~~TOP SECRET~~

HANDLE VIA
BYEMAN
CONTROL SYSTEM

14 00003351D

~~(S)~~ NATIONAL RECONNAISSANCE OFFICE
WASHINGTON, D.C.

THE NRO STAFF

October 12, 1966

As noted in text I think we should further emphasize that this is not a random type accident but was due to placement in very nearly identical orbits

MEMORANDUM FOR DR. FLAX

SUBJECT: Release of News Item

You have probably seen the recent newspaper articles quoting Hillard Paige of G.E., as announcing a "collision in space" of two experimental satellites (sample newspaper articles attached, Tab A).

The two vehicles in question are POPPY satellites.

We have requested, but not yet received, copies of the text of Dr. Paige's presentation. According to the local G.E. office, Paige's comment on the collision in space was made in an "off-hand" manner--and apart from the text.

The DOD information people have received numerous queries on this subject. Attached is a response-to-query (Tab B), prepared by the Navy. We recommend clearance of the release, except for paragraph (bottom of page 1) marked in red. [redacted] 50X1

Request your approval to release this item as outlined above.

Richard S Quiggins

Richard S. Quiggins
Colonel, USAF
Assistant Deputy Director
Plans & Policy, NRO Staff

2 attachments

Looks OK to me
JS

What was relative position & orbital elements, ΔV of displacement?

HANDLE VIA
BYEMAN
CONTROL SYSTEM

~~TOP SECRET~~

EXCLUDED FROM AUTOMATIC REGRADING
DOD DIRECTIVE 5200.10 DOES NOT APPLY

CONTROL NO ____
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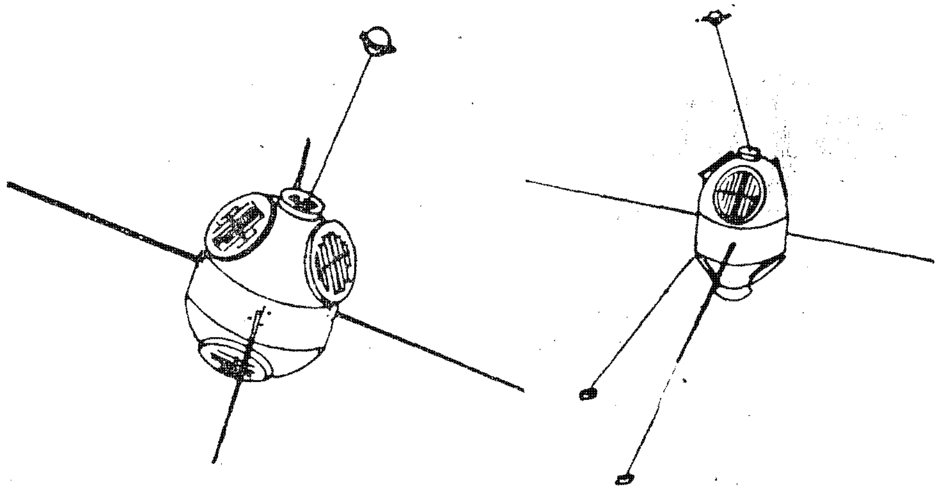
10 OCT 66
WASHINGTON POST



COLLIDING VEHICLES — The two experimental satellites that collided in space are shown in an artist's drawing. A microrocket aboard the craft at left slowed it down enough for the satellite at right to catch up. The antennas of the two vehicles made contact and caused the satellites to come together briefly.

First Satellite Collision in Space, A Sideswipe in 1965, Is Reported

By Thomas O'Toole
Washington Post Staff Writer

Two unmanned United States satellites apparently collided in space last year, but were undamaged and are still working.

The first known collision in space, it was more a sideswipe than a head-on crash. It involved a pair of experimental 100-pound spacecraft that had been "piggybacked" into orbit by an Air Force rocket with six other satellites from the Pacific Missile Range on March 9, 1965.

The accident occurred during the satellites' 1756th orbit, more than a month after launch, and was only disclosed yesterday.

It happened 560 miles above the earth when one of the two satellites slowed itself up with an on-board microthruster—described as a "very, very small rocket which helps the satellite maintain orbit."

When the first craft slowed down, the second caught up, and the antenna booms of the two craft came together like a pair of clanging swords.

For a few seconds, both craft swung locked in space together, but then moved apart and have not brushed antennas since.

Space experts figured the collision took place only because the two satellites had been sprung seconds apart into very close orbits.

The space mishap was disclosed, of all places, in Madrid, Spain, at the opening session of the 17th International Astronautical Congress, by Dr. Hilliard W. Paige, general manager of General Electric Co.'s Missile and Space Division in Valley Forge, Pa.

Dr. Paige dropped his somewhat sensational bombshell as he discussed the workings of the two colliding spacecraft—called Gravity Gradient satellites by GE, which built them for the U.S. Naval Research Laboratory.

Purely experimental, the two satellites are of a type that stabilize themselves in flight through the use of long weighted antennas. The antennas act like dumbbells to point the spacecraft at all times toward the earth.

The mishap was apparently first discovered at the North American Air Defense Command in Colorado Springs, Colo., where the two craft were being tracked.

At the point of apparent collision, telemetered data from both spacecraft showed a "slight shift in the direction of each spacecraft's tracking orbit," said one space official, which indicated the two craft had brushed together, then come apart.

But despite their speed of 20,000 miles an hour, neither craft was damaged enough to affect its instruments, which are still working and sending data.

"The bang they made in space," said one space official, "was probably not much stronger than the bumping of a car against the back of another car slowing down at a traffic light."

Inevitable Happens: Space Craft Collide

By JOHN NOBLE WILFORD
Special to The New York Times

MADRID, Oct. 10—With all the traffic in space nowadays, a collision was bound to occur — and it did. Two unmanned United States spacecraft bumped each other in orbit 18 months ago, it was disclosed here today at an international conference on space.

As far as anyone knows, it is the only collision to have occurred in space. The odds against such an accident were estimated at better than a million to one.

American space engineers reported at the 17th annual International Astronautical Congress that two naval research laboratory communications satellites with long antenna-like booms had drifted togther and crossed booms like fencers crossing foils. They soon parted, undamaged, and are still working.

Soviet scientists reported on their recent research on animals to develop new drugs and medicines to help space travelers overcome the adverse effects of long flights.

Without giving details from Soviet flights to indicate what effects they had in mind, the Soviet scientists said the need for such drugs was "urgent."

Royalty in Attendance

The six-day space Congress is sponsored by the International Federation, a nongovernmental group. It opened this morning with ceremonies attended by Prince Juan Carlos, son of the pretender to the Spanish throne; his wife, Princess Sophia, and her mother, Queen Mother Fredericka of Greece.

More than 1,000 scientists and engineers from 30 countries are attending.

The case of the colliding spacecraft was described in a paper by four engineers of the General Electric Company, which built the satellites for the Navy. The gravity stabilized research vehicles were launched simultaneously in February, 1965.

One was shaped like an unbalanced bar-bell, with a 30-foot rigid rod extended between its spherical body and the smaller ball-shaped tip at the other end. The other had three rods extended from its body.

The elongated shapes allow the satellites to have one part closer to earth and tugged in that direction by earth's gravity. The other end is pulled off into space by centrifugal force. The stand-off between the two forces results in a stable flight, eliminating the need for the small rockets used to keep most spacecraft in position.

For some reason not yet unexplained, two months after they were launched on their classified missions, one satellite overtook the other. They were flying in similar orbits at an altitude of about 400 miles but should have been more than 100 miles apart.

Ground trackers followed the satellites on their collision course, but were unable to do anything about it. after the vehicles had clashed booms, they quickly separated.

Neither Hurt by Crash

Dr. Hilliard W. Paige, general manager of the General Electric missile and space division at Valley Forge, Pa., sais that both vehicles were still in a stable orbit and operating nornally.

The accident went unreported by the Navy until today for the same reason that a wife bites her lip long before telling her husband of the dented fender.

"It was minor," said a General Electric engineer, "but embarrassing."

Five satellites using the so-called gravity-gradient stabilization have been launched since 1964—three by the Navy, one by the National Aeronautics and Space Administration and one by the Air Force.

The appeal for development of new space drugs was made by three Soviet scientists—V. E. Belai, P. V. Vassily and G. D. Glod. Thei rresearch suggested that "significant changes in the effect of various pharmaceutical preparations" had been found under space flight conditions.

They said that, therefore, new medicines especially adapted and tested for space conditions were necessary. Such drugs are also needed, the Soviet scientists said, to increase the resistance of human organisms to the unfavorable effects of long flights

Soviet experiments with animals have been directed at finding out how they are affected by narcotics, cardiovascular drugs and stimulants when subjected to the acceleration processes the bodies of astronauts undergo in space.

Apart from this commentary on drugs, the 33-man Soviet delegation to the meeting here has, so far, been conspicuously reticent. Two Soviet papers on weather satellite applications were abruptly withdrawn today.

According to a delegation official, the two scientists who were to have delivered the papers were unable to come to Madrid. No ofefr was made to have someone else read the papers for the absent scientists.

The chief Soviet space physician, Dr. Oleg G. Gazenko, confined himself to generalities about the stresses of space flight on the human body.

NY TIMES
11 OCTOBER 1966

DIRECTORATE FOR SECURITY REVIEW
DEPARTMENT OF DEFENSE OASD(PA)
COORDINATION RECORD

NO. 66-8960
DATE 12 Oct 66

TO:
SAFSS
Attention: Col Quiggins
Room 4C-1000

DESCRIPTION
Submitted by: DIRECTORATE FOR INFORMATION SERVICES (Navy)

Answer-to-Query, "Gravity Gradient Satellite," for release.

THE ATTACHED MATERIAL IS FORWARDED FOR REVIEW AND COMMENT IN ACCORDANCE WITH THE GUIDELINES ON THE REVERSE SIDE OF THIS FORM. QUESTIONS CONCERNING THIS CASE SHOULD BE DIRECTED TO Capt Lazenby
EXT. 72725

A REPLY IS REQUESTED BY C.O.B. 12 Oct. PLEASE EXPEDITE.

COORDINATION OFFICE ACTION

TO: Directorate for Security Review, OASD (PA)

REVIEW BY THIS OFFICE, IN ACCORDANCE WITH THE GUIDELINES ON THE REVERSE SIDE OF THIS FORM, RESULTS IN THE FOLLOWING RECOMMENDATION CONCERNING CLEARANCE FOR PUBLICATION *(check one)*:

☐ NO OBJECTION AS RECEIVED.

☒ NO OBJECTION SUBJECT TO AMENDMENTS MADE BY THIS OFFICE *(in black pencil)*. REASONS FOR AMENDMENTS *(security, policy, or accuracy)* ARE SPECIFIED BY PAGE NUMBERS LISTED BELOW.

☐ OBJECTION. AMENDMENTS TO PERMIT PUBLICATION ARE IMPRACTICABLE. REASONS ARE STATED BELOW.

1. DELETE LAST PARAGRAPH — PAGE 1 — SECURITY

2. ADD PHRASE SHOWN ON PAGE 2 — CLARITY

(Continue on reverse side if necessary.)

NAME, TITLE AND ORGANIZATION	DATE	SIGNATURE
RICHARD S. QUIGGINS, Colonel	14 Oct 66	Richard S. Quiggins

SD FORM 373, 1 MAR 64 — REPLACES SD FORM 373, 1 FEB 63, WHICH IS OBSOLETE.

DEPARTMENT OF DEFENSE
DIRECTORATE FOR INFORMATION SERVICES
Washington 25, D.C.

DATE October 12, 1966

MEMORANDUM TO DIRECTORATE FOR SECURITY REVIEW

FROM: (Check appropriately)
DEFENSE NEWS BRANCH ( )
ARMED FORCES NEWS BRANCH ( )
Army Member ( )
Navy Member (xxx)
Marine Corps Member ( )
Air Force Member ( )

SUBJECT: Attached Proposed ~~News Release~~/Answer-to-Query Entitled:

GRAVITY GRADIENT SATELLITE

1. Attached proposed ~~news release~~/answer-to-inquiry is forwarded to your office for clearance and return to this branch as soon as practicable.

2. This proposed ~~release~~/answer-to-inquiry has been cleared with the service concerned by the following offices:

CHINFO, OP 92

3. When ~~release~~/answer-to-inquiry is returned to this branch, please indicate clearances obtained by your office, in addition to those indicated above.

VR,

C. T. Edson, LCDR, USN

Chief, Navy News Branch

8960

On May 3, 1965, two Naval Research Laboratory produced research Gravity Gradient Satellites - G.G.S. II and G.G.S. III - passed close enough to each other to "interact."

The event was first noticed by Naval Research Laboratory scientists who were examining telemetered data from both satellites at the time. It was confirmed by the Naval Space Surveillance System whose data showed both satellites to be very close. Within the accuracy of the data, the two were "occupying the same space at the same time." The data, however, offered no proof that the two had physically collided or even touched. All that could be determined definitely was that the two were close enough to each other to "interact." The "interaction" may have been magnetic with no physical contact.

At the time the event occurred, the two were travelling 0.04 MPH or 2/3 inches per second relative to each other.

Both satellites started to tumble, according to data received at the same time it was learned that the event had occurred. No other ill effects were noted. Two days later, on May 5, 1965, both satellites stopped tumbling and restabilized with no noticeable deterioration in performance.

The two Gravity Gradient Satellites and several other satellites had been placed in orbit on Margh 9, 1965 by a Thor Agena D rocket. Gravity gradient dampers and data analysis were provided by General Electric, [illegible] two contributions to the entire program.

50X1

8960

Gravity gradient stabilization of satellites, a technique which enables a satellite to keep one point facing earth at all times, is achieved by placing a long arm with a weight on the end out from the body of the satellite, thereby achieving a "dumbbell" configuration. The pull of gravity, slightly greater on the end closer to the earth than on the end farthest away, causes the axis of the "dumbbell" to line up with the center of the earth.

The chances of two unmanned satellites colliding in orbit are extremely remote, if they are placed in orbit by separate launch vehicles. When both are launched by the same vehicle, as was the case with G.G.S. II and G.G.S. III, the chances are greater. In either case, there is little if any cause for concern about any manned or unmanned spaceflights colliding with another object.

* * * * *

INTO VERY NEARLY IDENTICAL ORBITS

NATIONAL RECONNAISSANCE OFFICE
WASHINGTON, D.C.

THE NRO STAFF

13 October 1966

MEMORANDUM FOR DR. FLAX

SUBJECT: Poppy News Release

Following is additional information, concerning the "interaction" of two Poppy satellites, which you requested - plus some additional pertinent facts:

Your question:
What was relative position and orbital elements, Delta V of displacement?

Relative position: [redacted]. The interaction caused both to tumble - both the [redacted] then stabilized in an inverted position. Inversion of the vehicles did not interfere with their data collection function.

After the interaction, the relative positions of the two sub-satellites reversed - that is, [redacted] was now in front of [redacted] On 16 June, NRL advised separation between the two payloads was approximately 62 N.M. 50X1

The nominal altitude of both Poppy vehicles was 500 nautical miles. Actual altitude ranged from 495 to 506 nautical miles.

Delta V of Displacement: (relative velocity at time of impact). At the moment of interaction, the relative velocity was estimated at .04 miles per hour.

Additional pertinent data: Incident occurred between revs 761-767 on 3 May 1965.

The satellites were launched 9 March 1965 aboard Thor Agena D booster - Poppy mission number [redacted] - Poppy sub-satellites ejected into separate orbits same day.

The planned optimum separation rate was 1.0 to 1.8 N.M. per day. Poppy payloads were launched with spring eject systems set at 1.1 N.M. per day (see Tab A).

Nine days after launch, ΔV of displacement was 1.6 N.M. per day - which was nominal.

In August 1965, the two Poppy balls crossed within 600 feet of each other.

Tab B is an additional item from this morning's Washington Post on this subject.

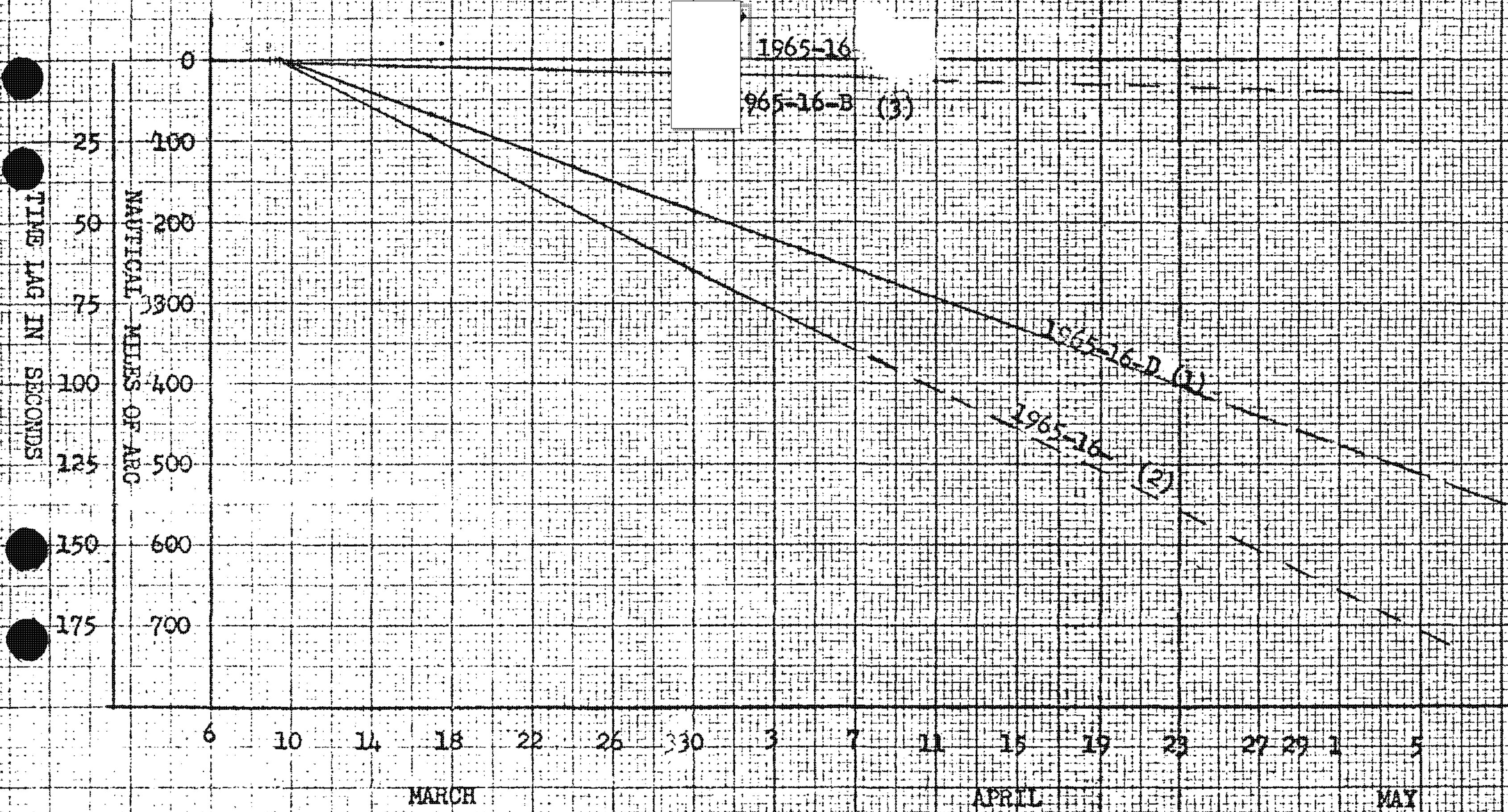
We will insure that the text of the release contains the emphasis which you noted on the original.

OASD/PA advises that the text of Dr. Paige's presentation in Madrid was not submitted to, or cleared by, either OASD/PA or by the Army, Navy or Air Force public affairs people. We have requested General Electric, through their local Washington office, to verify this with Dr. Paige, personally.

Attached, Tab C, is a copy of Dr. Paige's presentation, which we just received. The reference to the Poppy satellites is contained in the last paragraph of page 3.

RSQ

Richard S. Quiggins
Colonel, USAF



SATELLITE 1965-16 SEPARATION USING
1965-16-C AS Reference

50X1

Figure 6

TAB A

Space Secrets

Belated disclosure that two Air Force space vehicles collided in space in April, 1965, ought to remind the country that part of its space program is being carried on behind a cloak of secrecy as absolute as that which conceals space operations in the Soviet Union. The open policy of NASA, which has done so much to keep the whole nation interested in and excited about space progress, is in sharp contrast to the policy of the Air Force.

It is no doubt a comfortable environment for the bureaucracy in charge. Their launchings go unrecorded and unwitnessed. Their failures are reported and acknowledged only when they are pleased to disclose them. It saves them the awkward embarrassments that would result if a project blew up during hearings on their appropriations. As our chief source of information about enemy space operations, it also permits the timely release of enemy data at times and places that will best serve Air Force interest.

This particular incident might never have been known by American citizens if it had not seemed opportune for the Government to have it released at the Astronautical Congress meeting in Madrid. It is going to be more difficult to keep up American support and enthusiasm for our expensive space program if citizens can find out about a major part of it only as the result of information first released in other countries. It is simply nonsense to say that this, and all other information about the Air Force program, must be shrouded in secrecy for reasons of military security.

RECENT FLIGHT EXPERIENCE
OF
EARTH-ORBITING GRAVITY GRADIENT
STABILIZATION SYSTEMS

AUTHORS: L. K. Davis
R. V. Davis
R. J. Katucki
H. W. Paige
General Electric Company

PRESENTED BY: Dr. H. W. Paige
Vice President, General Electric Company
General Manager, Missile and Space Division

PRESENTED AT: XVII CONGRESS OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION

OCTOBER 10, 1966 MADRID, SPAIN

Thank you Dr. Bollay. Good morning gentlemen:

I sincerely appreciate this opportunity to discuss our recent flight experience with earth-orbiting, gravity gradient stabilization systems.

Last year, at the Sixteenth IAF Congress in Athens, I presented a paper on the fundamentals of gravity gradient stabilization systems and reported preliminary flight results on three G-E systems then in orbit.

This year, I will present more recent flight data on those three systems, report preliminary information on two new gravity gradient systems presently in orbit and discuss the status of future gravity gradient development programs.

The first successful gravity gradient stabilized satellite was launched by the Naval Research Laboratory in January 1964 in a 600-kilometer orbit. Initially the satellite had oscillations of plus and minus 45 degrees. Within three days, as we reported last year, the G-E gravity gradient system reduced these oscillations to less than five degrees. Today, almost three years later, the latest information from orbit confirms that osicillations are still below that value. Incidentally, this spacecraft has the second best record for long life operation of an earth-pointing gravity-gradient-stabilized satellite. The best record is still held by the moon.

In Athens, we mentioned that the Naval Research Laboratory launched two gravity-stabilized satellites into a 600 kilometer orbit from a single booster in March 1965. Both gravity gradient systems were built by General Electric; one was a two-axis system, the other was three-axis.

As an experiment, two inversion maneuvers were performed with the two-axis system. In performing these maneuvers, the rod was retracted on command and the satellite turned over due to conservation of momentum; the rod was then extended again and both times the satellite stabilized quickly to three degrees.

Oscillations in the three-axis system were damped to steady state conditions within three days. However, the satellite stabilized with a 78-degree yaw bias. An analysis of all available data appears to indicate that one of the rods is not erected in the proper position. Although the analysis has been extensive, both at NRL and at G-E, it has failed to yield data which would permit us to determine the exact cause for the apparent error in rod position.

Almost two months later, these two satellites drifted together and collided in what is probably the first man made satellite collision in space. After colliding, both satellites were quickly re-stabilized by their gravity gradient systems. Today, 18 months after launch, both of these satellites are still stabilized in orbit.

Since the last report to you, our gravity gradient systems have been used on two spacecraft, NASA's Geodetic Earth Orbiting Satellite, or "GEOS" as it's called, and the Air Force's Gravity Gradient Test Satellite designated "GGTS".

The purpose of GEOS was to provide a reference point in orbit for locating accurately a point on the earths surface. It was equipped with a two-axis gravity-stabilized system.

GEOS was injected into an eccentric orbit of 2600 kilometers apogee and 1300 kilometers perigee. Upon injection, the satellite was de-spun by a yo-yo to one rpm at which time the gravity gradient rod was extended about one meter. This partial rod extension freed the damper magnet from any magnetic field in the satellite. When next observed, the satellite's tumbling had been reduced to near orbital rate by the damper.

However, GEOS was captured with its payload facing into space and, to perform its geodetic mission, the payload had to look at the earth. Therefore, during its 83rd orbit, the satellite was inverted by the rod retraction and re-extension technique developed six months earlier. The inversion maneuver was completed successfully in 32 minutes.

The most recent data shows that the total pointing error of the system is within plus-and-minus ten degrees. This error is the same as predicted by computer analysis for the eccentric orbit achieved.

Another geodetic earth orbiting satellite, called GEOS B, will be launched next year. This satellite will be similar in design to the previous GEOS and will utilize the same gravity gradient control system.

Until June of this year, all gravity stabilized satellites had been flown at altitudes of 2600 kilometers or less. At the synchronous altitude of 36,000 kilometers, some people thought that low restoring torques, poorly defined magnetic field and relatively large effects of solar pressure, would prevent operation of gravity gradient stabilization systems. On June 16, 1966, a Titan 3C booster launched eight satellites into a near-synchronous altitude of 34,000 kilometers. Seven of these spacecraft were spin-stabilized communication satellites; the eighth was GGTS, the Gravity Gradient Test Satellite. The satellite itself and the gravity gradient stabilization system were built by G-E.

GGTS has a two-axis stabilization system utilizing rods and dampers of the same design as those flown at lower altitudes. The satellite is symmetrical about all axes to minimize solar disturbance torques. Magnetic disturbance torques were reduced by using non-magnetic materials whenever possible. Damper fluid viscosity was carefully chosen to provide an optimum trade-off between damping and damper induced disturbances.

Upon injection into orbit, the satellite tumbled. Within two days, the gravity gradient dampers had removed enough system energy to permit capture. Thirty-eight days after launch (instead of 80 days as originally predicted) the gravity gradient system had reduced the pitch oscillation to plus-and-minus seven degrees and the roll oscillation to plus-and-minus five degrees.

However, the satellite is not aligned with the local vertical but instead has a roll bias of about 13 degrees in a direction over the North Pole. It has been suggested that a magnetic particle held to the outside of the damper by the damper magnet would cause this pointing bias. Computer analysis of the orbital motion and damping period supports this suggestion. In addition, this theory is further emphasized by data obtained before and during a recent solar storm. The peak disturbance in pitch before the storm was measured at minus 6 degrees. On September 4th, at the time the storm had reached the satellite at earths synchronous altitude, the peak disturbance in pitch was plus 14 degrees. A change in amplitude this great can only be explained by the presence of a dipole generated by a magnetic particle. Although our investigation is still underway, it appears that correction of the bias in future flights will be a straightforward engineering solution.

The gravity gradient test satellite is still returning data to the Air Force's tracking net and this data is being analyzed to provide additional information. However, on the basis of information received to-date, the flight has shown that:

(1) Gravity stabilization is feasible at near synchronous altitudes;

(2) Magnetically-anchored dampers will perform satisfactorily and according to predictions at this altitude;

(3) The two-rod symmetrical configuration solves the problems of solar disturbance torques.

Another gravity gradient test satellite, designated GG II, will be launched by the Air Force early next year into a near synchronous orbit. This satellite, also built by General Electric will include three mercury fluid flywheels and earth and sun sensors to improve the stabilization system and to reduce the initial damping time.

The pitch and roll flywheels will be controlled by the earth sensor and are expected to reduce the initial damping time to five or six days. The third flywheel will control the yaw axis so that one face of the satellite always points at the sun. This yaw control, call "Sun Guide", is required to point the station keeping thrusters.

Later this year the Naval Research Laboratory will launch a new series of gravity gradient stabilized satellites in a 1,000 kilometer orbit.

Three of the satellites will use a two-axis gravity gradient stabilization system built by G-E and based on one of our designs previously proven in orbit. Since the payload of these satellites are required to point to the earth, each gravity gradient system will have the capability to invert the spacecraft if it is captured upside down. These satellites will be on operational missions; therefore, no gravity gradient experimentation is planned.

One of the NRL satellites will have a three-axis system and will be used for in-flight stabilization experiments. Accordingly, it will be the best instrumented gravity gradient stabilized satellite ever flown. For example, an infrared earth-horizon detector, a sun sensor, and a three-axis magnetometer will provide attitude data; an on-board tape recorder will permit a continuous record of attitude data. Improvements will also be incorporated in the stabilization system. For example, the satellite will be rotated about the vertical by a yaw axis flywheel. This yaw-around maneuver can also be accomplished by gyro compass action of a pitch axis flywheel being processed by gravity torques. As part of the in-flight experiments planned for this vehicle, an inversion maneuver will be attempted for the first time on a three-axis satellite.

About the middle of next year, the first in a series of three G-E gravity gradient stabilization systems will be tested in orbit as part of NASA's Application Technology Satellite Program. The first satellite in this series will orbit at a medium altitude of 11,300 kilometers; the other two spacecraft will orbit at the synchronous altitude.

In order to evaluate the relative merits of hysterises and eddy-current damping, the gravity gradient system in these satellites will contain two independent dampers so constructed that either may be engaged and the other dis-engaged upon ground command. The combination damper, with its clutch arrangement, is shown in schematic form on this slide.

Another unique requirement associated with the experimental objective of ATS is the capability to "re-configure" the spacecraft while in orbit. By changing the length of the primary boom, the spacecraft moment of inertia magnitudes can be varied; by changing the angle between the primary boom, the spacecraft moment of inertia ratios can be varied. Thus, with the capability for retraction, re-extension and "scissoring" of the primary boom system, numerous configurations can be studied in orbit.

The material presented in this paper has been concerned solely with the application of gravity gradient stabilization systems to unmanned spacecraft. During the past year, we also studied the application of gravity systems to manned spacecraft. The National Aeronautics and Space Administration is considering the use of an empty Saturn SIV B stage as a manned space laboratory. We have completed a design study which shows that three dampers identical to those already in orbit on the gravity gradient test satellite could stabilize the SIV B and allow it to be oriented by the gravity field. Previous tests and computer programs on the dynamics of stabilized vehicles indicate that the space pilots of the Saturn would be able to move around extensively without any noticeable tipping of the vehicle. The overall study is currently being reviewed by NASA.

In review gentlemen, thirteen of our gravity gradient stabilization systems are either performing in space or will be launched through 1968. These systems include: two and three axis designs, experimental and operational units, and flights at altitudes from 600 kilometers to synchronous.

On the basis of this experience, we feel that it is possible to develop an effective stabilization system to meet all requirements of unmanned spacecraft.

We think that passive, gravity gradient systems like those described in this paper are the right approach to general applications where the required pointing accuracy is one or two degrees or more and where a damping time of five or six days is permitted.

We believe that active stabilization systems, like that on Nimbus II, are the right approach toward specialized applications where extremely high pointing accuracy is required and where damping time is measured in seconds or a few hours. (Incidentally, the stabilization system in Nimbus II, currently in orbit, has operated perfectly for almost five months).

Both the passive and the active stabilization systems can be designed, developed and built to meet the universal requirements of long life operation in space.

Thank you.

LAUNCH DATE	SATELLITE DESIGNATION	SA[redacted]TE FABR[redacted]TION	[redacted]BRICATION	DESCRIPTION	DESC[redacted]PTION	[redacted] ORBIT	INCLINATION	PERFORMANCE
1962 - 65	Transit	APL	APL	One Rod Two Axis	Lossy Spring	740 km	-	Satellite Dead GG Oscillations 10° - 20°
1962 - 65	Transit	APL	APL	One Rod Two Axis	Lossy Spring	740 km	-	Satellite Dead GG Oscillations 10° - 20°
1962 - 65	Transit	APL	APL	One Rod Two Axis	Lossy Spring	740 km	-	Satellite Dead GG Oscillations 10°- 20°
Jan. 11, 1964	1964-1B/ GGSE-1	NRL	G E	One Rod Two Axis	Magnetic Vixcous Fluid	935/ 910 km	69.9°	± 5°
Mar. 9, 1965	1965-16B/ GGSE-2	NRL	G E	One Rod Two Axis	Magnetic Eddy Current	942/ 907 km	70.1°	±5 apparently cancelled with 1965- 16C
Mar. 9, 1965	1965-16C/ GGSE-3	NRL	G E	Three Rod Three Axis	Magnetic Viscous Fluid	943/ 906 km	70.1°	Pitch ±12°, Roll ±20°, Yaw ±32°; Satellite on a 78° Bias
Nov. 6, 1965	1965-89A/ GEOS-A	APL	G E	One Rod Two Axis	Magnetic Eddy Current	2600/ 1300 km	59.4°	Pitch & Roll ±7°, Yaw 10°
Mar. 30, 1966	1966-25B/ OVI-5	Convair	Convair	Six Rod Vertistat	Gravity Viscous Fluid	1059/ 987 km	144.7°	Stabilized Successfully
Jun 16, 1966	1966-53A/ GGTS	G E	G E	Two Rod Two Axis	Magnetic Viscous Fluid	33835/ 33683km	0.09°	Pitch & Roll ± 3°; 15° pointing bias over North Pole
Jul. 14, 1966	OVI-7	Convair	Convair	Six Rod Vertistat	Gravity Viscous Fluid	--	--	Failed to Orbit
Nov. 1966	NRL-1966	NRL	G E	One Rod Two Axis	Magnetic Eddy Current	925 km Planned		
		NRL	G E	One Rod Two Axis	Magnetic Eddy Current	925 km Planned		
		NRL	G E	One Rod Two Axis	Magnetic Eddy Current	925 km Planned		
		NRL	G E	Three Rod Three Axis	Magnetic Eddy Current	925 km Planned		
		NRL	Philco	Three Axis	Magnetic Eddy Current	925 km Planned		
Jan. 1967	GG II	G E	G E	Two Rod Three Axis	Flywheels	34,000 km Planned		
Jan. 1967	Dodge	APL	APL	Ten Rod	Eddy Current Hysteresis	36,000 km Planned		
1967 - 1968	Dodge M	APL	APL	Ten Rod	Eddy Current Hysteresis	36,000 km Planned		
Jun 1967	ATS-A	Hughes	G E	Six Rod Three Axis	Gravity Eddy Current Hysteresis	6,000 km Planned		
Sept. 1967	GEOS B	APL	G E	One Rod Two Axis	Magnetic Eddy Current	1100/ 1500 km Planned		
1968	ATS -D	Hughes	G E	Six Rod Three Axis	Gravity Eddy Current Hysteresis	36,000 km Planned		
1968	ATS -E	Hughes	G E	Six Rod Three Axis	Gravity Eddy Current Hysteresis	36,000 km Planned		

(S) NATIONAL RECONNAISSANCE OFFICE
WASHINGTON, D.C.

THE NRO STAFF

18 October 1966

MEMORANDUM FOR DR. FLAX

SUBJECT: Release of News Item

Attached (Tab A) is a response, prepared by General Garland, to your query concerning clearance of Hilliard Paige's recent speech in Madrid.

Tab B is a proposed memorandum to Mr. Sylvester requesting his assistance in reminding GE and NRL of the importance of following established clearance procedures involving matters of interest to DOD. Recommend you sign this memo.

Richard S. Quiggins
Colonel, USAF

DEPARTMENT OF THE AIR FORCE
WASHINGTON

OFFICE OF THE SECRETARY

OCT 14 1966

MEMORANDUM FOR ASSISTANT SECRETARY OF AIR FORCE (RESEARCH AND DEVELOPMENT)

The speech presentation made by Dr. H. W. Paige, Vice President of General Electric Company and General Manager of its Missile and Space Division, before the XVII Congress of the International Astronautical Federation at Madrid, Spain, on 10 October 1966, was not submitted to Department of Defense, or any of the three Service Departments, for review and clearance prior to its delivery.

General Electric Company wrote the presentation for Dr. Paige from previously cleared material except for the incident of the two satellites drifting together and colliding "in what is probably the first man made satellite collision in space." Dr. Paige, according to GE, had knowledge of this and asked the Naval Research Laboratory for permission to use the information in his presentation. This permission was granted by Mr. Robert Beale, project manager on GE-Navy space programs, about two weeks before the presentation. Neither Mr. Beale nor the Naval Research Laboratory has authority to clear speeches, news releases, or other informational items of national interest intended for public release.

The only clearance and releasing authority on this, and similar items intended for public dissemination, is the Assistant Secretary of Defense for Public Affairs, Mr. Sylvester. His office is aware of this infraction of the regulations.

WILLIAM C. GARLAND
Brigadier General, USAF
Deputy Director of Information

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(S) NATIONAL RECONNAISSANCE OFFICE
WASHINGTON, D.C.

OFFICE OF THE DIRECTOR

31 OCT 1966

MEMORANDUM FOR ASSISTANT SECRETARY OF DEFENSE (PUBLIC AFFAIRS)

SUBJECT: Release of News Item

This is in regard to the newspaper articles which resulted when Dr. Hilliard Paige, of the General Electric Company, described a "collision-in-space" during a recent presentation in Madrid, Spain.

The General Electric Company is a contractor for certain classified projects in the NRP, but was not involved in the classified aspects of the two satellites in question. For these satellites, they provided certain components of the gravity gradient stabilization system and provided data reduction services relative to performance of this system.

I am quite concerned about this incident for several reasons. First, the two space vehicles involved are National Reconnaissance Program sub-satellites launched last March (aboard a single booster). [redacted] the actual contact or interaction of the vehicles was the result of a malfunction. Secondly, Dr. Paige's remarks inflate an insignificant incident into a major catastrophe (while the two vehicles did in fact touch, or interact, there was no violent collision). Significantly, Dr. Paige's intent to announce this incident was not properly cleared in advance with the Department of Defense.

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Attached is a memorandum prepared by General Garland, of SAFOI, which describes the background concerning clearance of this material.

I would appreciate any action which your office might initiate with General Electric and the Naval Research Laboratory

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to assure future compliance with approved procedures for prior clearance of public information involving matters of interest to the Department of Defense.

Alexander H. Flax

Alexander H. Flax

Attachment
SAFOI Memo, Oct 14, 1966

OFFICE OF THE SECRETARY

OCT 1 4 1966

MEMORANDUM FOR ASSISTANT SECRETARY OF AIR FORCE (RESEARCH AND DEVELOPMENT)

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WILLIAM C. GARLAND
Brigadier General, USAF
Deputy Director of Information

DIST: 1cy Addressee
1cy SS-1
1cy SS-3
1cy RF
√ 1cy SS-5

Reavis : Pub Inf. Sec - C

9 November 1966

MEMORANDUM FOR RECORD

SUBJECT: Poppy Security

On Monday, 7 November, Mr. Sylvester (in response to a request from Dr. Flax) met with representatives of General Electric to discuss Dr. Paige's "collision-in-space" announcement.

On Tuesday, 8 November, Colonel Reavis, OASD/PA (Security Review) called to report the results of the meeting.

1. GE was represented by Messrs. Huffman and Cohen.

2. GE representatives said they had reviewed circumstances of incident and concluded that GE was not at fault since (1) GE work was done under an unclassified contract (2) No form 254 - Security Requirement - had been filed or requested in connection with the contract and (3) The incident had been previously reported in Aviation Week and Look Magazine.

I advised Reavis that I would check to verify items (1) and (2). OASD/PA had checked item (3) and was unable to locate any such reference in Aviation Week or Look.

RSQ

Richard S. Quiggins
Colonel, USAF