OXC - 2530
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27 October 1961

MEMORANDUM FOR THE RECORD

SUBJECT : Trip Report to LAC

1. A trip was made to Lockheed on 12 October to review and resolve the OXCART rendezvous problem. Present at the meeting were the following:

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DPD
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M-H
M-H
LAC
LAC
LAC
Castle AFB

2. The Minneapolis-Honeywell proposal for rendezvous accomplishment was reviewed for the benefit of those not familiar with it. Briefly, this system would operate as follows: The KC-135 has an APN-59 radar presently installed. The A-12 would have a radar beacon installed to aid in the vehicle's acquisition by the tanker's radar. A data link transmitter would be installed in the KC-135 and a receiver in the A-12. The KC-135's radar operator would insert and transmit via the data link the range and bearing signals to the A-12. In the A-12 these signals would be displayed to the pilot via the range and bearing instruments of the I.N.S. This system has one serious deficiency which renders it unsatisfactory for use. The tanker's radar scans in a forward direction only with only a slight amount of side look. There is approximately a 120° to 150° sector to the rear of the aircraft that is blanked out. This means that when the A-12 is within this sector it would not be seen on the tanker's radar. Hence, there would be no range and bearing data available during the refueling leg, when it is needed most. For this reason the M-H scheme was discarded.

3. A second rendezvous method was then described and discussed. This method involves the use of the ARC-50 as the principal tool. A

brief rundown of the ARC-50 will be given here for those not already familiar with it. An ARC-50 consists of two major sub-systems, the Translator and the Receiver-Transmitter. The Translator performs the RF functions in both receiving and transmitting and, in addition, contains an auxiliary narrow-band, AM modulator-demodulator. The Receiver-Transmitter provides communications using noise-correlation modulation and performs both narrow-band modulating and de-modulating functions. In noise-correlation modulation, the narrow-band signal balance-modulates the output of a wide-band pseudo-random noise source. The resultant wide-band signal then balance-modulates a radio frequency carrier. In this process, the energy of the transmitted signal is spread over a wide-band of frequencies so that the energy per unit bandwidth is very small. The transmitted intelligence is recaptured by synchronous demodulation of the received signal using a pseudo-random noise source identical to and synchronized with the noise source used at the transmitter. The transmitted signal of this system is extremely difficult to detect without the use of an identical pseudo-random noise source. A high degree of speech privacy is provided by the use of a pseudo-random noise source capable of producing a large number of statistically independent codes.

4. The ARC-50 has two modes of operation, the narrow-band mode which permits two-way voice communication with other UHF sets such as the ARC-34 or 27, the other mode is the wide-band mode which was described above. Also, when the equipment is operated in the wide-band mode, accurate range measurements can be made between two ARC-50 sets. When the ARC-50 is employed in conjunction with a direction finder, bearing data may also be obtained. Hence, the necessary data for accomplishing a rendezvous, range and bearing, are provided. by the ARC-50 and an associated direction finder.

5. The decision was made to discard the M-H scheme for rendezvous accomplishment and to utilize the ARC-50 and the ARA-25 Direction Finder for this purpose. Use of this combination will permit practically secure and non-detectable two-way voice communication, range measurement, and bearing determination, the parameters necessary for rendezvous accomplishment. Range information will be presented on a counter-type dial and bearings will be presented on an ADF needle. Range and bearing information as well as two-way voice communication may be obtained at line-of-sight ranges. Assuming the A-12 at 80,000 feet and the KC-135 at 35,000 feet the theoretical range would be approximately 650 miles. It can be seen that communications can be carried on and range and bearing data obtained at ranges far beyond the start-of-descent point which is nominally at a range of 150 miles.

6. The original OXCART electronic configuration as proposed by Lockheed consisted of the ARC-51 UHF commo set, the ARN-41C ADF, and the ARN-58 ILS. Subsequent decisions have pointed up the inadequacy of this configuration to meet all specified requirements. The ARC-51 commo function will be performed by the ARC-50 in addition to the rendezvous function. The requirement for an ARN-58 ILS was questioned, and it appears that this equipment can be eliminated, and this function performed by the GCA radar. Mr. [redacted] the Lockheed AR man, stated that the A-12 with landing gear extended, should be easily detectable by the GCA radar. This will be verified by tests, and if true, the ILS will be eliminated.

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7. Functional requirements as dictated to Lockheed are listed here in order of precedence: UHF Radio, Aerial Rendezvous System, HF Radio, TACAN, IFF, and ADF.

(a) The UHF Radio and Aerial Rendezvous functions will be adequately performed by the proposed ARC-50.

(b) The HF Radio is intended to provide both a recall capability and a means for the pilot to report trouble. A few words of discussion are warranted here. A limited recall capability could be provided from the tanker to the A-12 by means of the ARC-50 to a range of 400-600 miles. Beyond this range however, recall would be impossible. Admittedly, there would be no means for the pilot to report trouble after the tanker had disappeared from UHF range, which raises the question, would it be reasonable to expect the pilot to spend valuable time using the radio to report the cause of trouble if indeed he could know the cause of trouble, which seems highly unlikely in an aircraft of this type, as witness the B-58 experience. Investigation by Lockheed has proved the impossibility of installing an HF radio due to lack of space.

(c) The navigation function could be performed by VOR or TACAN. Investigation reveals that the long-range Air Force navigation plan calls for the widespread use of TACAN. No more VOR stations are under procurement, hence, there will be no expansion of these facilities. However, the VOR stations presently installed will be retained as long as economically feasible. A small VOR receiver can be installed in the aircraft, but a TACAN set is too large for installation.

(d) The IFF/SIF equipment can not be installed in the aircraft due to large size and weight.

(e) The ADF considered for installation is the ARN-41C. This is a small, lightweight equipment with a frequency range of 190-2850 KC. This equipment can be installed in the aircraft.

8. To recapitulate the above, it appears that because of space and weight limitations, it will be impossible to install the HF radio, TACAN, and IFF equipment. In this case the electronic configuration could consist of the ARC-50 and ARA-25 for UHF communications and rendezvous purposes, a small lightweight VOR receiver such as Aircraft Radio Corporation's Model 15F for navigation purposes, and the ARN-41C ADF.

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DPD-DD/P

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