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29 April 1958

MEMORANDUM FOR: Assistant Chief/TSS/Research and Development

SUBJECT : Technical Considerations Considered Applicable to a Proposed Powered Lighter-Than-Air Vehicle for Intelligence Gathering Purposes

1. The extensive use of balloons in several broad scientific fields has substantially advanced the state of the art in light weight plastic balloon fabric. The use of balloons as intelligence collecting vehicles such as the Air Force project GENETRIX and for other purposes in the intelligence fields such as personnel infiltration and leaflet dissemination has focused attention on this type vehicle for intelligence purposes. One of the principle contractors in the balloon research and development activity has for some time expressed a view that balloon technology is sufficiently advanced to utilize power with balloons to give some measure of control to flights that are now subject to vagueries of meteorological conditions. It is the intent of the attachment to this memorandum to outline some technical considerations believed to be pertinent to the utilization of a high altitude powered balloon for intelligence use and to recommend possible courses of action. It may be pertinent to point out that the previous Air Force project that utilized the free balloon for the collection of photo intelligence resulted in so much adverse propaganda that "balloons" became a dirty word to many intelligence people. It is hoped that a balloon that is at least partially controlled will overcome the principle reason for the lack of operational reliability encountered with the balloons in this Air Force type of project and it is believed that a relisble intelligence vehicle can be developed.

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Chief
TSS/Engineering Division

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TECHNICAL CONSIDERATIONS FOR A HIGH ALTITUDE POWERED LIGHTER THAN AIR VEHICLE

1. It is the intent of this paper to discuss briefly the possible applications of a high altitude powered vehicle to intelligence work and to outline some of the technical considerations that are believed to apply. Altitudes as high as 100,000 feet above mean sea level, payloads of at least 100 pounds, speeds up to at least 25 knots, and a range of 800 nautical miles are all believed to be possible. The vehicle would be a shaped polyethylene balloon driven by propellers and powered at high altitude by electric motors with a storage battery power supply. Such a vehicle could hold its position over a point without violating a border and obtain line of sight information up to about 400 miles inside the border. It could also use power to fly a prescribed course of fairly short to medium range inside the border and out again at altitudes approaching 100,000 feet. Long range overflights may be possible with a vehicle that is generally the same as the one described but is designed to float unpowered at high altitude during the daytime and to descend to about 40,000 feet at night and fly power on at this altitude. High winds at 40,000 feet would provide for an extended range capability and conventional aircraft power could be utilized at this low altitude that could allow for higher speeds and greater angular corrections of course. Guidance systems may be utilized that would direct this vehicle to a preassigned intelligence target, possibly anywhere in the Soviet Union.

2. Extensive work with polyethylene as a balloon material has resulted in greatly increased balloon technology. A shaped captive balloon has already been made of this material and successfully used to carry instrumentation in atomic bomb tests in Nevada. To apply power to such a vehicle requires that the envelope be pressurized so that its shape is maintained and it is this feature that is considered one of the most severe development problems. The pressure requirement is small, however, about .01" of water for a 25 knot air speed at 90,000 feet. A large free balloon is subject to almost this much internal pressure around the region of the top of the balloon. Air breathing engines such as the jet engine for power are tentatively ruled out at altitudes as high as 90,000 feet. Although some possibility may exist for their utilization, the high exit velocity of the gas compared with the low forward speed of the vehicle would result in extremely poor efficiencies and fuel requirements would be expected to be prohibitive. The storage battery exists that has the necessary power, about four horse power would be needed to drive the vehicle. Silver cell batteries can produce 50 watt hours per pound and a power pack of these batteries could power the vehicle. Solar batteries are not considered in view of this rather high power requirement. The propeller is considered as the propulsive force. A propeller disc area

of about 1000 square feet would be needed. Two propellers might be used and they would probably also be utilized for directional control.

3. A vehicle of this type is believed to have several advantages over existing aircraft for intelligence purposes at least for some applications. It is assumed here that very high performance aircraft of the most recent types can be utilized for intelligence gathering missions at altitudes in excess of that proposed for this vehicle and at very high speeds. It is supposed, however, that such aircraft can bring a target under surveillance for only a brief period of time. The same would be true if a reconnaissance satellite were used, and in the latter case, the target area would be alerted well in advance of the time it would be under surveillance. In any of the three applications outlined in paragraph one above, a target might be surveilled for a period of time measured in days. Since the lighter-than-air vehicle can float power off, it provides an extremely stable vibrationless platform for aerial photography or electronic equipment.

4. The lighter-than-air vehicle, powered or not, must depend upon favorable winds aloft to a certain extent for successful operations. Of course most aerial photo missions are weather dependent anyway but the operational meteorological requirements of this vehicle must be considered more strict. The application of power allows for a greater freedom of choice of weather conditions than the free balloon and it allows for positive control and enhances the prospects of recovery of the equipment carried. Because of the weight to horse power ratio of available battery sources, the range and speed of the proposed craft is limited. Probably at a 25 knot air speed the range would be limited to 200 miles neglecting wind effects. At 10 knot speeds it would probably fly 800 miles. The vehicle would be hard to see with the unaided eye but it must be assumed that it could be seen and photographed during daylight hours with a telephoto lens. Conventionally powered jet aircraft have already flown to altitudes in excess of 70,000 feet and might some day be capable of shooting down the powered balloon. Equipment carried on a balloon that must be oriented directionally poses problems when narrow tolerances are required.

5. If direct overflights of extended range can be considered a variation of the powered balloon described above is believed possible. A powered balloon could be made to float free at ceiling altitude at or near a 100,000 feet during the daylight hours and then descend to 40,000 feet at night. At this altitude it would utilize the usual high winds to extend its range and it could utilize power to make angular corrections in its course. It may be possible to provide a guidance system that would direct it to a predetermined target. This powered balloon would be launched in a slack condition and would not be full until reaching ceiling altitude much the same as balloons that are now in use. Sunset would result in heat loss of the lifting gas that would cause the vehicle to descend and a ballonet system would control the altitude at

40,000 feet. Conventional power systems can be utilized at this altitude and speeds higher than 25 knots are probable.

It is obvious that such a vehicle has the disadvantage of being quite vulnerable to attack by aircraft during its low level flight and it is expected that political considerations would weigh heavily in authorizing such an overflight. However, anticipating successful development, this vehicle would bring wide areas and selected points almost anywhere in the Soviet Union under direct surveillance for extended periods of time. Although it could be seen it would be extremely difficult to see. It could be detected by radar but would present a poor radar target at best. It is assumed that a cover story could be established to account for its presences and steps taken to insure that, should it be shot down, it would not be recovered intact. Guidance and intelligence gathering equipment could be automatically released to free-fall to the ground once an altitude lower than that programmed had been prematurely reached.

6. It is estimated that the cost of development of a powered high altitude balloon would be far less than that of almost any high performance aircraft. [redacted] has submitted an unsolicited proposal to [redacted] that offers to prove the feasibility of the basic idea by making at least two powered flights at 65,000 feet at a cost of $150,000 covering a period of one year. 25X1

7. It is recommended that if any of the possible applications described above are considered to offer a useful approach to the general field of intelligence from aeriel reconnaissance the following steps be considered:

(a) A paper study be made using actual desired air reconnaissance targets, utilizing whatever upper air wind data is available for the target area, to determine the necessary performance characteristics of the vehicle

(b) A proposal be solicited for the development of such a vehicle placing as much emphasis as possible on the requirements generated by a specific intelligence gathering mission.