



Unclassified



2001 NDIA Joint Services Small Arms Symposium

Non-Lethal Airburst Munition(s) for Objective Individual Combat Weapon

15 August 2001



**US Army, TACOM
Armament Research,
Development and Engineering
Center**

Camilo A. Sanchez
NLAB Munitions for OICW

US Army TACOM-ARDEC
AMSTA-AR-QAC-S, Bldg 65
Picatinny Arsenal NJ 07806-5000

csanchez@pica.army.mil
(973) 724-5495
DSN 880-5495
FAX 724-6930

Unclassified



Program Description



Program Name: NL AB Munitions for OICW

Concept:

- Exploit the ability of the OICW to airburst munitions at a precise location in space to emplace or employ NL concepts.
- Concepts that will be capable of dispersing or deploying Liquids, Aerosols, Powders & Objects will be designed, modeled and demonstrated.
- Payload analysis of NL RCA payloads will be conducted

Possible Payloads:

- **Counter Personnel**
 - Markers
 - Taggants
 - Incapacitants
 - Malodorants
 - OC/RCA
 - Stingball Grenade
 - Fuzed Blunt Injury
- **Counter Materiel**
 - Markers
 - Taggants
 - Anti-traction





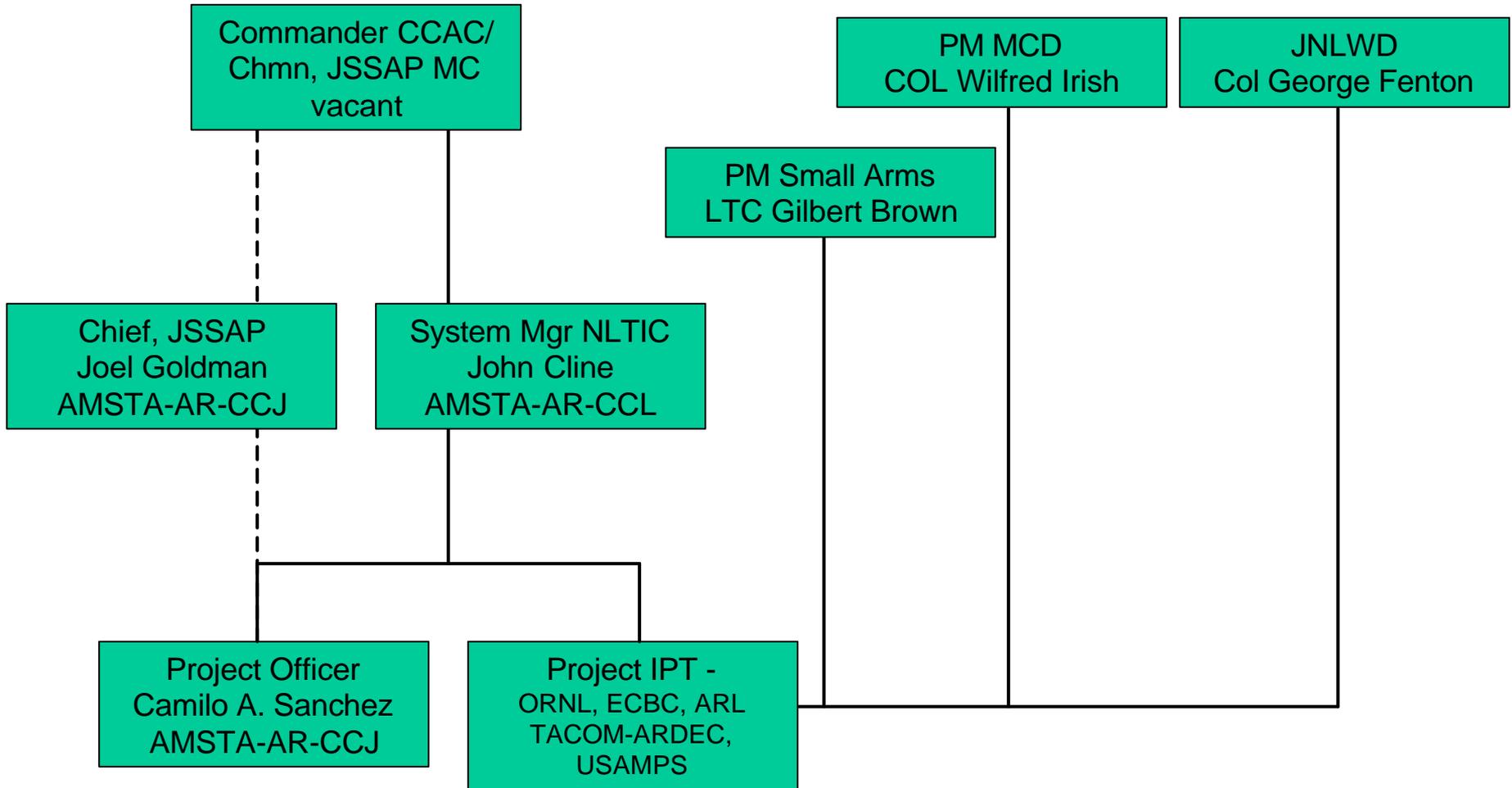
Organizational Structure



Research Lab

Acquisition Org.

Sponsor





Requirements

Objectives Proposed by Joint Non-Lethal Weapons Requirements Integration Group (RIG) – 26 April 2000

RANGE

5-1000 meters

TARGET ORIENTATION

Defilade, Open, Covered, Enclosed

PAYLOAD

Liquid, Powder, Aerosol, Objects

ACCURACY

Point =550, Area=1000

With PH given for certain radius.

OTHER

- Scalability to other size rounds
- All weather
- Gun/Ammo interface identification
- Operate same as lethal round

Measure of MS A Success:

| | Criteria | Threshold | Goal |
|---|----------------------------------|-----------|----------|
| 1 | Dispense Payload: | 250m | 5m-1000m |
| 2 | Technology Readiness Level (TRL) | 4* | 5 |

* Component and/or breadboard validation in a relevant environment



Preliminary Risks & Challenges

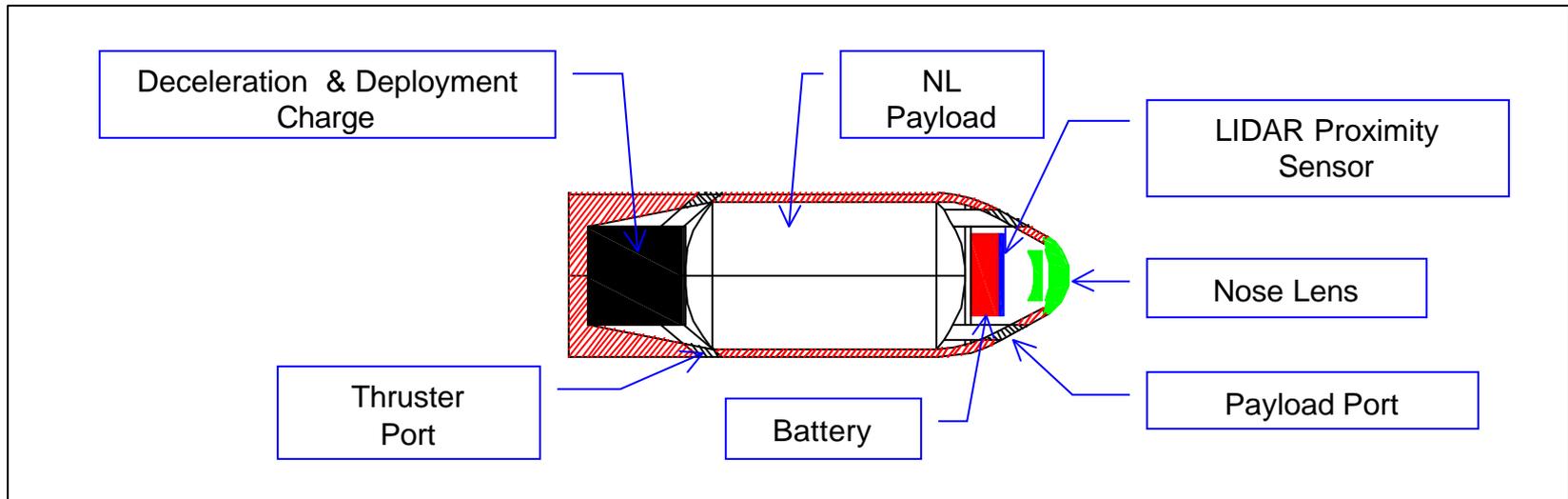
- **Potential lethal / injurious effects from projectile, airburst and parasitic mass**
- **20mm payload / volume limitations**
- Potential major weapon design changes in PD&RR
- MEMS S&A and Micro Energetic Initiator (MEI) development
- Burst point precision



OBJECTIVE INDIVIDUAL COMBAT WEAPON (OICW) AIRBURST NON LETHAL MUNITION PROGRAM



Integrated Proximity Sensor w/ Reverse Thrust Concept



- LIDAR proximity sensor (LPS) and controlled terminal deceleration for the deployment of an incapacitating agent.
- LPS located in the nose of the shell will initiate payload deployment at a pre-determined range from the target.
- Array of variable force-reversing thrusters will fire to decelerate the projectile to a non-lethal velocity and simultaneously release the payload. The force of the reversing thrusters may be adjusted to match the changing projectile velocity. In addition, the ejection of the NL payload will be used to provide a portion of the deceleration force.

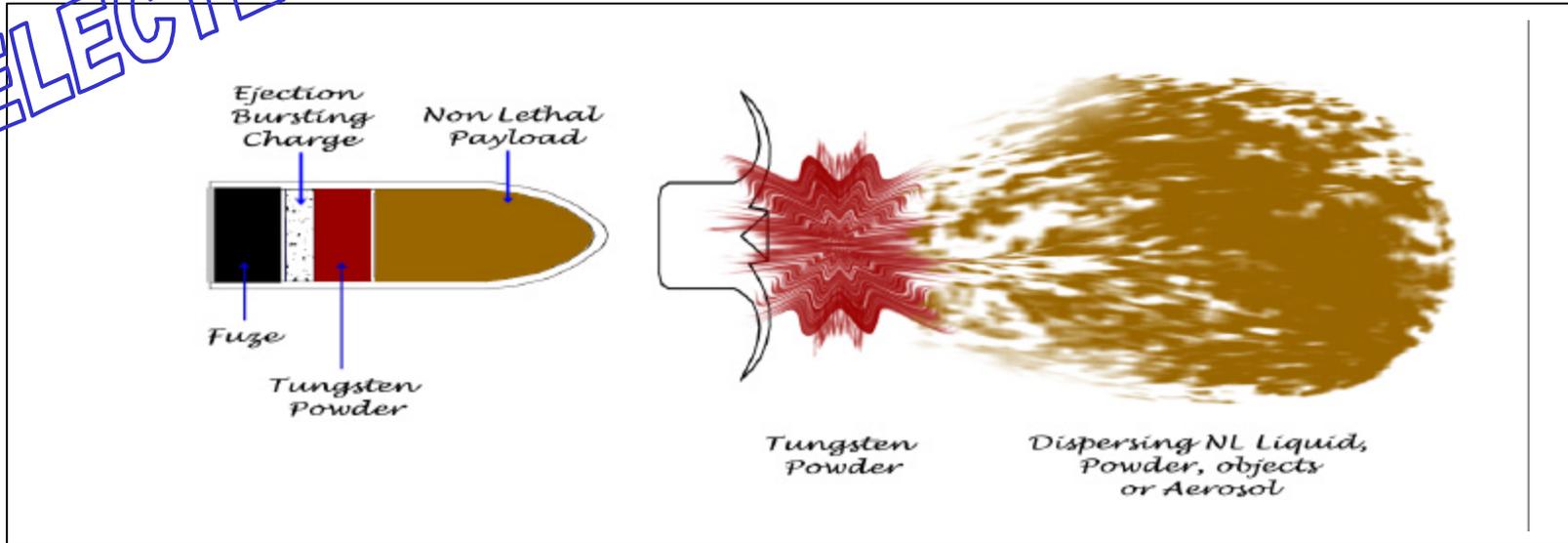


OBJECTIVE INDIVIDUAL COMBAT WEAPON (OICW) AIRBURST NON LETHAL MUNITION PROGRAM



Controlled Residual Kinetic Energy Concept

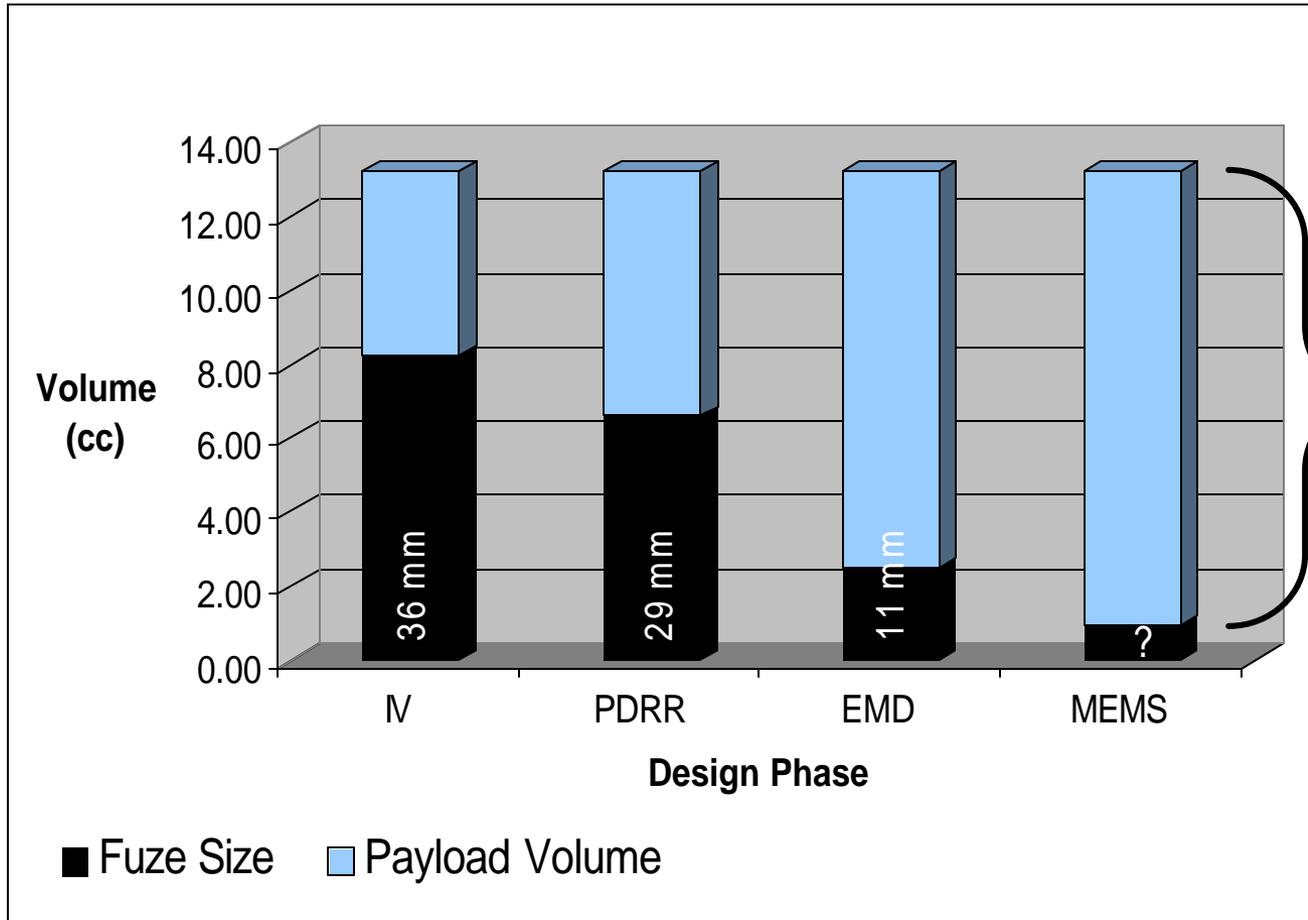
SELECTED



- The bursting charge projects the non-lethal payload of liquids/powders/aerosols/solids and a dense powder mass.
- The forward momentum of the non-lethal payload and dense powder mass reduce the forward momentum and kinetic energy of the residual projectile to a non-lethal level (“Davis Gun concept”).
- The high aerodynamic drag of the dense powder allows the kinetic energy of the dense powder payload to be rapidly dissipated.
- The aerodynamic characteristics of the non-lethal payload and the burst point from the target provide the non-lethal delivery of the non-lethal payload.
- Projectile mass, velocity, recoil impulse and trajectory are matched to the lethal projectile for Fire Control compatibility and reliable weapon function.



OICW Fuze + Payload Volume



NL Agent over 2X current amount.

Incapacitation area maximized

More effective over harsher atmospheric conditions



Model Inputs – Munition Configurations

Army was tasked to expedite a rapid scalability analysis of a NL 40 mm munition in addition to the 20mm NLAB OICW munition - Completed 10 May 01

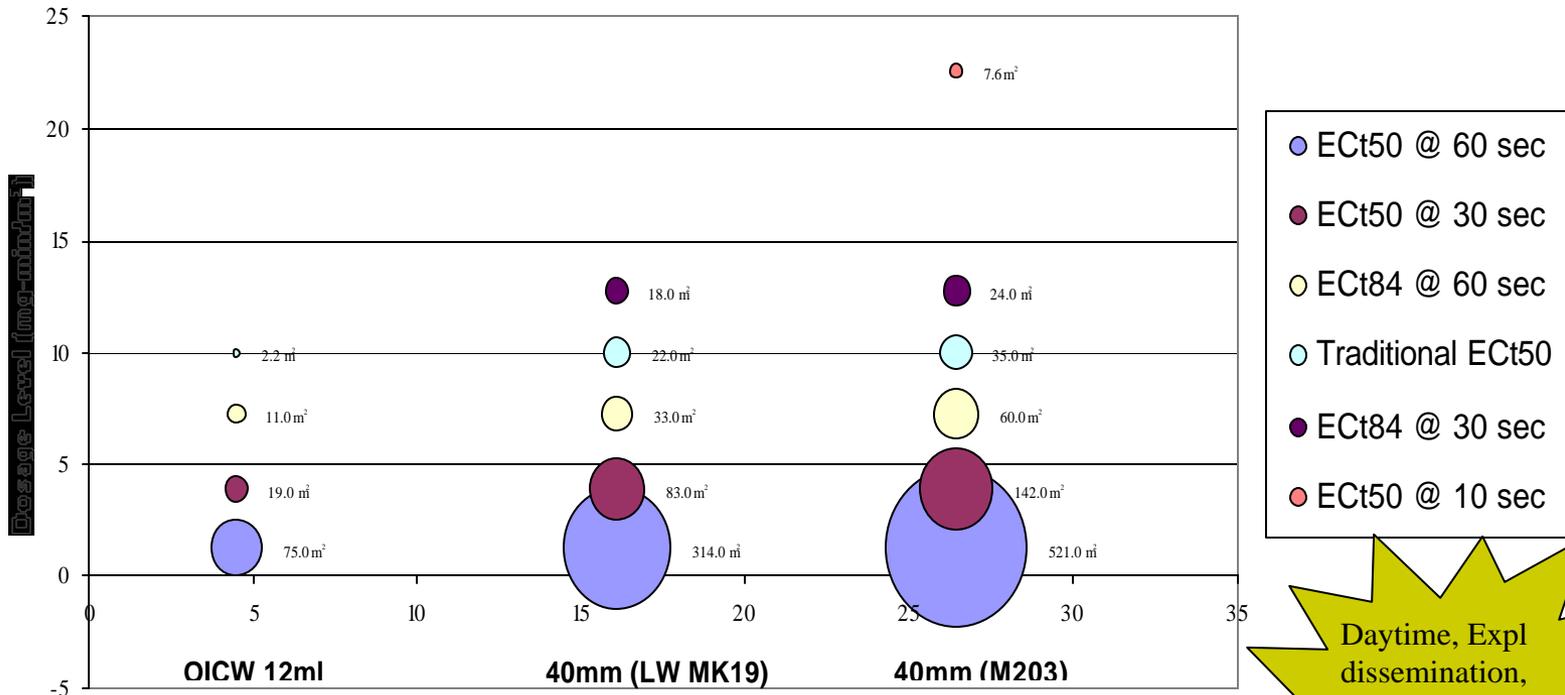
| Munition | OICW 20 mm | | Mk19 40mm | | M203 40 mm | |
|--------------------|-----------------|----------------|--------------|----------------|---------------|----------------|
| | Tot Volume (ml) | 12 | | 42 | | 69 |
| Dissemination | Expl | Pyro | Expl | Pyro | Expl | Pyro |
| CS (gms) | 9.3 | 5.3 | 33.2 | 18.5 | 54.6 | 30.0 |
| Airborne CS (gms) | 4.5 | 3.2 | 16.1 | 11.1 | 26.5 | 18.0 |
| Burn Time (sec) | Instant | 5.3 | Instant | 11.5 | Instant | 30.0 |
| CS density (gm/cc) | 1.4 cast | 1.1 pressed | 1.4 cast | 1.1 pressed | 1.4 cast | 1.1 pressed |



Modeling Results

- Effective Dosage vs. Coverage Area:

- The numbers appearing to the right of each bubble are the corresponding coverage area in m^2 . As expected, the coverage area decreases with increasing dosage level and decreasing time. The Traditional E_{Ct50} dosage ($10mg\text{-min}/m^3$), has historically been used as a 'worst case' and relates to highly motivated individuals who may be less susceptible to the effects of CS. The suitability of any of these rounds depends on the desired interpretation of incapacitation and effectiveness.



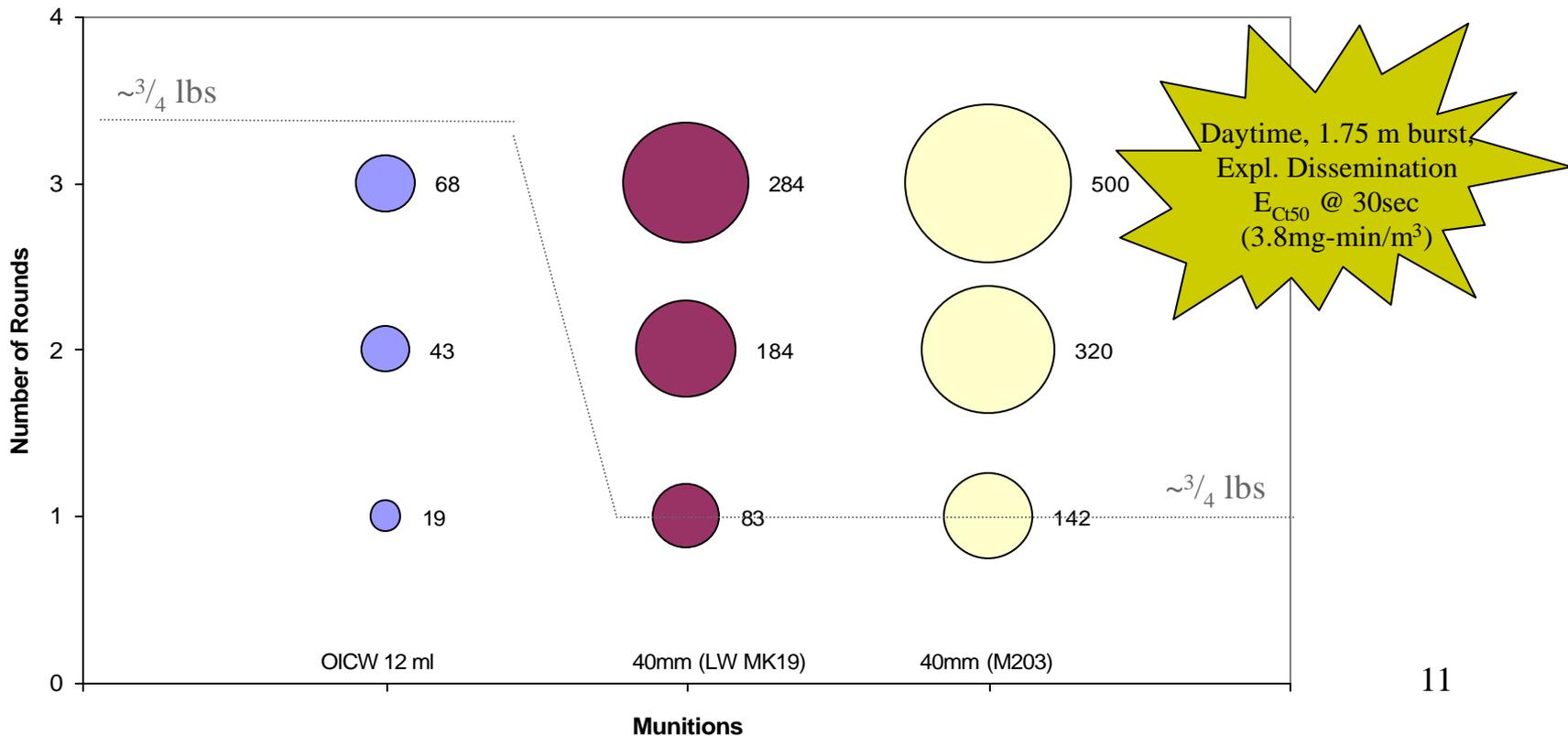
Note: Circular shape is not representative of actual pattern of coverage area.

Daytime, Expl dissemination, 1.75 m burst height



Modeling Results

- Multiple rounds vs. Coverage Area:
 - As expected, multiple rounds increases the coverage area.
 - The 40mm grenades' coverage is greater than the OICW by a factor of 4-7, but this ignores their greater weights (~3.5x OICW).
 - On an equal-weight basis, differences are significantly less substantial.





Human Effects



- The preliminary focus is on CS effect and overcoming the KE of projectile near target
- Dosage can vary from .1 mg-min/m³ to 10 mg-min/m³ for 50th %.
Recommending additional study to investigate suitable concentration/dosage metric
 - POC: L. Bickford – Edgewood Chemical Biological Center, SBCCOM
- Incapacitation mechanism: ocular (eyes), cutaneous (skin), and inhalation (breathing)
 - POC: Dr. Klauenberg – Human Effects Center of Excellence (HECOE), BAFB



Program Strategy

Conceptualization of Projectiles for Liquids, Aerosols, Powders & Objects

Down Select to 2 Design Approaches per Payload Concept

Preliminary Designs

Critical Technology Tests

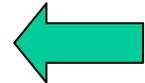
Exit Criteria for Pre-MS A

Conduct Design Reviews

Down Select to Most Promising Design per Concept

Prelim Legal Review

Fabricate Prototypes (validate M&S)



Conduct Developmental Tests using PD&RR Residual Hardware

Indep Assessment

Complete Milestone A

Select Representative Payloads

Phase A–Concept & Technology Devel Decision Review

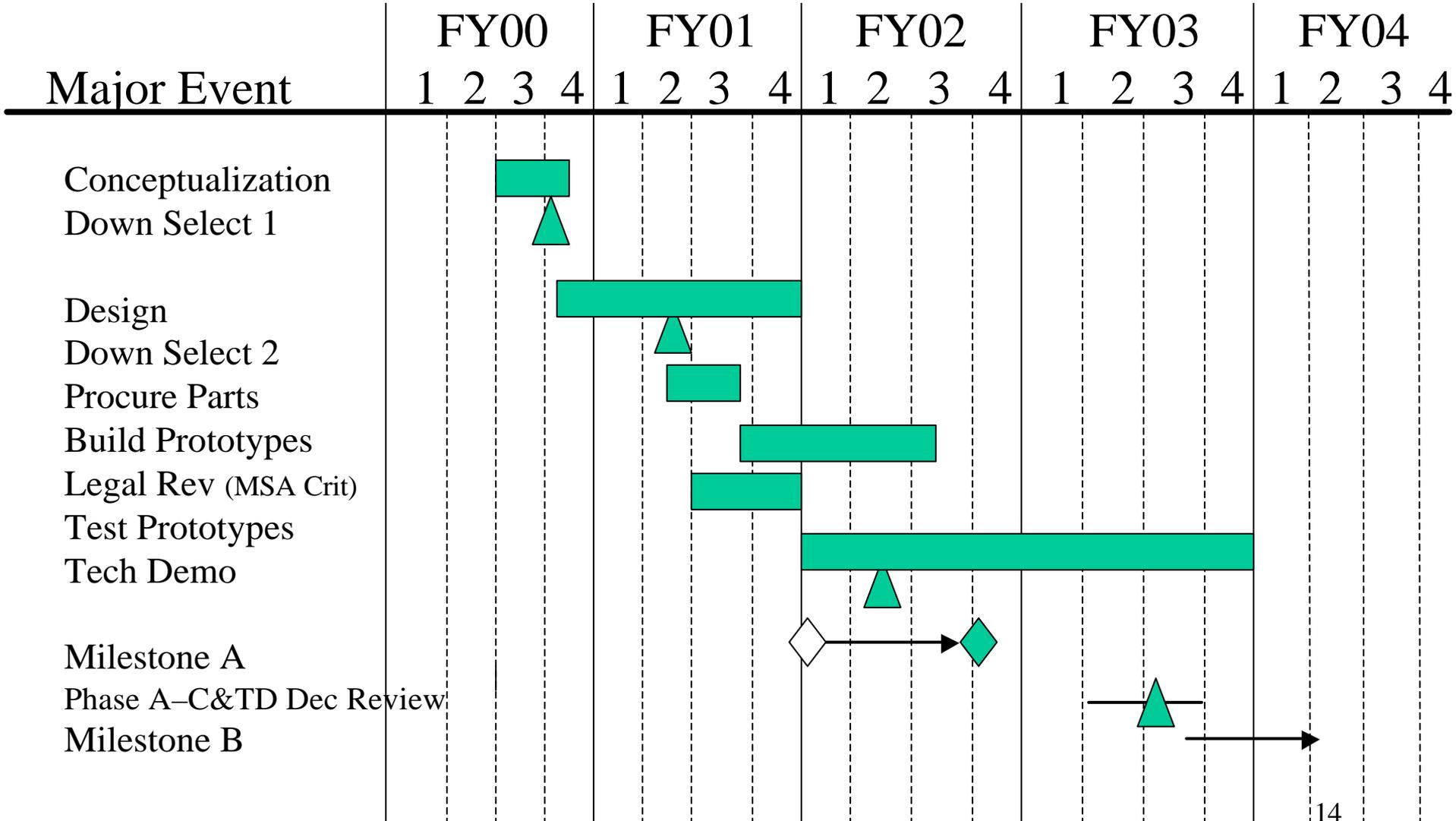
Develop and Test Fire Prototypes in PD&RR Weapon

Initiate MS B

Transition to PM

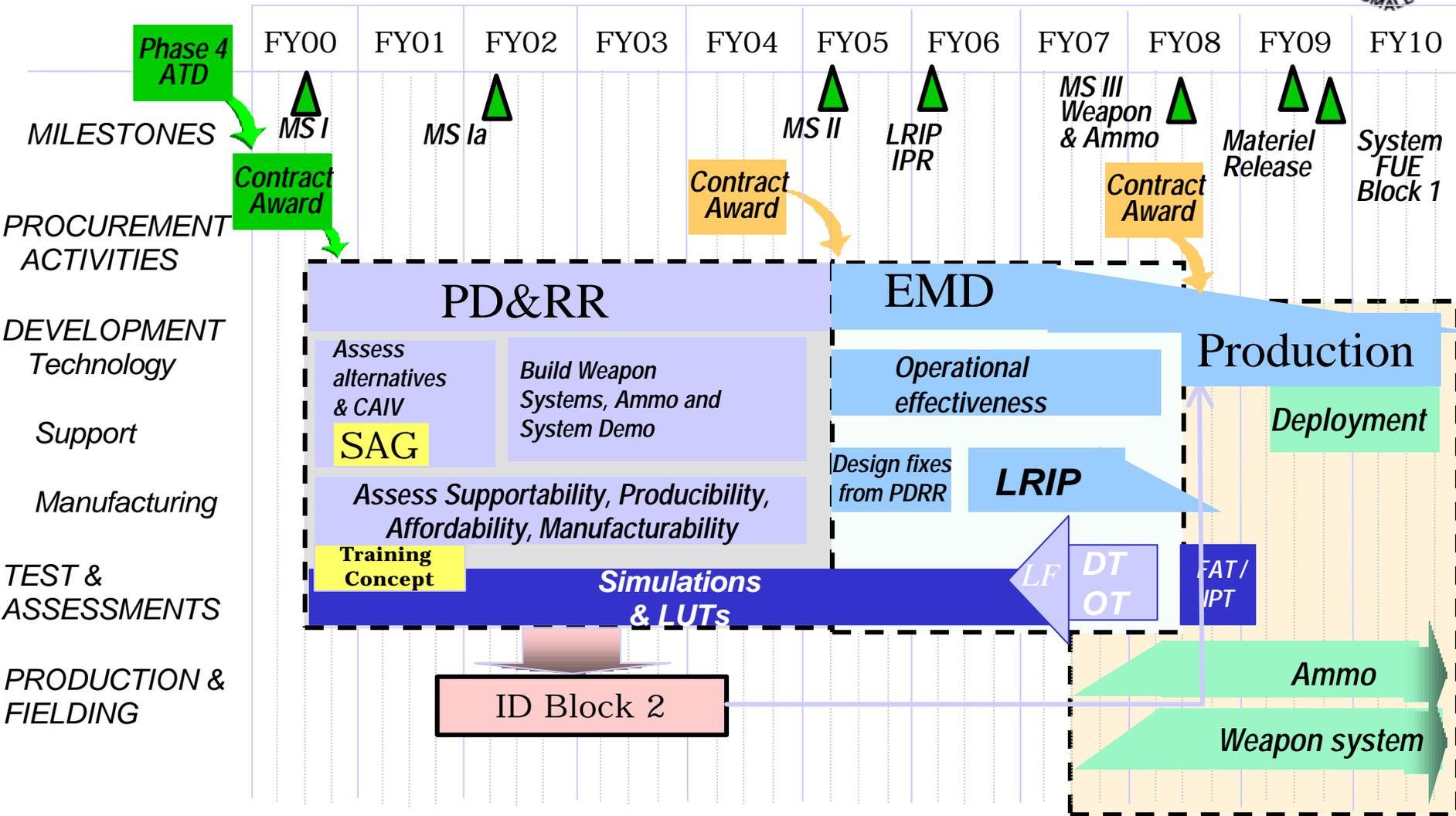


Major Events Schedule





OICW Program Schedule





Program Documentation



Signed Program Documentation:

| <u>Document Title</u> | <u>Date Signed</u> | <u>Service Endorsements</u> |
|-----------------------------------|--------------------|--|
| OICW Approved ORD | 24 Feb 00 | |
| Pre-Phase 0 Exit Criteria | 26 Apr 00 | |
| OICW NL Munitions | SOW | DRAFT |
| Army JAG Preliminary Legal Review | 06 July 01 | Coordinated w/ Navy JAG, Staff Judge Advocate to the USMC Cmdt |

Security Classification Guidance

| <u>Document Title</u> | <u>Date Signed</u> | <u>Status</u> |
|-----------------------|--------------------|---------------|
| SCG for OICW | Aug 2000 | Final |
| SCG for JNLW Program | Apr 1998 | Final |
| SCG for JNLW Program | May 2001 | Draft |



M&S/Experimentation - Applied or Planned

Modeling & Simulation

Engineering:

- Frangible case – material selection, natural vs. induced frangibility (applied)
 - Ballistic - PRODAS, 6DOF, deceleration rate, stability (applied/planned)
 - CS effectiveness—expanded to include 40 mm. Inputs include: burst height, dosage, dissemination method, weather, salvos (applied)
 - Gaussian plume models include: D2PC, VLSTRACK, and SEMCON
-

Experimentation

Technology Demonstration:

- Chamber testing - ECBC payload dissemination methods
 - i.e. Explosive (applied), Propellant (planned)
- Ballistic testing- demonstrate energetic ignition & velocity reduction (applied)
- Material frangibility –dynamic testing w/ energetics (planned)



Program Accomplishments

- Received favorable Army JAG preliminary legal review – coordinated w/ USN and USMC JAG
- 20 mm NLAB OICW static and Mann barrel tests conducted
 - Initiation survivability
 - Separation velocities for projectile and lead shot
 - i.e. >557 fps [Alum – 18 gms], > 167 fps [Ballast/CS – 60 gms]
 - Dynamic Goal: < 100 fps [Alum – 20 gms], > 767 fps [Ballast/CS – 60 gms]
- Modeling performed for 20 mm & 40 mm delivery vehicles. Results include:
 - Effective areas estimated for 50th & 84th percentile dosage;
 - 60 Sec, 30 Sec & 10 Sec time windows
- CS chamber testing performed on 20 mm configuration
- Frangible windshield materials statically tested, interfaces established
- Contract awarded to Alliant Techsystems - 30 May 01
 - OICW Cartridges & Fuzes
 - Firing support and LAP services