FREEDOM OF INFORMATION ACT *(FOIA)* RESPONSE AND INVOICE

REQUEST DATE	REQUEST NUMBER
20021224	03-101LK

TO
Andrews Space & Technology Inc.
Attn: Rachel Vogel
911 Western Ave, Suite 506
Seattle WA 98104

FROM
88 CG/SCCMF (FOIA Office)
Building 676 Rm 150
2435 5th Street Area B
Wright-Patterson AFB OH 45433

1. REQUESTED RECORDS

- [ ] COMPLETELY RELEASED
- [x] PARTIALLY RELEASABLE
- [x] DOCUMENTS ARE ATTACHED
- [ ] DOCUMENTS WILL BE FORWARDED ON RECEIPT OF PAYMENT
- [ ] DOCUMENTS MAY BE VIEWED AT THIS LOCATION *(Please call for an appointment)*
- [ ] TIME EXTENSION IS REQUIRED BECAUSE
- [ ] ALL OR PART OF THE REQUESTED RECORDS ARE NOT AT THIS LOCATION
- [ ] VOLUMINOUS RECORDS MUST BE COLLECTED AND REVIEWED
- [ ] RECORDS ARE BEING REVIEWED BY ANOTHER AGENCY FOR POSSIBLE RELEASE
- [ ] WE HOPE TO PROVIDE A FINAL DECISION BY ________

2. THE COSTS OF PROVIDING THESE DOCUMENTS ARE INDICATED BELOW

REQUEST ACTIONS	RATE	MATERIAL	TIME	COST
SEARCH *(Hourly)*	$44.00		3.00	$132.00
REVIEW *(Hourly)*	$44.00		2.00	$88.00
COPY *(Page)*	$0.15	60		$9.00
COMPUTER MACHINE TIME *(Hourly)*				
COMPUTER OPERATOR TIME *(Hourly)*				
COMPUTER TAPES				
OTHER CDs				
			TOTAL AMOUNT DUE	$229.00

3. Send your check or money order payable to "US DEPARTMENT OF TREASURY" with a copy of this invoice within 30 days.

(Future requests will not be processed until payment is received.)

3A. MAIL TO
88 CG/SCCMF (FOIA)
2435 5th Street, Rm 150
Wright-Patterson AFB OH 45433-7802

4. THIS ACKNOWLEDGES RECEIPT OF YOUR CHECK OR MONEY ORDER FOR PAYMENT OF REQUESTED DOCUMENTS

NUMBER	DATE	AMOUNT

5. ALL OR PART OF THE INFORMATION YOU REQUESTED IS NOT AVAILABLE AT THIS INSTALLATION. WE HAVE FORWARDED YOUR REQUEST TO THE FOLLOWING LOCATION FOR ACTION WITH DIRECT RESPONSE TO YOU.

6. COMMENTS

Attached:
1-Denial Letter
2-FOIA Request
3-Released Records
Point of Contact is Abby Boggs (937) 904-8203

7. FREEDOM OF INFORMATION ACT MANAGER

NAME AND PHONE	SIGNATURE	DATE
SHEREE M. COON (937) 904-8207	Sheree M. Coon	16 Apr 03

AFMC FORM 556, 19950201 *(EF-V4)* REPLACES AFMC 556, JUL 92 WHICH IS OBSOLETE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 88TH AIR BASE WING (AFMC)
WRIGHT-PATTERSON AIR FORCE BASE OHIO

APR 17 2003

88 ABW/JA
5135 Pearson Road RM 129
Wright-Patterson AFB OH 45433-5321

Andrews Space & Technology Inc.
Attn: Rachel Vogel
911 Western Ave, Suite 506
Seattle WA 98104

Dear Ms. Vogel,

This is in response to your 24 December 2002 Freedom of Information Act (FOIA) request for a copy of three proposals. Items 2) and 3) were referred to Kirtland AFB on 10 January 2003. This response is exclusive to item 1) Proposal # 93XRX-072. The FOIA control number assigned to this request is 03-101LK.

The records you have requested are partially exempt from disclosure. We are prohibited from releasing proposals in response to competitive solicitations except those set forth or incorporated by reference in the contract. This was a competitive proposal and a portion of the proposal (pages 1-17) was incorporated into the contract.. We may only release that portion of the proposal that was incorporated into the contract. If the part of the proposal that was not incorporated into the contract were released, it would cause substantial competitive harm to the Government's competition process and would disclose the bidder's proprietary bidding methodology. The authority for this exemption can be found in the United States Code, Title 5, Section 522(b)(3), 10 U.S.C. 2305(g), Protection of Contractor Proposals and FAR 24.202(a)(2).

If you decide to appeal this decision, write to the Secretary of the Air Force within 60 calendar days from the date of this letter. Include in the appeal your reasons for reconsideration and attach a copy of this letter. Address your letter as follows:

Secretary of the Air Force
THRU: 88 CG/SCCIADF
Bldg 16 Area B
2275 D Street RM 0047
Wright-Patterson AFB OH 45433-7220

Sincerely

Heather L. Osterhaus

FOR MICHAEL L. COLOPY, Colonel, USAF
Staff Judge Advocate

Kane Lynn C Civ 88 CG/SCCM

From: Rachel Vogel [rvogel@Andrews-
Sent: Tuesday, December 24, 2002 2:44 PM
To: 'Lynn.Kane@wpafb.af.mil'
Subject: SBIR Reports (Small Business Innovation Research)

Ms. Kane,
I am from Andrews Space & Technology and am inquiring about some SBIR reports. We were directed to you by Chrys Love at the FOIA office in the Air Force Research Laboratory. We would like any Freedom of Information Act (FOIA)-compliant documents pertaining to the following three SBIR reports.

1).
Proposal # 93XRX-072 F33657-93-C-2323 - ASC - WPAFB

Aerospace Recovery Systems, Inc. $73,337
1381 Rounds Avenue Phase: 1
Grants Pass OR 97527
Topic: Inflatable Airborne Manned/Unmanned Payload Delivery/Recovery Systems

2).
Proposal # 98PL-072 F29601-98-C-0178 → Det 8, AFRL/PK Kirtland

Aerospace Recovery Systems, Inc. $5,388
1381 Rounds Ave. Phase: 1
Grants Pass OR 97527
Topic: Inflatable Decelerator/Descent & Recovery Systems for Space, Suborbital & Near-Space Payloads & Manned Spacecraft

3).
Proposal # 011NM-0000 F29601-02-C-0008 "
AeroAstro, Inc. $731,534
520 Huntmar Drive Phase: 2
Herdon Virginia 20170
Topic: Lightweight Structural Aerobrake for Orbital Positioning and Manuevering

Any final reports/findings would be very helpful. Your assistance is much appreciated.

Rachel Vogel
rvogel@andrews-space.com
206-342-9934-131

O. P. R. ASC/PKF
CONTROL # 03-101
DUE DATE 27 Jan 02

Note:
WPAFB is responsible for item 1) only. Items 2) & 3) were referred to Kirtland AFB. Lynn

Rachel Vogel
Andrews Space & Technology Inc.
911 Western Ave., Suite 506
Seattle, WA 98104
Tel: 206-342-9934 x131
Fax: 206-342-9938
Email: rvogel@andrews-space.com

APPENDIX A

XRP93-072

U.S. DEPARTMENT OF DEFENSE

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

PROPOSAL COVER SHEET

Failure to use a RED Copy as the original for each proposal and to fill in all appropriate spaces may cause your proposal to be disqualified

TOPIC NUMBER: AF93-158

PROPOSAL TITLE: Inflatable Airborne Manned/Unmanned Payload Delivery/Recovery Systems

FIRM NAME: Aerospace Recovery Systems, Inc.

MAIL ADDRESS: 1381 Rounds Ave.

CITY: Grants Pass STATE: OR ZIP: 97527-9234

PROPOSED COST: $ 49,660 PHASE I OR II: I PROPOSAL PROPOSED DURATION IN MONTHS: Under 6 Mo.

BUSINESS CERTIFICATION:

	YES	NO
▶ Are you a small business as described in paragraph 2.2?	[X]	[ ]
▶ Are you a minority or small disadvantaged business as defined in paragraph 2.3? (Collected for statistical purposes only)	[ ]	[X]
▶ Are you a woman-owned small business as described in paragraph 2.4? (Collected for statistical purposes only)	[ ]	[X]
▶ Has this proposal been submitted to other US government agency/agencies, or DoD components, or other SBIR Activity? If yes, list the name(s) of the agency, DoD component or other SBIR office in the spaces to the left below. If it has been submitted to another SBIR activity list the Topic Numbers in the spaces to the right below.	[X]	[ ]

Naval Explosive Ordnance Disposal Tech. Ctr.
Indian Head MD, Mr. Syvrud (410)278-7909
under BAA # DAAD05-92-T-A459

▶ Number of employees including all affiliates (average for preceding 12 months): 6

PROJECT MANAGER/PRINCIPAL INVESTIGATOR	CORPORATE OFFICIAL (BUSINESS)
NAME: Robert T. Kendall, Jr.	NAME: Robert T. Kendall, Jr.
TITLE: Project Manager	TITLE: President
TELEPHONE: (503) 479-5956	TELEPHONE: (503) 479-5956

For any purpose other than to evaluate the proposal, this data except Appendix A and B shall not be disclosed outside the Government and shall not be duplicated, used or disclosed in whole or in part, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this data, the Government shall have the right to duplicate, use or disclose the data to the extent provided in the funding agreement. This restriction does not limit the Government's right to use information contained in the data if it is obtained from another source without restriction. The data subject to this restriction is contained on the pages of the proposal listed on the line below.

PROPRIETARY INFORMATION: All information on pages 3 thru 25, inclusive.

R. T. Kendall Sr. 1-6-93 — SIGNATURE OF PRINCIPAL INVESTIGATOR, DATE

Robert T. Kendall Jr. 1-6-93 — SIGNATURE OF CORPORATE BUSINESS OFFICIAL, DATE

F33657-93-C-2323
Attachment 1
Page 2

APPENDIX B

U.S. DEPARTMENT OF DEFENSE

SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM

PROJECT SUMMARY

Failure to use a RED Copy as the original for each proposal and to fill in all appropriate spaces may cause your proposal to be disqualified

TOPIC NUMBER: SBIR AF93-158

PROPOSAL TITLE: Inflatable Airborne Manned/Unmanned Payload Delivery/Recovery Systems

FIRM NAME: Aerospace Recovery Systems, Inc.

PHASE I or II PROPOSAL: I

Technical Abstract (Limit your abstract to 200 words with no classified or proprietary information/data.)

Several objectives in this proposal include systematic study of innovative ways and means to improve survivability and safety of airborne platforms (C-130,C-17,Heli-copter), flight crew, paratroops, cargo and equipment. High altitude deployment and glide operations, and, airborne snatch and recovery of individuals or cargo from ground or water pick-up sites will also be studied.

This proposal will determine feasibility of faster payload extraction from platforms at lower altitutes and greater speeds, and, high altitude payload deployment of inflatable gliders for pinpoint landings. Innovative cone-shaped decelerator and impact shock attenuator and glider configurations will be studied, based on proven prototype test vehicles, to determine the best means for rapid extraction/deployment to reduce dispersion of landed payloads. Feasibility of self-contained, stand-alone personnel and cargo deployment/extraction hardware, and safe recovery of personnel/cargo payloads during airborne post-mission snatch/recovery of SOF missions will be defined and studied.

Current airborne delivery systems/methods will be compared to proposed innovative inflatable delivery and recovery vehicles to verify proposed systems advantages based on flight tests of existing flight tested inflatable systems. Objective results, findings and conclusions will be presented on completion of the feasibility study.

Anticipated Benefits/Potential Commercial Applications of the Research or Development

Anticipated benefits include improved survivability of airborne transport, aircrew, paratroops and cargo/equipment before, during and after deployment, and, improved SOF airborne snatch/recovery operations. Potential commercial derivative applications using proven test vehicles exist for civil government airborne personnel/supplies disaster relief. Commercial air delivery services could use inflatable airborne delivery to remote island/jungle/ arctic, or, grid-locked metropolitan areas.

List a maximum of 8 Key Words that describe the Project.

Airlift	Commercial
Logistic	Tactical
Emergency	Aeronautical
Inflatable	Survivability

[illegible] on this page [illegible] classified or proprietary information or data
[illegible]

[redacted] PROPRIETARY INFORMATION

IDENTIFICATION & SIGNIFICANCE OF THE PROBLEM OR OPPORTUNITY

PROBLEM DEFINITION

Current methods used for airborne delivery of personnel and cargo face increased risk, reduced survivability and mission failure due to the continued advancement of hostile high technology weaponry. Innovative radar, communication and weapon systems present an ever greater threat to survival of airborne platforms such as C-130's, C-17's and rotary winged aircraft, as well as personnel and payload, forcing mission planners to reconsider riskier ground deployment methods rather than airborne deployment.

Prevailing airborne deployment practices require the delivery aircraft to slow down and then rise to higher altitudes to deploy payloads, exposing aircraft and payload to hostile fire. Paratroops and cargo also become airborne targets to hostile ground forces during descent. Paratroopers must sometimes untangle shroud lines or attempt to re-orient an inverted parachute, attempt to control oscillation, and, make many other decisions such as when to un-tether gear and weapons, how to land on dangerous terrain, and where to hide if under fire, find and retrieve tether-released gear, all in a very short period of time.

Dispersion of landed personnel and cargo slows regrouping and effectiveness of total ground operations. Supplies, equipment and weapons stores may be overturned, damaged, or, may not be readily accessible or close by after impact, reducing the element of surprise. Injuries sustained during deployment and landing as well as CBN agents present other elements of attrition, requiring evacuation and medical personnel support, slowing and compromising the mission.

LAPES and LARRS offer alternative limited solutions, but are complicated and requirement flat, unobstructed landing sites and non-volatile field conditions, which limit deployment operations, increase risk and reduce survivability. Paratroop deployment using these delivery methods presents significant risk including loss of aircraft, physical injury, or fatality to crew and paratroops.

SPECIAL OPERATIONS FORCES PROBLEMS

Special Operations Forces in all military branches face the same challenges and risks as regular military but have an added problem of post mission retrieval by airborne or waterborne platforms. Rotary winged airborne recovery is effective but in many cases is more risky due to its slower speed and need to hover during recovery operations. Individual ground snatch/retrieval have worked in the past, but SOF agencies indicate a need for and are soliciting advanced and improved methods of multiple operative

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delivery and retrieval systems for one or more personnel at a time by less risky methods to reduce risk to the recovery platform.

All military branches indicate an interest in high altitude, stand-off, airborne deployment of personnel and cargo within a glider-type vehicle, capable of manned or independent remote controlled flight for pin-point landing at predetermined landing sites to minimize risk and increase delivery platform survivability.

Many of the problems inherent in current deployment technology is based on restrictions imposed on military planners due to parachute limitations. Strategic and tactical operational procedures are developed around those limitations, forcing countermeasure and alternate actions, further slowing down and complicating deployment efforts.

Aircraft are being equipped with active and passive countermeasure weapons with added cost, weight, inventory and manpower support in order to advance ahead of new hostile technology. Military R & D branches such as the Army in their MTADS solicitation recognize these threats and are searching for solutions to these problems from the commercial market sector.

So, what are the alternatives to these problems, and, what can be done to reduce risk and increase survivability of both delivery platform and payload ?

OPPORTUNITIES AND OPTIONS

Ideally, alternate airborne deployment and recovery systems and methods must be developed and used to eliminate or minimize risks, and/or increase survivability. The delivery platform must deploy payloads at greater speeds and at lower altitudes, or, in stand-off deployments, at higher altitudes with decelerators that glide to designated landing sites. Use of rapid deployment systems to assure multiple payload extraction in less time, and, employing advanced automatic inflatable decelerator/attenuator payload landing devices will simplify operational training, minimize user decision making, streamlining operations and deployment methods, making use of more cost effective, proven, off-the-shelf products and existing technology.

There now exists new innovative products, devices, systems and methods available, and tested to eliminate or minimize risk while improving survivability of the delivery platform and payloads.

PHASE I TECHNICAL OBJECTIVES

There are several major technical objectives and related questions to be addressed in reducing risk and increasing survivability of airborne platforms, flight crews and deployed and recoverable

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manned/unmanned payloads including:

1. Reduction of delivery platform exposure to hostile forces' detection
2. Improved rapid payload deployment at higher speeds and lower altitudes
3. Provision for high altitude, remote, stand-off airborne paratrooper/cargo glider deployment
4. Reduced injury to landed personnel and reduced damage to landed cargo
5. Reduced dispersion of landed payloads on land or water to improve regrouping and mission readiness
6. Improved airborne SOF personnel delivery/retrieval and recovery
7. Reduced R&D costs through use of proven technology and off-the shelf hardware
8. Designs which allow interchangability and reuse of hardware and fabricated assemblies where possible

Some questions which will be answered in order to determine the feasibility of the proposed approach for the technical objectives include:

1. How to reduce delivery platform exposure to hostile forces detection systems and weapons ?
2. How and by what means to provide rapid deployment of personnel, supplies and equipment from airborne platforms ?
3. What are the advantages of the proposed deployment method?
4. What methods will be needed to minimize injury to personnel, damage to supplies and equipment after deployment ?
5. What are ways to reduce personnel and cargo dispersion to increase efficient post landing regrouping and operations?
6. What impact will new systems have on current airborne deployment operations ?
7. How, and by what means, can SOF personnel/cargo be snatched and recovered after mission completion ?
8. What are estimated costs and production schedules ?
9. What hardware is off-the-shelf and will have to be fabricated ?
10. What hardware is reusable and interchangeable between different applications and systems

Several drawings, a photo and proposed tested operational examples that follow, will illustrate and describe ways and means to meet the objectives and answer questions stated above to reduce risk and improve survivability of different airborne deployment operations. A VHS tape entitled "Inflatable Delivery/Recovery Vehicle Applications and Flight Tests" (enclosed) demonstrates low speed airborne deployment of an unmanned cargo payload and forms the basis of the proposed airborne deployment concepts in the Phase I Work Plan.

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PHASE I WORK PLAN

This proposal will be organized into separate subsections to respond to three different airborne operations, including:

I. Low altitude, high speed airborne manned/unmanned payload deployment, or Low altitude Inflatable Delivery Vehicle (LIDV)

II. High altitude remote stand-off airborne manned/unmanned payload glider deployment, or High altitude Inflatable Delivery Vehicle (HIDV)

III. Low altitude, low/high speed SOF individual and multiple personnel land or water delivery and snatch/recovery, or Low altitude SOF Inflatable Recovery Vehicle (SOFIRV)

I. LOW ALTITUDE INFLATABLE DELIVERY VEHICLE (LIDV)

WHAT IS PLANNED

"Know thy enemy" is a necessary aspect of planning what is needed and how to successfully achieve the above stated objectives. Defining threats to airborne payload deploying platforms is as much a part of R&D as operational strategy, logistics and tactics.

Many threats to the mission are well known as a result of recent conflicts and the newly available information surfacing from freed CIS (formerly USSR) territories. Understanding operating conditions for all types of conflicts, as well as knowing weaknesses and strengths of the adversary and his weapons, provides the ground-work for effective anti-threat and evasion survival technology.

Radar has limited effectiveness against fast, low flying aircraft. Advanced hostile ground-to-air fired weapons which rely on radar are therefore also less effective, as are sight-and-fire operated weapons.

Knowing the strengths and weaknesses of current airborne decelerators such as parachutes is equally important and must be considered in any mission. Some of the limitations and weaknesses of parachutes include:

1. Increased risk to deploying platform, crew and payload due to need to climb to higher altitudes, and, reduce speeds to extract/deploy cargo
2. Proper chute deployment, chute inversion, shroud line entanglement, oscillation control and interference with other descending paratroopers

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3. Tethering weapons, backpack or other gear at the right time
4. Exposure to hostile ground fire during descent, and after landing
5. Injury/fatality due to improper impact, obstacles, dragging by wind, land mines and drowning, CBN threats
6. Retrieval and loss of tethered equipment and weapons
7. Lack of communication and difficulty in regrouping due to great dispersion

Because parachute methods increase risk and reduce aircraft survivability when deployed, alternate ways and means of airborne deployment of manned and unmanned payloads are needed and will be defined and studied to determine feasibility in this proposal.

INFLATABLE DECELERATOR STRUCTURES - A PROVEN ALTERNATE AIRBORNE PAYLOAD DEPLOYMENT OPTION

Perhaps the best approach to reach the above stated objectives and answer related questions is to review uses of existing proven hardware applications, where possible, with proposed new, flight tested inflatable decelerators and impact attenuators which demonstrate advanced rapid deployment methods with the many advantages over parachutes.

Well known safety devices such as inflatable life vests, life rafts, pontoons, SOF Zodiac type boats used in military applications, and airline emergency passenger escape slides, oil spill containment booms, equipment lifting air jacks and fluid storage containers all have a few things in common including simple, light weight, stowable structures which have a long history of use and success. All have had to meet military and civilian specifications and requirements, and have been tested to be satisfactory for their intended uses, some of which have been in service over 20 years.

In this proposal, advanced technology and innovative fabrication concepts, materials and equipment will be combined with proven technology and state-of-the-art products to introduce newly developed and tested inflatable systems, including new airborne deployable payload decelerators, landing shock impact absorbing devices and systems, which add a significant element of safety not available with current technology. The long term objective will be to continue flight testing proposed deployment vehicles at higher speeds, using airborne platforms including government or private contract C-130, C-141, C-17 and even rotary winged aircraft.

Complimentary subsystems proposed will also be included to aid in the controlled rapid deployment necessary to minimize landing dispersion, and, impact shock attenuation. These systems will utilize tested manufacturing techniques and materials, as well as off-the-shelf hardware, currently being used in commercial and military applications, minimizing cost and development time and

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assuring near-term results.

OBJECTIVES TO MEET AND QUESTIONS TO ANSWER - LIVD

How can risk to delivery aircraft be reduced, and, increase survivability of the delivery aircraft, while increasing strategic and tactical rapid deployment advantages over that of the past ? What new approaches are available and/or proven that reduce injury to paratroopers, reduce damage to cargo and minimize dispersion ? Is there a cost effective, simple answer ?

INFLATABLE DELIVERY VEHICLE (IDV) FOR AIRBORNE PAYLOAD DELIVERY

The best way to minimize risk and improve survivability is by maintaining the lowest deployment altitude, perhaps at 200 feet AGL, and by increasing platform deployment speeds between 275 KIAS and 350 KIAS, or more. To offset the greater dispersion expected by greater aircraft speed, and, to assure rapid payload decelerator deployment at lower altitudes, innovative new systems, some of which have been successfully been flight tested, will be introduced.

The VHS tape enclosed successfully demonstrates deployment of a low speed unmanned simulated ejection seat attached to a stowed Inflatable Delivery Vehicle (IDV), which is inflated by compressed or other pressurizing gas to form a tubular-framed, cone-like fabric decelerator that envelops and protects the personnel or cargo during deployment, descent and landing. An inflatable impact attenuator designed to safely absorb and dissipate "G" landing forces through specially designed pressure relief rupture discs, is also provided.

In this flight test, a non-fragile payload with a net weight of 320 lbs (including lead ballast and the seat), along with the 40 pound inflatable decelerator, impact attenuator and inflation system/instrument module was used, bringing the gross weight to 420 pounds. A helicopter deployed the stowed IDV and ejection seat from a conservative altitude of 700 feet AGL at 95 MPH. The decelerator was pressurized to 3 psi and inflated within 3 seconds of release, followed by inflation of the impact attenuator, which filled in another 2 seconds, all within 275 feet of the point of departure.

The descending vehicle terminal velocity reached 40 FPS impact, when the impact attenuator deflated at a predetermined rate thru a pressure relief valve designed to allow safe dissipation of the shock energy in less the 100 milliseconds, which is considered by aeromedical experts to be acceptable for manned applications.

To further illustrate how this delivery vehicle would work within current and future airborne platforms such as the MC-130 and future C-17, drawing P-016/130-1 AC, Sheet 1, shows a comparison

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of the current parachute deployment methods and the ARS advanced approach for the future high speed, low altitude needs.

Figures 1, 2, 3 & 8 illustrate a current airborne deployment scenario using parachute decelerators. The 500 to 700 feet AGL altitude and 150 KIAS deployment speed compromise the mission, especially with the sophistication and accuracy of present and future anti-aircraft weapons.

Figures 4, 5, 6 & 7 illustrate a proposed alternate IDV method of rapid deployment of troops (and cargo) at speeds of 250 KIAS, or more, and as low as 200 feet AGL. As you recall from the VHS tape, the ARS Inflatable Delivery Vehicle prototype was successfully deployed within 275 feet of the point of release at an airspeed of 95 MPH, demonstrating the potential development of higher airspeed deployment at low altitudes, which are ARS goals being pursued within a privately funded IR & D program, currently underway.

Drawing M/C-016-A illustrates projected deceleration and descent/landing flight characteristics for other speeds of 150 KIAS, 350 KIAS and 600 KIAS, demonstrating similar trajectory features and landing impact forces, as preliminary tests indicate.

EJECTION SEAT DEPLOYMENT

To meet the proposal objectives, an ejection seat, or pallet, and, powered rail deployment system within the airborne platform would be used to rapidly deploy payloads at a predetermined rate. The proposed test IDV suggests a means to positively extract and control the rate of deployment, minimize or eliminate the parachute related problems listed above, as well as regulate ground dispersion to suit mission requirements.

Advantages provided by using the proposed IDV include:

1. Simple, modularized, self-contained IDV rail deployment assemblies which are easily loaded and unloaded within aircraft and are designed to automatically deploy and deliver 1-man, 3-man, 9-man, 12-man IDV's from the MC-130, and, possibly the CASA C-212/C-235, and, 16-man IDV's from a C-17, as well as standard smaller cargos and 88" or 108" wide cargos, with slight modification
2. Ease of boarding the aircraft without carrying heavy equipment, comfort en route and prior to deployment point, and, increased numbers of deployable troops to 81 in the MC-130 and 288 troops from the C-17
3. Minimal or no troop involvement in response/decision/action functions such as jumping, proper decelerator deployment, disentanglement, inversion during initial deployment, chute oscillation control, tethering, and retrieval of untethering of gear/weapons prior to landing
4. The IDV provides positively inflated stable decelerator,

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[redacted] PROPRIETARY INFORMATION

impact attenuator deployment and protection of the troops and cargo from high velocity wind streams immediately after deployment from the aircraft

5. Minimizes injury/fatality due to interference with other troops during descent, improper landing, obstacles, land mines, drowning, or loss of tethered gear/weapons
6. Hostile forces wouldn't be able to see what type of payload was inside the cone-shaped decelerator as it descends, providing a less obvious target, as well as an element of surprise, and alternately serving as a decoy
7. Impact attenuation on land or water, with continued flotation and immersion protection if water impact site
8. After landing, the still-inflated, cone-shaped decelerator, would serve as an object to hide behind once the trooper unharnessed, donned his gear and exits
9. The still-inflated IDV may also be inverted and used as a CBN agent shelter, command post, moisture condensate collector, or left upright to catch rain water. The airtight tubular structure could also be used to store liquids or other items
10. The current IDV prototype has been stowed and inflated 20 times to date with no evidence of deterioration over the two years since being fabricated, and may have a life expectancy in excess of 50 cycles
11. The IDV rail deployment system provides improved survivability through immediate emergency deployment and landing of all personnel or cargo in event of a airborne mishap

TROOP DEPLOYMENT SYSTEMS

When deploying individual troops from an MC-130 as figure 9 illustrates, (6) separate rail deployment systems are used to deploy (13) troops in a string by (3) strings across on the top level= (39) troops, and (14) troops in a string by (3) strings on the lower level= (42) troops, or a total of (81) troops.

Because the trooper is enveloped and protected by the trailing and inflating cone-shaped decelerator structure which presents a continuously greater surface area once leaving the ramp edge, there probably will be virtually no contact between deployed troops during decent.

Each 1-man IDV has it own inflatable decelerator, impact attenuator and inflation system which are automatically actuated upon leaving the rail system. The IDV then stabilizes, decelerates, descends and lands within 25 to 50 feet of each other, much like that shown on the the on the VHS tape. Once landed, the trooper unharnesses, gathers his weapon and gear, and departs to group with others.

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MULTIPLE TROOP INFLATABLE DELIVERY VEHICLES SYSTEMS

Multiples of troopers may be deployed at a time as shown in Figure 9, sheet 2. ARS has several conceptual designs illustrating 3-man, 9-man and 12-man (or 88" wide cargos) IDV's for the MC-130 aircraft which use the same rail bases ganged together. If a 12-man IDV deployment option is chosen, up to (60) troops may be deployed during each mission.

POST LANDING OPERATIONS

After landing, the group leader opens a valve in the inflatable decelerator structure to deflate it while the rest of the troops un-harness and gear up to regroup with others.

The 1-man IDV will be used as the baseline design delivery vehicle for this proposal and further testing, unless the soliciting agency determines one or all options should be developed.

C-17 1-MAN INFLATABLE DELIVERY VEHICLE DEPLOYMENT SYSTEMS

Figure 10, sheet 2, illustrates a C-17 1-man IDV deployment systems similar to that shown for the MC-130. The C-17, however, has a combination of "A", "B" and "C" rail subassemblies capable of deploying up to (6) lower level strings of (24) 1-man IDV's= (144) troops and (6) upper level strings of (24) 1-man IDV's, or a total of (288) 1-man IDV's per C-17 mission.

The Hydraulic/electric drive systems are proportionately larger to drive the greater load.

C-17 MULTIPLE-MAN INFLATABLE DELIVERY VEHICLE DEPLOYMENT SYSTEMS

Figure 10, sheet 2, shows the same 12-man and a 9-man IDV described for the MC-130. This combination provides up to (16) 12-man IDV's= (192) troops and (2) 9-man IDV's= (18) troops, or a total of (210) troops per mission.

If 16-man IDV's are used, a combination of (16) 16-man IDV's= (256) troops and (2) 9-man IDV's= (18) troops, or a total of (274) troops per mission.

SAFETY AND COMFORT FEATURES

Figures 9, 10 & 11 illustrating rail/IDV layout options for the MC-130 and the C-17 show generous walkways and provision for shift-type rest quarters for 1-man and multiple-man IDV's.

Another feature provided by using the Inflatable Delivery Vehicle and powered rail deployment system is improved survivability for troops in event of mishap such as serious damage to

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the aircraft while airborne which, would lead to a crash. The deployment system could be actuated, immediately deploying all troops, which is a significant advantage over parachute or other extraction options that require "just-right" conditions, and time to deploy and operate, especially at low altitudes.

II. HIGH ALTITUDE INFLATABLE DELIVERY VEHICLE (HIDV)

Another approach which will lower risk and increase survivability of all mission elements is to deploy payloads using high altitude, stand-off delivery methods when faced with an adversary with advanced anti-aircraft weapons.

To effectively escape these threats, delivering aircraft could deploy inflatable decelerators or gliders at 30,000 feet AGL with glide ratios exceeding 2:1 with up to 12 personnel or 4,300 lbs of cargo. To meet these objectives, standard ramp, or the proposed wing pod payload deployment methods illustrated by drawing PA-40-2.7K AC, could be used to extract personnel and cargo at high speeds.

Much of the Low Altitude Inflatable Delivery Vehicle technology, hardware and fabrication techniques are applicable to the proposed High Altitude airborne deployment, so feasibility studies and later R & D costs would be minimized. Use of existing C-130 six foot diameter by 23 foot long electronic warfare wing pods, with some modifications, would speed up proof-of-concept flight testing and later deployment of up to six individual SOF personnel. Use of rectangular wing pods, as illustrated in Figure 4, would allow deployment up to 12 personnel, or equivalent weight of cargo at one time, at speeds of 350 KIAS, or more.

III. LOW ALTITUDE SOF INFLATABLE RECOVERY VEHICLE (SOFIRV)

Many risks and threats face SOF operatives, aircrew and aircraft during all aspects of the mission. Reducing or eliminating any part of these threats reduces the risk and improves survivability. Insertion and recovery of SOF operatives becomes even more perilous with advanced radar and AAA, increasing the need to deploy at lower altitudes. But parachute insertion methods compromise the delivery platform and all personnel on board at low altitudes. And, past recovery methods have been unsuitable.

To reduce these threats, innovative alternative delivery and recovery methods and systems will be studied, as well as airborne insertion and recovery at lower altitudes and higher speeds.

Drawing PN-10-2.7K-AC, Figure 1, shows a scaled-up version of an airborne inflatable personnel/equipment insertion approach to achieve SOF goals of safe and rapid aerial platform delivery of SOF operatives at low altitude and high speed. To further reduce air-

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craft and flight crew exposure to hostile threats, a stowed aerodynamic inflatable nose and tail structure are included on the original inflatable delivery vehicle, which when inflated as shown by Sheet 2, provides a recovery vehicle without additional airborne insertion efforts to provide the snatch/recovery hardware.

Reuse of the original delivery vehicle inflatable drogue by reattaching it to the winch located in the aft end of the original delivery vehicle will provide drag stability during recovery and eliminates the need for extra hardware. The delivery vehicle is deflatable and is camouflaged for reuse after the mission is complete as shown by Figure 4, but may be left inflated and camouflaged as in Figure 3 on Sheet 1.

Once the mission is completed, a stowed, then inflatable, recovery vehicle can be uncovered and deployed in 5 seconds, followed by attachment of a tow cable to two air cylinder telescoping column spaced 50 feet apart, placing the snatch cable 50 feet AGL for snatch by a C-130 which homes in on transmitters located on top of the columns as shown by Figures 5 & 6. Feasibility of a stowed recovery vehicle to be independently inserted by aircraft as a submerged package to a predetermined recovery site, which can be inflated, automatically floating to the surface for water snatch/recovery will be studied. Telescoping columns can be raised from floating supports which raise the snatch line as previously described and as shown in Figure 6.

Once set up, the transmitter atop the column locates the snatch pick-up site for the low flying C-130 recovery aircraft, which centers the trailing snatch hook between and below the two columns supporting the pick-up cable attached to the Inflatable Recovery Vehicle (IRV). Once the snatch hook snags the recovery vehicle tow cable, the IRV with SOF team secured within, (see Sheet 2) is airborne. The tow cable could be nylon, which acts as a shock absorber, stretching until the IRV reaches C-130 speed. The trailing inflated drogue stabilizer is reeled out from a winch located in the aft end of the IRV to stabilize the IRV. An IRV retrieval winch, located on the forward bulkhead of the C-130 payload bay, then reels the IRV tow cable in thru a centering guide ass'y, recovering the IRV as shown by Figure 8. The IRV personnel team compartment protects the team from small arms fire by installation of external projectile resistant blankets. On-board compressed air cylinders will provide additional pressurizing air to all inflatable structures in event of unexpected depressurization.

The cable centering guide in the C-130 has a split, hinged door, to allow temporary passage of the snatch hook, and, is also split so as to hinge aside to the payload bay side walls, allowing passage of the IRV into the payload bay. Once the IRV reaches the tail of the C-130, the cable centering guide ass'y is hinged aside, and, the IRV is winched into the aircraft and deflated as shown in

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Figure 8. If multiple single-file IRV recovery is desired as shown by Figure 7, the tow retrieval process will be similar to retrieval of the single IRV recovery process described earlier. Then the cable guide is replaced so the drogue stabilizer can be retrieved. The drogue stabilizer is winched into the payload bay and deflated, after which the payload bay doors are closed, mission complete.

Feasibility of 1-man, and later 2-man Inflatable Recovery Vehicles will be studied and might be incorporated into the current flight test article shown on the VHS tape to save time and money.

RELATED WORK

In 1989 ARS embarked on an IR&D program to design, develop, fabricate and test a fully operational payload delivery vehicle capable of deploying, stabilizing, decelerating and safely landing a simulated deployment seat, ballasted to represent a 320 pound payload. In 1990 the fabrication and inflation testing of the prototype was completed and flight tested in 1991. The inflatable decelerator and impact attenuator weighed only 40 pounds, which is heavier than needed to minimize cost and extend its test life. An inflation system with an instrument package brought the total deployed weight to 420 pounds.

The seat, which could double as a cargo pallet, was provided with a stowed inflatable tubular fabric delivery system, was then suspended and towed by a helicopter at 95 MPH before being released at 700 foot AGL. The cone-shaped decelerator inflated to 3 PSI within 3 seconds and within 175 feet of the release point, followed by inflation of the impact shock attenuator in another 2 seconds, and vertical descent without oscillation for the remaining 8 seconds of flight at a terminal velocity of about 40 FPS. The impact attenuator deflated and absorbed the impact energy on landing without damage to the seat or inflatable structure, demonstrating proof-of-concept and a working full scale test vehicle as shown by the enclosed VHS tape.

It is anticipated that activities related to the proposed Phase I effort conducted by the principle investigator, and others who will be involved, will support Phase II efforts, including use of proven prototype vehicle test results and experience. The results of studies as to feasibility of objectives stated earlier based on past flight tests will improve chances of probable success of Phase II operational flight test hardware.

RELATIONSHIP WITH FUTURE R OR R & D

Based on past tests and experience, it is anticipated that the Phase I study will provide significant information to justify further analysis and testing of proposed means and devices to reduce risk and improve survivability of all airborne mission components.

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Minimizing exposure of delivery platform, crew, manned/unmanned payloads to mission hazards will save time and money, reducing the need for logistic and strategic defensive hardware, as well as related labor, material, inventory components, and, will incorporate interchangeability and compatibility with as many existing hardware products and methods as possible, with minimal operational interruption during transition.

The results of the Phase I study will have the advantage of knowledge available from proven hardware and prototype test vehicle which uses state-of-the-art, off-the-shelf parts and fabrication techniques, and has been tested in actual flight without the added cost of the research and development to prove the concept. This will assure an advanced start toward Phase II Research and Development with high probability of successfully completing and meeting the stated objectives.

POTENTIAL POST APPLICATIONS

The proposed project may be used by the Federal government entities including:

1. Regular Army, Navy, Air Force, SOF and Coast Guard airborne deployment and recovery of manned/unmanned payloads during peacetime or during hostile conflicts on land, at sea, in jungles, deserts or arctic locations.
2. BLM, Transportation, FEMA, Energy and FBI Departments may be supported or use these same airborne delivery components in response to fire, flood, earthquake, CBN disasters
3. Civil state and local governments may use these same airborne delivery components in response to fire, flood, earthquake, CBN disasters, as well as civil unrest
4. There are Space applications which can use the same basic design, with different materials and components, to recover and reuse high value launch vehicle components, or, satellites which may be destroyed during or after launch, fail in orbit, are placed in wrong orbits, or, for deorbit and recovery to prevent adding to space debris.

The proposed project will also provide commercial/private sector derivative airborne payload delivery and recovery with little or no modification in the following areas:

1. Package delivery and snatch recovery by companies such as UPS and Federal Express in areas plagued by airport and urban highway gridlock, airport landing and departure fees resulting in more efficient operations, lower cost and cleaner environment.
2. Remote location personnel and cargo deployment and snatch recovery by industrial/private users
3. Academia and private industry high altitude microgravity

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experiment program recovery

4. Hot air and lighter-than-air balloon personnel emergency escape and high altitude experiment recovery
5. Light aircraft, Ultra-lite, Hang Glider and Skydiver vehicle and personnel emergency escape and recovery

KEY PERSONNEL

Principle Investigator: Robert T. Kendall, Sr., Company Chief Scientist/designer. 50 years experience in commercial aerospace design, development, fabrication, testing, project management and flight tests. Credited with numerous patents, trade secrets, innovative designs and fabrication methods which reduced aircraft/spacecraft weight, simplified many previous designs, saving many millions of dollars in commercial and government programs. Published technical papers at public and corporate and secret aerospace functions include Douglas Aircraft, McDonnéll Douglas, Rockwell, Northrop, Lockheed and SAFE Symposiums over a 45 year period. Was one of the primary investigators and designers of the proposed Inflatable Delivery/Recovery Vehicle, participating in static and dynamic systems and flight test programs.

Project Manager : Robert T. Kendall, Jr., Company President, Program Manager, Design Engineer with a B.S.in Electromechanical Engineering. 25 years experience in commercial and military mechanical design, development, testing, program Management and fabrication of prototype test vehicles. Co-patentee of two inflatable products used to increase survivability and reduce risk during airborne manned/unmanned payload deployment, and unmanned space payloads. Is credited with publication of technical papers for Design News Magazine and presentations at AIAA and SAE seminars. Was one of the primary investigators and designers of the proposed Inflatable Delivery/Recovery Vehicles.

FACILITIES/EQUIPMENT

Facilities needed for Phase I will include:

Main Office - Located at 1381 Rounds Ave., Grants Pass OR 97527-9234, Phone (503) 479-5956, consisting of Management and engineering facilities with prototype fabrication and test areas on site and at subcontractor facilities within 10 miles of the main office.

Branch Office - Located at 752 Via Somonte, Palos Verdes CA 90274, Phone (310) 375-3435 (7-10 AM PST, and as scheduled otherwise), consisting primarily of Engineering facilities.

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ENVIRONMENTAL ASPECTS

Because Phase I efforts primarily address only feasibility of proposal objectives, there is no concern to comply with Federal, State or Local environmental regulations.

CONSULTANTS

It is anticipated that consultants specializing in disciplines not available within company personnel expertise' may be needed to provide information to meet objectives, determine project feasibility and will be detailed in Appendix C.

PRIOR, CURRENT AND PENDING SUPPORT

Parts of this proposal have been submitted as two separate six page preliminary "White Paper" proposals in response to BAA # DAAD05-92-T-A459, Directorate of Contracting, Attn: STEAP-PR-C/Mr. D. Hart, Ryan Bldg., Room 125 Ph:(410)278-7909, or, Commanding Officer, Naval Explosive Ordnance Disposal Technology Center, Attn.: Code 902B/Mr. Syvrud, Indian Head, MD 20640-5070. The submission deadline date was November 30, 1992, and was generally described as a need for innovative R&D projects in the area of Special Operations and Low Intensity Conflict. The objectives were to identify technologies to provide near, mid and long term solutions to enhance the capabilities of Army, Navy and Air Force SOF in areas such as High Speed/Low Detectability Mobility Platforms and SOF Resupply Systems among others. Respondents with acceptable proposals would then be invited to propose a standard full proposal for further evaluation and consideration.

White Paper Proposal No. 1 proposed a 6-man SOF low altitude, high speed rapid deployable airborne inflatable decelerator and impact attenuator to reduce risk and increase survivability of all mission components including aircraft, crew and manned/unmanned payloads with minimal dispersion and injury/damage.

White Paper proposal No. 2 proposed a stowed, then inflatable multiple SOF personnel post mission snatch/recovery vehicle from ground or water pick-up site, which is winch-retrieved into a C-130 or other airborne platform cargo bay, again to minimize risk and increase survivability of all components.

A third effort was made by this company as a subcontractor to Northrop Corporation in their "White Paper" BAA proposal for a High Altitude individual/multiple man C-130 deployable inflatable glider.

The Principle Investigator and Project Manager were the same stated in this proposal. No response has been received from the soliciting agency as of this writing; no funding will be offered until after winners have been chosen and standard contract is approved.

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