sofia operator having his machine set at the proper "decipher" position, receives the traffic in plain language, and thus can tell where one message ends and the second begins.

At the point where number 60 is complete, Sofia transmits to Berlin (machine set at "klar") "R R 60" followed by the time of receipt. Transmission from Berlin continues uninterrupted. "R R 61" and T.O.R. is given again when the tape has progressed this far. This information is logged and also passed verbally to the intercept operator on the Berlin side. All subsequent receipts on this tape are logged and these logs eventually reach the cryptanalytical section.

During the process of recording a transmission, a constant stream of chit-chat goes on between the two intercept men, and is simultaneously logged as it is read from the undulator tapes.

Before continuing, it might be explained here that the QEP number is the indicator group, and gives the set-up for the machine. Thus the multiple-message single tape (sometimes containing as many as 35000 letters) will be enciphered as if it were a single message.

As QEP 40 reaches the end of its run, two things can take place. Either QEP 40 continues until completed and QEP 66 is transmitted immediately following number 40, or else, on the completion of 40, transmission ceases, the German operator pulls back the same tape as much as 200 to 1000 letters, then transmits QEP 66 in the "klar" position, switches the machine to "cipher" and proceeds through the remainder of tape 40, followed immediately by tape 66, without any further introduction to the new QEP 66 tape. This superficially sound attempt to confuse gives us part of the text of tape 40 enciphered in two positions. The real reason for this helpful cooperation on the part of the German operator is not altogether understood. It sometimes occurs when a repetition, necessitated by QRM or the dropping of a character or two, is requested. Since there is no way in which the machine can be returned to that particular position, it is easier to re-run on a new position (setting), and the setting of the succeeding tape is chosen. If the entire tape has not been recorded satisfactorily, then the re-run is made at the original setting.

SECRET

DECLASSIFIED

Authority NND 963016

SECRET

IL 395(1
F-105
Page 6

The fact that the intercept operator covering Sofia can establish the approximate position on the tape where one message terminates, or the number of messages in each transmission is not of prime importance. But, the identification of the internal serial number is a major factor.

A message requiring transmission on more than one link is not "reperfed" with a new internal serial number, but the same tape is used for the re-transmission. When introduced on another circuit, a new QEP number is given which bears no relation to the previous setting. Identification however is made when the receiving operator receipts, using the procedure outlined previously.

The result is, two encipherments of the same text on independent settings!

Note: As it takes a few minutes to re-set the deciphering position of the machine, the QEP number is followed by a 3 minute pause before he transmission continues.

Search Group

Two operators are on continuous search. No teleprinter or perforator are employed. The procedure is much the same as in C.W. search. D/F stations are available for determining locations of new stations.

Antenna distribution panel

This equipment is located near the supervisor's desk. Twelve receivers can be plugged to each rhombic.

Slip Reading Room

All material, teleprinter, perforated, and undulator tape are canalized to this section.

If receiving conditions are ideal, the chances are favorable that all three tapes, recorded simultaneously, will agree. The purpose of this section is to compare the teletype copy against the undulator tape and make corrections on the former where necessary. The undulator copy will always be the most reliable. When conditions are adverse, the undulator tape will show up bad copy in a more recognizable form than teleprinter. The experienced slip reader has a better chance of reconstructing bad characters and determining the number of missing letters from the undulator copy than would be possible through the teleprint medium.

No amount of writing can demonstrate how to correct a bad group of letters, this technique comes only through constant practice.

For accurate reading, the slip reader manufactures a penciled gauge to conform to the particular copy at hand.

SECRET

The question was brought up by Lt. M.A. Anderson, USNR, in a previous report, why a metal gauge with prearranged distances could not be constructed and permanently mounted on the "slip table" to be used for all measuring work. This idea was mentioned to the slip supervisor, who explained that few undulator tapes are truly identical with respect to distances, but depend on character of signal being recorded plus motor speed.

When the correct gauge has been established, the slip is marked off in groups of ten letters. These ten letters are then checked against the W/T form - corrections or missing letters indicated (on the W/T form) where appropriate.

When no teleprint copy is available, the undulator material is transcribed by pencil on the W/T form.

To facilitate checking, if the transmission is a long one, the undulator tape is split and divided among three or four readers. Usually four W/T sheets and the equivalent amount of tape is distributed to each person.

About fifty readers constitute a watch in this room. A floor supervisor distributes work and directs operations on each watch.

The head supervisor with two assistants maintains the records and time sheets on all material in this section.

The following records are kept on each tape:

- Station serial number of roll.
- Time of receipt from receiving room.
- Name of floor supervisor.
- Time the roll (tape) is given to floor supervisor.
- Time completed
- Number of letters
- Time sent to perforation room
- Remarks (good, fair, poor)
- Procedure

"Procedure" as used here is a criterion of acceptability in regard to length of tape to the cryptanalytical section. Each circuit (link) has a name, z.b. SQUID, TUNA, etc. Each name then has a procedure sign, such as A1 = 9000 letters, etc. Thus, only traffic fulfilling these requirements is acceptable to Station X.

Three samples of time check were taken at random. This shows time delay only in Slip Reading Room:

<u>T.O.R. from Receiving Room</u>	<u>Time given to Floor Supervisor</u>	<u>Time Completed</u>	<u>Number of Letters</u>
0005	0125	0950	9000
0600	0655	1733	12500
1910	0755	1940	15400

(next day)

SECRET

DECLASSIFIED

Authority NND 96 30 16

How smoothly a message will flow through all stages of processing without interruption depends on its degree of priority. Station X decides from day to day which circuit has the highest urgency. A tape of lesser importance can easily be sidetracked for many hours if one is received later with a higher classification.

Upon completion of all checking and corrections, the undulator tape is transferred to a storeroom for filing.

The W/T form is sent to the perforating room for the final stage of processing.

Perforation Room

All W/T forms and perforated tapes eventually terminate in this room.

The equipment in this section consists of:

1. Teletype perforating machines.
2. Perforator duplicators.
3. Perforator tape counting machine
4. 2 Perf. transmitting channels to Station X.
5. Tape vulcanizing equipment

Two conditions are dealt with:

1. Quality of signal was such that perforated tape was made.
2. Signal too poor for perforation of tape.

Dealing with the first condition, a new perf. tape is made from the W/T form, this is then checked against original tape. If disagreement arises, both tapes are checked against the W/T form, this continues until one tape agrees, which by this time will contain a few patches. From this master, or patched copy, two clean duplicates are produced. One tape becomes the station file copy and is stored in the perforating storeroom. The other, after having been count checked and transmitted, is forwarded to Station X together with its W/T counterpart via courier.

If no perforated tape accompanies the W/T form, then two tapes are punched by different typists - then compared. If no discrepancies appear it is ready for counting and transmitting.

Two multiplex channels connect this section with Station X. Each tape is sent once over each channel. Station X compares the two copies, if they agree it is assumed they have been correctly transmitted. Considerable trouble has been experienced in the transmission stage, this is thought to be due to lack of sufficient maintenance personnel. It is here that much of the time delay is caused, a common source of annoyance is the tendency to drop characters.

Letter Count Check

One important factor must be brought forward at this point. The enemy uses no group or letter count in this traffic, which necessitates an above normal practice of accuracy throughout the entire processing procedure. It has happened that two typists punching tape of the same W/T form have dropped the same line, and on rarer instances, the same letter. (Typists do not copy simultaneously from the same W/T form). When this happens, the two tapes will agree on checking, but of course still be wrong. To prevent this, a perf. counter is used. The W/T form has 25 letters on each line. On starting the counter, the first letter on the perf. tape is checked against the first letter on the form, which must be the same. The tape is then run through the counter until the indicator shows "25", at this point the 25th position of the tape is compared with the same position on the form - this continues through each stage of 25 letters until complete.

Message Progress Sheets

A progress sheet is maintained on each tape, showing the time delays through each section, from the time the tape is received until it reaches Station X. Sample form is enclosed.

Four random samples were taken to show time elapsed from T.O.R. to T.O.T. to Station X.

<u>T.O.R. in Receiving Room</u>	<u>T.O.T. to Station X</u>	<u>Number of Letters</u>
0048/4	0925/10	3400
1617/6	0850/10	24568
1619/9	1135/10	3860
0034/10	1247/10	7200

Training

An independent group carries on all training, which can be subdivided into three stages:

1. Teletype keyboard instruction for girls being trained for perforation work.
2. Undulator tape reading for both radio operators and slip readers.
3. Radio operating instruction.

The source of civilian trained typists has long been exhausted. Consequently, many of those hired now require typing instructions. Little need be said about this phase of training. The problems are much the same as teaching punch tape operators in 20-G.

SECRET

IL 3950-A

F-105

Page 10

Teaching undulator tape reading is one of the major problems in this work. Both slip readers and radio operators must become highly proficient at this. Examples of gauges, exercises and instruction sheets are forwarded with this report.

The undulator alphabet is usually learned in three days, then three more days are allowed for practice. The instruction from here on is as follows:

1. Introduction to automatic and hand sent signals.
2. Teaching the perforator code, which is the same but read in terms of "holes" instead of the undulator tape.
3. Familiarization with operators' remarks.
4. Attack on actual tapes, practice in correct gauging.

After one month's training, a slip reader should be able to transcribe undulator tape to a W/T form at a speed of 30 letters per minute. Another month is allowed for building up speed. This takes care of the slip reader, now qualified for actual work. Girls are used exclusively for slip reading. Extended observations have proved the advisability of using the superior patience of women in this monotonous work.

The operator must now be considered. His course of instruction parallels that of the slip reader for the first month. During the second month of training, the mornings are devoted to continued slip reading. Afternoons are spent in the operating training room. Here the following subjects are covered:

1. Log keeping.
2. Recognition of tones.
3. Efficient receiver control.
4. Proficiency in translating operators remarks.
5. Q signals.
6. Learning upper and lower keyboard characters as 5-unit symbols.

After a month of half days, the operator spends another two or three full weeks in this practice. He is then used as relief operator or on slack circuits until considered capable of holding down a regular circuit without supervision.

The speed of transmission is 66 wpm. The operator must be able to keep up with all remarks and Q signals, recording them in his log, keeping the other operator informed of conditions on his side of the "link". Keep his tape rolled, marking it with the correct station serial number and cutting it at the appropriate position when the transmission culminates.

Frequency shifts occur even during periods of good signals, apparently in an attempt to throw off the intercept operator. Generally when conditions deteriorate, the appropriate Q signal, requesting or directing to shift to _____ kcs., or to shift up or down followed by a number denoting the number of kcs., is given. Thus the operator must be

SECRET

DECLASSIFIED

Authority NND 963816

able to scan the tape at transmission speed. Fortunately most requests for frequency shifts are sent in the "klar" position. Sometimes this helpful bit of information is hidden when the German operator keeps his machine on "cipher" and the transmission ends abruptly. The operator must then decide whether this is the end of a message, or a frequency shift. Experience now helps in making the correct decision.

About 25 frequencies are available to the German operator. The intercept man must decide on which of these he is most likely to pick up the new "link".

The majority of the operators are former radiomen. At first it was thought that experience gained in C.W. transmissions was of little aid, until one day they shifted to C.W. and used international morse. Another trick is keying the tone. The few men having no knowledge of morse, are given an hours instruction daily.

A few women are used on circuits, but the preference is for men. Although many reasons were given for this preference, it is not deemed necessary to go into detail on this subject.

Some HRO receivers are used, but they have mostly been replaced by the RCA-AR89. The HRO was found to be a bit too selective for this work.

On links where the quality of signal is consistently poor, the reception is augmented by the use of distant antennas. One antenna is located 500 miles to the north, the other less than 100 to the south. The transmission lines have boosters every 50 miles. The three signals cannot be mixed as in diversity, but are recorded independently.

SECRET

ERRATA SIGNIFICANCE TEST SCREEN

1. All notations

$${}^{2r}C_{r+a}$$

in probability formulae, are wrong.

The notations should read

$${}^rC_{\frac{r+a}{2}}$$

as correct.

2. All notations ϕ mean zero and not phi.

3. Page 3 just above the last paragraph

$$\text{Significance factor} = (1 + d^2)^{\frac{n}{2}} \prod_{a=0}^{\infty} \sqrt{K(a, d)}^{h_a}$$

is wrong. It should read

$$\text{Significance factor} = (1 - d^2)^{\frac{n}{2}} \text{ etc. as correct.}$$

4. Page 9 Plausable is wrong. It should read Plausible, as correct.

Small

SECRET

SECRET

16.10.44.

The following further captured machines have been received.

1. German Teleprinter Cypher Machine. Type 52b. No. 34494. Manufactured 1941. Parts of machine smashed but wiring almost intact.
2. Wheatstone Transmitter. No. 80244. In good condition.
3. Undulator. Type MSE 139a. No. 4105/298. In good condition.

W. G. Welchman

A.D. (Mch).

Distribution.

Director

D.D. (4).

D.D. (N.S.)

D.D. (A.S.)

D.D. (M.W.)

D.D. (C.S.A.)

D.D. (C.T.)

A.D. (C.C.R.)

Capt. Fried. (3)

Lt. Eachus.

I.E.

File

SECRET

DECLASSIFIED

Authority NND 963016