~~SECRET~~ LIMITED DISTRIBUTION

~~TOP SECRET~~

4 Dec 1961

MEMORANDUM FOR TECHNICAL OPERATIONS GROUP

FROM: NRL/NSA Committee

SUBJECT: Orbital Elements

1. 9 November, Mr. Howard Lorengen, Mr. Reid Mayo and Mr. Bruce Wald of NRL met with Dr. B. C. Getchell, Mr. Roger Thayer and [redacted] of NSA to consider some of the problems of a two satellite GRAB mission. It was immediately obvious to all concerned that no progress was possible if there was no tracking data of sufficient accuracy available to the processing elements of NSA. Therefore Dr. Getchell, Mr. Wald and [redacted] were asked to study the various orbital reports now being produced.

2. Mr. Wald scheduled a meeting at NRL with [redacted] on 14 November. [redacted] is very knowledgable, having worked at "Vanguard" and having set up two computing centers - one at Dahlgren, Virginia for the Navy "Fence" and the other in Greenbelt, Maryland for NASA. [redacted] of Cincinati University was the chief consultant on both projects. The three of us spent an afternoon with [redacted], much to our benefit. He suggested we follow up our conversation with a visit to Dahlgren.

On 20 November, we met [redacted] at the Space Surveillance System in Dahlgren. [redacted] and his staff were most helpful. After a day there, we agreed that we now had enough information to write this report.

3. Discussion of element reports:

a. NASA WORLD MAPS - NASA tracks only emitting satellites (108 mc) - about 10 in all. In their favor, they have a wide tracking network, two IBM 7090's, and use the most sophisticated extrapolation techniques (Kaunen's method). There is no reason to suspect their accuracy is ever worse than one second. We assume they are actually reporting historical data on their world maps and that they are doing all necessary quality control. However, there are obvious difficulities in relying on NASA reports. One is the lack of timeliness. As of 28 Nov 61, the most up to date tape from NASA is dated for the week of 2 Oct. Assuming the processing is to be done on a more current basis than is presently going on, this is a real liability. NSA is at a security disadvantage when asking for details of NASA operating procedure. The forwarding of magnetic tapes is a nuisance. Tracking data buried in 2400 ft of tape takes some time to find on the 704 so any program using this data would run slowly. Finally we wonder if GRAB's unclassified cover will vanish when two satellites are being used? Certainly we will have to gather data whenever they are correctly positioned so the sharing

~~TOP SECRET~~ Handle Via BYEMAN control system only

BYE-057370-99

~~SECRET~~ TALENT-[redacted] CONTROL SYSTEMS JOINTLY LIMITED DISTRIBUTION

~~SECRET~~ ~~TOP SECRET~~ LIMITED DISTRIBUTION

of collection time with cover experiments may not be possible.

b. SPADET (Space Detection) - This is the Air Force organization under NORAD. They have available to them all the data from all tracking facilities. They have computing facilities in Colorado Springs and publish reports on a periodic basis. These reports include elements, equator crossings and representative traces. At present the NSA is using these elements and equator crossings. However, the elements being published are most difficult to use correctly. The present NSA program makes the assumption that the nodal period equals the anomalistic period which is all right for G-2 due to its near perfect orbit but might be quite wrong on another satellite. [redacted] indicated some editing techniques used at Colorado Springs that are questionable and NSA has noted some rather large inconsistencies between successive reports from this organization. The reports are essentially future predictions, which we do not require, and for purposes of accuracy, are not very desirable.

c. SMITHSONIAN - The organization produces reports of elements based on NASA calculations. These have all the advantages and disadvantages of (a) except some accuracy is lost if Hansen's method is not used for extrapolation but some time is gained and trouble is lost by the abandonment of the full magnetic tapes in favor of a periodic report. The periods are irregular. The reports sometimes fail to give elements with the equator crossings.

d. SPACE SURVEILLANCE SYSTEM - This is the computing system based on the Navy "Fence" working under NORAD. They keep track of all orbiting man-made bodies on a daily basis. They have accuracies for most well placed satellites of better than one second. They produce reports weekly on all satellites (emitting or black) and can, on request, furnish more frequent information. The reports are in the form of elements which can be readily utilized by NSA. The people at Dahlgren perform, on a regular basis, quality control and have furnished us copies of their findings. They are anxious to have their reports used and are justifiably proud of them. We can reach them on the standard government dial system so we could get immediate response to future special requests. NSA has written NORAD in order to be placed on regular distribution for SPASUR reports.

e. OTHERS - The above represent the only input sources we know of that we can rely on for continuous high quality reporting of satellite positions.

4. In summary, there seem to be four sources available who publish periodic reports of satellite of satellite locations or elements to an accuracy (approximately one second or five miles) that should allow us [redacted] Of these, the reports from SPASUR appear to be the best for NSA's purposes. NSA has sent a letter asking for these reports. Less than 50 mile separation of two bodies will give any of these tracking systems some difficulty. This will have to be a future consideration in the design of the two body collecting experiment.

~~TOP SECRET~~ ~~SECRET~~ [redacted]

Handle Via BYEMAN Control System Only

BYE-057371-99

SECRET

This paper is to provide explanations of the factors and events leading up to the conclusion that the "high-frequency-band" portion of GRAB-2 is now inoperative. The evidence supporting this conclusion has been derrived from a detailed review of:

(1) Dispatches from

(2) Data analysis of data from both the experiment and from the scientific experiment telemetry signals,

(3) Experimental tests at Hybla Valley and

(4) Consultations with the "packaging" personnel.

In the normal interrogation operation a "turn-on" signal called Telltale, is radiated from the pack whenever the command receiver is successfully illuminated by the proper signal. This Telltale is normally heard when either portion of the experiment is turned-on and cannot be generated again until the experiment is turned off, either by the internal-timer or by an interrogation signal.

It was learned that after much study and experimentation the "bird" was occasionally developing within itself, its own "turn-off" signal which would turn off the "experiment" during or immediately following the Telltale signal. In the telemetering data sub-carriers on channel A are certain audio tones which shift in frequency to indicate internal package voltages and temperature. One of these apparently malfunctioned and drifted through the range of the turn-off tone filters; thus, leading us to conclude that the channel B turn-on was periodically inoperative.

Once an interrogation scheme was determined which would eliminate the premature "turn-off", the resulting data from "the experiment" proved to be completely lacking wide-pulses from the high frequency band even though this portion of the experiment was shown to be "turned-on" by a Telltale signal. Therefore, it is concluded that the high frequency band is inoperative.

HANDLE VIA
BYEMAN
CONTROL SYSTEM ONLY

SECRET

SECRET [redacted]

The nature of the failure is such as to make suspect the circuitry ahead of the Modulator. Any reduction of gain in the video amplifier could have reduced the sensivitity of the experiment and resulted in a situation similar to the experiment at this time. The individual items of this experiment were very thoroughly selected, assembled, checked and calibrated prior to launch. There is evidence that temperature inside the package has not exceeded +45°C and all components were tested at +60°C for several hours.

Some degree of sensitivity has been lost on the remaining low-frequency portion of "the experiment" but data is very usuable. In fact a slow reduction in system sensitivity may have valuable aspects in determining the [redacted] various radar families.

There is no reason to predict an early failure in the remaining low-band.

On 1 December the modulating tones for the channel A telemetering were inoperative leaving only the carrier on the frequency.

HANDLE VIA
BYEMAN
CONTROL SYSTEM ONLY

SECRET [redacted]