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NEWTOWN, CONNECTICUT

REPORT NUMBER: C(I,II,III,IV),
Nonr. 1126(00).

15 April, 1955.

S E C T I O N I

REPORT

on

PRELIMINARY AND OPERATIONAL FEASIBILITY TESTS OF "LONG-LINE" TECHNIQUE FOR IN-FLIGHT PICK-UP OF MEN AND MATERIALS WITH HIGH PERFORMANCE AIRCRAFT

under

OFFICE OF NAVAL RESEARCH
CONTRACT Nonr. 1126(00)

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[redacted] 15 April, 1955.

SECTION I

REPORT

on

PRELIMINARY AND OPERATIONAL FEASIBILITY TESTS OF "LOGO-LINE" TECHNIQUE FOR IN-FLIGHT PICK-UP OF MEN AND MATERIALS WITH HIGH PERFORMANCE AIRCRAFT

under

OFFICE OF NAVAL RESEARCH
CONTRACT Nonr. 1126(00)

ROBERT E. FULTON, JR. NEWTOWN, CONNECTICUT.

[redacted]

THIS REPORT COMPILED BY

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Leopold S. Godowsky

Karl K. Schakel

INDEX, SECTION I.

SUBJECT PAGE

SECTION I.

* Section IV is 16mm Kodachrome motion picture film taken during operational feasibility tests at NAAS, El Centro, California.

"LONG-LINE" TECHNIQUE

Assignment to develop a method by which in-flight pick-up of men and materials can be accomplished with high-performance aircraft.

One such method is LONG-LINE technique which works as follows:

1. By executing a continuous turn, aircraft lowers to ground a heavily weighted bag on end of a long cable.

2. Person to be picked up gets into bag and fires "ready" signal.

3. Aircraft raises end of cable off ground by straightening out turn and climbing while simultaneously person being picked up releases from the bag the heavy weight which brought it and the cable down.

4. Bag and passenger are winched into the aircraft.

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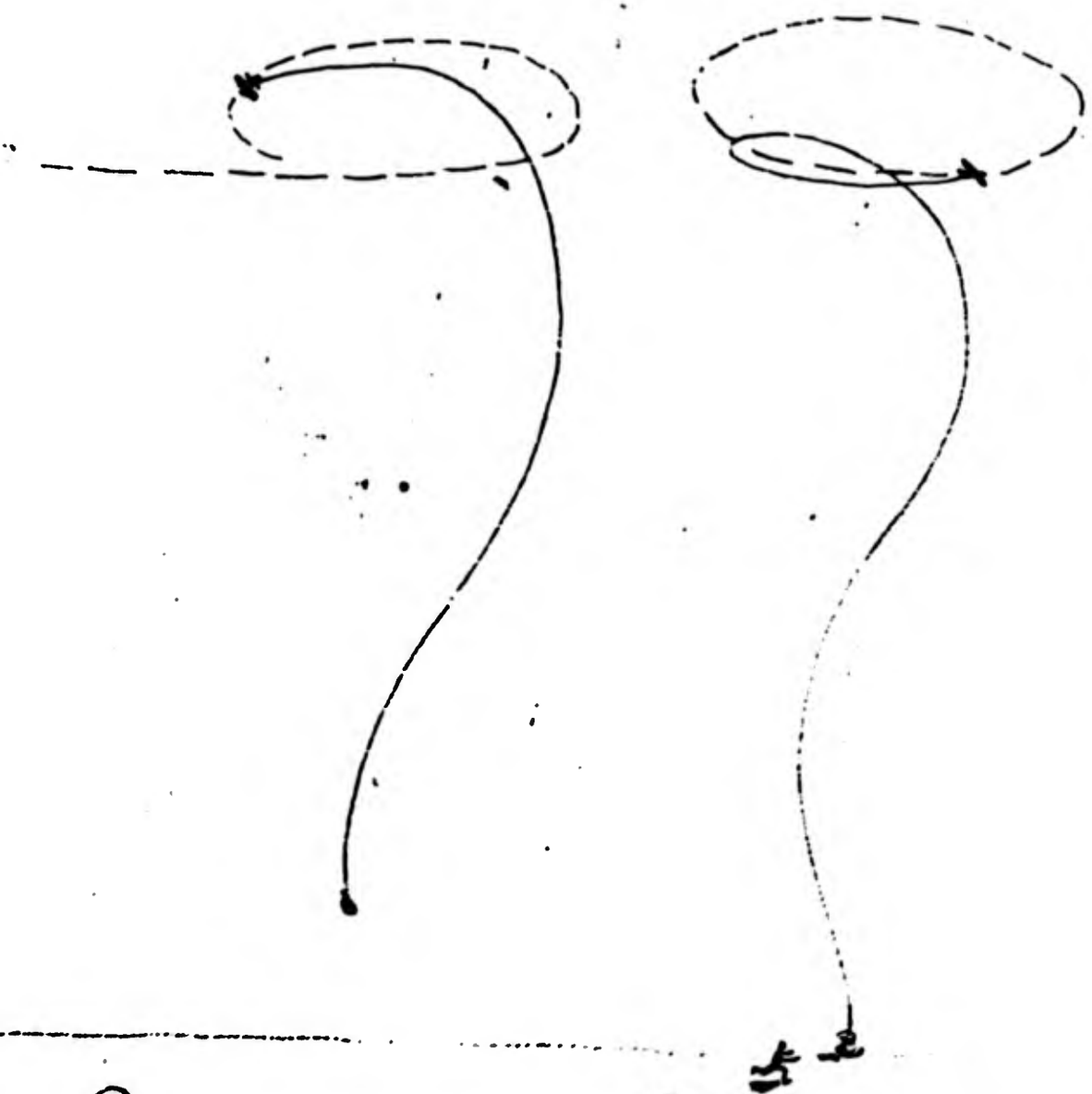
REPORT TITLE HIGH-PERFORMANCE AIRCRAFT PICK-UP.
"LONG-LINE" TECHNIQUE.



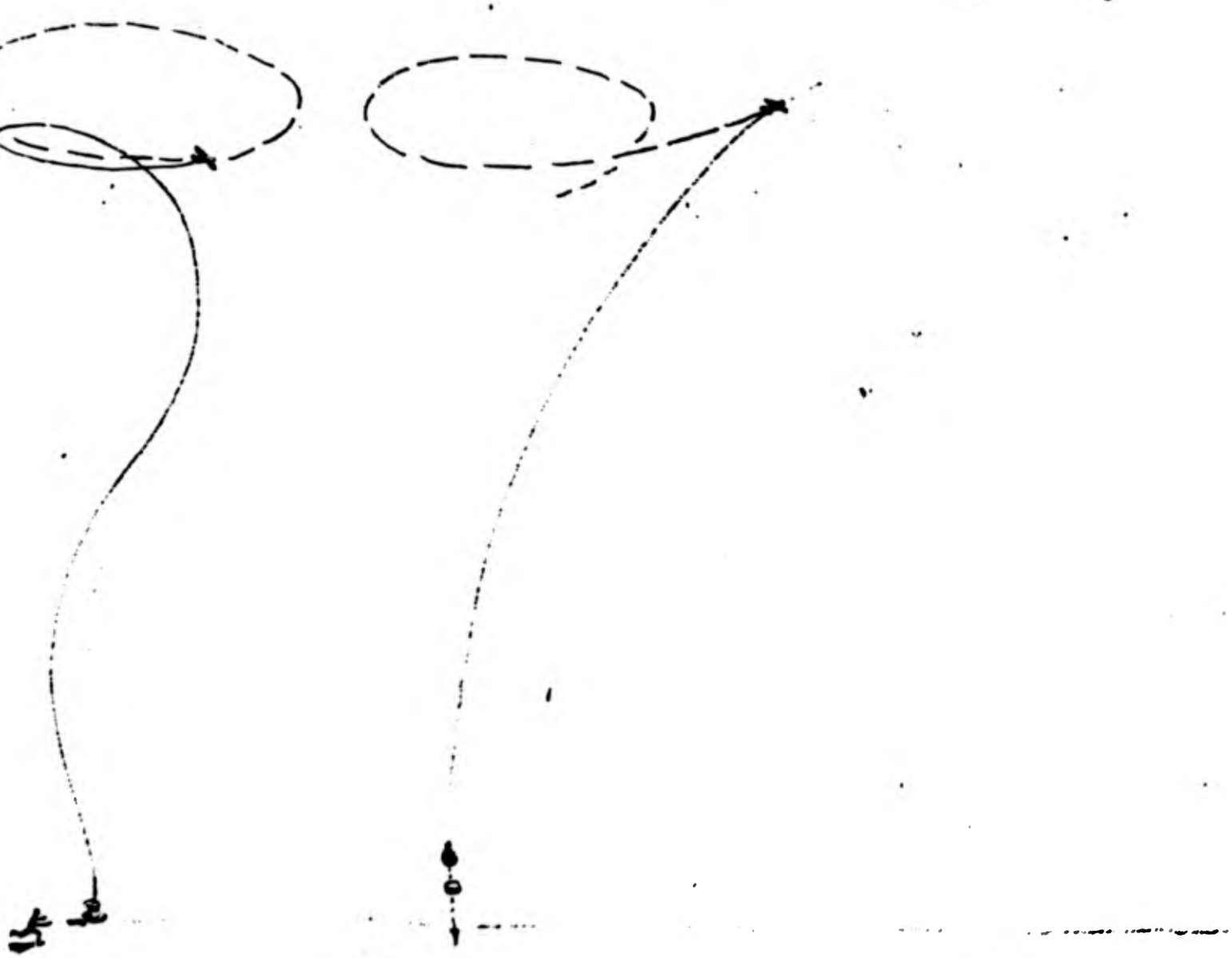
(1) AIRCRAFT EXECUTES CONTINUOUS TURN WHILE PAYING OUT SEVERAL THOUSAND FEET OF CABLE WITH HEAVY BALLAST IN BAG AT END.

(2) "PASSENGER" GETS INTO BAG WHILE PLANE CIRCLES.

1955 PAGE 2.

AFT PICK-UP.

UE.



PASSENGER' GETS
BAG WHILE PLANE
...E...

③ PLANE STRAIGHTENS OUT AND CLIMBS. AS BAG STARTS MOVING PASSENGER RELEASES BALLAST, BAG RISES.

④ LOAD IS WINCHED INTO AIRCRAFT.

20-2

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REPORT No. C (I) Memr. 1196(00), DATE 15 April, 1955. PAGE 3.

REPORT TITLE HIGH-PERFORMANCE AIRCRAFT PICK-UP, LONG-LINE.

PURPOSE OF REPORT

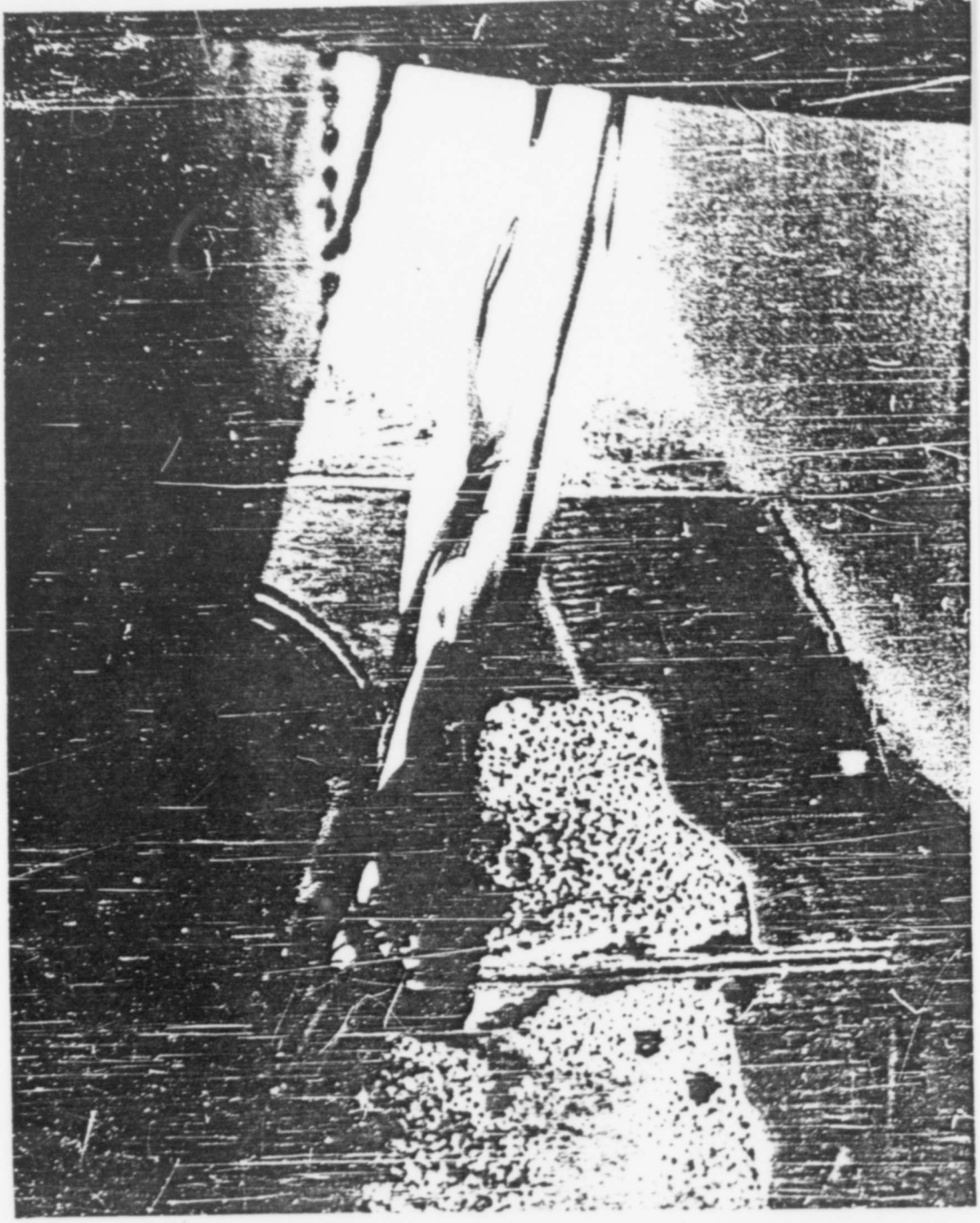
This report deals with tests conducted to investigate and determine operational feasibility of this technique.

Two separate test programs have been conducted to date:

1. Initial tests conducted on the East Coast with contractor-owned and operated small aircraft to investigate basic theory.

2. Preliminary large scale feasibility tests conducted at NAAS, El Centro, California, with Navy aircraft in the general size and speed categories that will be used for operational work and with operational size loads. Purpose of these tests was to determine whether the basic theory would work on an operational scale.

2-A



LOWERING 90 POUND SHOT BAG WITH 5 x 10 FOOT MARKER ON END OF 1/8 INCH CABLE THRU HOLD IN BOTTOM OF JD AT 130 KNOTS.

GROUND CREW REMOVING 90 lb. SHOT BAG AND ATTACHING 250 lb. DUMMY TO END OF 7,500 ft., 1/8 inch CABLE LOWERED FROM JD CIRCLING ABOVE AT 4,000 ft.

NOTE ANGLE OF CABLE. SINCE AIRCRAFT TAKES APPROXIMATELY TWO MINUTES TO FLY A FULL CIRCLE, CABLE MOVES AT ABOUT HALF THE SPEED OF THE SECOND HAND OF A WATCH.

RESULTS

Each of the above-mentioned test programs was of an exploratory nature.

The first phase proved that a weight on the end of a long line could be placed on the ground beneath a circling small aircraft and could be picked up again.

It also brought out the problem created by wind working on the aircraft and the cable, causing the former to drift off the target and the latter to raise and lower the load depending upon the aircraft's direction of flight into or with the wind respectively.

Inasmuch as wind has less effect on a high speed aircraft than on a slow one, it was felt that use of a Navy operational-type aircraft might largely eliminate this wind problem. It would also provide an opportunity to study the relationships of aircraft speed, altitude and rate of turn, weight of load, line length, angle of pick-up, etc., on a virtually operational scale.

The only Navy equipment available (a utility JD) for such preliminary testing proved to be poorly suited for the job and was available only intermittently and briefly between its regularly scheduled tow-target flights.

The aircraft had 2 major shortcomings for this job:

1. Side visibility for the pilot was virtually non-existent which made

RESULTS cont'd.

his job of circling a given (invisible) spot difficult.

2. The standard MK VIII tow-target winches installed in the JD did not have either sufficient braking capacity to permit lowering a load of more than 100 pounds or sufficient power to raise a greater load.

Thus the operational feasibility tests of this technique were circumscribed to a serious degree.

Despite these limitations, the following results were obtained:

1. A 90 pound load was repeatedly lowered to the ground on the end of a 1/8 inch steel cable from 7,000 to 10,000 feet in length and supported by an aircraft circling at between 3,000 and 5,000 feet altitude.

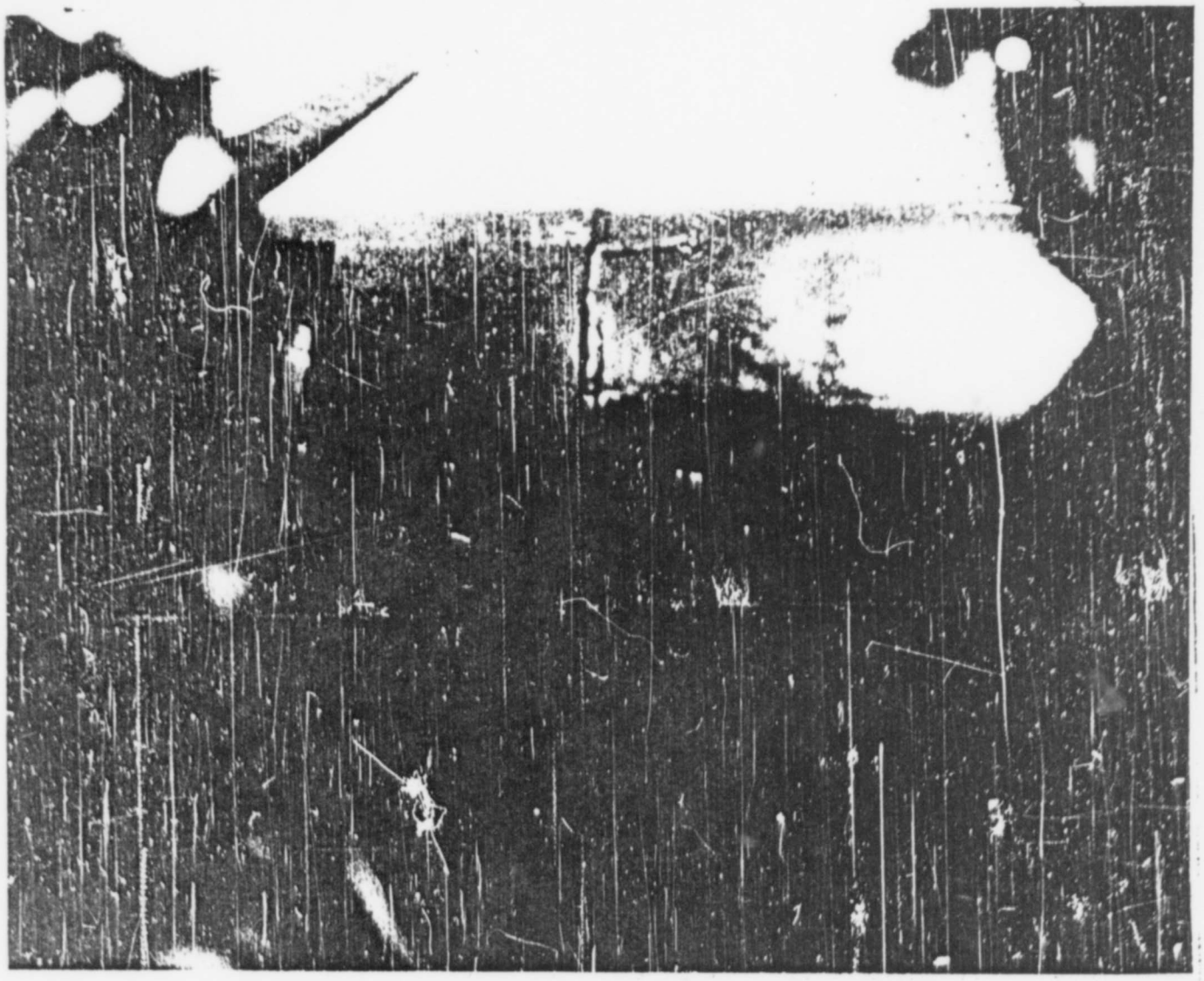
2. The load can be set down reasonably close to the target.

3. On the ground the 90 pound load was replaced with various loads up to as much as 250 pounds.

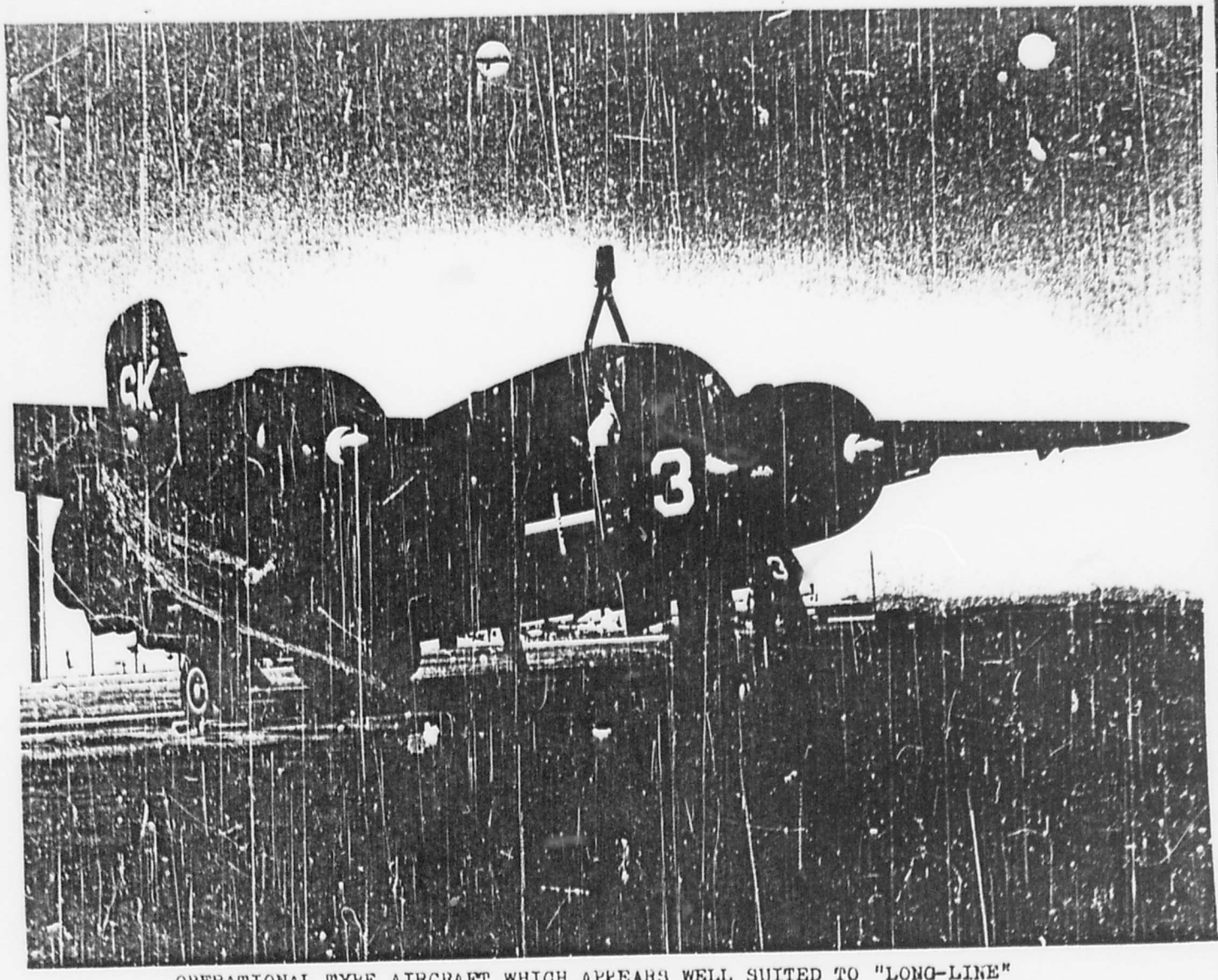
4. Such loads can successfully be raised off the ground at a good vertical angle (though this was not always accomplished during the tests).

5. Pick-up "G" loads appear generally to be minor both as to quantity and duration.

The ability of the technique to overcome the problem of wind (and consequently to eliminate dragging of the load along the ground) is still undetermined.



JD ENGINE NACELLE COMPLETELY OBSTRUCTED PILOT'S VIEW OF TARGET, MAKING IT VERY DIFFICULT ACCURATELY TO CIRCLE AND CONSEQUENTLY TO AVOID DRAGGING LOAD ALONG GROUND.



OPERATIONAL TYPE AIRCRAFT WHICH APPEARS WELL SUITED TO "LONG-LINE" WORK IS S2F. PILOT HAS GOOD VISIBILITY TO SIDE AND BELOW, AIRCRAFT HAS GOOD HIGH AND LOW SPEED PERFORMANCE, GOOD RANGE, A GOOD HOLD FOR INSTALLATION OF WINCH.

CONCLUSION

The LONG-LINE technique has the important advantage that no equipment is required on the ground (except a radio or other signalling device).

The technique has proven that it can work. It has not as yet proven, however, that it can do so consistently and reliably.

It would appear reasonable that if it can be made to work at all it can be made to do so every time under the same conditions. The matter is essentially one of complete understanding of all the factors involved and the gaining of sufficient experience to apply them.

It is felt that when a proper balance is achieved between the various factors of speed, weight, length of line, aircraft altitude, rate of turn, etc., LONG-LINE can achieve a reliability which will make it an outstanding solution to the basic assignment of this project.

RECOMMENDATION

Problems encountered with the JD operation were essentially the same as those with the Reliant. In both cases it was possible successfully to lower the load, get to it on the ground, increase it, and then raise it again into the air at a good vertical angle.

But in both cases, for each successful operation there were several failures. And the failures were always the same: the load would drag instead of rising.

In view of the potential advantages of the LONG-LINE technique and the experience which has already been gained, it is felt that further investigation and testing are justified.

To minimize both the time and expense involved, it is recommended that contractor-operated aircraft of Reliant or equivalent size be employed. The JD El Centro tests have established the fact that what can be accomplished with the Reliant can be paralleled with a larger aircraft. Conversely, if reliability of performance of the technique cannot be achieved with the lighter aircraft, it would not be reasonable to expect it with the heavier.

Experimentation may lead to the development of some new piece of equipment or some instrument which frequently is the secret to success with a project of this type.

Basic purpose of these tests should be to gain more experience and determine whether or not complete reliability can be attained. If not, the operation can be terminated with a minimum of loss. If successful, the knowledge gained can be directly applied to performance on an operational scale.

I N D E X, SECTIONS II, III & IV.

SUBJECT PAGE

SECTION II

(Preliminary LONG-LINE technique tests conducted with contractor-operated aircraft).

SECTION III

(Preliminary LONG-LINE operational feasibility tests conducted at NAAS, El Centro, California, with Navy aircraft).

S U B J E C T — PAGE

SECTION IV

(This Section consists of a 16mm kodachrome motion picture taken during operational feasibility tests conducted at MAAS, El Centro, California.

Running time is approximately 10 minutes.

Material illustrated includes the following:

1. JD aircraft.
2. Lowering load
3. Attaching banner
4. Attaching dynamometer to cable
5. Load indicator on control yoke
6. Target from air
7. Ground crew searching air for load
8. Driving over desert to load
9. Changing load
10. Load take-off.
11. Typical load landings
12. Typical load dragging
13. Typical load take-offs
14. JD pilot visibility
15. 32P aircraft