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STANDARD FORM NO. 64

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# *Office Memorandum* • UNITED STATES GOVERNMENT

TO : **The Files**

DATE: **31 October 1958**



FROM : [redacted] 25X1

SUBJECT: **Trip Report - Noise Modulated** [redacted] 25X1

1. On 28 October 1958 a visit was made to [redacted] 25X1
[redacted] to monitor the progress of RD-128, 25X1
Task Order 7, study of noise modulated [redacted] Participating in 25X1
discussions concerning this program were:

[redacted] 25X1

2. [redacted] reviewed the theory of noise modulation and 25X1
detection. He pointed out that the correlation detection employed in such systems utilizes the total energy present in a signal regardless of its waveform and that the waveform of a signal may vary greatly without any loss in total energy transmitted. Anti-jam noise systems employ a rapidly changing waveform which the enemy finds extremely difficult to duplicate, and without an exact replica of the signal, demodulation is impossible. If the energy in the signal is uniformly distributed in both time and frequency, it sounds like normal background noise to conventional intercept equipment. The ability of the correlation receiver to integrate widely dispersed pulses makes it possible to recover signals well beneath the noise level, thus providing another avenue of protection against unfriendly intercept.

3. The extent to which the system will operate below the ambient noise level is determined by the WT product - the combination of baud length and bandwidth. The greater this WT product, the greater protection a signal has against jamming or intercept. Since any single pulse, regardless of its shape, has a WT product of 1, it is necessary to transmit a string of pulses for each baud to gain a WT advantage. [redacted] said that two techniques are in current use for generating 25X1
such a string of pulses.

4. The first method, used in the [redacted] is a multiplier- 25X1
integrator system which transmits the output of one of two key generators representing mark and space. An exact duplicate of the key generator signal used at the transmitter must be available at the receiver for comparison purposes, and it is here that the principal shortcoming of the multiplier-integrator technique is evident. Precise time information

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is needed to keep the two reference signals in synchronism, since the slightest drift causes the correlation detector output to fall off sharply, and with very much "loss of sync" the intended receiver is no more able to demodulate the incoming noise signal than is the enemy intercept station. Attempts have been made to transmit the reference signal to the receiver on another frequency, according to [redacted] but the path losses and distortion introduced make such a solution practically worthless. 25X1

5. In the second method, an impulse is sent into a complex filter, and the output of the filter, which appears as a badly distorted noise signal, is transmitted to the receiver. There it is fed into a complementary filter and emerges as a reasonable facsimile of the original pulse. These two filters, [redacted] observed, are merely a split delay line. The structure of the delay line is changed constantly according to a prearranged code to frustrate enemy analysis. Precise time synchronism is not necessary with matched filter systems, but the complexity of the filters makes it doubtful that this is a suitable approach for our noise modulated [redacted] 25X1 25X1 25X1

[redacted] said that [redacted] has recently designed a matched filter system for [redacted] and that it was being constructed at [redacted] It is a 60 wpm system using a 10 kc bandwidth. 25X1 25X1 25X1 25X1

6. [redacted] said that it was now possible to predict certain things about the proposed noise modulated [redacted] that were not certain when the program began. A crystal oven in the field unit now appears almost inevitable, since the stability of the transmitted signal is extremely critical. If more than about 10 cycles of frequency drift occurs, according to preliminary calculations, the message could be missed completely. FSK modulation will probably be used and about 23 db of signal compression is anticipated. It may be advisable to begin transmitting the signal gradually so that there is no abrupt increase in noise level on the operating frequency. [redacted] strongly urged that a [redacted] similar to that used to [redacted] be incorporated into the receiving equipment to combat multipath. He said that 7 to 8 db of signal power would be lost if multipath reflections - which contain a sizable amount of the transmitted energy - are not recovered and correlated. The contractor inquired whether a short burst of CW could precede the transmitted message for time and frequency synchronization. He was told that such a solution was highly unsatisfactory and asked to investigate the suitability of a 100 millisecond recognition signal using a very simple code which would carry little or no information but which might solve the recognition problem. He was told that the base station would know [redacted] 25X1 25X1 25X1 25X1

[redacted] 25X1