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At that time it was concluded that the probability of intercept was so low that the chances of detection were so low as to justify the risk involved. Unless a full scale effort were mounted to attempt detection

Subj  
Ref (A)

Encl. (1) Probability of Detection of Satellite Systems  
By Bruce Wald.

1. Ref (A) Reported the detection of 7102 Satellites by [redacted] and requested technical comment on the probability of intercept studies and the technical difficulties involved in encryption.

2. The problem of the probability of intercept was raised initially during the review of the project prior to its approval by the Secretary of Defense's office. At that time Encl. (1) was written and a copy of this report was reviewed by the D.S.D. Secretary's office prior to approval of the project. A technical review of this report has been made but no new technical factors have been added which would modify any of the basic parameters. Copies of this report are enclosed.

3. During the early phases of this project extensive efforts were made to detect [redacted] satellites at the various [redacted] Navy Elint

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sites by the N.Rh. representative while ~~at the sites instructing stations~~ at the stations during the operational instruction period, without success.

also conducted similar checks using their best Elint equipment and a 60 foot antenna <sup>which was</sup> trainable in azimuth and elevation.

who conducted these tests was unable to intercept the signals from ~~our~~ our first Great Satellite.

4. Unfortunately in 7102C Satellite the 85 to 105 M.C. Band contained several television signals which triggered the satellite system almost continuously. These long video pulses which form the television picture caused the satellite to trigger almost continuously while over Europe. This in effect caused the signal to be present almost continuously. This of course enhanced the detection probability since instead of functioning on an intermittent low duty cycle pulse system basis it now was emitting an almost steady signal. Thus by using the beat frequency oscillator <sup>to aid in detection</sup> considerable advantage in sensitivity would be available to the intercept receiver.

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5. The intercept by [redacted] resulted from considerable A priori knowledge. Lt [redacted] who is the C/O of the station actually wrote the major portion of the SOP when he was stationed at the Naval Security Group Headquarters prior to his transfer to [redacted] so he was thoroughly familiar with every detail of the Satellite design and operations. Also a major portion of the stations operating personnel are cleared for the Poppy program and actively participate in it so their knowledge of the signal characteristics is complete. These same personnel also have participated in the attempts to intercept the Satellite which were conducted by NRH personnel at [redacted] during the early phases of each operation. The station also has improved its capability for intercept in this band through the acquisition of new type GFL receivers with somewhat better ~~sensitivity~~ <sup>sensitivity</sup> than the conventional ECM type receivers usually employed in this range. Also the <sup>large</sup> Log Periodic antenna installed at this station provided considerable gain [redacted] usual broad band antennas utilized at most Elint sites. The

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The altitude of the ~~satellite~~ during the test was very much similar to that during intercept.

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possessions of these refinements plus the a priori <sup>knowledge</sup> available established a potential capability not available at most F-117 sites. However the low altitude (approximately 190 N Miles) at the time of intercept compared to the 500 M. Miles which is nominally desired for these satellites gives a major increase in signal strength. The monograph Encl. 2. shows the path losses for various satellites using line of sight propagation paths. by Mr Mayo of NRW ~~attempted~~ simulated the equipment configuration used by  ~~at this~~ <sup>site</sup> ~~intercept~~ at the <sup>site</sup> Hupla Valley. Using all the same A priori knowledge  had available Mr Mayo was unable to detect the satellite 7102C until the third orbit monitored, though it was emitting the same type signal as in Germany since the TV Station in Richmond Virginia was exciting it almost continuously in the 85 to 105 M.C band. Beyond accurate measurements could be made  the signal to narrowband the satellite burned up in the earth's atmosphere.

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gineers ~~have~~ feel the summary of the above data on the interception of the 710 2<sup>0</sup> signals is as follows: There has probably been some gain at the Elint sites in the past five years in system sensitivity and antenna gain but there are not major increases and would only have slight effect on the probability of intercept figures shown in Wald's original reports. The most significant factor which made the intercept possible was the extremely low perigee (100 miles or less when intercepted) and the presence of an almost continuously transmitting signal from the data channel. The usual intermittent character of the signal with large percentages of times when the receiver is quiescent was not available to lower the probability of detection. In general it is felt that an effort considerably in excess of the usual Elint type operation would be required to detect this signal. It is felt that the probability that the Soviets detected this signal with Kraus

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ly remote. The best assurance against detection is to strive with increased emphasis to place the Satellite in the desired 500 N. Mile altitude orbit.

8. From the inception of this project NRI Engineers have faced the reality that with the increased number of satellites in orbit and realizing that Elint Capabilities throughout the world are improving slowly but steadily, eventually ~~encryptions~~ <sup>encryphment</sup> would be required. Since NSA is recognized as the authority in this field a review of the present state of the art was requested by NRI. [ ] of the encyphment area of NSA lead the discussion and furnish the following summary of engineering state of the art.

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