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SEA-BASED AIRBORNE ASSAULT--A NEW MISSION FOR THE NAVY

Robert D. Arnold, et al

Center for Naval Analyses
Arlington, Virginia

29 June 1962

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NAVWAG INTERIM RESEARCH MEMORANDUM

Naval Warfare Analysis Group

SEA-BASED AIRBORNE ASSAULT — A NEW MISSION FOR THE NAVY (U)

By

Robert D. Arnold
Phil E. De Poy
Manley St. Denis

NIRM-9

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SEA-BASED AIRBORNE ASSAULT —
A NEW MISSION FOR THE NAVY (U)

ABSTRACT

A new mission for aircraft carriers is proposed. The mission is to provide mobile bases from which to operate transport aircraft capable of landing troops and equipment at inland points where a threat requiring immediate discriminating response may exist. Mission requirements are examined, and capability estimates are derived from predictable aircraft technology. It is concluded that the mission is feasible.

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I. INTRODUCTION

Purpose

The purpose of this study is to inquire into the feasibility and possible military effectiveness of a new mission for aircraft carriers. This mission is to provide mobile sea bases from which to operate transport aircraft capable of landing troops and equipment at distant points where a threat requiring immediate discriminating response may exist. The mission exploits the unique capability of the aircraft carrier to move an air base, completely under United States control, to a location not more than several hundred miles away from such a threatened point when the political situation gives some advance indication of the requirement.

Background

The combat aircraft carrier has currently one of three primary missions: that of air strike, of antisubmarine warfare, or of amphibious assault. The first leads to the concept of the task force with the attack carrier (CVA) as its kernel; the second leads to the hunter-killer group centered around the antisubmarine warfare carrier (CVS); the third to the amphibious assault ship (LPH). These traditional missions have been and will remain of high Navy priority, but they do not by themselves cover the whole spectrum of primary missions for which the carrier is well suited.

The additional sea-based airborne assault mission with which this report is concerned is more closely related to the current amphibious assault mission than to the air strike and antisubmarine warfare missions. There is, however, an important difference. The amphibious assault mission has as its central purpose the securing of a beachhead from which to conduct operations against the adjacent territory. Such a mission requires only short range aircraft. As against this, the primary functions of the sea-based airborne assault mission are to deliver self-sustaining forces to a threatened area or to deliver advance forces capable of securing an airhead

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for a larger force. Since the objective area may be fairly distantly located from the shore, such a mission may depend in an essential manner on the availability of aircraft of range exceeding by a large measure that of aircraft designed primarily for over-the-beach assault.

It cannot be assumed that an adequate capability for the new mission will come about as a by-product of evolutionary improvements in the capability to carry out the vertical envelopment phase of an amphibious assault. This is because aircraft development to maximize the rapid build-up of forces close to the shore is not necessarily compatible with aircraft development to maximize the rapid build-up of forces deep inland. And neither is the development of sea-based tactical transport aircraft necessarily compatible with the development of land-based tactical transport aircraft. The new carrier mission can become a reality if, and only if, it is adopted as a distinct Navy mission so that the necessary aircraft development can be prosecuted and so that the necessary carriers can be included either in the program for the disposition of carriers retired from the attack mission, or in the new-construction LPH program.

The new mission is exemplified by the following tasks:

(a) Very rapid application of a small combat force having high initial firepower to stabilize a minor disturbance before it gets out of hand, to prevent a coup d'etat in a national capital, to seize or prepare an airstrip for larger transport aircraft, or to conduct a holding operation until larger slower-reacting forces can be brought in.

(b) Very rapid establishment of an American (or United Nations, if appropriate) "presence" at a point of incipient trouble.

(c) Very rapid provision of logistic support, particularly in technical items, to indigenous forces.

(d) Very rapid provision of technical and military advice and assistance to indigenous forces.

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The cardinal feature of this mission is the ability to react quickly to a wide variety of situations which may occur in any part of the world. In planning to cope with such situations, three possibilities must be taken into account:

(1) that the area to which the combat force may need to be deployed is distant from the sea;

(2) that airfields may not be available in the area, either because they are non-existent or because they are denied; and

(3) that the reaction time may need to be extremely short once the decision to commit forces has been made.

Consideration of these points suggests that if the combat force is to be transported overland by aircraft, the aircraft must have adequate range and be capable of landing on and taking off from unprepared terrain.

The rapid deployment of a combat force to an overseas area of operations is feasible only by aircraft and may be carried out by either:

(1) aircraft operating from fixed bases; or

(2) carrier-based aircraft.

The former method coincides with the operational concept of STRAC; the latter possibility is examined in this memorandum.

No comparative analysis as to the relative effectiveness of these two modes is undertaken. It is recognized, however, that although carrier-based aircraft will not be able to operate on as large a scale as fixed-base aircraft, the former could have a great (and sometimes decisive) advantage if the reaction time of the sea-based system is significantly shorter than that of the land-based system. Whether such gain in reaction time can indeed be realized in a specific context depends on the circumstances attending the particular operations and cannot be predicted. Several pertinent observations should be made, however.

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(a) Fixed-base aircraft must start either from CONUS or from available overseas staging bases; both of these may prove to be quite remote from the area of operations. As against this, it may be expected that carrier-based aircraft will take to the air from points much closer to the area, especially if strategic warning (even minimal) is available.

(b) Fixed-base aircraft would be faced with fuel, ordnance, and spares supply problems which in many situations could be severe. The stockpiling of adequate and safeguarded supplies of these items at staging fields is beset by continual political and diplomatic problems. For carrier-based aircraft the corresponding logistic problem would be greatly reduced in severity and would be entirely within our control.

(c) Another problem which may arise for fixed-base aircraft is that of circuitous routing to avoid overflying foreign countries; an indirect route to the area of operations could increase reaction time significantly. The alternative solution of seeking permission to overfly could increase the reaction time still more, or even prevent the contemplated operations. It would appear that carrier-based forces would be somewhat freer of these restrictions, by virtue of having greater flexibility in the choice of aircraft launch points.

(d) Fixed-base aircraft of conventional fixed-wing type are potentially hamstrung if the intermediate staging fields or the terminal fields they require are unavailable for any reason (refusal of permission to land, interdiction by enemy measures). The use of carriers would eliminate the need for intermediate staging fields altogether. The elimination of terminal airfields requires aircraft capable of landing on unprepared terrain. Radius limitations of such aircraft may preclude their use unless they can be held in readiness or quickly assembled close enough to the objective area. There may be no available assembly area ashore (even for an austere facility) sufficiently close to some objective which can still be reached from the sea.

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(e) Finally, by its mere presence a carrier-based combat force close to the troubled area would be a credible show of strength and an eloquent index of our determination. An equivalent or even larger force which would be invisible because distantly based on CONUS would speak less convincingly of our intentions and as such would not be as strong a booster of morale to the resisting forces and a deterrent to the enemy.

The foregoing exposition has been made not for the purpose of proving the superiority of a carrier-based over a fixed-base combat force, but to make a prima facie case for considering the merits of a carrier-based force in roles complementary to rather than competitive with those that may be executed by a fixed-base combat force.

Scope

This report is limited to determing what size of combat group could be carried in present carriers without major conversion. There is some advantage to restricting the scope of the study to present carriers. First, their characteristics are known, and hence the analysis can be more definite. Second, if the long-range assault mission should be implemented, it would first be done by exploiting existing carriers rather than by building new ones. This follows not only for economic reasons, but also because of the need to acquire some operational experience for eventually specifying with greater confidence the desirable characteristics of new designs, as has been the case in the evolution of the LPH.

The condition that the aircraft be capable of operating from unprepared ground in the combat area limits consideration to vertical (or short) take-off and landing aircraft (V/STOL).

The condition that the area of operations may be distant from the carrier imposes a minimum required radius of action on the aircraft to be considered. What this minimum required radius should be is discussed in Chapter IX below.

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The time frame of the study is the late 1960's and early 1970's.

Approach

To determine the potential capabilities of a long-range carrier-based combat force, the following steps are taken.

(a) Performance characteristics of present-state-of-the-art VTOL aircraft are compared in order to select a configuration for use in determining the mission capability.

(b) Sensitivity analyses on the selected configuration are carried out to determine the effect of variations in the assumptions used to calculate aircraft capability.

(c) Prediction of advanced-state-of-the-art VTOL aircraft are used as a basis for the estimation of future capability.

(d) Estimates are made of air group size for carriers currently operational.

(e) Estimate of the build-up of military force in the objective area as a function of range from ship are calculated for the aircraft designs studied.

(f) A survey is made of aircraft mission radii required for operations in areas of probable conflict occurrence.

(g) The foregoing are combined to determine the feasibility of the sea-based airborne assault mission.

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II. CONCLUSIONS

- The sea-based airborne assault mission is technologically feasible within the present state of the art. This conclusion is based on the engineering design and predicted logistic performance of a VTOL aircraft about to go into pilot production. This statement is valid even though this aircraft was not specifically designed for this mission. The operational conditions for which the mission can be carried out effectively are as yet somewhat limited. But development of a VTOL aircraft optimized for the mission should remove some of the limitations pointed out in this report.

- An appreciable improvement in mission capability over that attainable with present state-of-the-art VTOL aircraft can result if adequate R&D support is given to the mission.

- The military worth of such a sea-based airborne assault force as is studied herein depends upon the strategic importance attached to the unique capability such a force would provide. This is the capability to project a small United States force to any threatened point in the non-Communist world in a matter of a few hours, provided that there has been a prior political or intelligence indication of the threat. The initial force would be the size of a fraction of a Marine battalion—the fraction depending upon the distance of the threatened area from the coast—with an ultimate build-up to full battalion strength.

- To provide this military capability would require the provision of the following forces and their necessary support:

For each Sea-Based Airborne Assault Force:

- One aircraft carrier of LPH-4 size or two of LPH-2 size.

- One air group consisting of 42 aircraft and associated air group personnel.

- One Marine Battalion Landing Team, or its equivalent.

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III. RECOMMENDATIONS

It is recommended that:

A. The strategic value of the Sea-Based Airborne Assault Mission be determined by those concerned with Navy policy planning.

B. The military feasibility of the mission be determined by those concerned with fleet operations and readiness.

C. The development of long-range V/STOL transport aircraft compatible with carrier operations be considered in the generation of operational requirements by those concerned with Navy research and development.

D. The provision of aircraft carriers for the mission be considered by those concerned with the shipbuilding and conversion program.

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IV. V/STOL AIRCRAFT CHARACTERISTICS

Although only a single V/STOL transport aircraft configuration, the helicopter, is currently operational, a large number of other configurations have been proposed and developed to varying degrees. The present state of development of V/STOL configurations is summarized in Table I.

Because of the possible operational availability of new configurations in the future and because of the changing characteristics of helicopters as the state of the art develops, it is thought preferable to discuss the aircraft under two groups: those which are within the present state of the art, and those requiring advanced techniques for their realization. In this manner the time dependency of the technical inputs to the study and the conclusions derived therefrom are demarcated.

Although it is not the purpose of this study to select a single configuration or proposed design which appears most promising for the mission described herein, certain criteria for selecting configurations with which to assess the feasibility of the mission must be established. The first criterion results from the time frame for which the analysis is to be made. Since the aircraft would need be producible in quantity in five to ten years, the configuration should be that of a fairly well-developed type. The second criterion derives from the requirement that the aircraft must have an unrefueled radius of several hundred miles with adequate payload and still be of a size and weight compatible with carrier handling and storage.

The configurations which appear to meet best the first of these criteria are:

(1) Helicopter

(2) Compound helicopter

(3) Tilt-rotor

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TABLE I

PRESENT STATE OF VTOL AIRCRAFT DEVELOPMENT

Type	State of Development
Helicopter	Operational
Compound helicopter	McDonnell XVI test vehicle successfully tested. Westland Rotodyne prototype first flight Jan 59 (United Kingdom).
Tilt-rotor	Bell-Helicopter XV-3 test vehicle evaluation by Air Force, NASA, and Navy completed. First flight Aug 1955.
Deflected turbine thrust	Bell Aircraft X-14 test vehicle undergoing evaluation at NASA/Ames.
Tilting turbojet	Bell Aircraft D-188 test vehicle development canceled before completion of aircraft.
Tilting ducted fan	Doak Aircraft VZ-4 test vehicle undergoing evaluation by NASA/Langley and Navy.
Tilt-wing	Boeing Vertol (76)-VZ2 (first flight July 58) test vehicles undergoing evaluation by Navy and NASA/Langley. Hiller X-18 (first flight Nov 59) test vehicle evaluation by Navy and NASA/Langley completed.
Deflected slipstream	Fairchild VZ-5FA and Ryan VZ-3 test vehicles undergoing testing by NASA and Army.
Tilt-wing/deflected slipstream	Kaman K-16B test vehicle undergoing tests by NASA/Ames.
Tilt-prop	Curtiss X-100 test vehicle at NASA/Langley for tests. First flight spring 1960.
Submerged-fan	Vanguard Aircraft test vehicle undergoing tests at NASA/Ames.

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(4) Tilt-wing

(5) Tilt-duct

(6) Conventional-type aircraft equipped with boundary layer control or other high-lift devices to provide a STOL capability.

Other configurations which have been proposed, such as the lift-fan and deflected slipstream, do not appear so far advanced as the above and therefore are deemed not to meet the first criterion.

A discussion of these configurations is made on the basis of the following considerations:

(1) Logistic performance, including payload-radius and speed;

(2) Downwash velocity as it affects landing surface limitations;

(3) The operational implications of VTOL or STOL as a design choice; and

(4) Vulnerability.

Logistic Performance

The logistic performance of V/STOL transport aircraft can be discussed on the basis of two measures of effectiveness: the total military payload delivered in the landing zone by the first wave of aircraft and the rate of force build-up in the landing zone.

Reference (a) presents a comparison of the payload-radius characteristics for those five types of configurations which have been considered for VTOL transports. The gross weights of the VTOL designs range from 37,000 pounds to 53,000 pounds. All designs were based on real engines at ratings which could be expected within the next three to five years; four 4,800-horsepower turbo-shaft engines for the tilt-duct design and 3,200-horsepower turboshaft engines for the remainder of the designs

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(two engines each for the helicopter and compound helicopter and four engines each for the tilt-rotor and tilt-wing).

The payloads are shown as a function of radius in Figure 1 for a selected mission. The mission considered is based on an initial STOL take-off (500 feet over a 50-foot obstacle) and VTOL at the destination with a thrust-to-weight ratio of at least 1.15. Payload is assumed to be carried in both directions, and take-off and landing conditions were established as a 3,000-foot altitude and a temperature of 100°F.

In order to compare these data on a more common basis, they are shown in Figure 2 as the ratio of payload to gross weight as a function of radius.

It can be seen from Figures 1 and 2 that the tilt-wing configuration appears to provide the best payload-carrying capability at radii in excess of 300 miles of any of the VTOL designs considered. Similar results have been obtained in other studies comparing tilt-wing designs with helicopters and compound helicopters (e.g., references (b) and (c)).

Speeds of the aircraft considered in reference (a) are similar for all of the configurations except the helicopter. Cruise speed for the helicopter design considered is approximately 125 knots true air speed (KTAS). Cruise speeds for the other designs ranged from 150 to 175 KTAS. Maximum speeds are approximately 150 KTAS for the helicopter and 250 to 300 KTAS for the other configurations.

Although the speeds are similar for all of the configurations considered in reference (a), higher speeds could be realized in future VTOL aircraft with other configurations. One promising high-speed configuration appears to be the lift-fan, or fan-in-wing configuration. As mentioned earlier, however, the state of the art for the lift-fan scheme is not so far advanced as that for the other transport configurations and does not at present provide sufficient performance or safety to be considered for the time period specified (see reference (a)).

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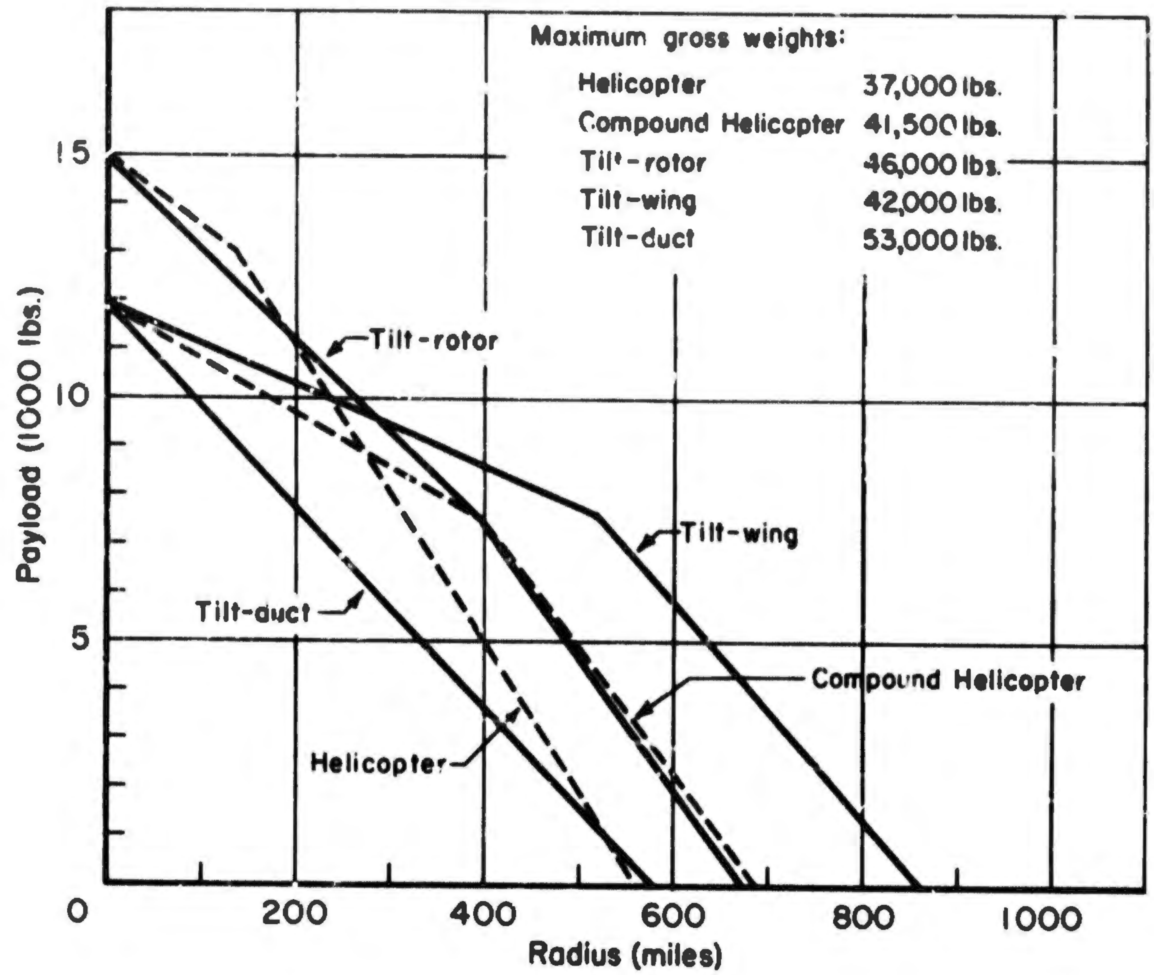

FIG. 1: PAYLOAD-RADIUS CHARACTERISTICS FOR VARIOUS VTOL CONFIGURATIONS (Figure 22 of reference (a))

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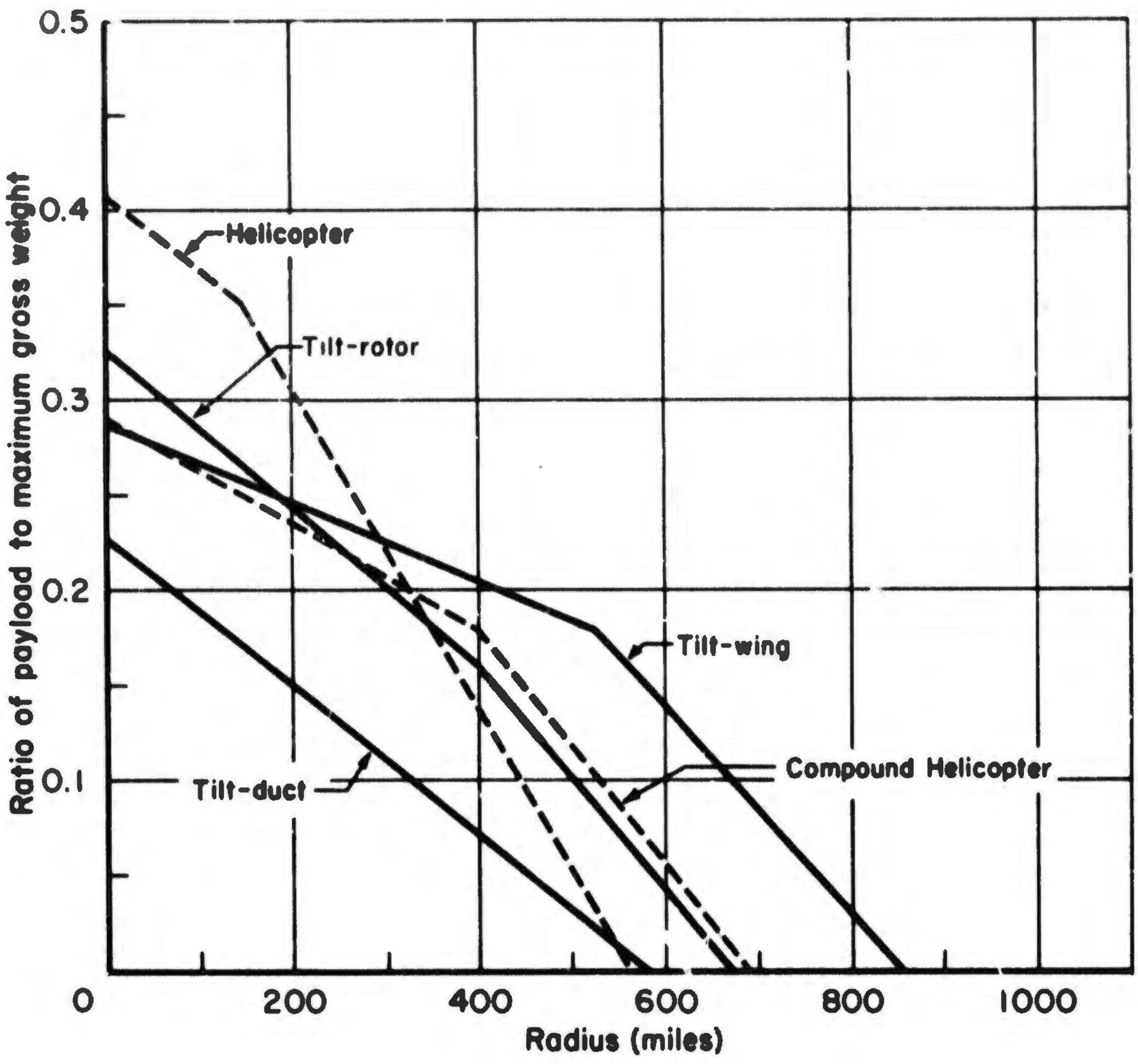

FIG. 2: PAYLOAD/GROSS WEIGHT-RADIUS CHARACTERISTICS FOR VARIOUS VTOL CONFIGURATIONS

The performance of conventional types of aircraft equipped with high-lift devices for a STOL capability has not been specifically included, since the designs can vary a great deal. In general it can be stated that the logistic performance is better for this type of aircraft than for VTOL configurations. In order to select a suitable configuration, however, these gains in performance must be weighed against the operational penalties for lacking a VTOL capability. These penalties will be discussed in a later section.

Downwash Velocity

Although relatively little is known about ground erosion with high downwash velocities, it can be stated that the severity of the erosion problem increases with increasing downwash velocity and increasing air temperature. Operational experience may show, for example, that a configuration with a downwash velocity on the order of 150 knots (e.g., fan-in-wing) may operate only from substantial sod or more solid surfaces, whereas helicopters with downwash velocities on the order of 50 knots can operate from loose surfaces such as gravel. Although limitations on landing surfaces may not in most cases compromise the effectiveness of the aircraft for the mission considered in this study, it is desirable to have as low a downwash velocity as possible in order to minimize the restrictions that must be imposed on landing areas.

Estimates of downwash velocities for various VTOL configurations are contained in reference (c) and are shown in Figure 3.

Operational Implications of VTOL or STOL as a Design Choice

The choice of VTOL or STOL for this mission, as in others, depends on the type of terrain on which the aircraft must operate. If large enough clearings were available and the terrain were smooth enough, in most of the areas of interest, to permit STOL operations, it would not be wise to incur the performance penalties of a VTOL configuration. If, on the other hand, the terrain in some areas of interest would limit or preclude STOL operations, a VTOL configuration would be indicated if the performance penalties were not too severe.

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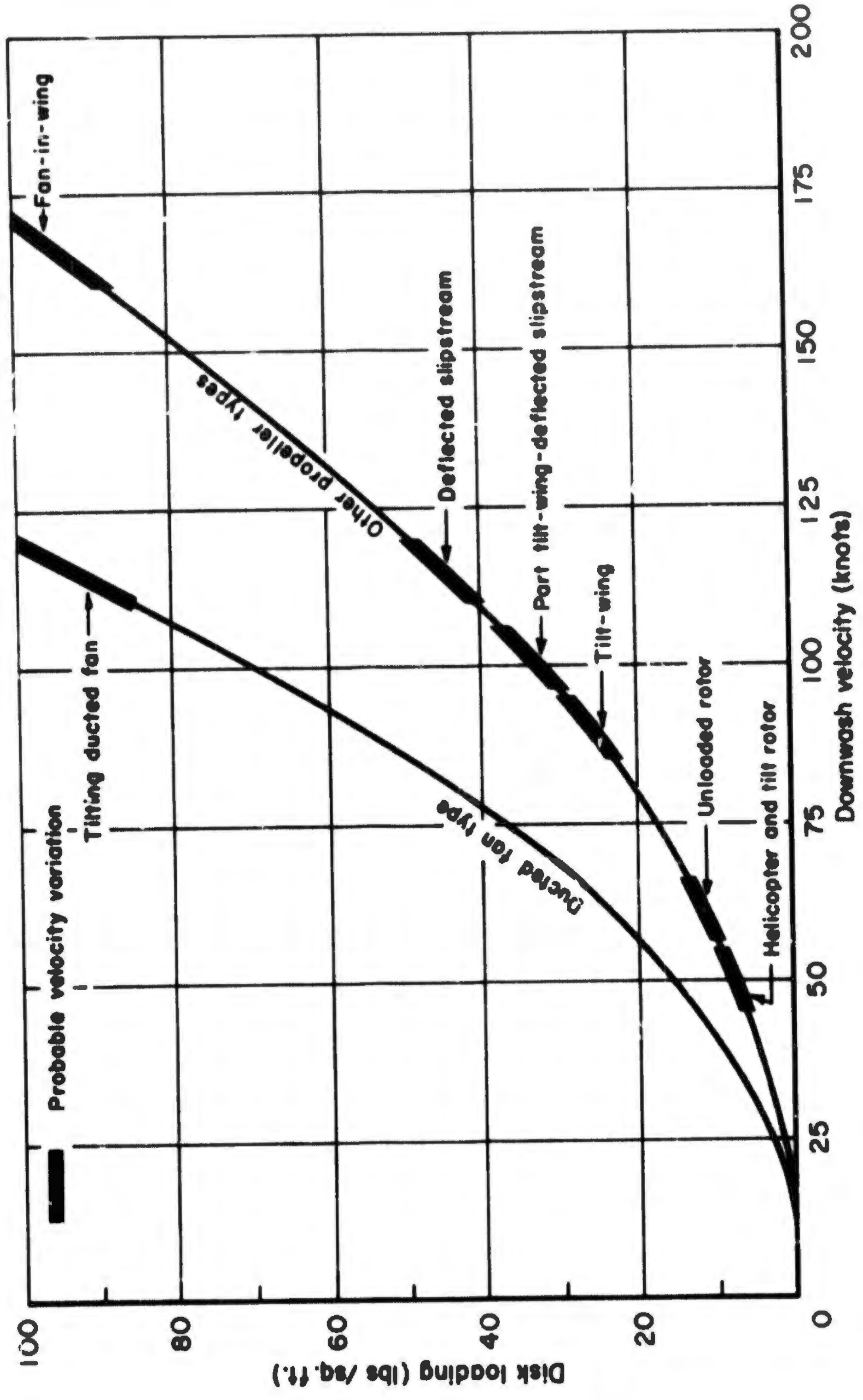

FIG. 3: ESTIMATED VTOL DOWNWASH VELOCITY
(Figure 1 of reference (c))

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Since the initial take-off for the mission considered in this study is to be made from a carrier, a VTOL configuration could be overloaded and operated in an STO fashion by deck-launching with a small amount of wind-over-the-deck. Although it might be desirable to catapult these aircraft in order to achieve better performance, it would appear that the weight penalty resulting from strengthening the aircraft structure and protecting personnel and equipment would offset any large gains in performance.

Since a VTOL aircraft could be operated in a STOL manner with an overload, STOL and VTOL performance must be compared on the basis of the take-off distance for a given payload. Such a comparison was made in reference (d) for a STOL configuration designed for a 500-foot take-off and a tilt-wing VTOL configuration, and is shown in Figure 4. From Figure 4 it is seen that the STOL aircraft is superior (in useful load to gross weight ratio) to the tilt-wing VTOL aircraft only for take-off runs between about 800 and 1,900 feet. If a take-off run of less than 800 feet is required, the tilt-wing VTOL configuration provides a greater load-carrying capability. If the aircraft is operated from a runway or clearing greater than 1,900 feet long, the tilt-wing VTOL is also superior.

Similar results are shown in Figure 5. If the weight-to-thrust ratio exceeds that required for VTOL, a considerable take-off distance is required.

The safety aspect of the operation cannot be ignored. Since VTOL configurations are normally overpowered sufficiently to provide a hover capability at the design gross weight with one engine inoperative, and STOL configurations normally require 100 per cent power to meet their design point specifications, operation of VTOL configurations would appear to be safer than that for STOL designs when both are operated at their design points. At gross weights which require power on all four engines in order to hover, VTOL aircraft can operate safely in one of two ways. The first is to hover below a critical altitude so that the loss of power on one engine would not result in a serious crash. The other is to operate

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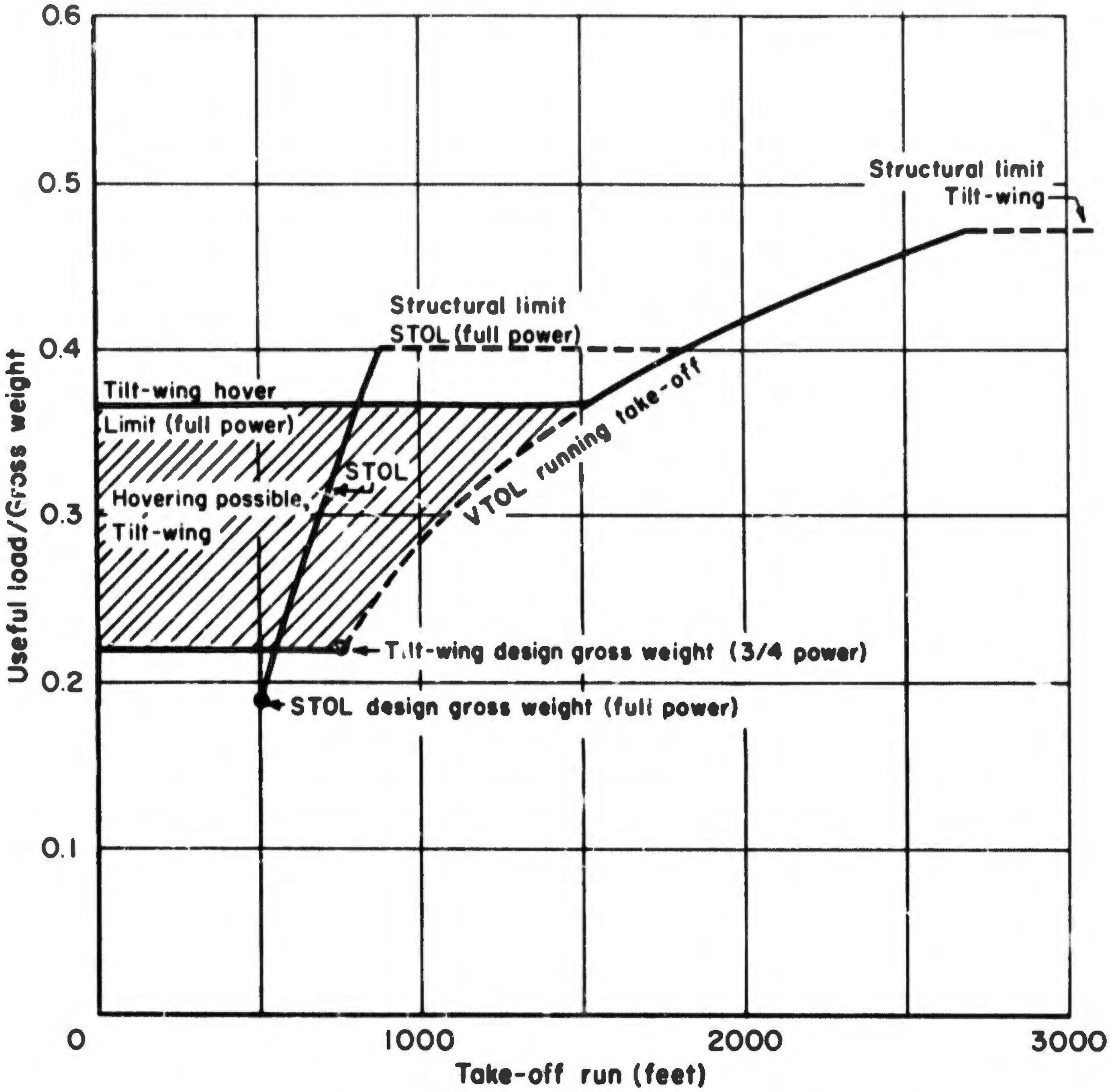

FIG. 4: COMPARISON OF TAKE-OFF DISTANCES FOR A STOL CONFIGURATION AND A TILT-WING VTOL CONFIGURATION
(Figure 11 of reference (d))

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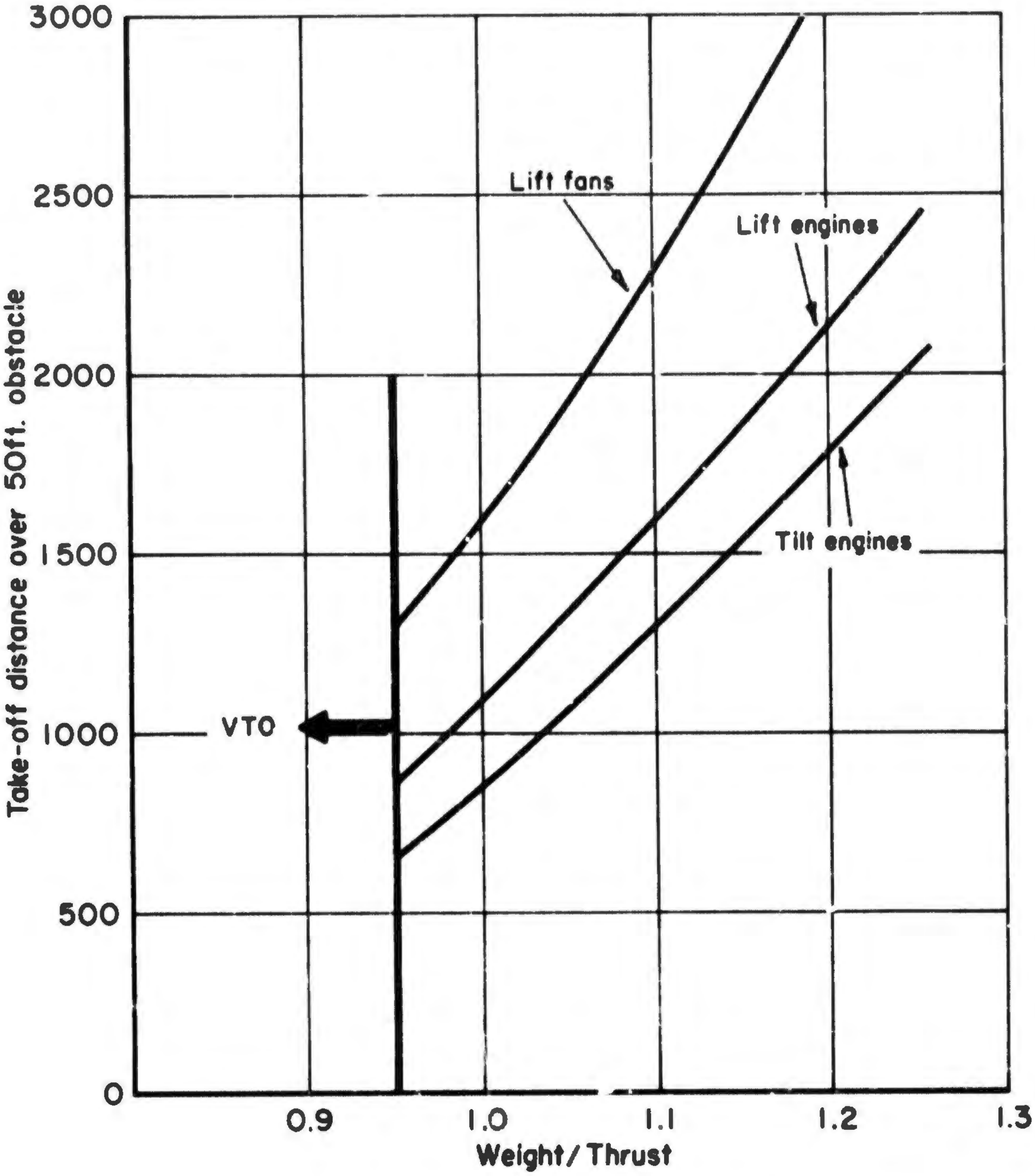

FIG. 5: TAKE-OFF DISTANCES FOR STO OPERATION OF VARIOUS VTOL CONFIGURATIONS
(Figure 15 of reference (a))

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above the critical altitude with sufficient forward speed so that a safe landing could be made with one engine inoperative. At higher gross weights, VTOL aircraft can operate in a STOL manner. Thus, VTOL operation appears to be at least as safe as STOL operation under all conditions.

The excess power of a VTOL aircraft makes it an effective STOL aircraft when operated with an overload. As will be seen in a later section, the limitations on take-off and landing weights imposed by operation at high elevations or temperatures may require that STOL operation be used in some areas. In that event, the VTOL aircraft appears to be competitive on a performance basis with an aircraft designed only for STOL.

Vulnerability

It is difficult to compare the vulnerability of various types of aircraft for this mission since the defense environment can be expected to vary over an extremely wide range. Two requirements can be stated, however. First, it is desired to maintain as high a cruising speed as possible in order to minimize vulnerability to interceptors and ground fire. Secondly, it is desired to have good performance at low altitude in order that low penetrations can be made through the more severe defense environments.

Since aircraft for this mission cannot normally depend on air support from CVA's, it may be desirable to consider the addition of a few light aircraft such as the L^2VMA proposed by Ryan Aircraft Company or the V-451 proposed by Chance Vought Corporation (see reference (e)). These aircraft are turboprop-powered STOL configurations with gross weights on the order of 5,000 pounds. They might be used as fighter escorts for the mission as well as for air support at the destination. Since they are quite small, they would displace only a few transport aircraft from the complement.

Selection of Aircraft Designs for Further Analysis

Present LPH-based aircraft are limited to a 35,000-pound gross weight. This limitation is imposed by the rated elevator capacity of the LPH-2 class. For the selection of present-state-of-the-art and future aircraft, such a limitation is not observed for the reason that:

(a) The aircraft need not be operated on the elevators when fully-laden, but may be fueled and loaded (or drained and unloaded, if necessary) on the flight deck.

(b) The capacity of the elevators can be modestly up-graded without undertaking a major conversion.

The foregoing discussions lead to the following selection of V/STOL transport aircraft to serve as a basis for estimating the potential capability of a sea-based airborne assault force.

(a) Present state of the art:

- Helicopter YHC-1B "Chinook," and
- Tri-service transport, tilt-wing turbo-prop XC-142.

(b) Future aircraft:

- Helicopter,
- Compound helicopter, and
- Tilt-wing turbo-prop.

The selection of future aircraft is somewhat arbitrary and should not be considered prejudicial toward other types which, if adequately funded, could well become operationally available in the early 1970's.

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V. VTOL TRANSPORT AIRCRAFT BASED ON THE PRESENT STATE OF THE ART

VTOL Transport Aircraft Presently Operational

The only VTOL transport aircraft presently operational are helicopters. Of the several in existence, the only one of interest in the present context is the YHC-1B "Chinook" medium transport helicopter, first flown in September, 1961. The basic design and performance characteristic of this aircraft are summarized in Table II. The payload-radius characteristic for cruise at sea level on a standard day, taken from reference (f), are shown in Figure 6. In this and all subsequent payload-radius characteristic curves it is assumed that the aircraft carries the indicated payload out and half of this weight back.

VTOL Transport Aircraft in the Design Stage

The characteristics of VTOL transport aircraft suitable for the sea-based airborne assault mission can be accurately predicted from the present state of the art of aircraft design. The first VTOL transport aircraft, other than helicopters, that could become available in the immediate future (1965-70) is the Tri-Service Transport, XC-142. Although the XC-142 is not presently planned to be carrier compatible, it was originally designed to Navy specifications and could be made carrier compatible with the installation of tail and wing folds. The XC-142 is a tilt-wing, turbo-prop configuration. Its characteristics are given in reference (g) and are summarized in Table III. Along with the data corresponding to the design as presently conceived, certain data are given for a first-growth version.

In what follows, the XC-142 will be used as a model to determine in some detail the technical feasibility of the proposed sea-based airborne assault mission. Reasons for choosing this design are that:

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TABLE II

DESIGN AND PERFORMANCE CHARACTERISTICS OF YHC-1B

HELICOPTER "CHINOOK"

Builder: Boeing	
Dimensions	
Length: Fuselage/open rotors	51/98.3 ft.
Width:	8.4/44 ft.
Height:	18.5 ft.
No. of rotors:	Two
Normal disc loading:	4.86 lbs./ft.^{2}
Weights	
Empty:	16,159 lbs.
Fixed useful load (crew of 2):	452 lbs.
Internal fuel capacity:	4,155 lbs.
Normal gross weight:	26,600 lbs.
Maximum overload gross weight:	33,000 lbs.
Powerplant	
No. and type:	2/T55-L-5
Maximum/Normal rating of each engine:	2200/1850 shp
Performance	
Maximum speed at sea level:	159 knots
Cruising speed at sea level:	130 knots

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TABLE III: DESIGN AND PERFORMANCE CHARACTERISTICS OF THE TRI-SERVICE VTOL TRANSPORT, XC-142

Characteristics	Present Design	First Growth** Version
Dimensions		
Overall Length	58 ft. 1.5 in.	58 ft. 1.5 in.
Wing Span	67 ft. 6.0 in.	71 ft.
Overall Height	26 ft. 1.0 in.	26 ft. 1.0 in.
Folded Dimensions *		
Length	50 ft.	50 ft.
Width	29 ft.	29 ft.
Height	16 ft. 6 in.	16 ft. 6 in.
Cargo Compartment Dimensions		
Length	30 ft.	30 ft.
Width	7 ft. 6 in.	7 ft. 6 in.
Weights		
Empty	22,595 lbs.	—
Design gross weight	37,424 lbs. (VTOL)	46,875 lbs. (STOL)
Powerplant		
No. and type	Four T-64-GE-6 turboprops	Four T-64-GE-ST129
Rated shaft horsepower	2805 HP	3159 HP
Performance		
Maximum speed at sea level	355 knots	352 knots
Cruising speed at sea level	200 knots	200 knots
Cruising speed at 20,000 ft.	240 knots	240 knots

* Reference (h). Initial design does not fold but a folding design would have these dimensions.
** Reference (i).

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Conditions:

2 minute warm up at normal rated power
Cruise at sea level on a standard day at best-range speed
10% initial fuel reserve
Empty weight = 16,159#
Crew etc. 452#

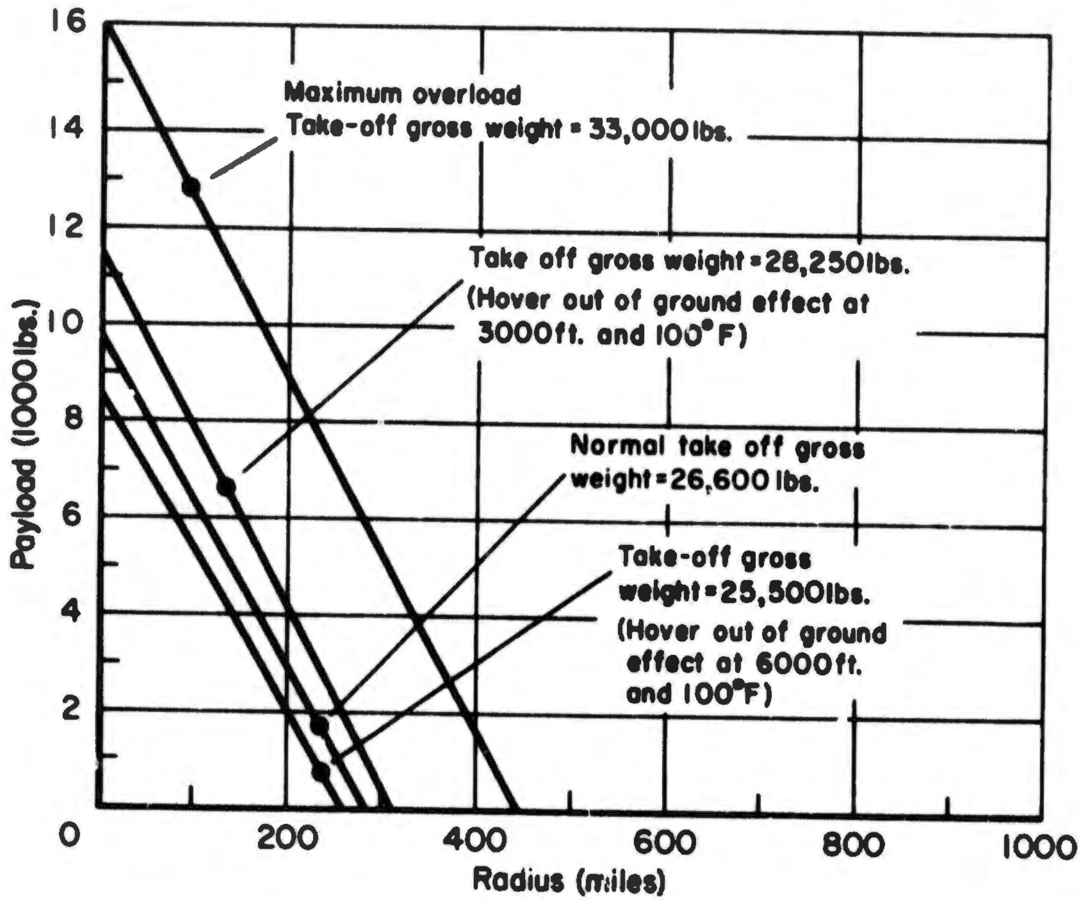

FIG. 6: YHC-1B HELICOPTER ("CHINOOK")
PAYLOAD VS RADIUS AT SEA LEVEL

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(a) it is based entirely on present engine performance and tested VTOL concepts,

(b) it is an engineered (rather than a parametric) design, which means that performance can be specified in some detail; and,

(c) it represents the configuration which could become operational at the earliest date.

The payload-radius characteristics of the XC-142 are shown in Figure 7 for a minimum-altitude, optimal-cruise-speed mission (LO-LO profile). Radii are based on an overloaded VTO from a carrier (with a 20-knot wind-over-the-deck), cruise at minimum altitude at 200 KTAS, VTOL at the objective, and VL on the carrier. The VTO from the carrier with a 20-knot wind-over-the-deck is equivalent to an STO with a take-off distance of 500 feet under no-wind conditions. Take-off performance is based on conditions at sea level at a temperature of 15°C over that defined by the International Standard Atmosphere at sea level (I.S.A. + 15°C). The atmospheric conditions at the objective are assumed to be sea-level, standard day. The payload-radius characteristics of the first growth version of the XC-142 proposed by Chance Vought (see reference (i)) are also shown in Figure 7. The first growth version is based on the installation of four 3159-SHP T-64-GE-ST129 engines and a slightly increased tail and wing area.

The payload-radius characteristics for a high-altitude, optimal-cruise-speed mission (HI-HI profile) are shown for both versions in Figure 8. Radii for this mission are based on an overloaded VTO from the carrier at sea level, I.S.A. + 15°C conditions, VTOL at sea-level, standard day conditions in the objective area, and cruise to and from the objective at 20,000-foot altitude and 240 KTAS.

If the radius for the mission is too large to permit a low-altitude cruise over the entire profile but it is important to approach the objective area at low altitude, then a HI-LO-LO-HI mission profile is appropriate. This

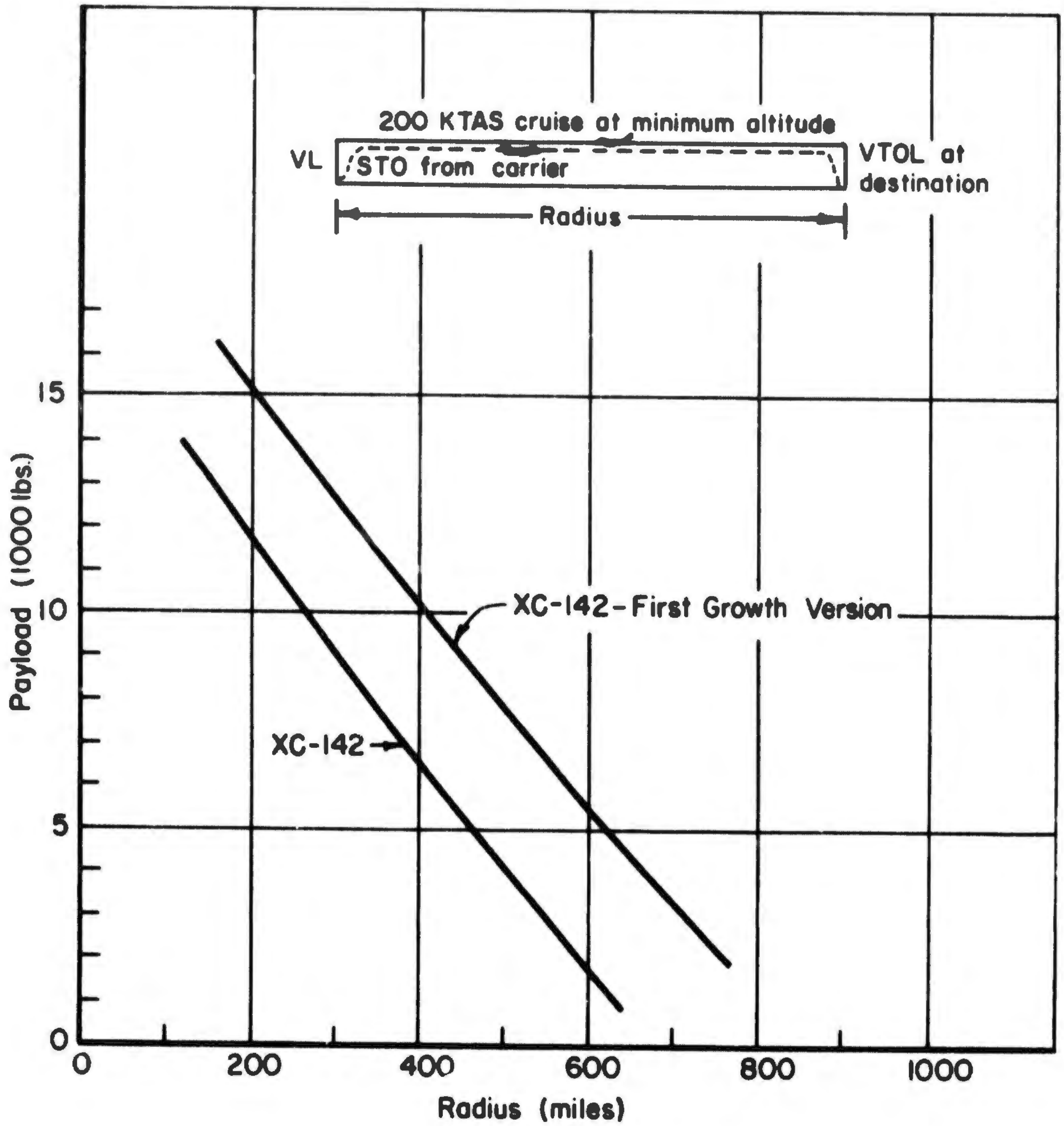

FIG. 7: XC-142 PAYLOAD-RADIUS CHARACTERISTICS
(LO-LO Mission Profile)

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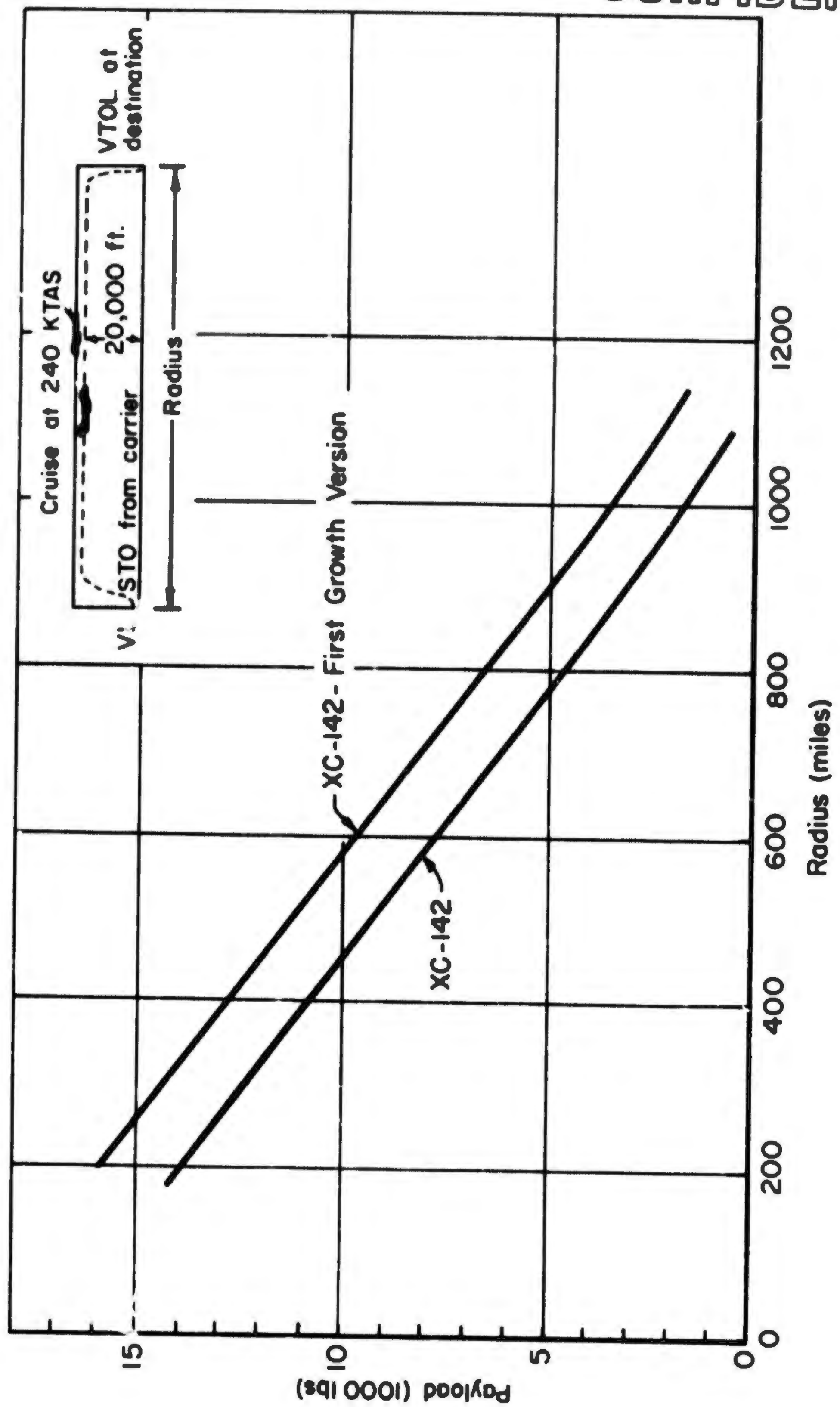

FIG. 8: XC-142 PAYLOAD-RADIUS CHARACTERISTICS
(HI-HI Mission Profile)

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consists of an overloaded VTO (20-knot wind-over-the-deck) for the carrier at sea-level, I.S.A. +15°C conditions, cruise-out at 20,000 feet and 240 KTAS, a 100-mile run-in to the objective area at minimum altitude and optimal low-altitude cruise speed (200 KTAS), and VTOL at the destination. Atmospheric conditions at the destination are assumed to be sea-level, standard day, although the effects of other conditions on the maximum payload which can be carrier are considered later. The return profile consists of a 100-mile minimum-altitude, 200 KTAS run-out from the target, cruise-in at 20,000 feet 240 KTAS, and a VL on the carrier with a fuel reserve of ten per cent of the initial fuel. As in the other profiles, one-half of the payload carried to the destination is assumed to be carried on the return trip. Payload-radius characteristics for the XC-142 and its first growth version are shown for the HI-LO-LO-HI mission profile in Figure 9.

Altitude-Temperature Effects

The effect on performance of increased altitude or temperature in the objective area is a reduction in total thrust and hence a reduction in maximum landing or take-off weight. Assuming that the take-off weight at the carrier is the controlling factor in determining the payload, the objective area landing weights are as shown in Figure 10 for a HI-HI and for a HI-LO-LO-HI mission profile. The percentage of the standard-day, sea-level lift required to give a VTOL capability at each landing weight is also shown. These data have been then combined with thrust data for various temperatures and altitudes (references (g) and (i)) to determine the maximum radius to which the maximum payload (as determined by the carrier take-off conditions) could be carried.

Payload-radius characteristics for the HI-LO-LO-HI profile are shown in Figure 11 for sea-level and 6,000-foot elevations, and standard-day and tropical-day (I.S.A. + 30°F) conditions. It can be seen that the 6,000-foot tropical-day conditions inflict a severe penalty on the payload which can be carried. If these atmospheric conditions exist at the objective area, STOL would probably be necessary there.

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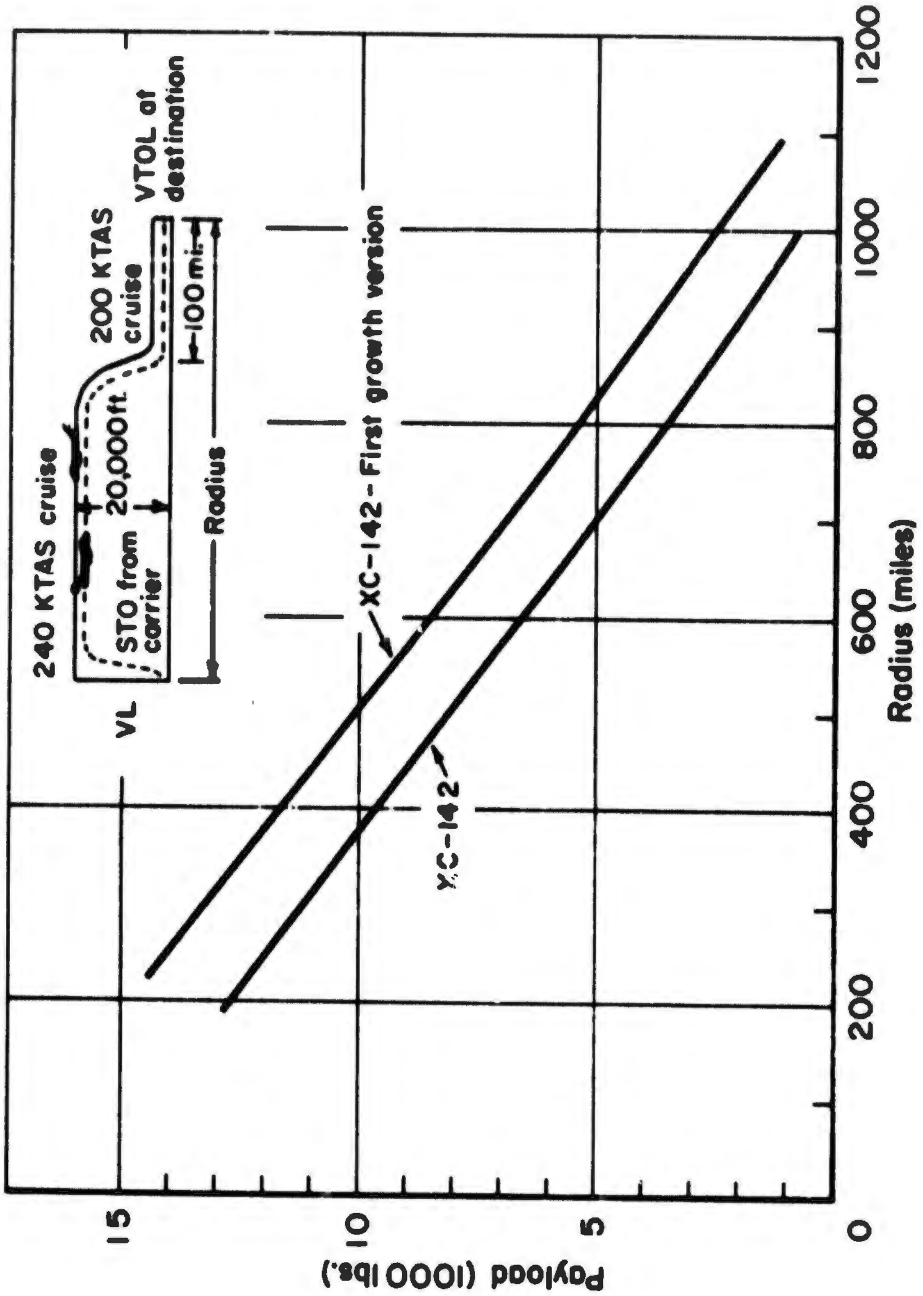

FIG. 9: XC-142 PAYLOAD RADIUS CHARACTERISTICS
(HI-LO-LO-HI Mission Profile)

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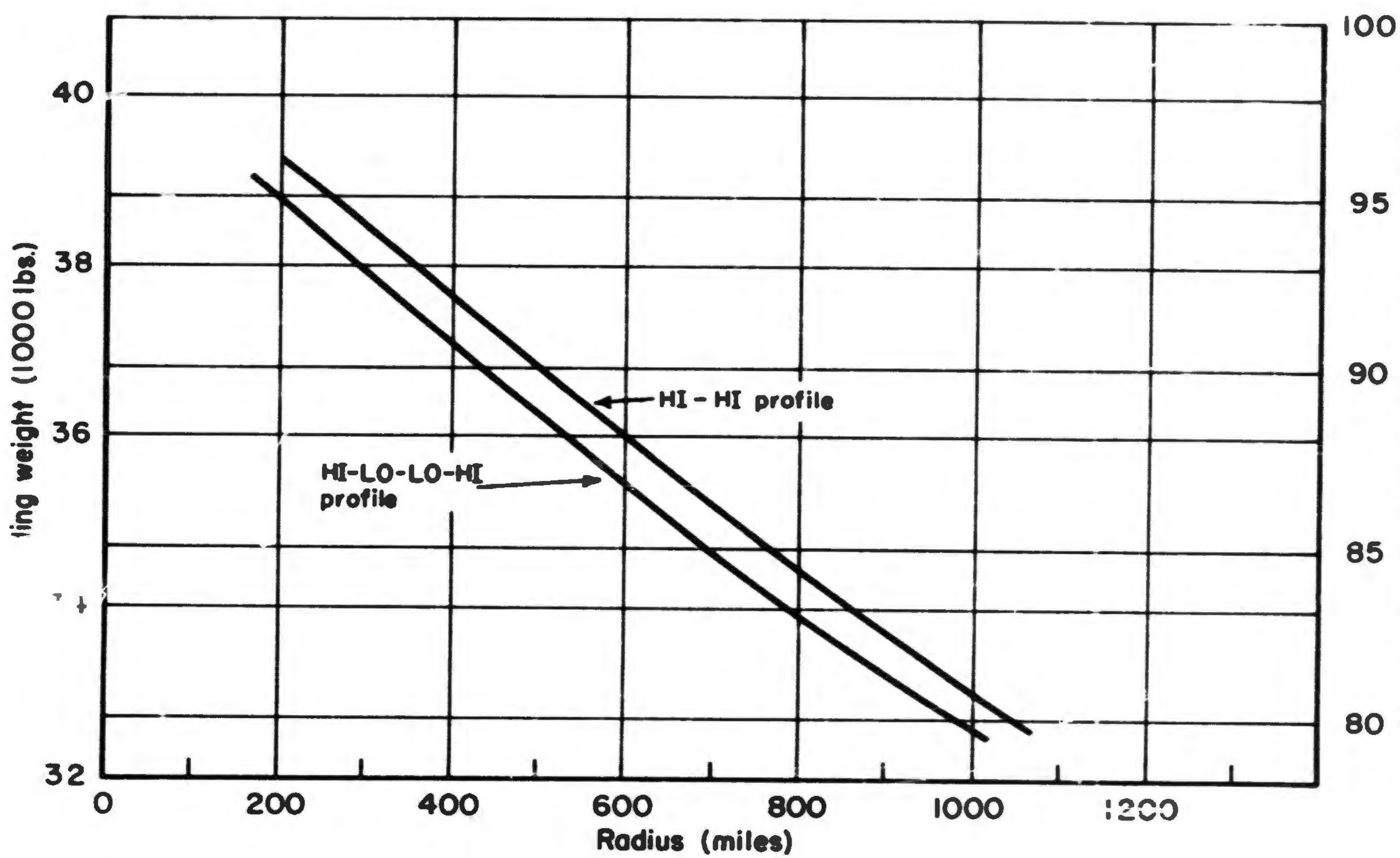

FIG. 10: XC-142 LANDING WEIGHTS AT OBJECTIVE
(41,500 lb. take-off weight)

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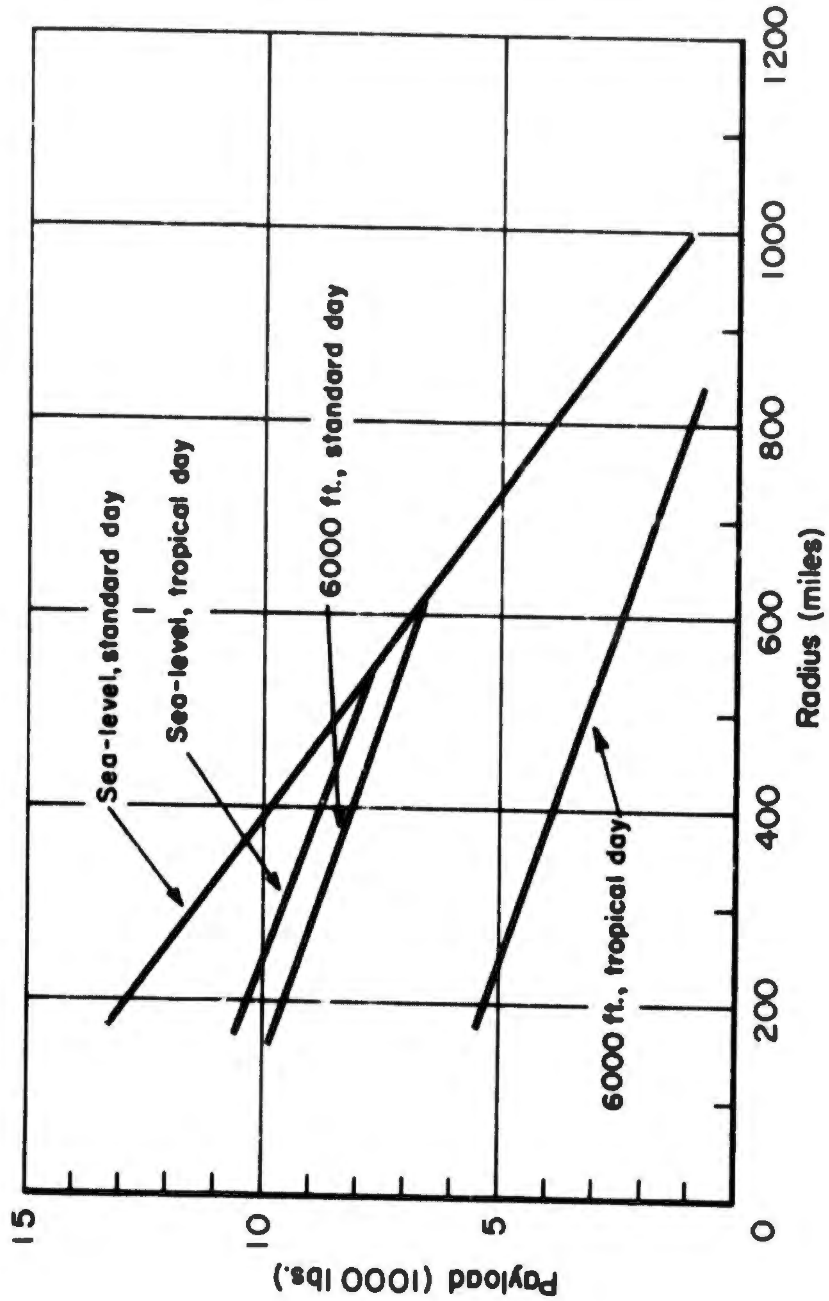

FIG. 11: TEMPERATURE-ALTITUDE (AT OBJECTIVE AREA) EFFECTS ON MAXIMUM PAYLOAD CARRIED

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VI. FUTURE AIRCRAFT

Performance characteristics of future aircraft have been predicted by extrapolating from the present state of the art: they must, consequently, be considered as speculative. Some guidance for this extrapolation is available in studies forecasting future growth, such as references (f), (j), and (k). The performance characteristics assumed herein are based on the data contained in these references.

Because of the imposed conditions that the aircraft for the mission of this study be producible in fairly large quantities by the early 1970's and that the downwash velocities the aircraft generate when taking off or landing be sufficiently moderate so as not to create problems of erosion and ingestion when operating from unprepared landing sites, consideration is restricted to three configurations: the helicopter, the compound helicopter or unloaded rotor, and the turbo-prop-powered, tilt-wing aircraft.

It was thought sufficient for the present purpose to restrict consideration to a single take-off gross weight of 40,000 pounds. Although this is not necessarily the optimum size for each of the configurations studied, it is felt that the potential sea-based airborne assault mission capability can be evaluated on the basis of this single value.

Technical and performance data of these aircraft pertinent to an estimate of their payload-radius characteristics are discussed in what follows. The data significant in this regard are:

(a) Cruising speed, V_c

(b) Specific range (mile per pound of fuel), r_{sp}

(c) Basic weight fraction (ratio of basic to take-off gross weight), W_b/W.

The data assumed represent only a modest upgrading of current or proposed designs.

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In line with reference (f) cruising speed has been assumed as follows:

Helicopter	V_c = 150 knots
Compound helicopter	250 knots
Turbo-prop, tilt-wing	400 knots

The specific range has been assumed to be given by the relation

$$r_{sp} = kW^{-a}$$

where W is the take-off gross weight and k is a factor of proportionality dependent on the aircraft configuration. The data of reference (f) give a = 8/9 and the following values for k:

Helicopter	k = 88
Compound helicopter	132
Turbo-prop, tilt-wing	198

The basic weight fraction depends on the design limit load factor, which in turn depends on the design speed. Reference (f) gives these estimates:

Helicopter	W_b/W = 0.40
Compound helicopter	0.45
Turbo-prop, tilt-wing	0.55

These assumptions follow closely the empirical relation.

$$\frac{W_b}{W} = 0.30 + 6.25 \times 10^{-4} V_c .$$

See Figure 12.

Payload-radius characteristics of future aircraft have been derived by the methodology described in Appendix A and are plotted in Figure 13.

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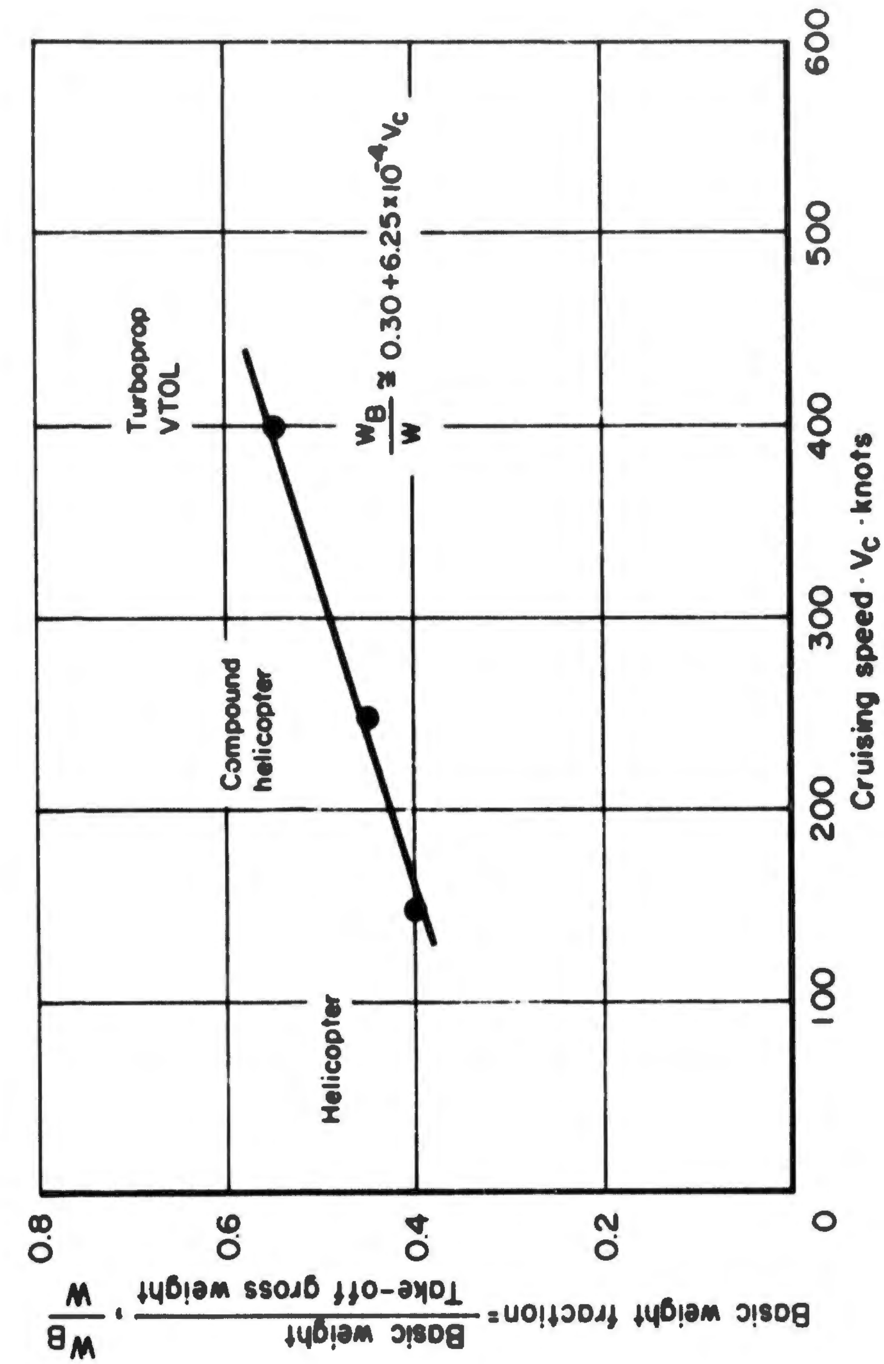

FIG. 12: BASIC WEIGHT FRACTION OF 1970-75 VTOL AIRCRAFT AS A FRACTION OF CRUISING SPEED

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Conditions:

Cruise at sea level on a standard day at best-range speed
10% initial fuel reserve
Crew weight = 452#

Empty weights:	Helicopter	16,000 lbs.
	Compound helicopter	18,000 lbs.
	Tilt-wing turbo prop	22,000 lbs.

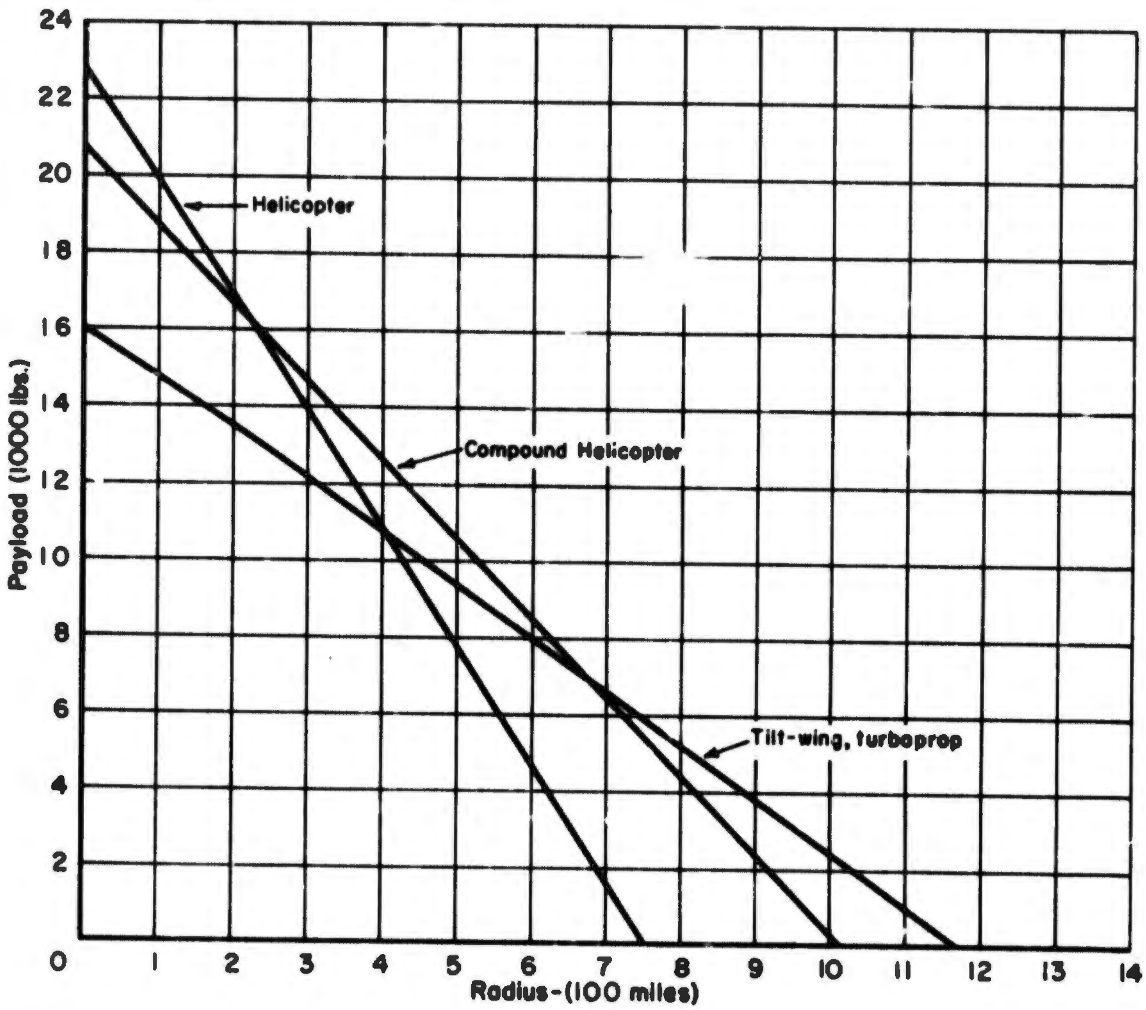

FIG. 13: PAYLOAD VS SEA-LEVEL RADIUS FOR THREE 1970-75 VTOL CONFIGURATIONS OF 40,000 LBS. GROSS WEIGHT

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VII. NUMBER OF VTOL AIRCRAFT EMBARKED ON A SINGLE CARRIER

The size of the aircraft complement embarkable on a carrier is taken directly (or estimated) from spotting studies when these were available. Extension of the spotting data corresponding to a particular aircraft on one carrier to other carriers for which spotting studies are not available has been done either on the basis of ratios of parking areas or ratios of air group sizes. In the case of future aircraft, for which no spotting studies on any class of carriers are available, the air group has been assumed to be equal that of the XC-142.

The ground rule for spotting is to use maximum density spotting on the hangar deck and on that part of the flight deck not required to be clear for an arrested landing (see reference (l)). The customary factor of 85 per cent to change from maximum density spotting to operational spotting has not been applied. The rationale for this rule is that during an operation requiring an arrested landing (e.g., conventional COD) there will be no V/STOL transport operations, thus permitting maximum-density spotting. During V/STOL operations, on the other hand, the clear-deck requirement will be reduced and the parking of the V/STOL aircraft can be at less than maximum density.

The air group sizes of present-state-of-the-art VTOL aircraft have been calculated as follows.

(a) YHC-1B.

Examination of reference (m), which contains a spotting study of this aircraft on LPH-2 and LPH-4/CVS-13, indicates that the following maximum-density complements are attainable if allowance is made for stationing on the flight deck four aircraft with unfolded wings:

LPH-2	47
LPH-4/CVS-13	89.

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For other carriers the spotting numbers are assumed to vary directly with the parking area. These ratios are listed in Table IV, with LPH-4/CVS-13 used as the reference carrier. Application of these ratios gives 130 aircraft on CVA-19 and 117 aircraft on CVS-10.

(b) XC-142 and Future Aircraft

Reference (h) contains a spotting arrangement of this aircraft on carriers of the CVS-10 class; 55 of these aircraft can be embarked. Application of the parking area ratios yields 42 aircraft for the LPH-4/CVS-13; application of the air group ratios yields 22 aircraft for the LPH-2.

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TABLE IV

ESTIMATED VTOL TRANSPORT AIRCRAFT COMPLEMENTS FOR EXISTING CARRIERS

Carrier Class	Deck	Number in Class	Parking Area (1,000 sq.ft.) (Ref.(1))	Parking Area Ratio	Aircraft Complement from Spotting Studies		Derived Aircraft Complement	
					YHC-1B	XC-142	YHC-1B	XC-142
CVA-19	Angled	7	95	1.46	--	--	130	61
CVS-10	Angled	8	85	1.31	--	55	117	--
CVS-13 LPH-4	Axial	9[(a)]	65	1.00	89	--	--	42
LPH-2	Axial	4[(b)]	--	--	47	--	--	22
AKV-37 (ExCVE)	Axial	10	--	.38[(c)]	--	--	--	16

(a) CVS-39; LPH-4, -5, -8; AVT-8, -9, -10, -11, -12.

(b) Funded through FY 62.

(c) Parking area ratio taken as same as total deck area ratio.

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VIII. MILITARY CAPABILITY OF A SINGLE-CARRIER AIRBORNE ASSAULT FORCE

The performance characteristics of the transport aircraft (Chapters V and VI) may now be combined with the number of aircraft on a single carrier (Chapter VII) to compute, as a function of radius, the total payload landed in the first wave and the subsequent build-up with time. The total number of troops delivered can then be determined on the basis of the total delivered payload.

To determine the number of landed troops corresponding to the total weight landed, the following assumptions are made. The troop complement aboard the carrier will consist of approximately 1,200 men. The first assault wave will carry troops, equipment, and supplies amounting to 400 pounds per man (225 pounds weight of a man is included). Therefore, in the first wave, five troops will be delivered per ton of payload. Subsequent waves will carry more equipment and supplies per man so that at such time as all 1,200 troops are ashore the total weight landed will be 600 tons, or 1,000 pounds per man.

The figure of five troops per ton in the first wave is based on the assumption that the aircraft payload is weight-limited. At short mission radii, where the allowed payload weight is high, the payload may be limited by the area or volume of the cargo compartment. For a mission requiring only troops, small arms, and supplies, the cargo volume will be assumed to limit the number of troops per aircraft to 24 (960 troops in the 40 first-wave aircraft). That is, three quarters of each compartment will be taken up by troops and the remaining one quarter, 400 cubic feet, will be available for supplies. This allows 16 cubic feet of supply space per man, which is adequate for the 175 pounds of supplies per man assumed to be carried on the first wave (e.g., materiel for a Marine rifle company requires 0.05 cubic feet per pound, see reference (n)).

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If, on the other hand, the mission is one requiring vehicles and heavy equipment, there will be a cargo area limitation. In this case it will be assumed that the average number of troops per aircraft in the first wave is 16 (640 troops in the 40 first-wave aircraft). Half of the total compartment area is occupied by troops, leaving an average of 7 square feet per man for vehicles, equipment, and supplies. Again, this is adequate for the 175 pounds of supplies and equipment per man assumed to be carried in the first wave (e.g., major items of equipment for a Marine Infantry Battalion require 0.036 square feet per pound, see reference (n)).

For waves subsequent to the first, there will be a sufficient reduction in the number of troops per wave (as supplies are built up) to allow full utilization of the payload weight capability—that is, to incur no space limitation. This still allows all 1,200 troops with associated vehicles and equipment to be landed by the time the total tonnage ashore has reached 600 short tons, or an average of 1,000 pounds per man.

No specific troop task units have been considered for the purposes of this study. As a matter of interest, however, the average weights per troop landed are shown in Table V for a number of typical units or operations. This table is intended only to give a rough indication of the mobility, firepower, and logistic endurance corresponding to values of the average weight per man ranging from 400 to 1,000 pounds.

Based on the complement which could be carried on a CVS-13 (or LPH-4) class carrier and assuming a HI-LO-LO-HI mission profile, the total payload and the number of troops which would be delivered in the first wave by the XC-142 and its first growth version are shown in Figure 14. An aircraft availability of 95 per cent is assumed for the first sortie (see reference (r)). At short radii, the cargo compartment space limitations are indicated by the horizontal lines marked 16 troops per aircraft (missions requiring vehicles and heavy equipment) and 24 troops per aircraft (other missions).

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TABLE V

TYPICAL WEIGHT PER MAN IN ASSAULT FORCES

Units	Troops	Total weight per man (lbs.)(a)	Heaviest Weapons	Number of Vehicles	References
Marine Rifle Company	201	330	30 Cal. MG 3.5 in. Rockets	None	Ref. (n)
Marine Infantry Battalion	1,184	565	81 mm Mortars 106 mm Rifles	55	Ref. (n)
Marine Vertical Assault					
Brigadelex (1959 Series Average)					
D-Day	976	403	4.2 in. Mortars 106 mm Rifles	73	Ref. (o)
D & D+1	1,082	525	"	101	"
Brigadelex 3-60					
D-Day	1,076	532	"	93	Ref. (p)
Exercise Total	1,140	582	"	93	"
STRAC, 1 Battle Group	2,181	1,115	(b)	(b)	Ref. (q)

Notes: (a) Includes 225 pounds for man and pack.
(b) "With minimum equipment and essential (6 days) supplies necessary to execute mission."

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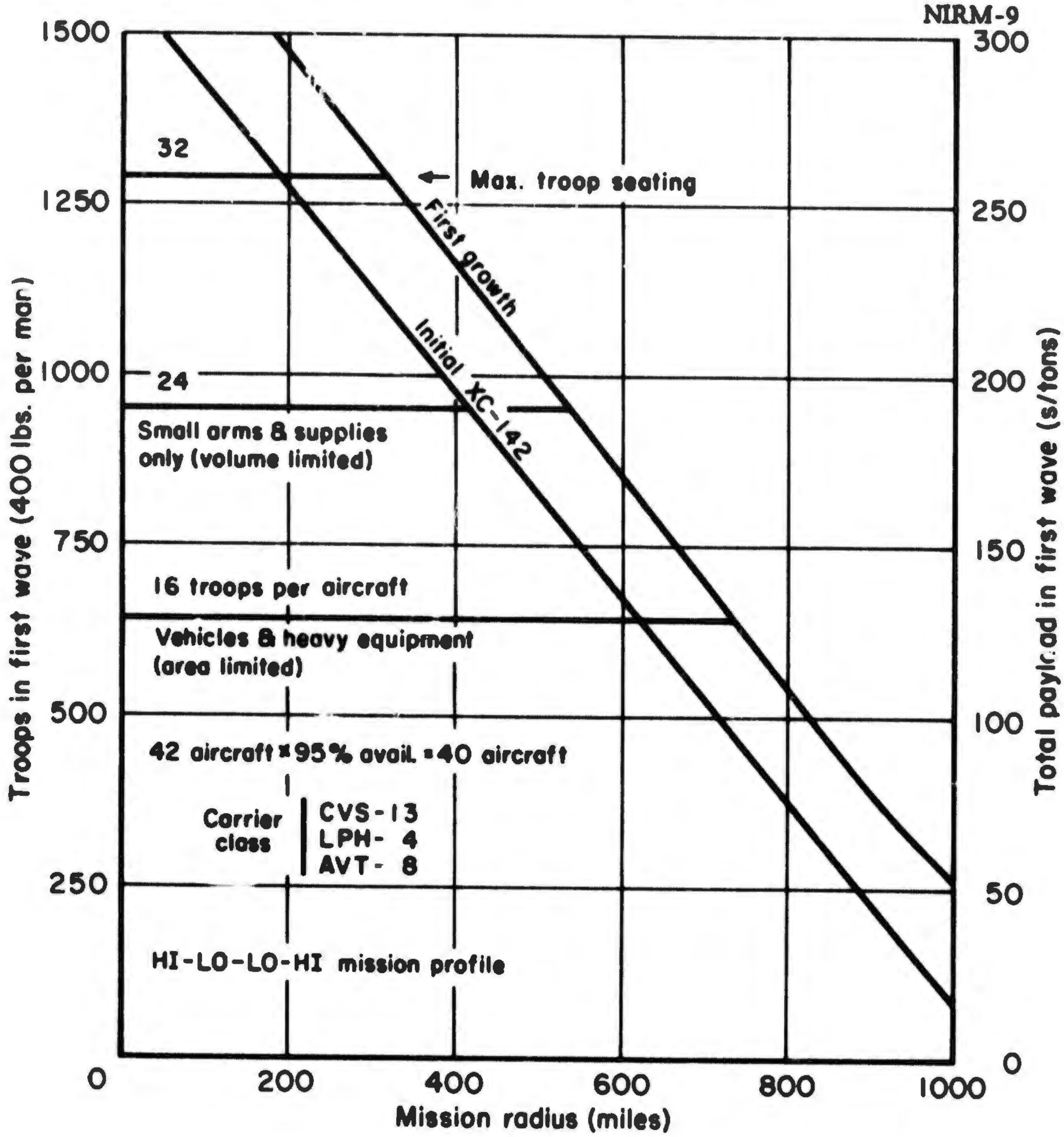

FIG. 14: FIRST-WAVE PAYLOAD VS. RADIUS

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In order to predict the build-up of the delivered payload with time, the following additional assumptions are made. The aircraft availability for follow-on sorties is 0.80 for the second sortie and 0.70 for the third and subsequent sorties (see reference (r)). Based on average loading and unloading rates, fueling rates, and handling times aboard an LPH-2 carrier given in reference (r), the average deck time is 30 minutes. The average ground time at the destination is five minutes. An average total time of 10 minutes is required for take-offs and landings. The initial launch rate is one aircraft per minute. The total payload delivered at a radius of 250 miles by a CVS-13 carrier complement of the YHC-1B is shown in Figure 15. The payload build-up is based on a maximum overload (33,000 pounds) take-off and a LO-LO mission profile. The total payloads delivered at radii of 250, 500, and 750 miles by a basic XC-142 complement are shown in Figure 16. (Payloads delivered at radii of 500 and 750 miles are not shown for the YHC-1B since its maximum LO-LO profile radius is 450 miles.) The payload build-up for the XC-142 complement are based on a HI-LO-LO-HI mission profile (the profile is described in more detail in Chapter V). Any first-wave payload reduction which may result from space limitations, depending upon the type of mission and the radius as shown in Figure 14, is not reflected in the tonnage build-up figures.

The force build-up rates have also been determined for the future VTOL aircraft discussed in Chapter VI. These rates are also based on the number of aircraft which could be included in a CVS-13 carrier complement and the same assumptions regarding launch rates and average deck and ground times as were used for the XC-142. Payload-radius characteristics for the future aircraft are based on a VTO from the carrier at standard-day conditions, and a minimum-altitude, optimum-speed cruise to and from the objective area. Note that these take-off and cruise conditions are more stringent than those assumed for the XC-142 in Figure 16. Performance estimates for similar conditions (overloaded take-off and high-altitude cruise) are not available, but these conditions would result in some improvement over the build-up rates given below.

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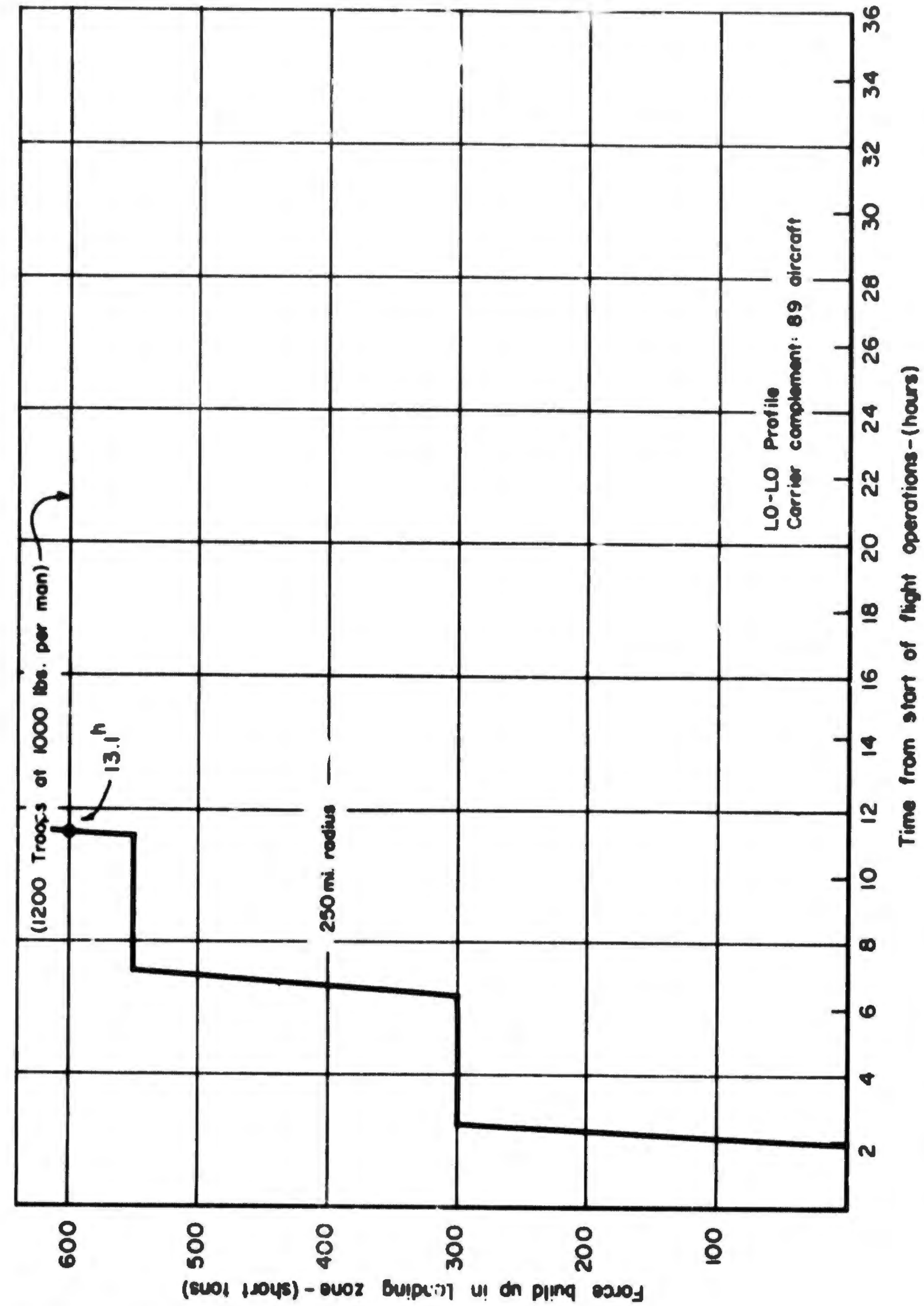

FIG. 15: FORCE BUILD-UP IN LANDING ZONE THRU HC-1B HELICOPTER OPERATIONS

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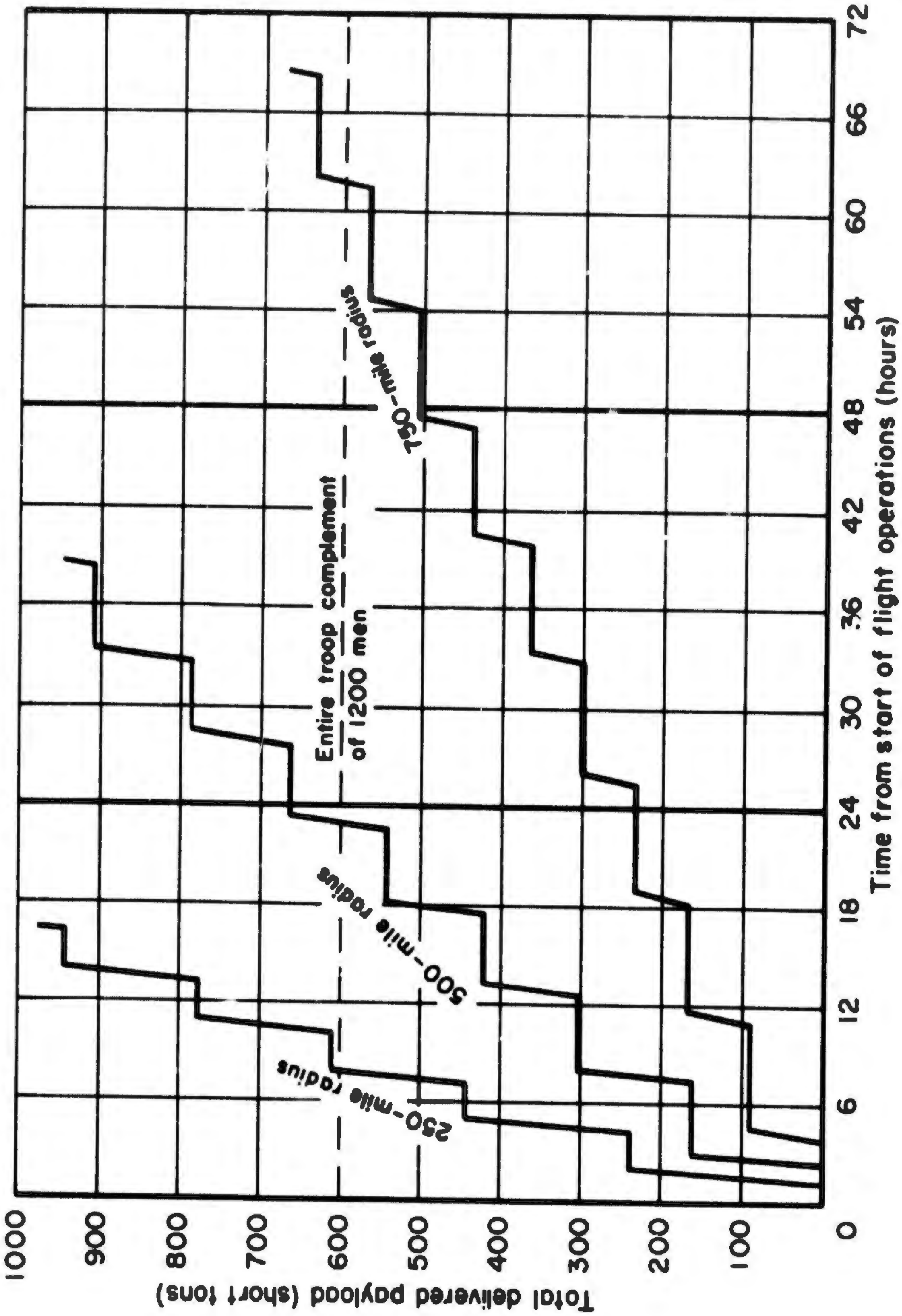

FIG. 16: TOTAL DELIVERED PAYLOAD
(42 XC-142)
(HI-LO-LO-HI Mission Profile)

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The build-up rates for a future (1970-75) helicopter are shown in Figure 17. Rates are shown only for 250- and 500-mile radii since the helicopter cannot reach the 750-mile radius. The initial-wave tonnage corresponds to 1,480 troops at 250 miles and 730 troops at 500 miles; the actual number of first-wave troops is subject to the compartment space limitations discussed above.

The rates of build-up using a compound helicopter are shown in Figure 18. The initial-wave tonnages at radii of 250, 500, and 750 miles correspond to 1,520, 1,020, and 520 troops. The force build-ups using a future tilt-wing VTOL aircraft are shown in Figure 19. Initial-wave tonnages delivered by this aircraft at the three radii correspond to 1,225, 900, and 550 troops. Again, the actual number of first-wave troops may be space-limited to 960 or 640, depending upon the nature of the mission.

The data for these three aircraft have been compared in Figure 20 on the basis of the time required to build-up to a total delivered payload of 600 tons. From the figure, it can be seen that the tilt-wing VTOL aircraft is estimated to be able to deliver the troop complement in 25 to 40 per cent less time than a complement of compound helicopters and 50 to 60 per cent less time than a helicopter complement.

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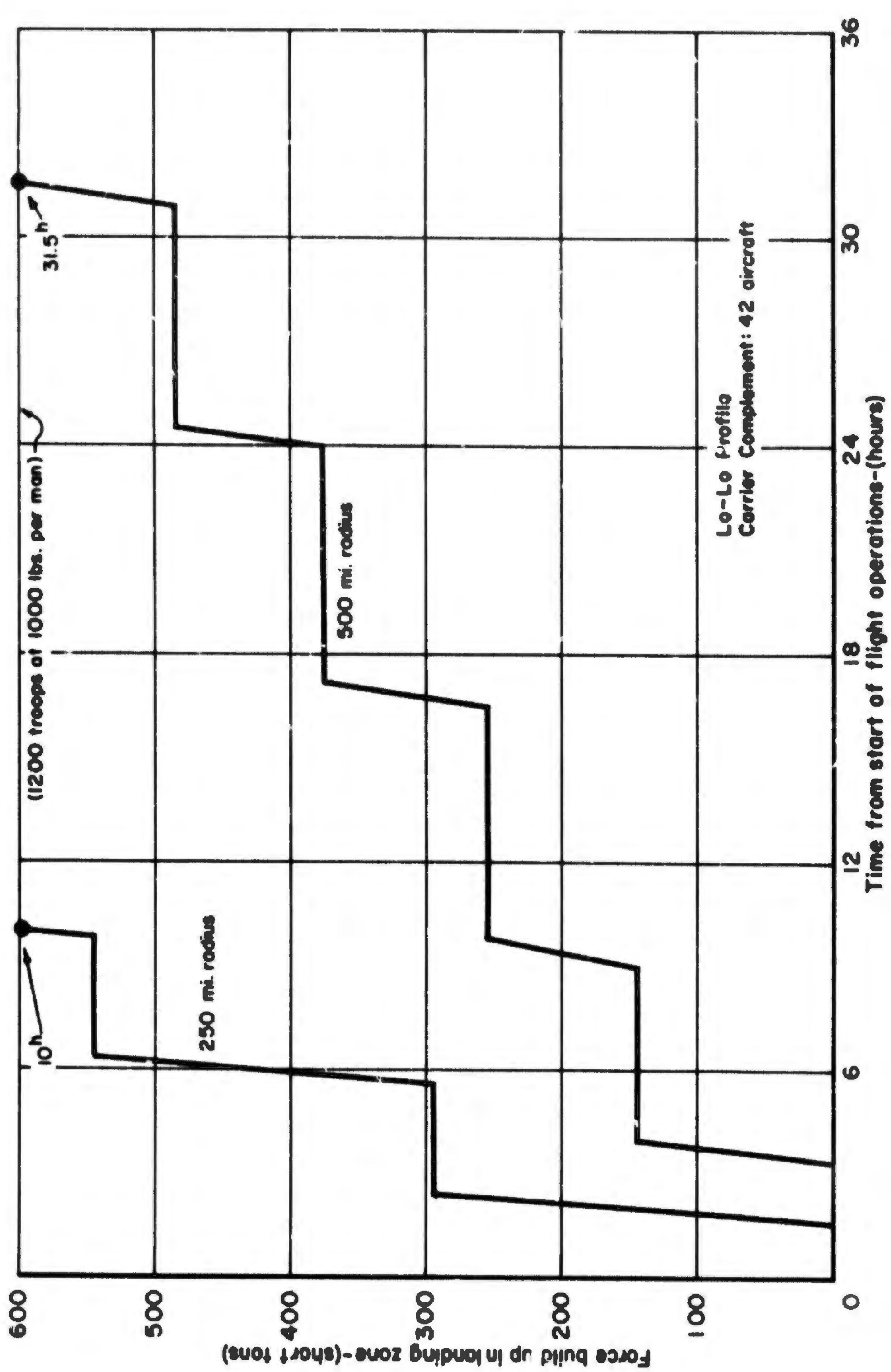

FIG. 17: FORCE BUILDUP IN LANDING ZONE THRU HELICOPTER OPERATIONS

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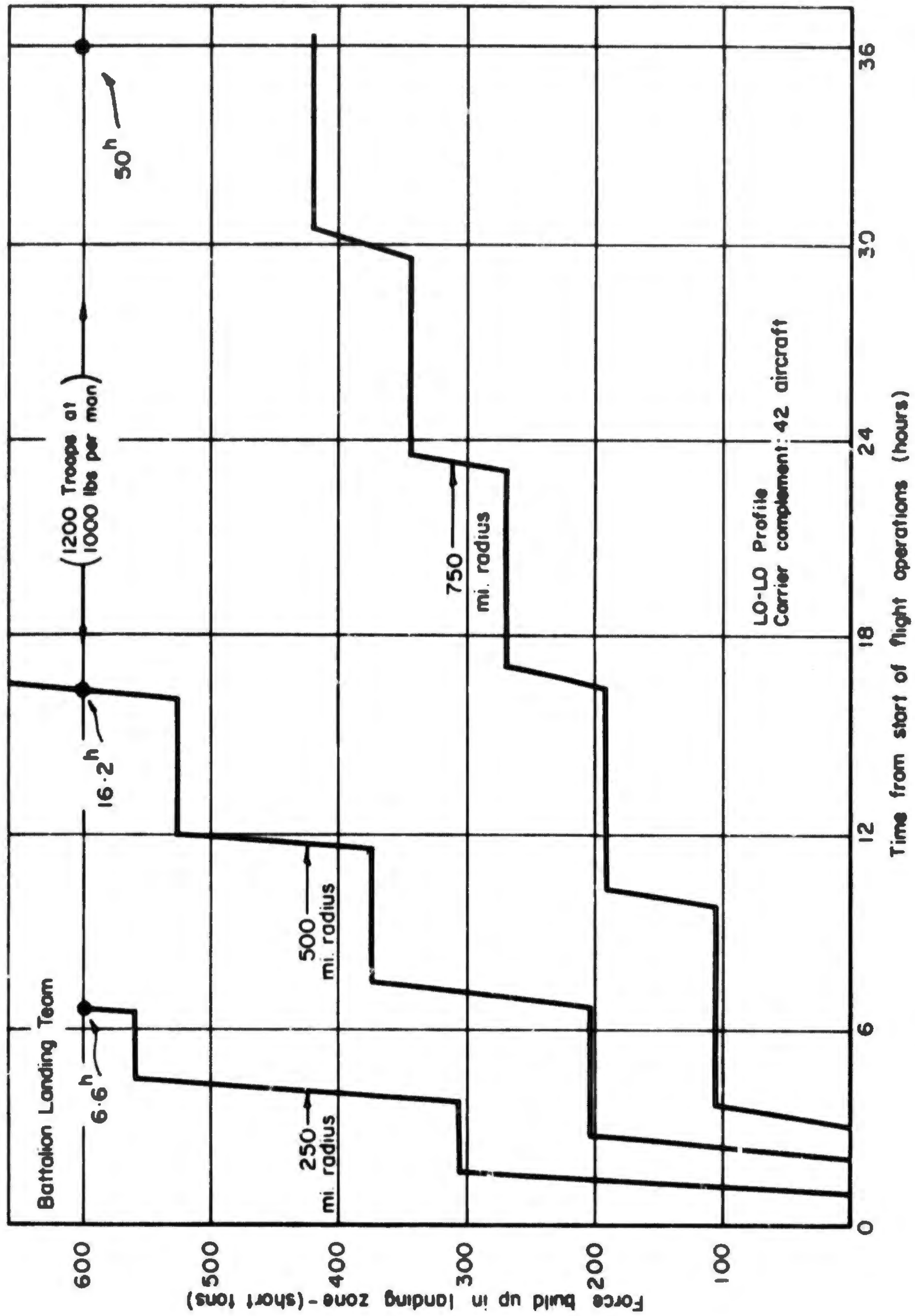

FIG. 18: FORCE BUILD UP IN LANDING ZONE THRU COMPOUND HELICOPTER OPERATIONS

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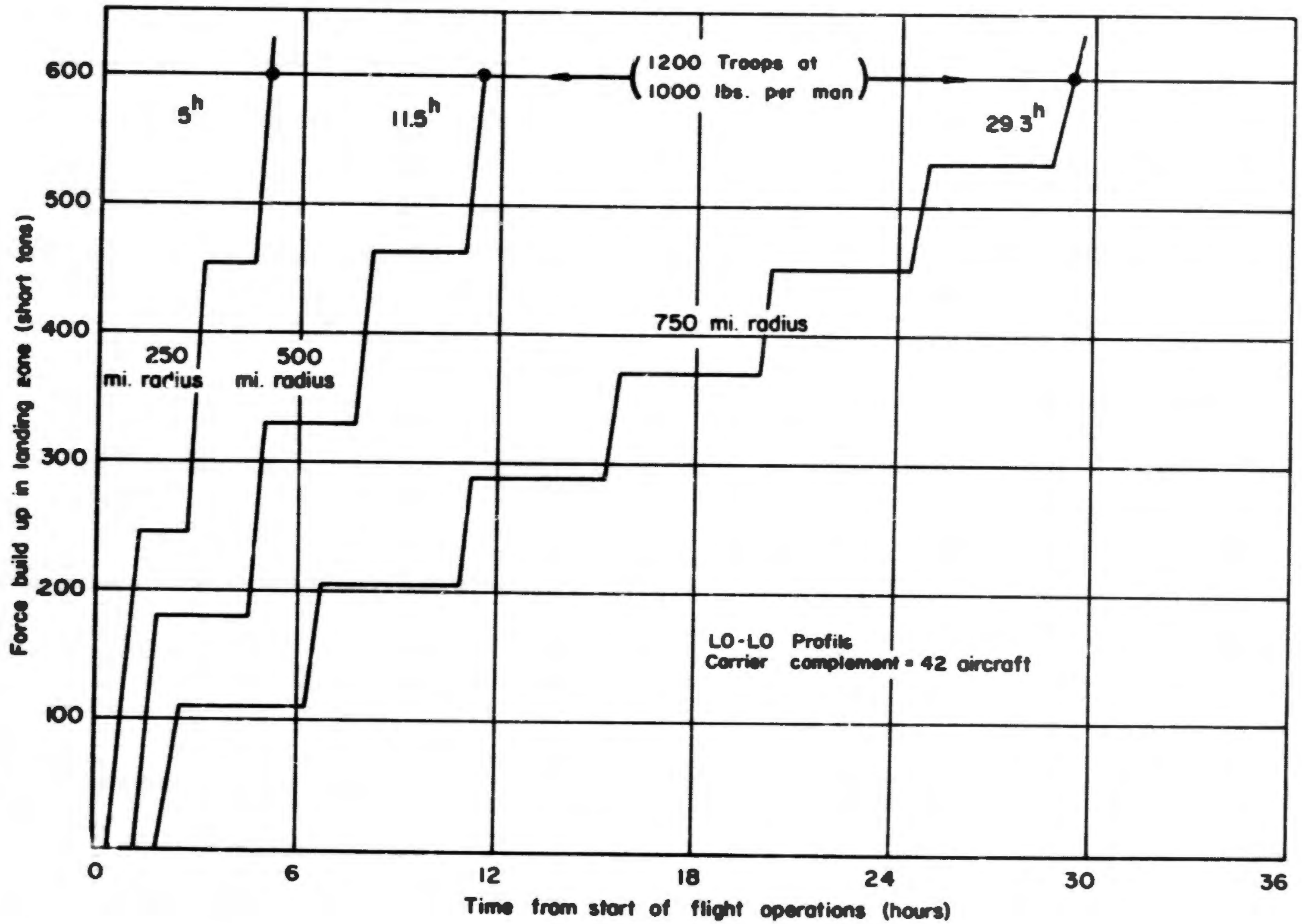

FIG. 19: FORCE BUILD UP IN LANDING ZONE THRU TILT-WING TURBO PROP OPERATIONS

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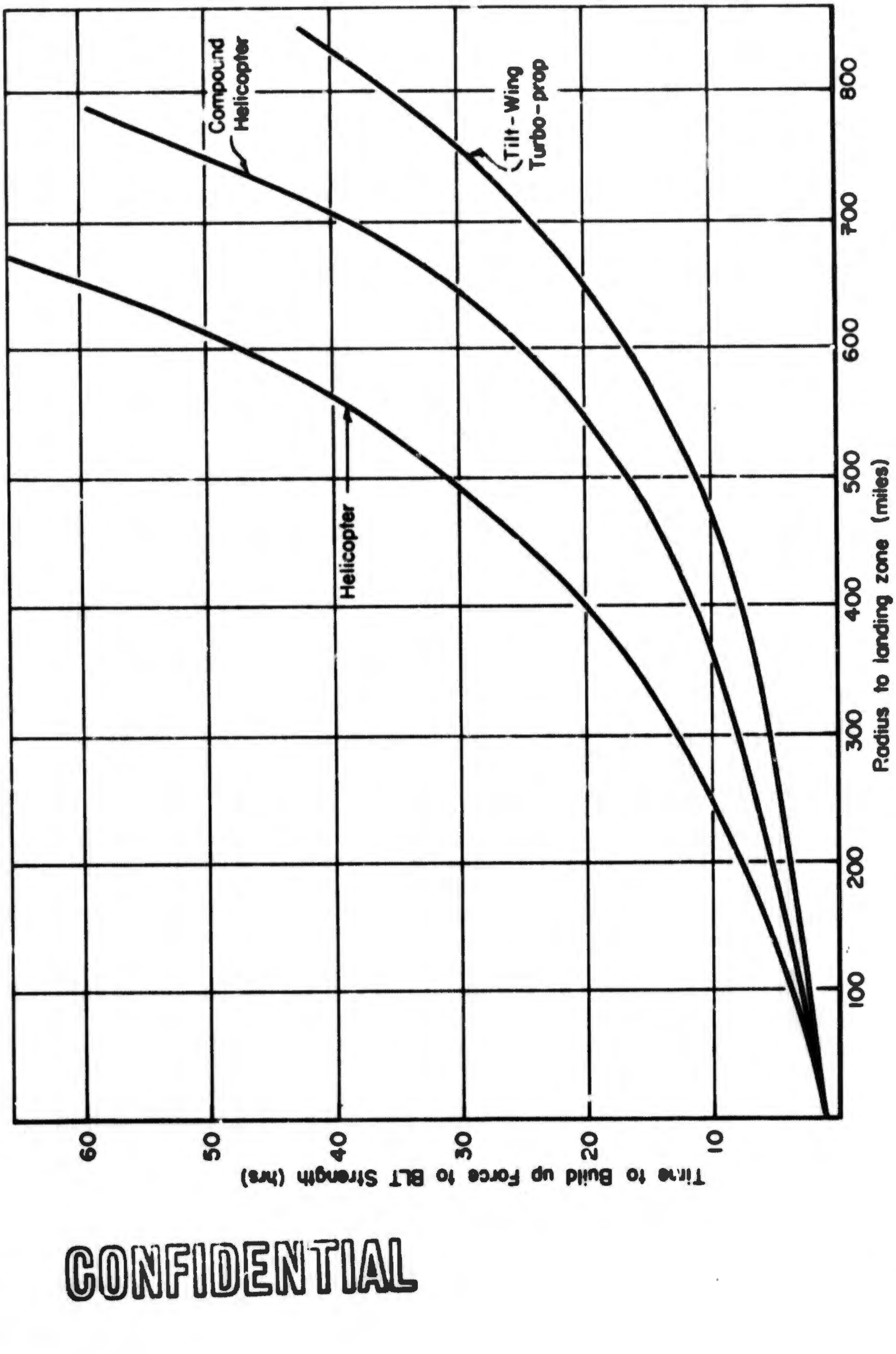

FIG. 20: TIME FOR FORCE BUILD UP TO BLT STRENGTH AS A FUNCTION OF RADIUS TO LANDING ZONE FOR FUTURE AIRCRAFT

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IX. LOCATIONS OF AREAS OF POSSIBLE CONFLICT

An important variable affecting the force build-up in the objective area is the distance thereto from the carrier at the time the decision to commit forces is taken. The reaction time from the commitment decision to the initial landing of troops in the designated area can be as short as a few hours if the carrier is suitably located at the moment of decision. Having a carrier in the right position at the right time depends upon how many carriers are deployed along the periphery of the land areas in which this type of force might be employed. It also depends upon the amount of time available between the receipt of some indication that these forces may be needed (only enough indication to start the carrier steaming in the right direction) and the decision to commit the forces to action.

In this connection it is interesting to note that if one carrier were stationed in the vicinity of the Chagos Archipelago in the Indian Ocean and a second carrier in the Philippine Sea, one or the other could reach any point along a 50-mile stand-off line paralleling the continental perimeter from the Union of South Africa to South Korea, by steaming at high speed (30 knots) for three days or less.

In situations in which a reasonable amount of advance warning is available, the sea-based force would be able to arrive at the scene of action well before any other U. S. forces could. The arrival of the earliest land-based forces will lag by a time interval which will depend upon the availability and location of staging airfields and, except for paratroops, the availability and location of landing fields close to the destination.

In what follows strategic warning is not discussed and the time required to build up a force in the objective area is calculated on the assumption that the carrier is already at the stand-off line when decision to commit is made.

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The radius of operation in this case is made up of two components: the stand-off distance and the overland run.

The stand-off will have a minimum value to allow for maneuvering freedom during the operations. This minimum stand-off will depend on the status of the country or neighboring countries on the coast (whether friendly, neutral or inimical), and on the capability of the country (or countries) to pose a threat to the carrier.

A rational basis for estimating the required stand-off has not been found. Accordingly, the arbitrary stand-off of 50 miles has been assumed.

An estimate of the distance from the nearest approachable coast to an area of conflict can be based on the assumption that the area of conflict is the capital of the country involved. These distances are given in Tables VI, VII, and VIII, for Asian, African, and South American countries which are not part of the Sino-Soviet Bloc. Indicated also in these tables are other countries that may need to be overflown to reach the capital. Comulative frequency curves for the combined total of the three areas are shown in Figure 21. This figure indicates that 90 per cent of the capitals can be reached by aircraft having a 550 nautical mile radius when the carrier's stand-off distance is 50 miles. This figure excludes: India, Afghanistan, Uganda, Northern Rhodesia, Chad, Ubangi-Chari, Ruanda-Urundi, and Paraguay. A radius of 600 miles would include all countries except: Ubangi-Chari, Ruanda-Urundi and Paraguay. To reach all Asian, African and South American capitals from a stand-off distance of 50 miles requires that the aircraft have a radius of 680 nautical miles.

A comprehensive view of the importance of range is obtainable from Figure 22 which shows geographical areas that can be reached by flying 500 miles and 1,000 miles from the nearest launch point 50 miles out from the shore. The required radius to any point or area of interest can be estimated by interpolation. Examination of these maps

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TABLE VI

CAPITAL-TO-COAST DISTANCES FOR ASIAN COUNTRIES NOT AFFILIATED WITH THE SINO-SOVIET BLOC

Country	Capital	Distance (miles)	Countries to be overflown
Brunei	Brunei	0	
Burma	Rangoon	↓	
Ceylon	Colombo		
Indonesia	Djakarta		
Japan	Tokyo		
Kuwait	Kuwait		
Lebanon	Beirut		
Malay	Kuala Lumpur		
Pakistan	Karachi		
Sarawak	Kuching		
South Korea	Seoul		
Thailand	Bangkok		
Vietnam	Saigon		
Syria	Damascus	55	Lebanon
Cambodia	Phnom Penh	70	
Jordan	Amman	70	
Madagascar	Tananarive	105	
Saudi Arabia	Riyadh	220	
Laos	Vientiane	220	
Turkey	Ankara	240	
Iraq	Baghdad	310 from Persian Gulf	
		450 from Mediterranean	
Bhutan	Bumthang	320	Pakistan, India
Sikkim	Gangtok	330	Pakistan, India
Iran	Teheran	350	
Nepal	Katwanda	390	India
India	New Delhi	500	
Afghanistan	Kabul	630	

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TABLE VII
CAPITAL-TO-COAST DISTANCES FOR AFRICAN COUNTRIES NOT AFFILIATED WITH THE SINO-SOVIET BLOC

Country	Capital	Distance (miles)	Countries to be overflown
Algeria	Algiers	0	
Angola	Luanda		
Dahomey	Porto-Novo		
French Guinea	Cona Kry		
Gabon	Libreville		
Gambia	Bathurst		
Ghana	Accra		
Liberia	Monrovia		
Libya	Bengasi Tripoli		
Morocco	Casablanca		
Mozambique	Lourenco Marques		
Nigeria	Lagos		
Portuguese Guina	Bissau		
Senegal	Dakar		
Sierra Leone	Freetown		
Spanish Guinea	Santa Isabel		
Tanganyika	Dar es Salaam		
Togo	Lome		
Trust Territory of Somaliland	Magadiscio		
Tunisia	Tunis		
Zanzibar	Zanzibar		
Ivory Coast	Abidjan	20	
Spanish Sahar	El Auin	30	
British Somaliland	Hargeisa	50	
Egypt	Cairo	65	
Swaziland	Mbabane	100	Mozambique
Madagascar	Lananarive	105	
Cameroons	Yaounde	130	
South West Africa	Windhoek	145	

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TABLE VII
(continued)

Country	Capital	Distance (miles)	Countries to be overflown
Basutoband	Maseru	195	Union of So. Africa
Nyasaland	Zomba	200	Mozambique
Middle Congo	Brazzaville	205	
Belgian Congo	Leopoldville	210	
Southern Rhodesia	Salisbury	235	Mozambique
Kenya	Nairobi	240	
Union of South Africa	Pretoria	240	
Sudan	Khartoum	345	
Ethiopia	Addis Ababa	355	
Upper Volta	Ougadougou	440	Ghana
Northern Rhodesia	Lusaka	485	Mozambique; Southern Rhodesia
Uganda	Enteblee	495	Kenya
Bechuanaland	Vryburg	520	Union of So. Africa
Chad	Fort Lamy	520	Cameroons
Runanda-Urundi	Usumbiua	585	Tanganyika
Central African Republic	Banqui	585	

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TABLE VIII

CAPITAL-TO-COAST DISTANCES FOR SOUTH AMERICAN COUNTRIES NOT AFFILIATED WITH THE SINO-SOVIET BLOC

Country	Capital	Distance (miles)	Countries to be overflown
Argentina	Buenos Aires	0	
Brazil	Rio de Janeiro	↓	
British Guiana	Georgetown		
French Guiana	Cayenne		
Peru	Lima		
Surinam	Paramariba		
Trinidad	Port-of-Spain		
Uruguay	Montevideo		
Venezuela	Caracas		
Chile	Santiago	85	
Ecuador	Quito	130	
Columbia	Bogota	170	
Bolivia	La Paz	215	
Paraguay	Asuncion	585	Brazil

shows that most of the areas likely to be involved in the sea-based airborne assault mission lie within 500 miles of the 50-mile-offshore line. There are, however, certain areas of possible interest which lie as far as 900 miles from the offshore line. Some of these more remote regions, and the radii required to reach them, are listed in Table IX.

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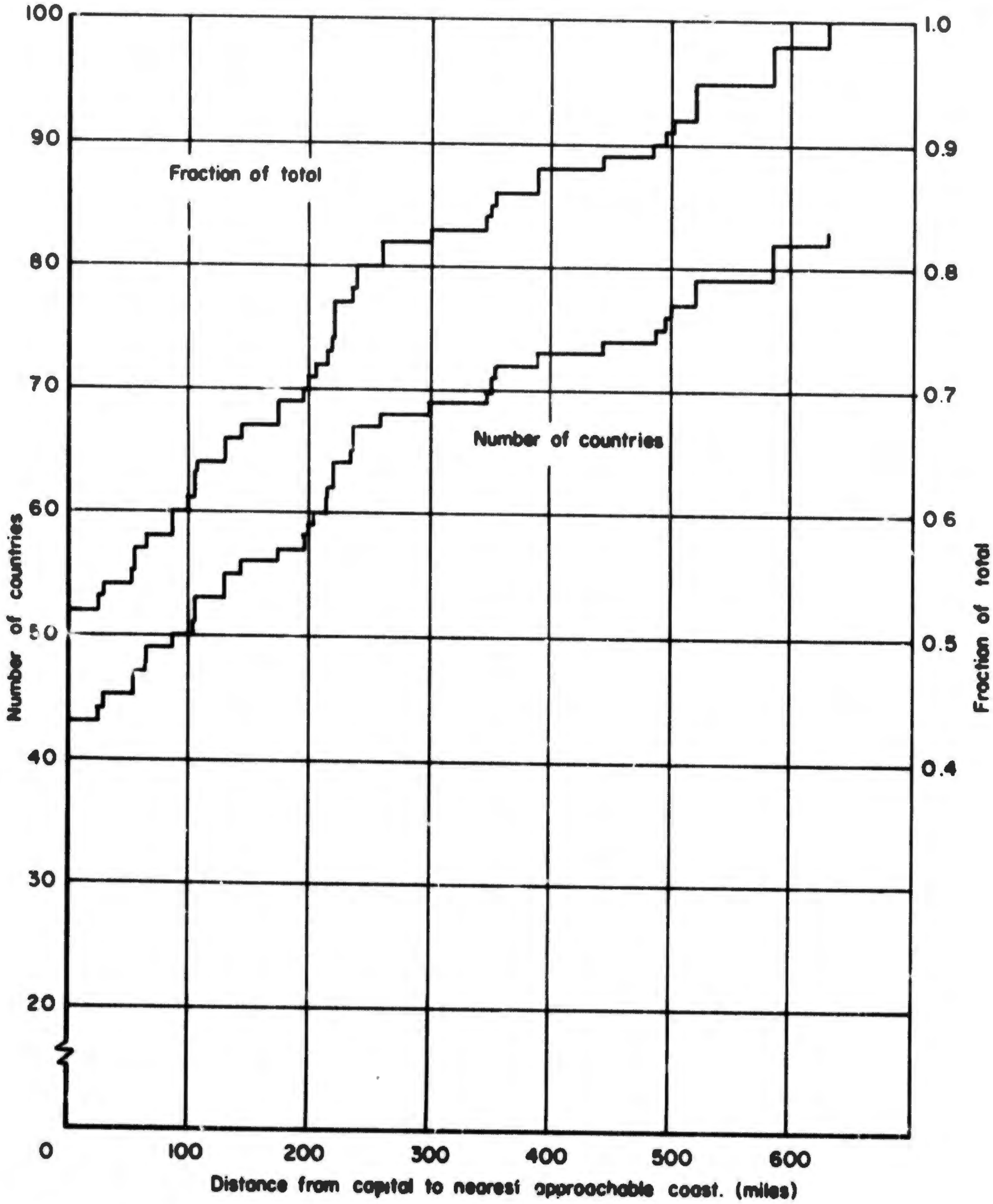

FIG. 21: CUMULATIVE FREQUENCY DISTRIBUTION OF DISTANCE FROM CAPITAL TO NEAREST COAST APPROACHABLE FROM THE OPEN SEA – FOR ASIAN, AFRICAN AND SOUTH AMERICAN COUNTRIES NOT AFFILIATED WITH THE SOVIET BLOC

FIG. 22A: REQUIRED MISSION RADII

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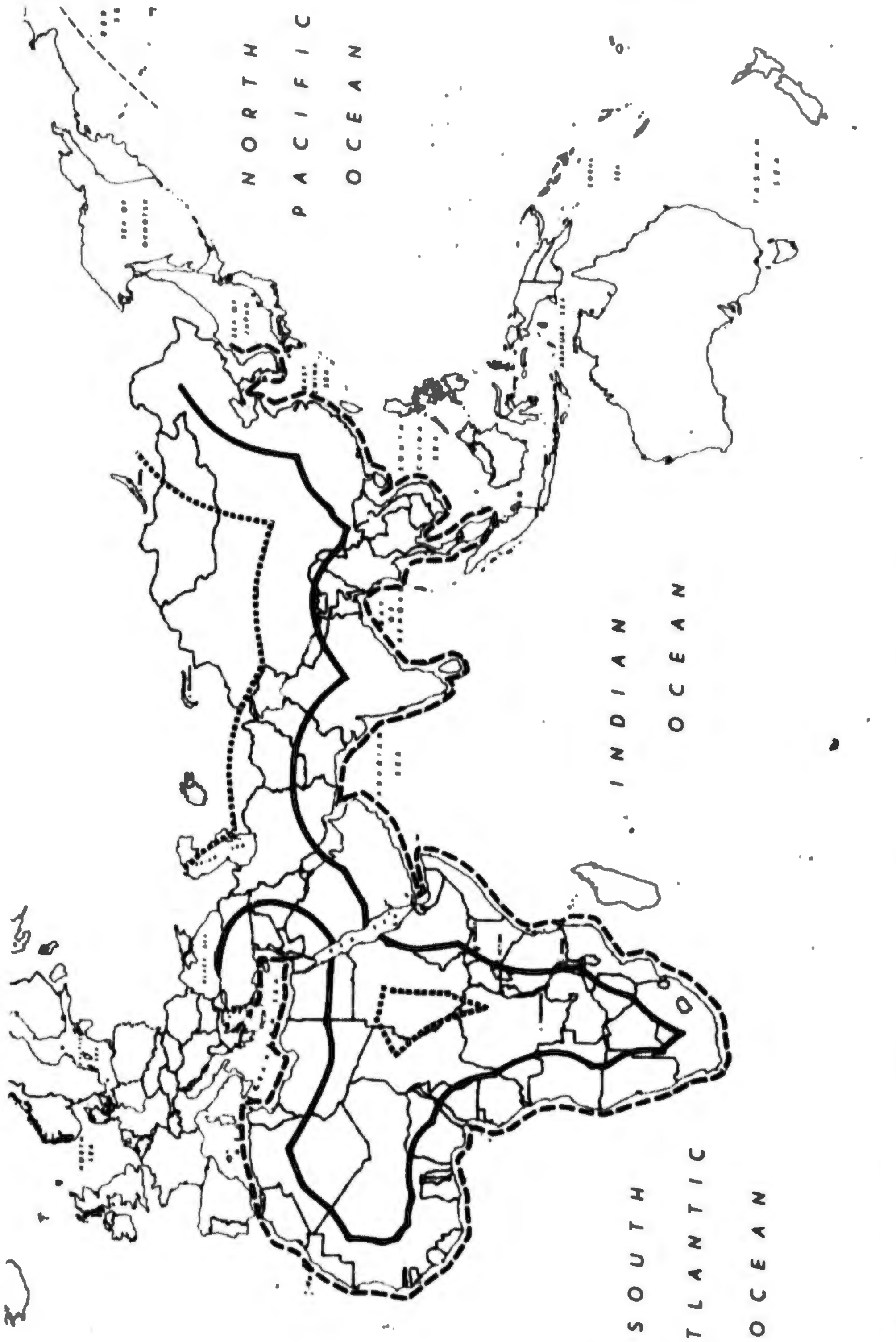

FIG. 22B: REQUIRED MISSION RADII

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TABLE IX

LAND AREAS EXCLUDED BY 500-MILE AND 1,000-MILE RADII

Region	Radius (miles)	Excluded	Approximate Required Radius (miles)
Far East	500	All countries are completely covered by 400 mile radius except farthest inland part of Burma which requires....	600
Middle East	500	Turkey-USSR border	700
		Kabul Area, Afghanistan	700
		Farthest India-Nepal border	700
		Iran-USSR border	750-900
		Baghdad area	600*
		Kuwait	700*
		Teheran area	800*
	1,000	Reaches into USSR	
Africa	500	Large part of Congo including Elizabethville at	900
		Aswan, Egypt	600
		Most of Northern Rhodesia	
	1,000	Area in S. W. Sudan	
South America	500	Paraguay	
		Interior Brazil	
	1,000	Entire continent is covered by...............	900

* If carrier does not enter Persian Gulf.

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X. DISCUSSION AND SUMMARY— FEASIBILITY OF THE SEA-BASED AIRBORNE ASSAULT MISSION

The mission proposed in this report, the airborne assault mission, differs fundamentally from the traditional amphibious assault mission in that its purpose is not related to the establishment of a beachhead, but rather is to place a small force very quickly wherever it may be required. The locations of potential trouble spots which could require the employment of an airborne assault force are distributed from the seacoast to almost 1,000 miles inland (see Chapter IX). Very few locations, however, exceed 750 miles (all national capitals are at less than 650 miles) and a large portion of the area of interest (including 90 per cent of the national capitals) is within 500 miles of the coast. Eighty per cent of the capitals lie within 250 miles of the coast. The feasibility of the mission must be discussed, then, in terms of the military capability that might be projected to these radii.

The results of this study indicate that the following capability can be realized by a single-carrier force in the early 1970's (Chapter VIII).

- At a 500-mile radius a force of 800 troops can be landed in one wave within three hours of first launch from a carrier in position. These troops will have with them small arms and supplies which, together with the weight of the men, will make the total weight landed 160 tons, or 400 pounds per man. If the mission is one requiring vehicles and heavier weapons (up to the size of 4.2 inch mortars and 106 mm recoilless rifles), aircraft compartment space may limit the size of the first-wave force to 650 men (see Figure 14). At the end of one day there can be four additional waves and the force landed can add up to 1,200 troops at an average of 1,000 pounds per man, which corresponds to a well-equipped and supplied Marine Battalion Landing Team. Resupply from the carrier by means of the transport aircraft can initially continue at the rate of 100 tons every five hours (see Figure 16).

- At a radius of 750 miles, the capability is reduced but is still appreciable. The force in the first wave is 400 troops (with or without vehicles) at an average of 400

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pounds per man, landed within five hours after first launch. The build-up to 1,200 troops at 1,000 pounds per man occurs during the third day, and the initial rate of resupply is 60 tons every seven hours.

- At a 250-mile radius the first-wave force is landed in two hours. Compartment space limits size to 950 men for a mission requiring only small arms, and 650 men if vehicles and heavy equipment are needed. In either case, the total weight landed in the first wave averages 400 pounds per man. The build-up to 1,200 troops at 1,000 pounds per man requires less than 12 hours. Resupply waves, each capable of carrying 160 tons of supplies, can arrive every three hours.

The conditions to which the above capabilities apply have been selected to represent a set of well-defined and predictable circumstances in order to allow quantitative estimates to be made. The assumptions made and the effects of their variation are here summarized:

- Aircraft performance is based upon the design characteristics of the initial XC-142 aircraft, which is scheduled for first flight in mid-1964. The first-stage growth of this aircraft, based on an engine improvement expected by early 1965, would increase the mission capability by about 35 tons first-wave payload, or about 175 troops, at any given radius (see Figure 14).

- The assumed profile is: cruise at 20,000 feet, 100-mile sea-level run-in to the target area, vertical landing and take-off, 100-mile sea-level run-out, and return cruise at 20,000 feet (HI-LO-LO-HI). A mission flown entirely at sea level, other conditions remaining the same, would reduce the first-wave payload to 80 tons (400 troops) at 500 miles and would be unable to reach 750 miles. At 250 miles, however, the first-wave payload would be 200 tons which is enough to allow the maximum (space-limited) force of 950 troops (see Figure 7).

- Future aircraft performance, based upon extrapolation of the state of the art to the 1970-75 period, could provide a sea-level-all-the-way capability which is an improvement over the XC-142 HI-LO-LO-HI profile capability (compare Figures 16 and 19). High-level cruise would allow still greater capability.

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- The selected conditions assume that the vertical landing and take-off in the objective area will be made under atmospheric conditions corresponding to a standard day at sea level. If the objective area is at a 6,000-foot altitude, or if the temperature there is 90°F (sea-level tropical day), the payload capability will be affected for radii of less than 500 miles (see Figure 11). A combination of high altitude and temperature (6,000 feet, tropical day) will severely reduce the payload capability at all radii. These reductions are the result of the decrease in hovering gross weight necessitated by the decrease in thrust under the non-standard atmospheric conditions. There can be conditions (target area at long radius, at high altitude, and at high temperature) in which the accomplishment of the mission will depend upon the availability of ground conditions suitable for STOL.

- It is assumed that the single aircraft carrier is an LPH-4 (or CVS-39 or AVT-8). It would require two carriers of the LPH-2 class or three of the AKV-37 class to achieve the same capability (see Table IV). If the single carrier is a CVS-10, the one-wave payload weight capability will be increased 30 per cent; if a CVA-19, 40 per cent. Since these increases are due to increased aircraft complements, the first-wave aircraft compartment space limits would be raised in proportion. The CVS-10 could launch an entire battalion with small arms and supplies (or about 800 troops with vehicles and heavy equipment) in a single wave.

- The selected conditions assume a stand-down followed by around-the-clock employment of the transport aircraft. If the first wave has to arrive at the objective area at night, it must be preceded by parachuted reconnaissance troops to prepare landing aids. The force build-up rate (Figure 16) assumes adequate pilot availability for around-the-clock flying, and assumes that the aircraft availability will remain at 70 per cent after the first two waves. Insofar as these availabilities are not attained, the build-up and resupply rates will be reduced; but the size of the force in the first wave will, of course, not be affected. The initial resupply rates cannot in any case be maintained indefinitely, because of the increasing aircraft maintenance requirements as maximum aircraft utilization continues.

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- The selected conditions assume that the entire carrier aircraft complement is made up of transport aircraft. Any requirement for other aircraft types, such as very light attack aircraft or sea-air rescue aircraft, will correspondingly reduce the airborne assault capability of the carrier.

- The capability under the selected conditions has been expressed in terms of total payload in a single wave of aircraft (see Figure 14). There are, in addition, limitations on the size of individual items of equipment which can be transported to various radii (see Figure 9). This limit, for the selected conditions, exceeds 4,000 pounds out to a 750-mile radius, so it does not affect the transportation of equipment normally associated with Marine vertical envelopment operations. It does, however, exclude such heavy equipment as tanks, 2½-ton trucks, 105-mm howitzers, and the ONTOS anti-tank weapon.

- The capability figures presented herein do not reflect any transport aircraft attrition.

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APPENDIX A

PAYLOAD-RADIUS CALCULATION

1. Useful Load.

$$W_u = W - (W_b + W_c)$$

where:

W_u = useful load

W = take-off gross weight

W_b = basic weight (sum of fixed weights)

W_c = crew weight, assumed at 400 pounds

$$W_b = kW$$

The factor k depends on the aircraft configuration and is

k = 0.4 helicopter
0.45 compound helicopter
0.55 turbo-prop, tilt-wing

Note:

$$k \cong 0.30 + 6.25 \times 10^{-4} V_c$$

where V_c = cruising speed.

2. Maximum Payload.

$$W_{p\,max.} = W_u - 2\left(\frac{10}{9}\right) W_{ftol}$$

where

2 = factor to allow for sortie and return

$\frac{10}{9}$ = factor to account for a fuel reserve equal to 10 per cent of total.

W_{ftol} = weight of fuel for take-off and landing

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[redacted]

W_{ftol} = (T/W)(t/60)(W/p)(sfc)

where

T/W = thrust to weight ratio. T/W is assumed at 1.05 to be maintained at sea level on a standard day.

t = total time required to take-off (5 minutes) and to land (3 minutes).

p = power loading. This is assumed as follows:

helicopter	p = 10 pounds per horsepower
compound helicopter	p = 8
turbo-prop tilt-wing	p = 4.

sfc = specific fuel consumption, assumed at 0.5 pounds of fuel per horsepower per hour.

3. Maximum Radius (at zero payload).

$$R_{max} = \frac{1}{2} \times W_{fcn} \times r_{sp}.$$

Where

W_{fcn} = net weight of fuel for cruising.

$$W_{fcn} = \frac{9}{10} \left[W_u - 2\left(\frac{10}{9}\right) W_{ftol} \right].$$

r_{sp} = specific range (mile per pound of fuel)

$$r_{sp} = CW^{-8/9}$$

where

C = 88 helicopter
132 compound helicopter
198 turboprop tilt-wing

4. For intermediate radii a straight line interpolation is sufficiently accurate.

[redacted]

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