~~TOP SECRET~~

HANDLE VIA
BYEMAN
CONTROL SYSTEM

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

THE NRO STAFF

March 23, 1970

Dr. McLucas has seen.

NOTE TO DR. McLUCAS

SUBJECT: TAGBOARD Navigation

You asked for a layman's description of why the fancy computation to satisfy DP's.

The drone senses Mach through pitot sensors and adjusts altitude and attitude to hold constant Mach. This mechanization is necessary due to the sensitivity of the engine performance to Mach but results in a somewhat unpredictable altitude and wind history. This consideration plus the 3000 n mi range cause any preprogrammed auto pilot only scheme to have errors considerably in excess of the 28 n mi (± 14) camera swath. Therefore some system of on-board navigation is required.

The inertial navigator selected has been performing very well, it has an allowable error of 1.5 n mi/hr but has been yielding only 2250 ft cumulative max error at end of mission.

The navigator operates by constantly computing present position and steers to maintain the great circle course between selected destination points (DPs). These destination points (up to 32) are preprogrammed and cannot be changed in flight. The INS computer is mechanized to compute and cause execution of steering correction to maintain course between DPs. A separate computer routine compares present position with next DP to determine "satisfy" conditions which cause the following DP to be entered into computer. It was this separate routine which used latitude and longitude angle functions in a manner such that truncation errors occurred and, since the DP never was adequately satisfied no new DPs were ever entered. The changes were simply to open up the "satisfy" conditions and

include a "fail-safe" provision so that if the drone goes too far past a DP fuel is shut off.

You asked whether one could simply use predicted time between DPs and a clock to determine DP satisfaction. Actually, such a scheme could work pretty well. The drone would steer the course between DPs as now, it would satisfy the DP with an error proportional to velocity error but after "satisfy" it would steer back to the desired course to next DP at an intercept angle of up to 45°. Thus the erroneous portion of the track would be in a circle around the DP of radius equal to the in-track difference between actual position at the predicted time and the DP. Although this would work, I am not sure of implementation difficulty and I think they have the problem in the "satisfy" computation worked out satisfactorily now.

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Director