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Requirements for Image Forming Satellite Reconnaissance Responsive to Warning/Indications Needs

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5 January 1968

Introduction*

1. The steps that might be taken by a nation initiating hostilities might range from those limited actions required to attain maximum surprise to intensive and widespread preparations involving all or most of the components of the armed forces as well as major segments of the economy and civil defense entities to insure that maximum weight would be applied while attempting to hold damage from retaliation to acceptable levels.

2. Whether enemy steps to assure readiness for war involve a minimum of preparation or widespread preparatory activity, there would be concomitant warning indicators. Our ability to detect and correctly evaluate these indicators would vary with the degree of enemy preparations but the detection and evaluation processes can be considered in terms of two fairly specific categories as follows:

a. Tactical Warning - Warning of the actual approach of the enemy (or his weapons) acquired by mechanical sensors, for the most part, transmitted through operational channels to tactical force commanders for prompt tactical reactions and countermeasures.

b. Strategic Warning - Warning of enemy preparations to attack acquired by intelligence sources and methods, transmitted through intelligence channels, evaluated by intelligence organizations, and passed to national security authorities at the highest level for use in determining national policies and reactions.

3. Within the above defined categories, there is a major difference in the degree to which each imposes demands on the intelligence community. The time span during which tactical warning may be possible

*Discussion in paragraphs 1-5 is consistent with the conclusions and text of NIE 11-10-66. Like the estimate, discussion is oriented toward the possibility of hostilities between the U.S. and the USSR. Should China, or some other power, develop a threat similar to that now possessed only by the USSR, system requirements expressed in paragraphs 11-14 would remain the same.

could be limited to the flight time of an ICBM from launch to impact in the target area -- an elapsed time of about 30 minutes. Such warning information would be important to the intelligence community for its own purposes but, within the limits of the available time, there appears to be very little that intelligence processing can add to such information that would enhance its value to command authorities. Should the enemy decide to add weight to his ICBM attack by employing long range bombers launched from normal operating bases, there would be an interval of five or six hours between departures from bases and detection by U.S. early warning radars, thus, extending the time interval for tactical warning, i.e., "the approach of enemy weapons," to a few hours rather than a few minutes.

4. A different set of circumstances would prevail if a decision were made to initiate a maximum weight attack. In this case more long range aircraft, including medium bombers, would probably be used, and a pre-strike maintenance standdown would probably be carried out. Aircraft would probably be staged through the Arctic bases and more missile submarines probably would leave port and move to launch positions within range of U.S. targets. Other elements of military forces likely would be brought to maximum alert and even deployed to advanced positions in preparation for a simultaneous attack against Europe.

5. It is also possible that the initial attack might involve an effort somewhere between the extremes of maximum surprise and maximum weight. In these cases the attack mix could include as much of the strategic missile, submarine, and bomber force as could be readied but might involve only those defensive elements and ground forces that could be employed without extensive preparation.

6. Although the role of indications or warning intelligence is the same for each of the three cases, i.e., to provide an alert to U.S. defenses and hard, credible information to decision makers, it is obvious that the short time lapse between missile launch from hardened silos and warhead impact on U.S. targets (total 30 minutes) makes warning of maximum surprise extremely difficult to obtain. If, however, a useful

and practical image-forming warning system can be developed against the maximum surprise attack alternative, we could expect to do better against a maximum weight attack or against a compromise of surprise and weight. For this reason we will examine image-forming satellite sensors in light of their potential to contribute to warning of a maximum surprise attack, then successively study them in terms of providing warning of hostilities requiring longer preparation time or more comprehensive preparations.

Maximum Surprise Attack

7. The intelligence task posed by a maximum surprise attack is to obtain instant knowledge that missiles are about to be or have been launched from known hardened ICBM and IR/MRBM facilities (which could be peaked to readiness without revealing external indications), from mobile launchers that may eventually be deployed to supplement hardened facilities, and from submarines on stations or near pre-determined launch points. Currently the U.S. has in operation the BMEWS system which can detect and warn of a trans-Arctic missile attack about 15 minutes after launch or about 15 minutes prior to impact on U.S. targets. No complete operational system is deployed to provide continuous warning of a submarine launched missile attack*, that is, to sense these missiles after launch and prior to impact. An attack involving only submarine-launched missiles, however, does not seem sufficiently realistic to justify considering it in isolation at this time.

Reconnaissance Requirement

8. Image-forming sensors flown so as to provide high probability of detecting missile launches during the three-minute interval between launch and first stage burnout, could add 12-15 minutes to the BMEWS warning time. To be effective, imagery surveillance must be continuous and must provide information almost in real time. We have looked into possibilities for obtaining prelaunch or on-launch indications of an ICBM attack from SIGINT

*The first detected movement of a number of submarines to potential launch positions, however, would almost certainly bring on a state of U.S. military alert.

satellite reconnaissance but we are not persuaded that payoff is likely*. In our view the requirement for continuous surveillance of the USSR and eventually China (and perhaps other areas as may possess an ICBM capability) completely rules out using aerodynamic platforms for acquiring imagery.

9. At present and for the foreseeable future, the state-of-the-art limits choices of mechanical image-forming sensors to three types that may be carried by satellite vehicles**. These are: conventional photographic***; [redacted] None of these appears to offer a solution to the problem of obtaining warning against an ICBM attack commensurate with the enormous expense of building and maintaining systems needed to provide even a minimum chance of success****. [redacted]

[redacted] Air Force projects beginning with MIDAS and moving through 461 to 949 have been designed to accomplish this goal. The successes demonstrated by the now operating project 461 are extremely encouraging and promise that 949, if successful, may be a means of adding as much as 15 minutes to the BMEWS warning of a surprise missile attack.

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*This subject, however, requires an indepth study to identify warning/indications requirements for SIGINT and then isolating those requirements which could be satisfied in whole or in part by a satellite SIGINT sensor.

**It is recognized that technical breakthrough is possible and that sensors now not within the state-of-the-art may become operationally feasible at which time their warning potential should be evaluated.

***Throughout this paper the terms photographic and photography refer to panchromatic sensors; i.e., sensitive to visible light of all colors whether recorded on film emulsion or electronically.

****See Tab A for a discussion of problems inherent in producing applicable imagery from photographic [redacted] sensors in low earth orbit [redacted]

Maximum Weight Attack

10. The reconnaissance problem posed by either a maximum weight or an optimum weight attack is both easier and more difficult than that posed by a maximum surprise attack. It is easier because the former would require that a full array of military and economic preparations be undertaken, many of which likely could be detected through reconnaissance. On the other hand, since a maximum weight attack could develop from a decision made well in advance an enemy would have time to make subtle changes difficult to interpret, to adopt maximum security measures, and to mount large scale deception efforts.

Imagery Reconnaissance Requirements

11. Imagery reconnaissance can provide uniquely firm information on activity at a particular point in time. Knowledge that changes (possibly indicating preparation for hostilities) are underway can stimulate efforts to check other sources or to energize other collection efforts. By correlating imagery analysis with information from other sources* a more complete evaluation of enemy activities may be achieved which, if assessed to be ominous, would constitute warning that could be used to alert United States forces and National Command authorities. We believe that imagery reconnaissance can contribute vital inputs to the warning intelligence process if the requirements discussed in ensuing paragraphs can be met. In saying this, however, we are not endorsing development of an imagery reconnaissance system for the sole purpose of responding to warning/indications needs. Rather, our requirements should be interpreted as calling for a flexible system that can carry out the warning/indications role and at the same time possess a capability to assist in satisfying routine, current intelligence, and special reconnaissance tasks.

12. At Tab B is the rationale for target category selection; illustrative targets are named in Tab C. Tab D recapitulates briefings provided by the National Photographic Interpretation Center relating to the resolution required to report out essential elements of information pertinent to warning/indications. Tab E condenses the information from Tabs B, C, and D. It presents targets by category and against each category specifies the number of installations now included, the estimated lead time

*Quite logically, the reverse may also occur; i.e., other sources may provide tip-off information, in which case, imagery analysis could be used for verification.

available, the imagery resolution that must be delivered to the ground, the coverage frequencies and sample sizes deemed necessary*, the maximum obliquity permissible and the essential indicator activity (either negative or positive) which requires detection. To summarize, the important parameters that imagery reconnaissance must meet are:

a. Consistent production of about two and one-half foot resolution**,

b. The capability to accomplish daily sampling of target categories; and

c. The capability to deliver results to the ground within about an hour, i.e., in near-real time.

13. Implicit in the need for daily sampling is a requirement for a system (or systems) on orbit full time with the capability to deliver imagery to the ground for analysis soon after sensing has been achieved. Aside from the obvious advantages stemming from the ability to program for further coverage in full knowledge of information already acquired, the system, when called upon, should be able to deliver coverage of key installations to the decision authority within a few hours after sensing with the maximum proportion of this time available for interpretation and analysis.

14. In a crisis, whether resulting from increasing tensions or from sudden indication of an enemy alert, quick coverage of targets and receipt of information on them is mandatory if the premise of buying time for decision making is accepted as an important consideration. But to conclude that a quick-response system should be operated only when it is established that a crisis exists, introduces the probability that the capability will not be available when needed. Thus, we believe that once an imagery system capable of providing warning/indications information becomes operative, it must be used constantly, both to perfect management

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* Daily sample sizes are commensurate with obtaining a high statistical confidence (70-90%) of detecting abnormal activity occurring within a homogeneous target array. As shown in Tab G systems capable of meeting warning/indications requirements and at the same time able to accomplish routine or special surveillance tasks can fully program all targets within the lead times determined for each category. This indicates that such a system can handle almost any level of sampling required.

**See Tab D for summaries of NPIC briefings on the kinds of information that can be derived from this resolution.

techniques and to compile and continually update a data base of information for warning purposes. This data base, in all probability, will include many targets of high priority current interest. Also stemming from daily sampling and near-real time transmittal of imagery to the ground is the unavoidable conclusion that interpretation and analytical components must be able to cope with the products in a timely manner; otherwise, the collection system's potential will be wasted.

Present and Future Prospects for Obtaining Warning/ Indications Information from Satellite Imagery

15. The currently operating KH-8 high resolution photo system is providing resolutions well within the requirement for warning/ indications imagery. While the photographic swath acquired is quite narrow, the system is not overly limited in this respect. Instead, its major limitations are the inability to be on orbit on demand and the lack of capability to deliver imagery to the ground on a timely basis. Even at best, assuming that a regularly scheduled vehicle were on orbit over the right places and that a decision were made to deorbit a recovery vehicle under emergency procedures, unacceptable delays would occur before the photography could be physically acquired and interpreted. Were no vehicle currently orbiting, delays involved in obtaining launch, target coverage, film recovery and photo interpretation would be increased substantially. Limited improvements to timeliness over a short run probably could be obtained by instituting a capability for launches on demand (one day's notice probably would be the best achievable), for recovery of film after one day on orbit, and for processing and interpretation to be accomplished near the recovery site or inflight to Washington. While these modifications might be better than nothing as emergency measures in a known crisis, they do not scratch the surface of warning/indications needs since it is unlikely that daily sampling and return of data could be sustained even for a relatively short time.

16. In addition to inadequate response time, a further limiting factor is the failure of current high resolution reconnaissance to obtain sufficiently frequent coverage of warning/indications targets. As shown in Tab F, key installations subordinate to the Soviet Northern Fleet and to the Southwest Bomber Command received only intermittent high

resolution coverage from the 14 successful missions flown during 1966. Thus, though a photographic data base has been established on many of the locations included in Tab E that is of proven value for order of battle analysis, it is nevertheless essentially static information on a fleeting situation occuring weeks or months ago. In contrast, the data base necessary for warning purposes must present a current view of activities at installations against which repetitive coverage obtained almost daily can be applied to reveal abnormal activities or changes. Such a data base is not now available nor is it feasible to create and continually maintain one with satellite photography as long as the exposed film is stored on orbit for days and as long as physical recovery methods are employed in returning photography to the ground*. For this reason we believe that a principal task for a system capable of responding to warning/indications requirements will be to compile and update specialized information bases on the installations listed in Tab C.

17. The oncoming high resolution KH-9, with its 30-45 days on orbit and individual recovery of several re-entry vehicles, will have greater potential for warning/indications than has the KH-8. The longer orbit life will permit greater flexibility in acquiring coverage and will permit 30-45 days of continuous sampling while the multiple recovery capability will afford the chance to obtain samples over time periods of varying duration. Although the 30-45 day duration missions are attractive, there will be four periods a year of 45-60 days each when no KH-9 vehicle will be on orbit -- these periods presumably partially filled by 8-14 day KH-8 missions (assuming four successful KH-9 and four successful KH-8 missions a year). But, even if additional vehicles were added to the program for the purpose of providing continuous on-orbit capability the time interval between sensing and analysis (three days or more) will be excessive.

18. Also oncoming is the Manned Orbital Laboratory which, while configured to acquire very high resolution technical intelligence photography of objectives, will have a potential to obtain some coverage of warning/indications installations. Of particular interest are the plans for achieving long on-orbit life and readout and transfer of imagery to ground stations via

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*This is not to say that we should not go ahead with the development of such "norms" as may be deduced based on review and tabulation of data from past and future coverage.

data link and reporting by voice. But, as with the KH-8/KH-9 mix discussed above, unless provisions are made to achieve continuous on-orbit capability either by adding launches or by developing ways to increase on-orbit life, warning/indications requirements will not be met.*

19. Further in the future may be reconnaissance systems employing imagery producing sensors such as

during normal peacetime consitions--which, as discussed in Tab A, we believe are not likely to be overcome. As to requirements for reconnaissance capability, we note that the lead time permitted by a number of the warning/indications target categories, when coupled with the concept of daily sampling of target categories argues that this capability might be nice to have but hardly essential.** Therefore, while the potential for acquiring reconnaissance appears attractive, we believe that efforts to develop a photographic warning/indications capability should be accorded first priority attention.

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*A bench-tested concept based on modification of the KH-8 system and providing for readout of photography at about 2 1/2 foot resolution by data link has been suggested. This system proposes to have a response time of 2 to 11 hours from collection to readout depending on target location in relation to ground stations. Since on-orbit life probably could not exceed one month, and since access to the target area would be limited, two to three vehicles on orbit simultaneously or up to 36 launches a year would be required to obtain daily coverage.

** reconnaissance system, however, would be useful in any Trans/Post SIOP period for strike effectiveness assessment.

Impact of Meeting Warning/Indications Requirements on Other Programs

20. As stated earlier, the impact of a high resolution near-real time imagery collection capability will be felt throughout the intelligence community. Without knowing precisely what amount of imagery will be delivered to the ground daily, we are certain that new techniques for rapid scanning and communication of findings throughout the intelligence community will have to be developed. Although we have not studied interpretation and analytical aspects in detail, we are aware of efforts to develop electronic comparison devices for measuring and recording changes and generally keeping track of developments at selected locations. With the establishment of COMIREX in July 1967, two subcomponents responsible for certain aspects of imagery exploitation were constituted. As soon as a reconnaissance system capable of meeting parameters described in paragraphs 11 - 14 is defined, these groups will begin study of its impact and will make recommendations appropriate to its use. At that time comprehensive assessments will be made of processing problems and costs, analytical procedures, and plans for rapid communication of information to National Command authorities.

21. Beyond the immediate application to warning/indications analysis, is the potential for using a near-real time system to acquire high resolution surveillance coverage responsive to a variety of strategic or tactical intelligence requirements*. We believe that, except for crisis periods, once familiarity with individual installations is obtained and norms have been recorded, sampling rates can be reduced thereby permitting a greater percentage of system capability to be used in satisfaction of routine or special surveillance needs. Again, although we cannot at this time measure this interrelationship in terms of money and man-hours, we believe opportunities for achieving significant savings in other NRP as well as other intelligence collection programs will arise.

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*See Tab G for estimates of capability based on various concepts employing long-life vehicles and readout via data link.

Parameters for Image Forming Satellite Reconnaissance Systems Applicable to Warning/Indications Needs

22 Conclusions

A. Reconnaissance designed to provide warning of a maximum surprise missile attack as defined in NIE 11-10-66, must improve on BMEWS alert by producing instant information that an attack has been launched--thereby increasing warning time from the present 15 minutes to about 30 minutes. To do this surveillance must be continuous, warning given must be unequivocal, and reporting to command authorities must be accomplished almost in real time.

B. Because of system sizes, complexities, and number of vehicles required present state-of-the-art photographic sensors, [redacted] flown in low or medium earth orbits are considered to be technically and economically unwise means of obtaining warning of a surprise missile attack.

C. We are not aware of any image forming sensor system which is capable of adding even a few minutes to BMEWS warning of a maximum surprise attack. It appears that systems such as a [redacted] satellite (Air Force Project 949) or over the horizon radars are more promising avenues than imagery.

D. Imagery reconnaissance can contribute vital information applicable to warning/indications of a maximum weight or an attack combining weight with surprise if the following specifications can be met:

1. Consistent production of high quality imagery at about 2 1/2 foot resolution.

2. The capability to perform daily sampling of target categories discussed in Tab B, and

3. Ability to deliver interpretable imagery to ground processing center(s) in near-real time (approximately one hour) to permit presentation of information derived from imagery, or the actual imagery itself, to decision authorities within a few hours after sensing has occured. The maximum proportion of this time should be available for interpretation and analysis.

E. The impact of a high resolution near-real time imagery collection capability will be felt throughout the intelligence community. The system will demand the development of supporting interpretation and analytical techniques and procedures designed to assure the timely infusion of imagery information into intelligence and decision making processes and will be expensive both in terms of money and man-hour costs. On the other hand, we envision a multipurpose reconnaissance system that can assist in satisfying current intelligence, search, and special surveillance needs (see Tab G) as well as respond to warning/indications requirements. This should afford possible opportunities for savings through reductions, in, or elimination of, a wide variety of collection programs.

F. Present operational and future photographic satellite systems have been designed to produce suitable resolution for warning/indications, but these systems depend on physical recovery of the imagery and cannot respond to requirements for sustained daily sampling and the near-real time return of imagery to the ground.

G. While other image-forming sensors, such as [redacted] may eventually provide a capability for conducting [redacted] development of a photographic system should be accorded priority attention. This conclusion, we believe, is consistent with both the lead times that are available and with the premise that daily sampling of key target categories can assure timely detection of abnormal activity (see Tab E).

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H. Although current systems have established a photographic data base on most warning/indications targets that is valuable for order of battle analysis and other intelligence purposes, a warning data base must be compiled from frequent repetitive coverage so that deviation from norms may be recognized and assessed quickly. Such a data base does not now exist nor is it feasible to create and continually maintain one with photography from present systems. Therefore, we believe that an initial task for a system capable of responding to warning needs will be to establish and update an information base on applicable targets.

23. Recommendations

It is recommended that USIB:

a. In recognition of the possibility of a maximum surprise missile attack note that development and deployment of a [redacted] is a possible means of adding a few minutes to BMEWS warning.

b. Note paragraphs D and E above and confirm the desirability of having an imagery reconnaissance system or systems, meeting the specifications of D as applied to warning/indications of a maximum weight attack, and to the performance of current intelligence, search, and special surveillance tasks as outlined in E.

c. Forward the attached study to NRO for systems analysis to determine:

(1) Ways and means of meeting the specifications, including the optimum mix use of current and planned reconnaissance programs against existing search and surveillance requirements.

(2) The costs and time schedule involved, and

(3) Whether alternative specifications could result in substantial savings or in overall improvement of capability at small additional cost.

Use of Satellite Imagery to Warn of a Surprise ICBM Attack

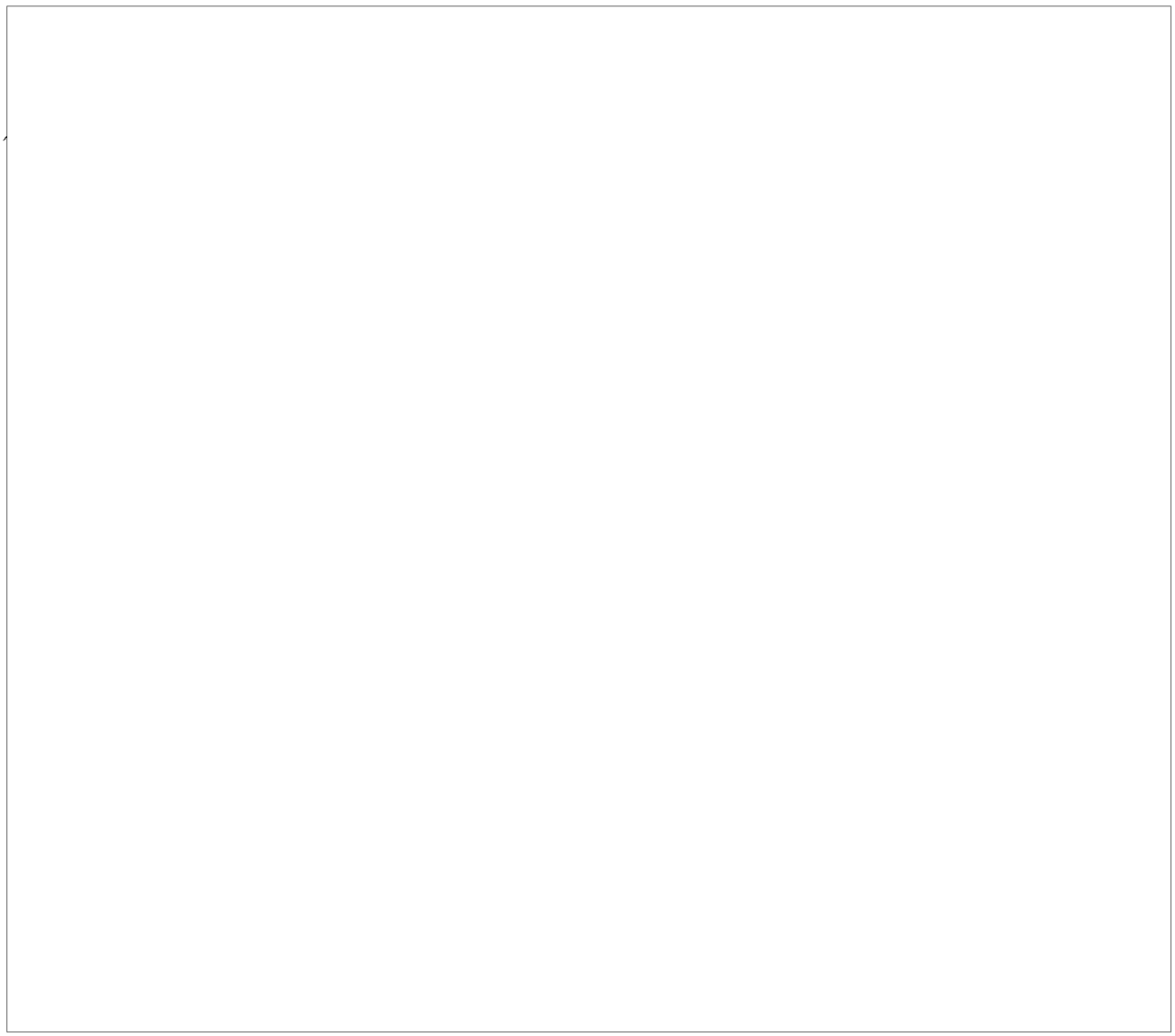
Conventional Satellite Photographic Sensor

1. To increase the present BMEWS tactical warning time through the use of a satellite photographic sensor would require continuous surveillance of the USSR with a system having at least 20-foot resolution. Although this requirement can be met within the present state-of-the-art by vehicles in low earth orbit, such an approach is not practical. For example, approximately 1500 vehicles with the KH-4 coverage capability on orbit simultaneously, with replacements added as individual vehicles become inoperative, would be required to achieve continuous daytime surveillance of the USSR. A photographic system, however, would be degraded by darkness; therefore, unless bright missile plumes could be detected, it is unlikely that useful information would be obtained at night. We believe that problems and costs associated with launch, control, readout and analysis of the required number of vehicles and their products would be overwhelming, thereby, precluding further consideration of this possibility.

2. Investigation of the alternative of developing and flying photographic sensors at higher altitudes shows that the number of vehicles required decreases proportionately with altitude flown, however, the number of vehicles required remains so excessively high as to be impractical, (i.e., at 2200 n.m. approximately 150 sensors on orbit simultaneously and continuously would be required).

3. A single photographic sensor at synchronous altitude could obtain virtually full coverage of the Sino-Soviet area but would need a focal length exceeding 200 feet to achieve 20-foot resolution. Building and flying a sensor of this size and weight is clearly prohibitive at this time.

4. Thus, in summary, it seems quite clear that use of a photographic satellite sensor system to provide warning of a maximum surprise missile attack is completely unsuitable because of number of vehicles involved, sensor sizes, or technical complications.



Tab B

Target Selection Rationale

1. The following target lists at Tab C are illustrative types of installations or activities on which an image-forming reconnaissance satellite can collect information having potential indications or warning significance. Tab E groups these targets by category and sets forth the amount and type of sampling required.

2. Against certain of these activities, satellite reconnaissance affords a unique surveillance capability relatively immune to enemy countermeasures; for others it can provide supplementary information. For instance,

a. While deployment of LRA bombers to Arctic staging bases can be accomplished under conditions of communications silence there is a possibility that detection of such moves may still be found in SIGINT. However, both their absence from home bases and presence at a staging base would be apparent on photography.

b. Actual deployment of LRA bombers in Eastern Europe would be detected by SENTINEL FAN, a pulsed OHD radar scheduled to be installed at Orford Ness, England, and oriented over the Soviet Union, primarily for R&D and detection of aircraft movements and missile launches. The system will be capable of detections to a range of about 2,000 NM from the site.

c. Deployment of long range submarines is susceptible to detection by SONAR and other means as they depart their operating bases and when they arrive at or near their operating areas. For this category of targets, satellite reconnaissance would supplement other sensors rather than constitute a unique collection capability.

d. Ground forces comprise a mixed bag of targets because of the varied kinds of activity involved and the varying degree to which these activities are susceptible to monitoring by other collection devices. Army combat formations in the interior of the Soviet Union are extremely difficult targets because of their remoteness from observation by Western observers and their security measures which restrict severely the amount of information which can be collected from their communications activity. Overhead photography of their installations and home stations is currently providing an increasing amount of information about their status but on an intermittent basis too infrequent for warning purposes. Mobilization and "fleshing out" of units not now up to strength would become apparent from frequently recurring photographs showing ground traces of increased equipment and training activity. Changes in numbers of personnel present would be inferential rather than direct because of the difficulty in determining whether the existing barracks and other buildings are only partially or fully occupied. Mobilization measures on a scale sufficient to become evident from photography of ground forces installations would be a rather long lead time activity also susceptible to detection by other collection sources. The release of tanks, vehicles and other mobile equipment to units being augmented could become apparent from either the absence of such equipment from normal storage areas or the increased quantities present at the receiving units. On this basis, holding depots should be included in a list because of the unique capability of overhead sensors to monitor such preparatory activity.

e. Extensive deployment of ground combat forces to forward areas could become apparent from their vacating home stations and congesting rail shipping facilities en route to and through border crossing points. Photography of railroad transloading and transshipment facilities would reveal increased

activity and het involve only a small number of targets. Evidence of such logistic moves have been reported by COMINT and ground observers. But days, and even weeks, have elapsed before it was possible to correlate and verify a full realization of what had occurred.

Submarine Operating Bases

3. The extent to which Soviet long range submarines might be alerted for participating in an attack against the U.S. could become evident in reconnaissance imagery of selected bases. The criteria for selecting these bases are:

a. Main operating bases for missile submarines.

b. Major naval submarine missile storages areas.

c. Major shipyard and repair bases at which long range missile submarines are nearly always present for repairs, maintenance, overhaul, conversion, or fitting out.

Medium Bomber Bases

4. Warning/Indications information relating to the alert status of the Soviet medium bomber force may become available through reconnaissance of the listed airfields. All are home bases for units which have frequently participated in Arctic staging exercises.

Fighter Deployment Bases

5. The activity at an air defense fighter base is considered to be of a nature which will not change substantially as the alert status changes. The most significant indicator could well be the deployment of these units to other bases along the periphery of the Soviet Union for the following reasons:

a. To close gaps in peripheral fighter defenses.

b. Dispersal to auxiliary fields of some aircraft to reduce vulnerability.

c. Deployment to bases nearer the routes of anticipated approach by enemy bombers.

The bases selected fit one or more of these criteria. They are normally not occupied and, therefore, would be a useful target primarily during a period of heightened tension.

Ground Forces Associated Targets

6. Deployment of ground forces combat units toward Soviet border areas has obvious indications significance. Such movement must be analyzed against a base of knowledge about related supporting activities and for that reason there has been added a listing of various support units which would also be involved in preparations for any military campaign.

7. Ground forces combat units in the Soviet Zone, Germany, are not considered to be lucrative targets for a satellite sensor for various reasons, among which are:

a. Proximity to training areas in which they could assemble and from which they could launch hostilities under the guise of a training exercise.

b. Movement from home bases to deployment areas could be accomplished during darkness or periods of cloud cover.

c. Ground observers and ground based detection systems are deemed more appropriate.

8. In view of the estimated likelihood that combat forces from the western USSR would be redeployed to augment forces in the GSFG prior to launching a ground campaign, those forces have been included in the target list. Military depots and other support forces in the same general area are also included on the assumption that their activities might provide evidence of preparations prior to actual departure of combat units from home bases.

9. Any list of ground forces targets prepared on the basis of present information must be tentative and subject to revision as a data base is developed by the addition of new information. The frequency of coverage of each target category can also best be determined from actual operating experience. In the initial phase of any reconnaissance warning program, daily coverage may be necessary to establish a norm of activity against which to judge whether subsequently collected information is so abnormal as to constitute warning. Similarly the number of targets in any category which will provide reasonable assurance of being valid sample of that type of activity will vary depending upon the full scope of information available, and the area in which such activities are located. Surveillance of support-type installations might not become necessary until after abnormal activities had been detected at the combat units which depended upon them for support. A trade-off could also be determined between numbers of targets and their categories, based on the existing international situation or the area in which a threat of hostilities appeared to be growing.

Missile Sites

10. Hardened missile sites are not considered to be a lucrative strategic warning target for a photographic image forming sensor. An operational missile site is always in a high state of readiness and could launch its missile in a short time, requiring possibly only a few minutes for preparation and this could be accomplished withoug any visible external activities affording any clues. The time interval between readiness and actual launch can easily be of such short duration that the missile could have arrived on target before the reconnaissance vehicle could complete the sensing and reporting cycle. During periods of international tension it could become

desirable to add hardened missile sites to the warning list but it is believed that their inclusion at other times for repetitive coverage would not develop a base line of significant activity useful for warning purposes.

11. Soft missile sites are estimated to be in a 1 - 3 hour readiness condition which would extend the possibilities for detection of launch preparations beyond that available for a hard site. Furthermore, during periods of tension, soft sites might be brought to readiness condition two and held at this posture for sometime.