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"LOTS" OF LTA APPLICATIONS

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ABSTRACT: This paper will briefly describe current problems facing the logistical planner in utilizing the new ships of the modern, intermodal sea transportation systems in a logistics-over-the-shore (undeveloped) environment. Then the employment of two potential LTA vehicle systems are described and discussed as significant parts of possible solutions to this range of logistical problems. Vulnerability aspects of these LTA vehicles are also briefly addressed because of their possible employment near combat areas.

INTRODUCTION

Definition of LOTS.

The acronymn LOTS refers to "logistics-over-the-shore" operations, where armed forces operating in the field on a foreign shore are being resupplied over an undeveloped beach (i.e. no port facilities are available to assist in cargo discharge). Also implied in this definition is that no hostile activities are being conducted against the resupply operation.

Because of the non-hostile environment and the vast amount of supplies

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being delivered to the shore in a LOTS operation, commercial cargo ships are normally used to carry the bulk of cargoes required. This was fine in the days of the boom-and-hatch, or breakbulk, freighter, because these ships could carry virtually any military cargo, go anywhere military forces could go, and unload themselves when they got there (self-sustaining cargo capability). Nowadays, new, commercial maritime innovations such as the container ships, barge carriers like LASH and Sea Barge, and Roll-on/Roll-off (RO/RO) ships are highly specialized vessels, operating as intermodal sea transportation systems, over particular route systems. These ships are not self-sustaining and cannot be unloaded except in sophisticated ports with certain facilities. Container ships are unloaded with specialized, shore-side cranes. Barge carriers can discharge barges, but cranes and other materials handling equipment (MHE) are required at the pier; additionally, barge marshalling and tug facilities are required. Some designs of RO/RO ships are self-sustaining with on-board ramps, but strong piers and adjacent parking and warehousing facilities are also useful. Other RO/RO's operate only in ports where ramps are available to them to allow for vehicular traffic on and off the ship. Some work has been done in resolving these problems, but usually the discharge methods are slow and heavy lift capacities are severely constrained. Thus, until now, logistical planners faced with handling cargoes from these ships in a LOTS environment had almost insurmountable problems in rapidly discharging sufficient quantities of military cargoes over a beach because the unit load weights are so large and MHE capabilities to work effectively at the surf zone are limited. Typical cargo discharge problems faced are: 8' x 8' x 20' container gross weight is 22 1/2 tons; LASH barges can gross to 450 long tons; Sea Barge barges to 1000 long tons; and 50 short tons is a typical weight for unit deliveries of tanks and other tracked vehicles. Therefore, while the new ship systems can transport a great deal, some imagination is needed in managing their discharge from ships in a LOTS operation.

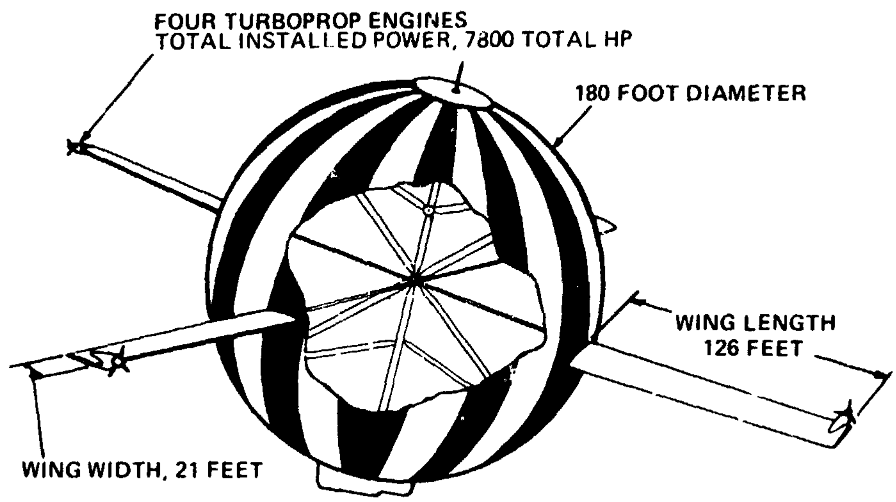
LTA Role in LOTS.

What is it that LTA technology can offer to the LOTS operation? Relatively high speed transportation of heavy equipments or bulk supplies from ship to/over shore.

Originally under consideration was a family of applications which would have included blimps, the hybrid LTA vehicle, Aerocrane, and tethered balloon cargo lift systems. The inability to resolve the exchange of payload for ballast at the cargo destination forces elimination of consideration of the blimp as a cargo transport vehicle. The remaining two LTA vehicles offer complimentary capabilities for employment by the logistics planner.

LTA Vehicle Candidates for LOTS.

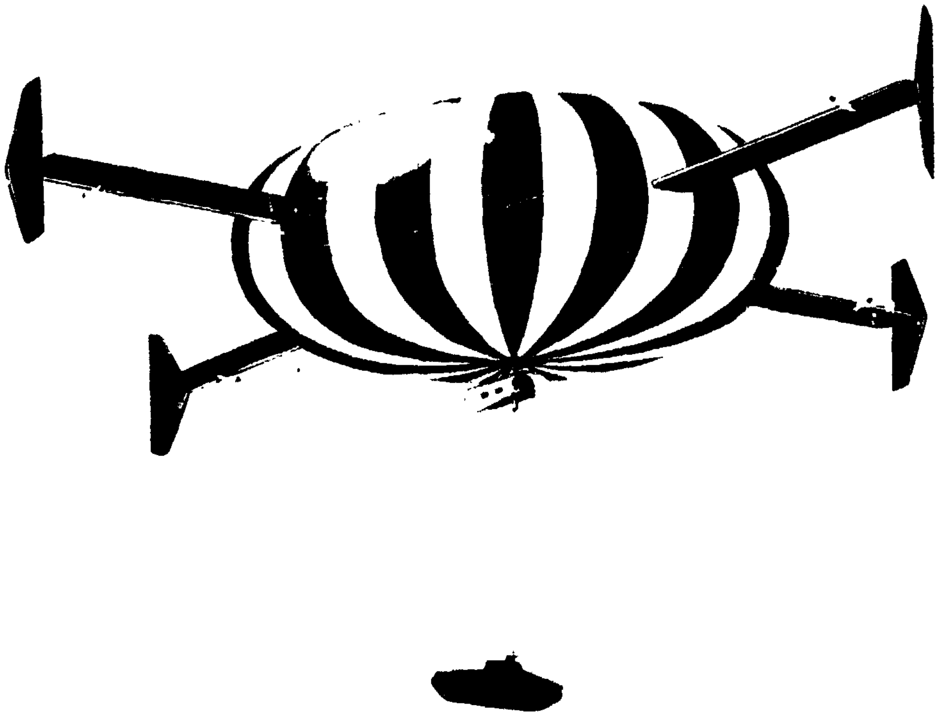
The Aerocrane Concept- The Aerocrane is a hybrid LTA vehicle using aerostatic lift and aerodynamic lift and translation to perform its function. The helium contained in the aerostat supports the weight of the entire aircraft, its fuel, crew and 40% of its payload. The aerodynamic lift provides the balance of the payload lift and horizontal translation capability.



90 Ton Aerocrane

The 90 long ton sling load version would be powered by four, 2000 HP turboprop engines operating at one-fourth rated capacity (design payload ranges of from 50 to 500 long tons are considered feasible). Thus even with the failure of 3 engines the craft could perform to its rated capacity (eccentric power application by one engine would not be a problem because of the highly rigid connection of all the wings into the Aerocrane structure). The control cab would be powered and geared to rotate at the same speed, and in the opposite rotation to, the aircraft structure to maintain a "still" position relative to the aircraft. A 20° tilt of its axis would be necessary to obtain forward translation. When a load is delivered, the cyclic and collective controls determining the wings' angle of attack would be reversed and the rotating wings would then generate downward thrust to cancel the aerostatic lift. Fuller details on the aerocrane's design concepts, operational characteristics, and other factors are available in References 1 through 6.

Variation of Aerocrane- Another variant of the Aerocrane concept is shown below. The major differences include: the minor diameter equals the major radius; the vehicle would not be tilted to achieve a translation vector; the engines on the wings would only rotate the aircraft to control the vertical motion vector; and cycloidal propulsion (similar in principle to the vertical screws employed by some tug boats) would provide the horizontal translation vector.



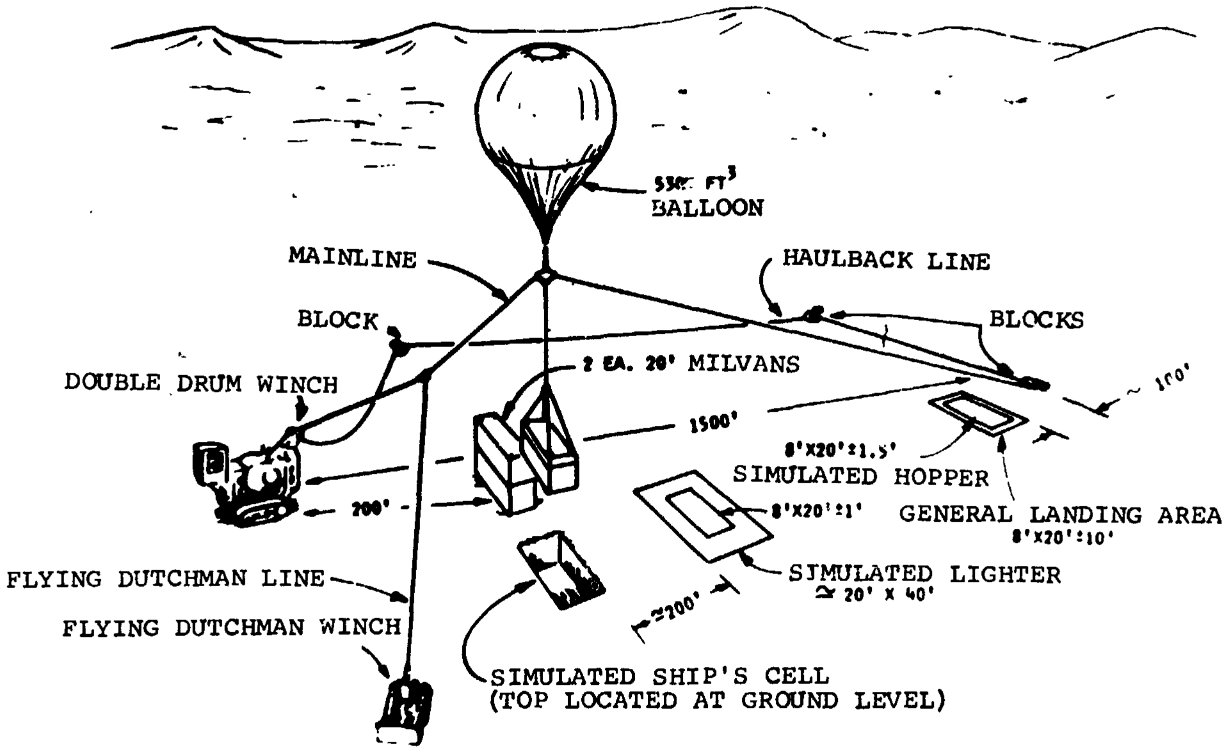
Aerocrane Variant

Parametric differences from the original concept are: for equivalent volume aerostats, the oblate spheroid only has 15% more surface area which requires an insignificant increase in volume to compensate for the very slight increase in aircraft weight and maintain a constant payload capacity; the theoretical drag coefficient is reduced by 50% from 0.2 to 0.1; and the speed is increased from 36 knots to 60-80 knots for the feasible payload ranges contemplated (horizontal translation speed increases with the size of the aircraft). This variation of the Aerocrane is much more complex in construction and control requirements and should only be considered if the higher speed capability is absolutely necessary. This concept variation is very recent and further information concerning it can be obtained from Reference 7 and Mr. Arthur Crimmins, All-American Engineering Co., Wilmington, Delaware.

Tethered Lighter Than Air Systems (TELTA)- A TELTA system could be one of several possible variants, but the idea stems from logging operations that have been conducted for the past ten years in Oregon. The concept was tested for possible military logistics applications at the Oregon logging sites in 1972 and 1973 by the Range Measurements

Laboratory (RML) Patrick AFB, Florida and the Naval Facilities Engineering Command (NAVFAC).

SHIP-TO-SHORE SITE LAYOUT



Oregon Test Array

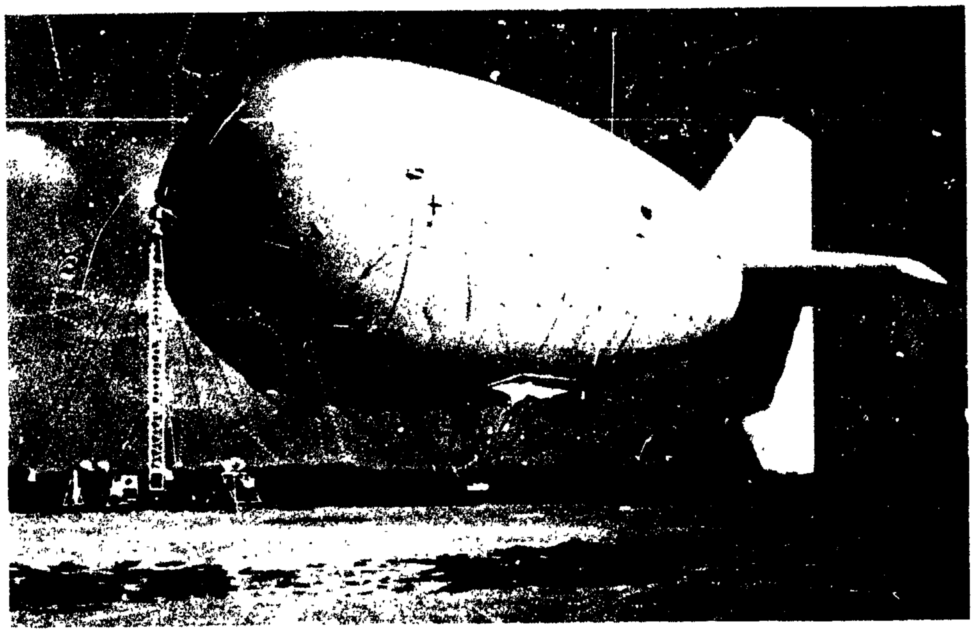
References 8, 9, 10, and 11 provide complete reports on the test details, findings, and recommendations.

NAVFAC's concept of the system would be based on one or more aerodynamically shaped balloons similar to ILC's Family II design, but with total internal capacity sufficient to lift a 22 1/2 short tone payload.

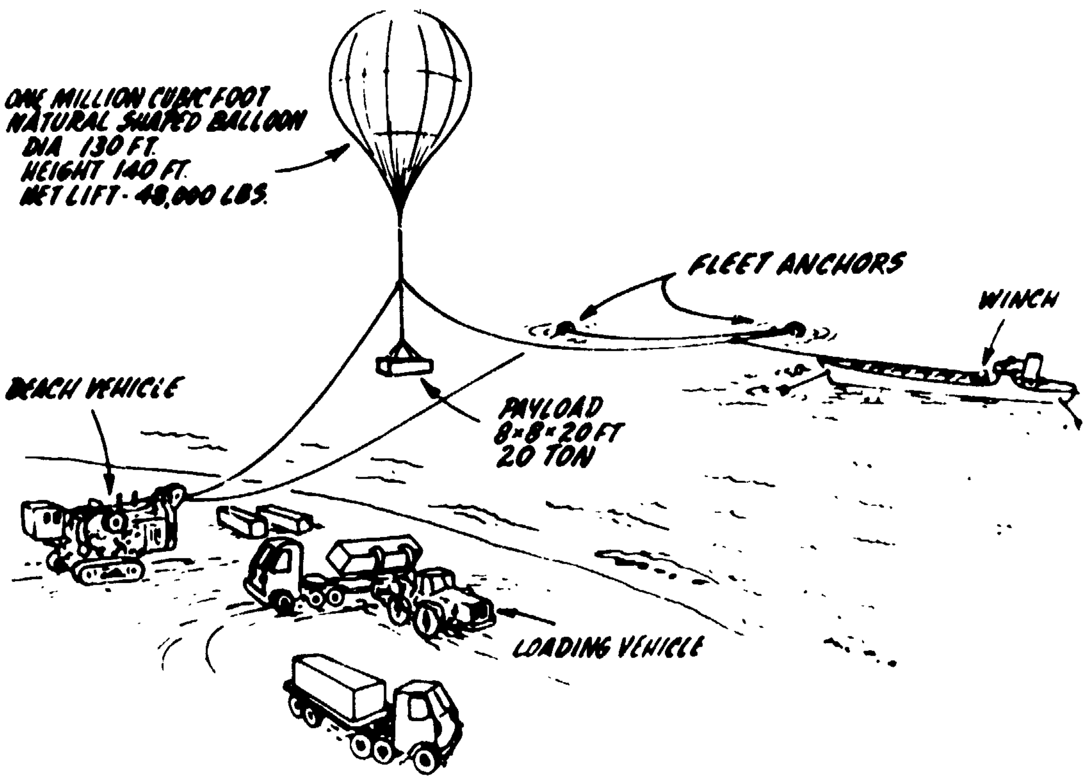
Included in the system would be two yarders, one ashore and one to seaward aboard a ship, plus a flying dutchman for lateral positioning control perpendicular to the established line of travel.

This system would be employed to pick-up unit loads from shipboard for transfer ashore. Load sizes would range from multiple pallet sizes to 8' x 8' x 20' containers in transfers not to exceed a nautical mile in distance. Load cycle times would be approximately 6 minutes.

In other sessions of the workshop, more detailed information will also be presented on the characteristics of the Aerocrane and TELTA balloon systems.



Family II Balloon



Ship-to-Shore TELTA Cargo Transfer System

LTA VEHICLE EMPLOYMENTS IN LOTS

Characteristics of Aerocrane Employment.

The basic characteristics of the mission profile of the Aerocrane in a LOTS operation would feature lifts of single-unit, heavy and/or high volume cargoes or bulk deliveries of other lesser commodities. Distances covered would be 15-75 nautical miles, enabling significant standoff distances to seaward and/or inland penetration. The time constraint of one hour and various speed capabilities (dependent upon size and model variant of Aerocrane) define the range limitations above. Generally, deliveries would be made directly to warehousing or distribution centers from shipboard, avoiding the congestion of deliveries over and through a narrow beach corridor. Such deliveries also avoid the surf zone which is always a critical and dangerous factor in any ship-to-shore movement evolution. Deployment of the Aerocrane can be accomplished by dedicating its payload capacity to a fuel load and let it fly to the desired transoceanic destination; or it could be towed by a ship as well.

Types of Aerocrane Operations.

Offshore Cargo-Handling Facilities for Ships- The Aerocrane and TELTA cargo delivery systems could not be expected to handle all the cargo deliveries of a LOTS operation. But the Aerocrane could assist in the positioning of equipment and hardware needed for typical dry cargo discharge operations. Placement of pontoon causeway sections for transshipment platforms and/or "roadways over water" (shorefast causeways) to the beach is possible. Delivery of crawler cranes, truck tractors and trailers, and other MHE to offshore transshipment points and beach sites could also be accomplished. This would give the on-site commander great flexibility in realigning his cargo discharge points based on the mobility and lifting capacity of the Aerocrane. Ramps to serve RO/RO ships could also be positioned at the transshipment points or at the seaward ends of shorefast causeways. Thus the Aerocrane would facilitate the installation of the hardware and MHE to discharge container, barge, and RO/RO ships which require certain sophisticated port capabilities, as well as directly off-loading priority cargo items from these ships onto beach sites.

The Aerocrane could also assist in the positioning of the heavy hardware items needed to establish the TELTA balloon cargo discharge system, such as the yarders, flying dutchman, mooring points, and cable runs. Additionally, Aerocrane could rapidly position floodable caissons for use as breakwaters in open roadsteads.

LSA Development Ashore- Logistics Support Areas (LSA's) could be built up ashore in similar fashion by first, putting in heavy ground clearing and road-building equipment; next pre-fabricated warehouses and

MHE would be introduced; and finally delivery of supplies and consumables to the new warehouse facilities would complete the operation with periodic resupply missions flown to keep stocks up to needed levels. The operation could be simplified to: providing tents and MHE, dumping supplies in a clearing, and providing tractors and trailers for deliveries. This would enable a rapid build-up of supplies in selected areas, well inland from the beach-oriented operations.

Forward Resupply- The Aerocrane could also provide inland resupply of critical items of major equipment, ammunition, food, and medical supplies at depots just to the rear of forward combat zones. This capability would drastically increase the effectiveness of the major LSA's and enable forward troops to be well supplied and mobile. Also, rapid removal of major equipments damaged in combat would facilitate their repair for reuse in the combat zone, decreasing the drain upon the stock levels of these items.

The Aerocrane's chief advantage in all these evolutions is its ability to pick up major, heavy equipments or bulk quantities of critical, consumable supplies (ammo, food, medical supplies, etc.) directly from shipboard or an LSA and deliver it directly to the "retail" depot without transshipment at a beachline or other point.

Characteristics of TELTA Balloon Employments.

The TELTA balloon cargo systems would be addressed to short-leg lifts of up to a mile and would lift cargoes over the surf zone and just beyond the beach area. Loads would be limited to the gross capacity of an 8' x 8' x 20' container, i.e., 22 1/2 short tons. Conceivably cycle times would be about 6 minutes per lift. The TELTA balloon cargo carrying system would become one of the several, near-shore, cargo discharge capabilities. The TELTA balloon(s) could be inflated prior to deployment and towed to a destination by a ship, or be inflated onsite.

Types of TELTA Balloon Operations.

The TELTA Balloon system as now envisioned by the Army and Navy, could become the primary means for discharge of non-selfsustaining containerships in the near-shore, sea area. Additionally, the system could be employed for deliveries of: unitized pallet loads of cargoes from breakbulk ships, or barges from LASH or Sea Barge ships, and off-loading small or light vehicles from RO/RO ships.

Hopefully, the TELTA balloon system's main feature will be a rapid cyclic rate over the designed one mile distance. This would be a significant improvement over current capabilities wherein 8-10 minutes cycles are required to off-load containers or other cargoes into lighterage for transfer to the shore; and then they must be further transshipped at the beach to overland transportation for movement to a marshalling area. The TELTA balloon lifts the cargo from the ship, over the surf zone, and directly into the cargo marshalling area. Reference 5 provides more conceptual and detailed data concerning this and other military logistics applications of the TELTA balloon system.

LOTS SCENARIO

The offshore picture then becomes one where lighterage, barges, and ships are being discharged of cargo, containers, and cargo-laden vehicles at causeways, jacked-up piers, or floating platforms close-in to the shore. A little more seaward, TELTA balloon systems are off-loading container and/or RO/RO ships with loads up to 20 long tons directly to the shore. And further seaward, other ships are having bulk priority cargoes and heavy lift items being lifted directly ashore (beyond the beaches) by Aerocranes before the ships go along-side the TELTA or other cargo discharge stations. Additionally, some Aerocranes are helping to maintain or reposition some cargo discharge facilities or are retrograding damaged vehicles and equipment, such as tanks, other armor, trucks, helicopters, etc. Also included in the task force of ships would be a Liquified Natural Gas carrier filled with helium for support of the LTA systems employed in the LOTS operation.

VULNERABILITY CONSIDERATIONS

Common Problems with Both Systems.

The first consideration in any military operation is to be where the enemy isn't, or be there in strength against weakness. Proper placement of forces would then eliminate much of the threat against these deceptively tough vehicles. The point here is, that many people are unfamiliar with the low over-pressures characteristic of the proposed Aerocrane and TELTA balloon systems. They expect the helium envelope to "pop" when punctured and do not appreciate what the low escape velocity of helium means. For example, if the hybrid vehicle Aerocrane (in the 90 ton payload configuration) has a hole one square foot in area at the exact top of the lifting sphere, it would take eight hours for it to lose enough of its positive buoyancy to become neutrally buoyant. This gives plenty of time for the Aerocrane (and in like manner the TELTA balloon) to complete any current lift (or even a series of lifts missions) and be repaired at a convenient location and time. However, if either of these cargo systems are punctured, the resultant loss of pressure will eventually cause dimpling of the aerostat as it is moved through the air. This greatly increases the drag forces upon the vehicles and reduces their speed capability.

Anything that can either tear gigantic holes in the aerostat or cause severe over-pressures from within will disable these systems almost instanteously. But while such weapons systems can be derived from available technology, none now exist. Existing fusing techniques for explosive shells cannot be employed against the aerostats surfaces to cause delayed internal or exterior point detonation. And tactical laser weapons are not yet available. However, employment of LTA technology in or near combat zones will probably hasten developments of these potential anti-LTA weapons capabilities.

Considerations Peculiar to the Aerocrane.

Essentially the supporting structure of the Aerocrane can be hardened to a reasonable degree and the extra weight can be taken up with more helium in a larger aerostat. The supporting structure can be built of non-radar reflecting materials, giving the Aerocrane a very small reflecting picture to V.T. fuses or radar-guided missiles. The cross-sectional area of the aerostat's supporting structure represents only one or two percent of aerostat's total cross-sectional target area, yielding a low probability of a damaging, point-detonating explosion inside the helium envelope. With an armored control cab, the Aerocrane can be rendered relatively invulnerable to most of the normal types of ordnance that could be used against it. Finally, with turboprop engines, vulnerability to infra-red (I-R) guided missiles must be addressed. At long ranges the I-R weapon can track toward the Aerocrane. But as the missile gets closer (and with exhaust gases vented out the wing tips) eventually it will attempt to follow a wing tip and be turned away. Thus the Aerocrane is actually little more vulnerable to any form of existing weapons technology than an upowered, non-rigid aerostat.

CONCLUSION

It appears that with proper appreciation for the vulnerability considerations and unique lifting capabilities of the Aerocrane and TELTA balloon systems, that they have the potential to offer new and significant logistics support capabilities in the arenas adjacent to combat environments. These potential capabilities could also help solve some of the monumental problems now facing logistical planners in handling the ship-to-shore movement of cargoes from the new, highly specialized ships of the intermodal sea transportation systems becoming characteristic of current and future U.S. Flag merchant marine operations.

REFERENCES:

1. Nichols, J.B., and Doolittle, D.B., Hybrid Aircraft for Heavy Lift, American Helicopter Society, New York, New York (May, 1974).

2. All-American Engineering Co., Military Applications of the Aerocrane, Wilmington, Delaware.

3. ILC Dover, ILC Aerostats, Dover, Delaware, pp 14-19.

4. All-American Engineering Co., Sensitivity Analysis of Aerocrane Hybrid Vehicles Report No. ADTR 74-3, Wilmington, Delaware (July 15, 1974).

5. Range Measurements Laboratory (RML), Air Force Eastern Test Range (AFETR), A Presentation of Balloon RDT&E Activities, (January 30, 1974).

6. Nichols, J.B., Evaluation of the All-American Engineering Corporation "AEROCRANE" - A Hybrid Aircraft Heavy Lift System, ATR-74 (7291)-1, The Aerospace Corp., El Segundo, California, (October, 1973).

7. Reference 4, pp. 44-52.

8. RML, AFETR, A Proposal for Providing Logistics Support, Patrick AFB, Florida, (January, 1974).

9. RML, AFETR, (Sponsored by Advanced Research Projects Agency, ARPA Order No. 2176), Ship-to-Shore Oregon Test Series II - Preliminary Report, TELTA Report No. 73-026, Patrick AFB, Florida, (April 20, 1973).

10. RML, AFETR, Ship-to-Shore Oregon Test Series II Final Report, TELTA Report No. 73-030, Patrick AFB, Florida, (June 11, 1973).

11. Reference 5, pp. 3, 8, 9.