DDI-434-69

13 February 1969

MEMORANDUM FOR: Deputy Director for Intelligence

SUBJECT : Warning Capabilities of Near-Real-Time Photographic Satellite Systems

1. The attached memorandum is a critical examination of how well near-real-time photographic satellite systems are likely to perform the strategic warning task. The major findings are that such a system would provide a valuable addition to our capabilities for strategic warning of large-scale attack against Eurasia involving ground forces, but it would make only a marginal improvement in our warning capabilities for attack against North America. Unless other more suitable indicators of intercontinental attack can be developed, these findings bring into question whether the improvement in our warning capabilities would be worth the investment and five-year operating cost of up to [redacted] for such a system.

2. The memorandum addresses itself only to the strategic warning problem; other uses for such a system have also been suggested but are not covered in this examination. The memorandum proposes that these other possible uses be examined similarly and that certain critical factors in the warning role be studied in greater detail.

3. Because much greater warning capabilities for a near-real-time photographic satellite system have been assumed by some people in the Agency or implied in their writings, I recommend that this memorandum be circulated to them for background. I shall, of course, pass it to Roland Inlow for use in his study of the problem.

Edward W. Proctor

EDWARD W. PROCTOR
Assistant Deputy Director for Intelligence

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13 February 1969

MEMORANDUM

SUBJECT: Warning Capabilities of Near-Real-Time Photographic Satellite Systems

1. Much has been assumed about the warning capabilities of the near-real-time photographic satellite (NRTPS) systems currently under consideration. The purpose of this memorandum is to make a critical examination of the capabilities such systems are likely to have for providing indicators for strategic warning, especially of activities consistent with preparations for an attack against North America or Western Europe. NRTPS systems would not be suited for providing tactical warning of such attacks; we would have to depend on such sources as BMEWS and SIGINT, for example, to provide information that the USSR had actually launched its long-range missiles and aircraft.

2. This memorandum examines the kinds and characteristics of the indicator targets likely to be available when a system of this type might become operational. It assumes that the system itself would perform as expected and that photography of a given installation

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would be of sufficient quality to determine whether a specific target was actually on alert. The principal sources for this examination are a COMIREX paper and a draft memorandum from NRO.*

3. The COMIREX paper presents a list of more than 500 targets in fourteen categories where photographable changes could provide indications of preparation for attack. These installations have several characteristics which affect the capability of a NRTPS system to provide strategic warning. Principal among these are the number, type, and location of these targets and the weather and light conditions present.

4. Many of these targets are close together. Because all of the NRTPS systems currently being considered are "spotting" systems, only a portion of the targets on the list could be photographed in any one day. Although [redacted] satellite system could be programmed to acquire photography anywhere in the world on a given day, it must be aimed at a very small area on the earth's surface (5 nm to 10 nm square). Because time is required to re-aim the system, usually only one target from among the many in a cluster could be programmed

*The COMIREX paper, Requirements for Image Forming Satellite Reconnaissance Responsive to Warning/Indications Needs, was dated 5 January 1968. The NRO draft memorandum with the same title was transmitted informally to Mr. Tidwell on 23 September 1968.

during any single pass over the area. One of the more comprehensive NRTPS systems photographic satellites considered in the NRO draft memorandum could be aimed at an average of the 500 targets during any one day.

5. Another consideration is the fact that several of the 500 targets on the COMIREX list will probably be phased out of Soviet forces at about the time a NRTPS system becomes operational. Specifically, the current NIPP projects the complete phase-out of two large categories of targets-- Without these two categories, a little more than half (284) of the targets would remain. Some 43 of these targets would fall in categories associated with intercontinental attack The remainder (241)--related to ground forces and aircraft and missile bases--fall into categories related to Eurasian attack.

6. Many of the intercontinental attack bases are in areas with seasonally poor light and weather conditions. Sixty percent are continuously dark during the winter for periods ranging from more than one month to four-and-a-half months (average 55 days). In other words, after the soft ICBM sites are phased out and a NRTPS

system becomes operational, only [redacted] intercontinental attack warning targets could be photographed during December--weather conditions permitting.

7. When weather conditions are considered, we could expect in typical December weather to obtain a total of 87 photographs of these intercontinental attack warning targets during the entire month (an average of 2.8 per day); these photographs would probably include repeated coverage of some targets, and some might not be covered at all.* December is obviously the worst month as far as light conditions are concerned. During June photographic conditions for these targets are considerably better, and we should expect to acquire almost four times as many photographs of these intercontinental targets (an average of 10.4 per day) than in December.

8. Some effects of weather can be illustrated by examining conditions at the [redacted]--a base not in the winter dark zone. The base was obscured by clouds (more than 25 percent cloud cover) for about 63 percent of the time during 1964, but more important the clear periods were much shorter than the

*This calculation includes the effects of the "cluster-spotting" consideration discussed in paragraph 4.

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cloudy periods. For example, there were only three periods with more than 5 clear days and fourteen periods with more than 5 obscured days during 1964; one of these obscured periods lasted 20 days.

9. The confidence we can have in the capabilities of a NRTPS system to provide warning indications depends on two more factors.

a. The size of the sample necessary to provide a given level of confidence of detecting a significant change in the alert status of the indicator targets in various categories, and

b. The minimum lead time during which the various targets would exhibit these photographable indications of alert.

10. The COMIREX paper presents estimates of both these factors for each of the categories of targets. For example, in the case of one of the intercontinental attack categories,

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sufficient to provide 90 percent assurance of detecting a significant change in the alert status of these bases.*

11. All the factors related to the target categories--location, light and weather conditions, and minimum lead time can be combined with the expected performance [redacted] comprehensive NRTPS systems** to assess how much of the needed photography it would acquire. The following tabulation presents the results of calculations combining all these factors and shows,

*The statistical assumptions used to determine the sample size necessary for various levels of assurance are more applicable to large populations and large samples from such populations. When the size of the population is small and the size of the sample is 10 or less (as is the case for most of the categories), somewhat larger samples are required. The size sample necessary for a given level of assurance depends upon the portion of the population normally on alert and the variation in this portion. Because information on these factors has not been developed, it was assumed that the portion normally on alert was the same for all categories (10 percent) and that there was little or no variation in this figure. Until refinements in statistical method and more realistic assumptions about alert status can be made, conclusions based on these calculations must be considered illustrative. Such refinements would probably result in some undetermined reduction in the estimated effectiveness of a NRTPS system.

**The system considered in this calculation is described in the NRO draft memorandum and involves [redacted] sensor satellites and one relay satellite in orbit. NRO projects non-recurring cost at almost [redacted] and annual operating cost at more than [redacted] Costs of exploiting the imagery after it has been collected are not included.

in percentage terms, how much the expected yield would be above (+) or below (-) the number of photographs required for 90 percent assurance of detecting a significant increase in the alert status of each target category for two months--a typical December and June:

Target Category	December	June
[redacted]		

12. From this, it is clear that there is likely to be enough photography on only one category of intercontinental attack bases [redacted] to have a high assurance of detecting significant increases in alert status. Unless other types of more photographable targets can be developed as indicators of intercontinental attack alert, a fairly complex and

costly NRTPS system is not likely to add much to our ability to provide strategic warning of intercontinental attack.

13. The case is somewhat different for indicator targets for Eurasian attack. The tabulation shows that during winter and summer there is likely to be more than enough photography on three ground force associated categories--[redacted]--to provide high assurance of detecting significant changes in alert status. To this could be added bases for [redacted] support during non-winter months. The NRTPS system would not be expected to provide sufficient photography for high assurance of detecting a significant increase in the alert status of the remaining target categories for Eurasian attack--[redacted]

14. An examination of the factors affecting these calculations reveals that one of the most important is the estimate of minimum lead time, the period from the time when a target would first show detectable signs of alert status to the time when weapons or troops would arrive on target. In all categories involving aircraft, the

minimum lead times range between a few hours to a day or two. With such short lead times it is not surprising that none of these would work out favorably. In the categories involving ground forces and logistical support, the minimum lead times are as high as ten days. Because of this, because there are a large number of ground force targets, and because these targets are generally located below the winter dark zone, we should expect the results obtained.

15. Obviously, if the Soviets were to take longer than the minimum lead times to attack, there would be more opportunities to photograph targets on alert status. The Soviet invasion of Czechoslovakia is a case in point. Not only was the lead time two or three times the minimum required, but also this event occurred in the summer months and involved ground forces primarily. In this particular crisis situation, other sources had provided sufficient information for us to determine twenty days before the event that the Soviets had assembled and positioned forces capable of occupying Czechoslovakia. A NRTPS system would have provided more comprehensive, continuous, and responsive coverage of the activities as they developed. The question then, as it would have been if we had a NRTPS system available, was whether the Soviets intended to use these forces to occupy Czechoslovakia.

16. In sum, one of the more complex and costly NRTPS systems considered by the NRO would provide valuable additional indications for strategic warning of large-scale attack against Eurasian targets involving ground forces; it would provide only marginally additional indicators of preparations for surprise intercontinental attack. Unless other more suitable indicators of intercontinental attack can be developed, these findings bring into question whether the increase in our warning capabilities provided by such a system would be worth investment and five-year operating costs of [redacted]

17. The NRO draft memorandum raises this point explicitly:

> "The costs involved in continuous operation of a [redacted] satellite imagery system inevitably lead to the serious question of the economic feasibility of a system dedicated solely to the Warning/Indicator mission. Fortunately, if adequate data return capacity is provided, some of the system concepts considered will have collection capacity and access such that a great deal of other imagery can be acquired without interfering with the imaging of the Warning/Indicator targets."

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The COMIREX paper reaches essentially the same conclusions. For this reason uses other than strategic warning have been suggested including "crisis management", general area search, target surveillance, and monitoring of an arms control agreement; these have not been addressed in this memorandum. Thus, the question is not whether a NRTPS system would provide information that would be useful. Rather, the question is whether the additional capability to acquire such information with the flexibility and the speed of response and the continuity of flow of a NRTPS system is worth the costs involved and whether sufficiently compensating trade-offs can be made by transferring some of the search and surveillance tasks from other systems (KH-8, 9, and 10) to a NRTPS system.

18. Obviously, this has not been a definitive discussion of the effectiveness of a NRTPS system for strategic warning or other possible purposes; therefore, additional studies are necessary to determine whether a NRTPS system would be worth the cost. Some of these have been noted above; these include improvement in the statistical methodology, the development of new indicator targets especially for intercontinental attack, and refinement of

estimates of lead times not only for the USSR but for other geographic areas as well. In addition, studies of the use of a NRTPS system for other purposes must be made and the trade-offs in performance and cost examined before any large investment is committed to a NRTPS system.

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