Apollo
Pogo effects
64 2. Loads

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

3. Computer

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August 17, 1968

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Signature of _____

Lieutenant General Samuel C. Phillips, USAF
Apollo Program Director
National Aeronautics and Space Administration
Washington, D. C. 20546

Dear Sam:

Soon after the Apollo 6 flight, we undertook development of a POGO sensor. At that time, of course, we did not know what the outcome of our various studies and tests would be and we considered it good "insurance" to carry along the development of such a sensor in the event that we could later define a firm requirement.

Our sensor has completed its preliminary development stages and we are now in a position where we would have to spend a great deal more effort and money to turn it into a flight instrument. However, since we have not identified a requirement for the sensor and, in fact, are unable to specify how the sensor could be used in flight, we would like to terminate all further effort on this device.

The POGO sensor, as developed by MSC, consists of an array of Command Module mounted accelerometers, together with a display meter (or display light) on the instrument panel. Initially, our desire was to develop a meter so that the astronaut could visualize not only the level of "POGO," but also the rate of change of this level. Because of space limitations, the meter extended 4 to 5 inches out from the instrument panel toward the astronaut's head. This, of course, was unacceptable. We then changed to a development of a display of lights instead of the meter. These lights could come on green, yellow, and red, depending on three predetermined oscillation levels. The light display only extends about 1 inch from the display panel and would, therefore, be acceptable from this point of view. However, the amount of information displayed to the pilot is insufficient.

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We recently held a meeting at MSC to determine whether we should proceed with the development and installation of the POGO sensor. Our joint conclusion was that we should not. This conclusion was based on the following facts:

a. MSFC has high confidence that the POGO problem has been fixed.

b. A sensor could be made available, but it has the previously described limitations.

c. Sensing elements mounted in the Command Module must be located in a relatively insensitive location and, therefore, could not give a good indication of POGO.

d. Abort criteria, based on POGO alone, cannot be defined.

The first point that POGO has been fixed has been discussed elsewhere and will not be amplified in this letter. Also, I have already said all that can be said about the second point. In regard to point c, our various mathematical analyses have indicated that the elements of the spacecraft that are most sensitive to launch vehicle oscillations are the SPS tanks and the LM. Oscillations in the Command Module where the POGO sensor would have to be mounted in order to be compatible with current Program plans are minimal and not directly correlated with the highest oscillations at all frequencies. In other words, accelerometers located at any place within the Command Module could not give a broad indication of oscillations elsewhere in the spacecraft.

However, the most important point in reaching our conclusion is the fact that it is not possible to define abort criteria based on POGO. I can best explain this by giving consideration first to our established abort limits based on launch vehicle rates. All of MSC's and MSFC's analyses over the past several years have indicated that once the rate limits are reached, then the launch vehicle is in a diverging situation. In other words, the rate limits were not necessarily selected because the launch vehicle will break up at the established limit; rather, they were selected because there is an extremely high probability that once these limits have been reached, the rates will increase even further and breakup is certain to occur.

The POGO situation is different. All of our experience to date has been that POGO is self-limiting. In other words, for any given POGO level that might be set as an abort criterion, it is not at all clear that higher POGO levels would be reached which would result in space vehicle breakup. It would, of course, not make good sense to abort unless breakup were certain, and breakup is not certain at any given POGO level. Since abort criteria cannot be established, there is no reason to carry a POGO sensor.

If POGO should occur on the next manned flight (and we don't believe that it will), then we believe that we should not abort unless the POGO has a catastrophic effect on the space vehicle. Such an effect would be sensed either as a high space vehicle rate or a space vehicle breakup and would lead to an abort using our normal abort criteria.

For these reasons, we have decided not to install a POGO sensor in our spacecraft. We would, also, like to cancel all further developmental effort as soon as possible. Your concurrence in this approach is requested.

Sincerely yours,

George

George M. Low
Manager
Apollo Spacecraft Program

cc:
NASA Hqs, G. H. Hage, MA