



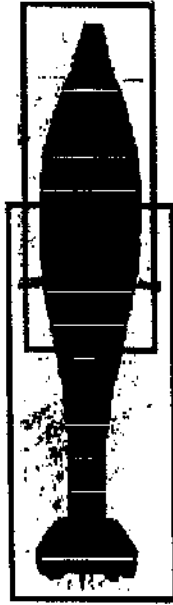
Nonlethal Delivery System for Nonlethal Mortar Payload

WEAPONS AND MATERIALS
RESEARCH DIRECTORATE
Propulsion and Flight Division

Concept: Design, fabricate, & test a nonlethal delivery mortar for existing launch system.

Delivery Unit
plastic
"soft-land"

Payload Unit
paper/plastic/others
"breakup"



Tasks:

- FY98**
- Contacts/Coordination
 - System Analysis
 - Payload Study
 - Delivery/Payload Unit Designs
 - Unit Fabrication

FY99

- Mortar Assembly
- Range Test (Nonseparating)
- Evaluation / Design Updates
- Range Tests (Separating)
- User Demo
- Analysis / Documentation

Potential Users:

Infantry, USMC, Dual Use Technology

Deliverables:

- Prototype hardware (launchable mortar)
- Alternative payload capability
- User demo
- Final report including all analyses

Cost:

	In-House / Materials / Contractor / Total			
FY98	80K	10K	30K	120K
FY99	90K	20K	20K	130K
TOTAL COST:				250K

**FY98/FY99 NONLETHAL TECHNOLOGY INVESTMENT FUNDING PROPOSAL
FOR U.S. DEPARTMENT OF DEFENSE NONLETHAL WEAPONS PROGRAM**

Title of Submission: Nonlethal Delivery System for Nonlethal Mortar Payload

Proposed Concept: FY98/FY99 Nonlethal Technology Investment Focus Areas call for nonlethal delivery systems that provide capabilities for longer ranges and larger payloads. An effort is proposed here to design, fabricate, and test a nonlethal payload delivery concept for an existing U.S. Army mortar system. The proposed effort focuses on the design of a fin-stabilized shell configuration for an existing launch system, in either 60, 81, or 120-mm caliber. The design would have immediate application for the nonlethal delivery of certain nonlethal payloads to ranges beginning near 400 meters, and extendable to much larger ranges and payloads. The engineering concepts to be developed and tested in the proposed effort are likely to impact the design of nonlethal delivery systems across a broad range of military and non-military launch missions in mortar and artillery systems.

The focus areas addressed in the Call for Proposals from the Nonlethal Weapons Directorate of the Department of the Navy dated 28 May 97 suggest a trend in future nonlethal missions that require nonlethal delivery of a variety of payloads including submunitions, powders, gels, or liquids. A robust nonlethal delivery system capable of handling at least some of these proposed payloads will provide a major element for satisfying proposed missions. An initial survey and study involving users and designers will be made to determine which caliber mortar system should be adapted for near-term, short range, nonlethal applications. Focus Area criteria will be considered such as the requirement that the system be "man packable and transportable." Accurate delivery to ranges out to several thousand meters is possible with the current mortar systems, but it is proposed to focus initial development of a nonlethal delivery system to shorter ranges (400-800 meters) that require either Zone 0 or 1 Charges.

Potential missions will extend current ground-launched non-lethal engagement ranges for scenarios in which close proximity is impossible or too dangerous. An indirect capability reduces risk from small and medium caliber direct counter-fire from enemy forces. Future missions will be possible for longer ranges and larger payloads, implying control of larger ground areas.

Potential for Joint Application: Nonlethal control of areas within U.S. military safeguard has already been established as a priority area across the services. Ground forces needing to control areas beyond the current ranges of hand-held direct fire nonlethal weapons will benefit immediately from the proposed ammunition to be developed here. The technology will form a foundation for designing a widening range of nonlethal delivery missions throughout the services.

Potential joint applications exist for the development of the nonlethal delivery system beyond the traditional nonlethal mission. This aspect promises to reduce the cost of development by allowing test firings to be conducted with environmentally-friendly payloads that include, in addition to anti-personnel or anti-materiel payloads, indirect military support and non-military applications. Examples include the delivery of payloads to suppress certain types of fires in the battlefield or field fires in range test areas known to have unexploded ordnance or toxic residuals.

Technical Description: The initial design of a nonlethal delivery projectile is based upon the typical mortar configuration such as the 81-mm M821 HE, launched from the M252 launch system. The nonlethal delivery mortar consists of two units: (1) a delivery unit and (2) a payload unit. The units separate in-flight in order to disperse the payload and initiate a breakup sequence. The separation of the delivery and payload units can be initiated using a non-explosive initiator such as a lit fuze cord, a deceleration-sensitive spring, or nosetip heating/failure criteria such as that reported by Guidos (1995).

The "delivery unit" consists of a hollow inner rod that extends throughout most of the length of the configuration. The rod contains fins as well as a forward cup that holds the payload unit in place and acts as an obturator. Recent technology reported by Bundy (1996) suggests that certain families of plastic can be used as the material of choice for the delivery unit. The plastics have good structural characteristics that will need to withstand the expected launch loads as presented by Schmidt (1975). Plastics also have good in-bore and in-flight heating properties (Hollis, Guidos, & Conroy, 1997). Most importantly, plastics are relatively light, allowing for rapid in-flight deceleration and soft landing, to be provided by a plastic ribbon-like deceleration cord carried within the hollow inner rod and deployed during the separation sequence.

The "payload unit" slides onto the inner rod and is held in place against the forward cup of the delivery unit. At initiation of the breakup sequence, the payload unit separates from the delivery unit and disperses the payload within. The payload unit can be fabricated using paper and/or plastic-wrap technology common to the pyrotechniques/fireworks industry, or using new material technology currently being pursued in related research areas, depending upon the specific payload and mission.

References:

1. Guidos, B.J. "Computed In-Flight Temperature Response of a 120-mm XM797 Gas Generator Training Round Nose Cap," U.S. Army Research Laboratory, ARL-MR-267, October 1995.
2. Bundy, M.L., "Plastic Fins for Kinetic Energy (KE) Penetrators," U.S. Army Research Laboratory, ARL-TR-1267, December 1996.
3. Schmidt, E.M., "The Pressure Distributions About 60-mm and 81-mm Mortar Projectiles During Shot Ejection," U.S. Army Ballistic Research Laboratories, BRL-MR-2535, Sept 1975.
4. Hollis, M.S., B.J. Guidos, and P.J. Conroy, "Thermal Analysis of a Subminiature Telemetry System Mounted in a Kinetic Energy Projectile Base," Proceedings of ASME National Heat Transfer Conference, Baltimore, Maryland, August 1997.

Risk Areas: No known risk areas.

Timeline:

<u>Activity / Likely Contributors</u>	<u>Quarter</u>
Initiate Contacts / Coordination / System Study - AB	1
Identify Nonlethal Payloads / Characteristics - AB	1
Aerodynamics/Trajectory/Nonlethality Analysis - AB	2
Interior / Exterior Ballistics Analyses - PFD	2
Acquire Detonator/ Charge Designs for Existing System - AB	3
Delivery Unit / Payload Unit / Initiator Design - AB	3
Delivery Unit / Payload Unit Fabrication - AB/LANL	4
Acquire Existing Detonator / Charges - AB	5

Mortar Assembly - PFD	5
Range Tests of Non-Separating Prototypes - AB / ATC	5
Performance Evaluation / Design Updates - AB	6
Range Tests of Separating Prototype - AB / ATC	6
User Demonstration of Prototype - AB / ATC / CP	7
Analysis / Documentation / Recommendations - AB	8

AB - Aerodynamics Branch, Army Research Laboratory; PFD - Propulsion & Flight Division; Army Research Laboratory; LANL - Los Alamos National Laboratory; ATC - Aberdeen Test Center; CP - USMC Camp Pendleton

Cost:

<u>FY98</u> <u>Task</u>	<u>In-House</u>	<u>Materials</u>	<u>Contractor</u>
Initiate Contacts / Coordination / System Study	\$10K	--	--
Identify Nonlethal Payloads / Characteristics	\$ 5K	--	--
Aerodynamics/Trajectory/ Nonlethality/ Ballistics Analyses	\$25K	--	--
Delivery Unit / Payload Unit / Initiator Design	\$35K	--	--
Delivery Unit Fabrication	--	--	\$20K
Payload Unit Fabrication	\$ 5K	\$10K	\$10K
Sub totals	\$80K	\$10K	\$30K
Total - FY98	\$120K		
<u>FY99</u> <u>Task</u>	<u>In-House</u>	<u>Materials</u>	<u>Contractor</u>
Mortar Assembly	\$15K	--	--
Range Tests of Non-Separating Prototypes	\$20K	\$10K	--
Performance Evaluation / Design Updates	\$10K	--	\$20K
Range Tests of Separating Prototype	\$25K	\$10K	--
User Demonstration of Prototype	\$10K	--	--
Analysis / Documentation / Recommendations	\$10K	--	--
Sub totals	\$90K	\$20K	\$20K
Total - FY99	\$130K		
TOTAL COST FY98-FY99:	\$250K		

Project Deliverables: The project deliverables include analyses, experimental results, and prototype hardware. The system design to be delivered will be retrofittable for a wide range of mortar-compatible payloads. Briefings will be delivered as requested and a final report will be published.

Technical POC:

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