



Lethality, Survivability, Mobility and Sustainment for America's Army



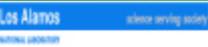
# The Challenges of a Green Primer

Presented by:

**Hugh A. Huntzinger**  
*TACOM-ARDEC*

In association with:

**Sung Kim**  
*NSWC-CRANE*



# Green Ammunition

## Target Materials

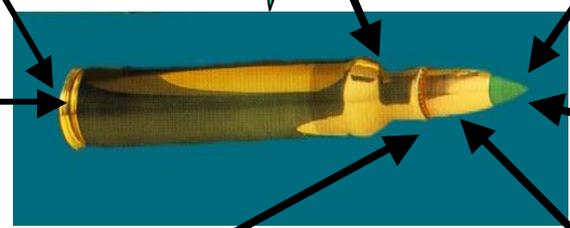


**VOCs**  
Primer Pocket Sealant  
Lacquer Thinner MEK  
Xylene MIK  
Toluene

**ODCs**  
Casemouth Sealant  
Methyl Chloroform

**VOCs**  
Blank Ctg Tip Sealant  
Ethyl Acetate Toluene  
MEK Xylene  
MIK

**HEAVY METALS**  
Primer Compositions  
Lead Styphnate  
Barium Nitrate  
Antimony Sulfide



**VOCs**  
Combat Ctg Tip ID  
Glycol

## Tracer & Ignitor Compositions

**VOCs**  
Ethyl Alcohol

**HEAVY METALS**  
Barium Peroxide  
Lead Dioxide  
Barium Nitrate

**ODCs**  
Methyl Chloroform

**HEAVY METALS**  
Projectile Slug  
Lead\Antimony

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# Joint Working Group for Non-Toxic Ammunition



## CHAIR – TACOM-ARDEC

Naval Surface Warfare Center – Crane  
Naval Air Warfare Center - China Lake  
Naval Surface Warfare Center - Indian Head  
Air Force- AFCEE  
Air Force - Randolph AFB  
Marine Corps System Command- Arlington  
Coast Guard HQ-Washington  
National Guard HQ- Arlington  
USAIC- Ft. Benning  
US Army Reserve Command  
Army Center for Health Promotion &  
Prevention Medicine

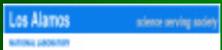
Naval Special Warfare - Coronado  
Ft Dix Force Projection  
Army Environmental Center- Edgewood  
Army Training & Support Center- Ft. Eustis

**Formed by ARDEC in October 1995**

Industrial Operations Command  
Lake City Army Ammunition Plant

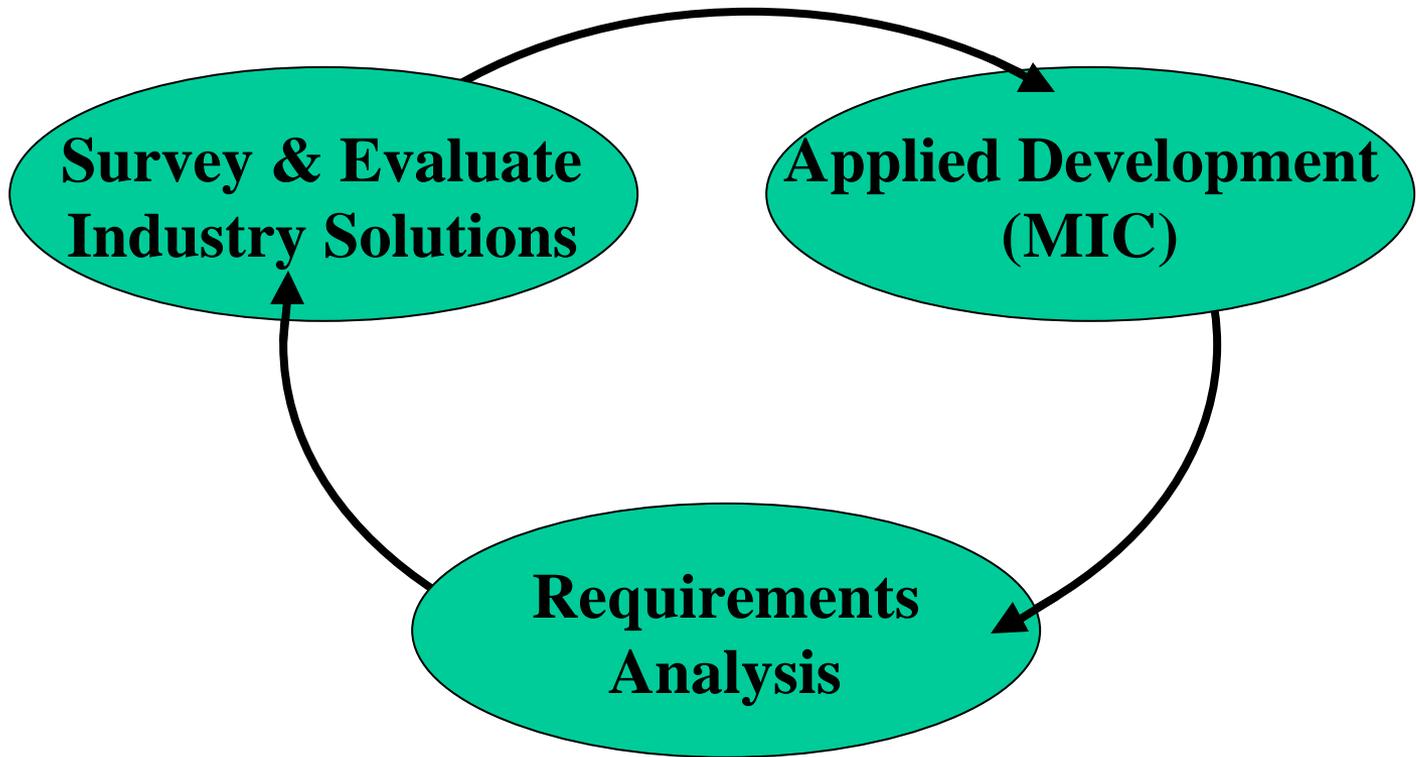


DOE- Oak Ridge National Lab  
DOE- Los Alamos National Lab  
DOE- Kansas City Plant  
Federal Bureau of Investigation  
Federal Law Enforcement  
Training Center

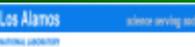


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# Green Primer Replacement Effort Technical Approach



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# Expected DoD Benefit

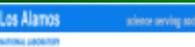


- **Projected FY01 - FY03 Heavy Metals Usage for Small Caliber Primers (Avg: 335 M Rounds)**

- Lead Styphanate: 25,106 lbs
- Barium Nitrate: 22,928 lbs
- Antimony Sulfide: 9,410 lbs

**28+ Tons of Heavy Metal Materials**

- **Current Process is Labor Intensive & Multi-Stepped**
  - MIC Process is expected to lend itself to Automation
- **Technology will leverage into Larger Calibers**
  - Lead Styphanate Based Variants



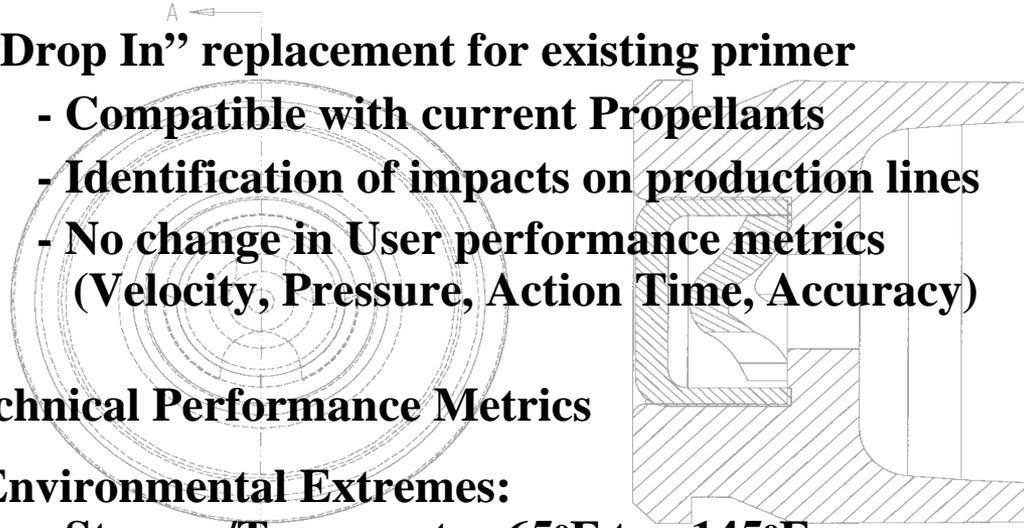
# Green Primer Replacement Effort

## Functional Requirements



### Basic Design Objective

- “Drop In” replacement for existing primer
  - Compatible with current Propellants
  - Identification of impacts on production lines
  - No change in User performance metrics (Velocity, Pressure, Action Time, Accuracy)



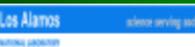
### Key Technical Performance Metrics

- Environmental Extremes:
  - Storage/Transport: -65°F to +145°F
  - Operational: -65°F to +160°F
- Action Time:
  - Max Individual <2.5 mSec. (MIL-P-46610; MIL-P-3984)
- Ignition Sensitivity:
  - “All Fire”: 12 inches
  - “No Fire”: 3 inches

SECTION A-A  
SCALE 10.000

PRIMER NO. 41

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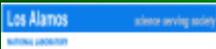


# Green Primer Replacement Effort

## COTS Industry Solutions



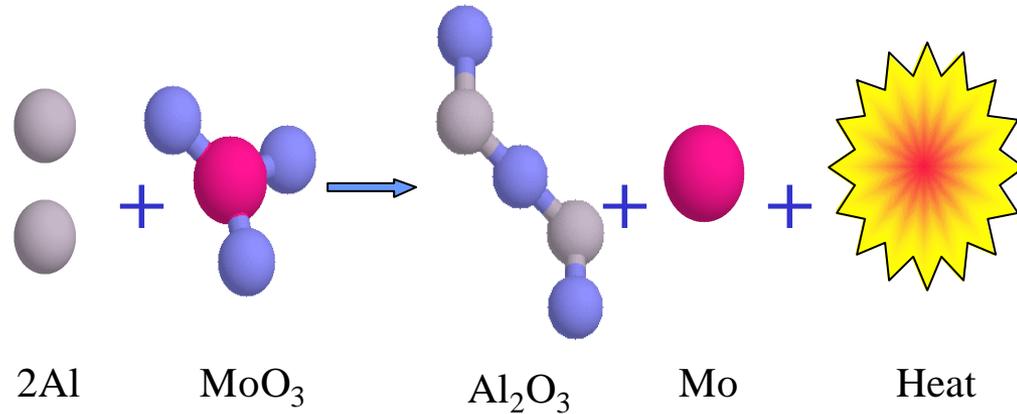
- Prior to FY96 - Services had initiated in-house efforts based on tightening Environmental Regulations
  - Duplication of effort between services
  - Evaluation Process not firmly Structured or Coordinated
- Several potential contenders were investigated, to varying depths. Key performance shortcomings included:
  - Insufficient extreme cold temperature performance
  - Hydroscopicity
  - Primer Sensitivity concerns
- FY96 - JWG Formed; first joint MIC R&D effort initiated



# Green Primer Replacement Effort Metastable Intermolecular Composites (MIC)



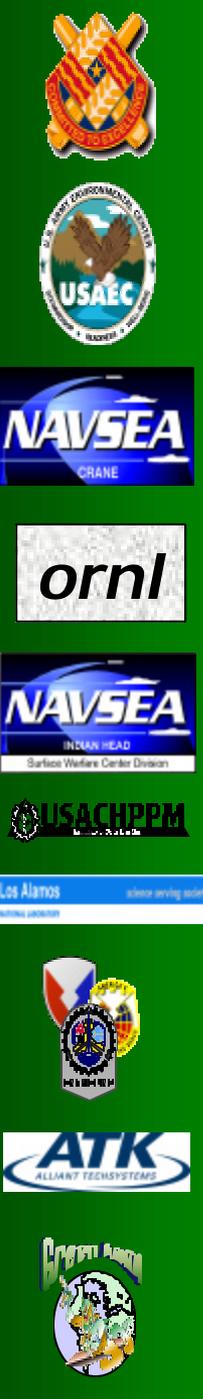
5.56 mm primer cup & anvil



MIC-loaded 5.56mm primer

- ✓ **New Family of Highly Energetic Materials**
- ✓ **Tailored from Joint DoD\DoE Development Program**
- ✓ **Function Not Effected by Temperature**
- ✓ **Resistant to Water Degradation**

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# Green Primer Replacement Effort

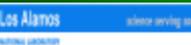


METASTABLE INTERMOLECULAR COMPOSITES

## MIC Accomplishments

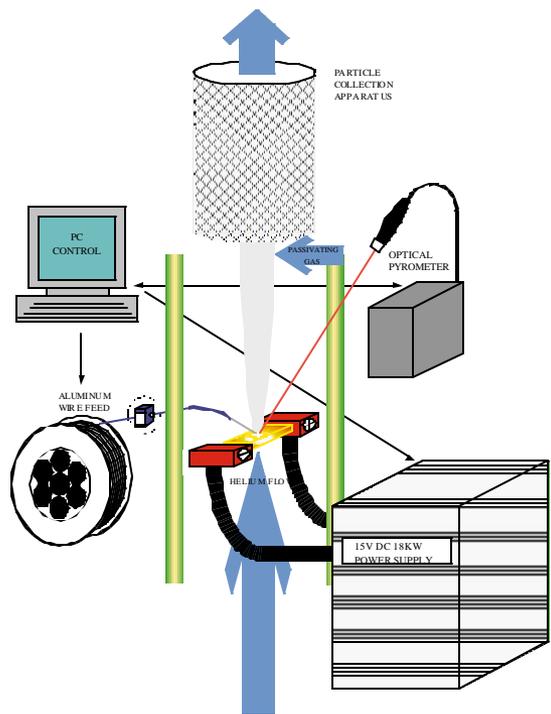
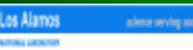
- Joint Working Group for MIC Formed
- Demonstrated transfer of technology from DOE
- MIC Laboratory established at ARDEC
- Demonstrated methods of standardized characterization
- Supported NSWC with equipment and characterization
- Scaled-up LANL reactor output
- Technology Transfer to Industry of  $\text{MoO}_3$

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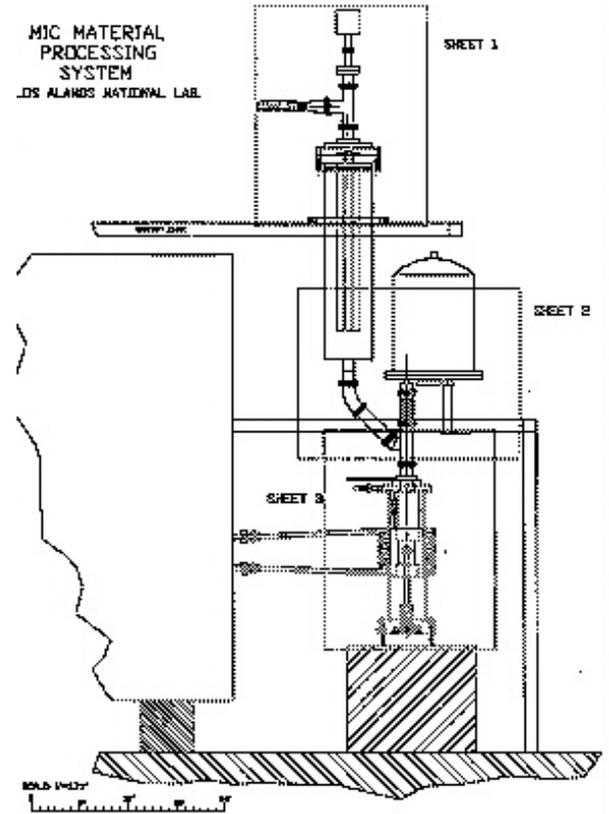




# UFAL/UFM Reactors LANL Tech Transfer



**IHDIIV Resistance  
Heating Reactor**



**ARDEC RF  
Heating Reactor**

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# MIC Primer Flame Tests



PVU-1/A Primer



1.0 msec Duration

MIC Primer



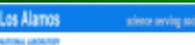
t = 1.0 msec



t = 5.0 msec

**>3000 primers have  
been loaded and tested**

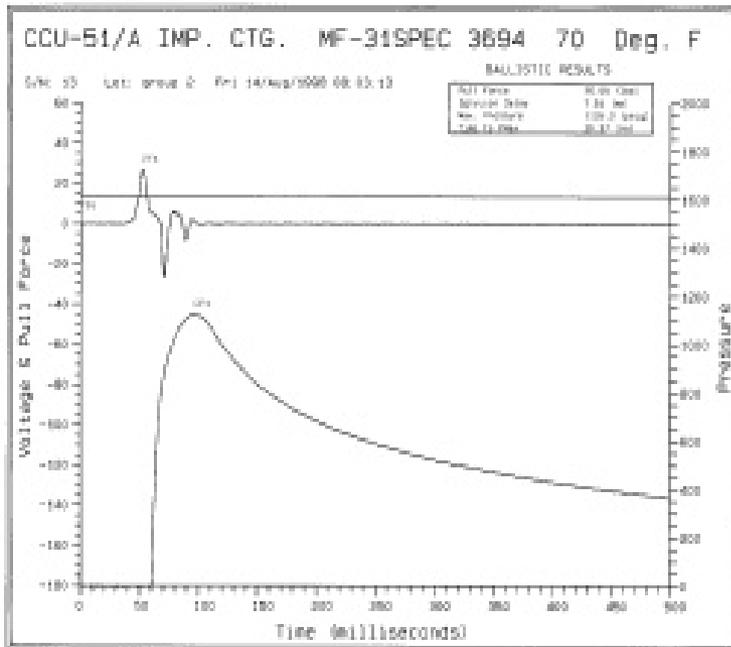
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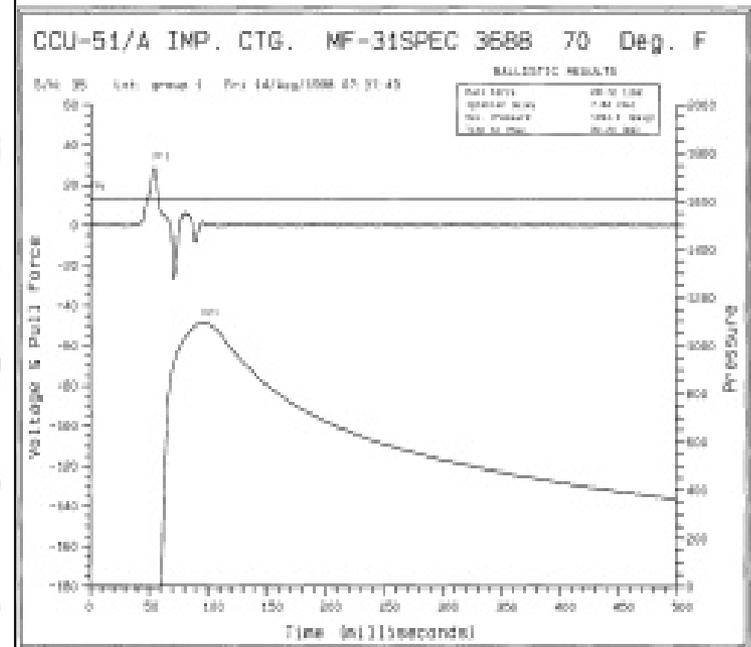
# CCU-51/A Test Results



- MIC Primer

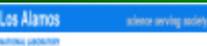


- Standard PVU-1/A Primer

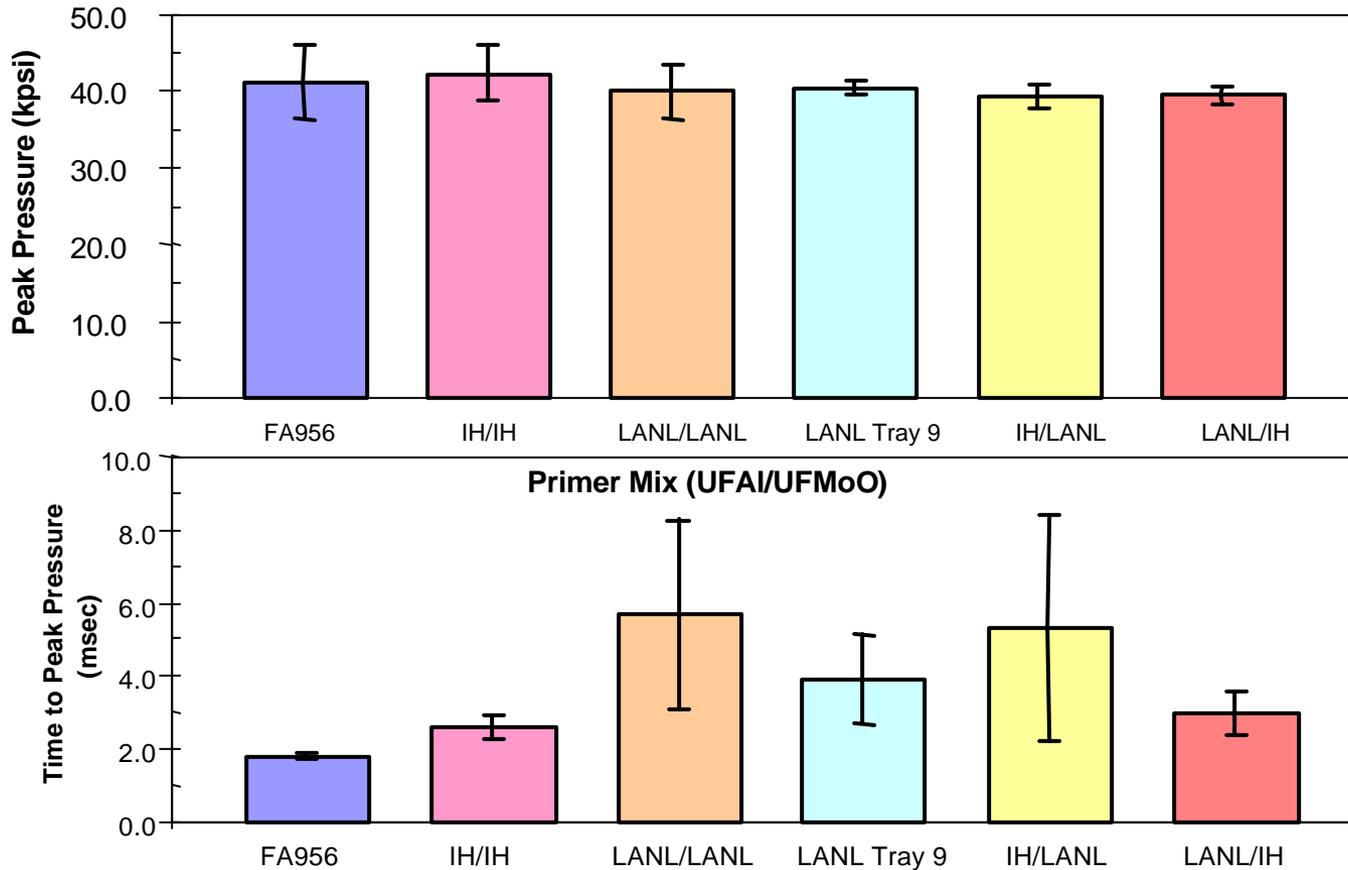


- No Change in Cartridge Internal Ballistics

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# 5.56mm #41 Primer Test Results



- Pressures approaching Lead primer Mean & Standard Deviation
- Time to peak pressure approaching Lead primer values

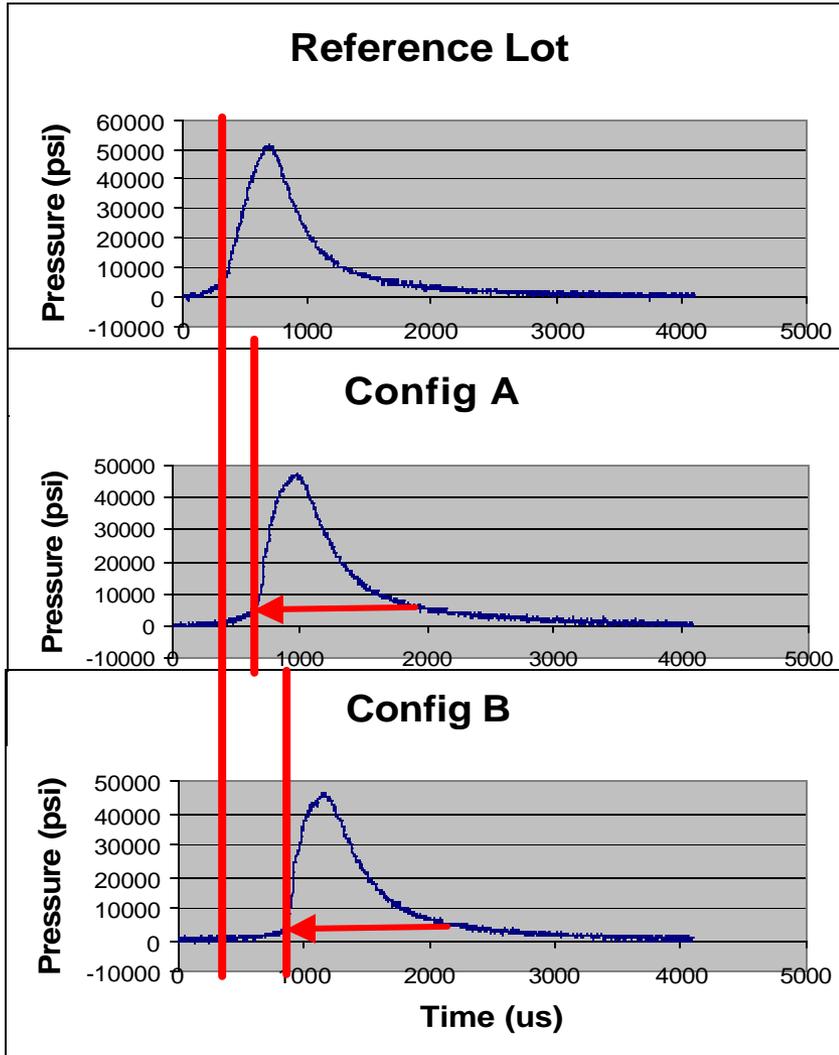
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# Green Primer Replacement Effort



## METASTABLE INTERMOLECULAR COMPOSITES



### Ballistic Results:

- Velocity OK
- Pressure OK
- Port Pressure OK
- *Slower Action Time*

### Safety Testing:

- *High Electrostatic Sensitivity*

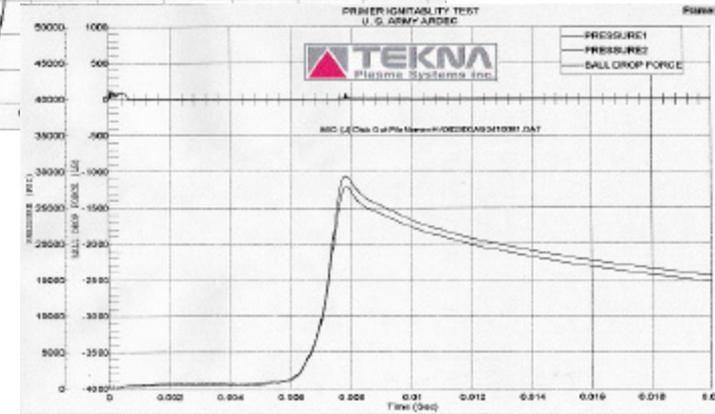
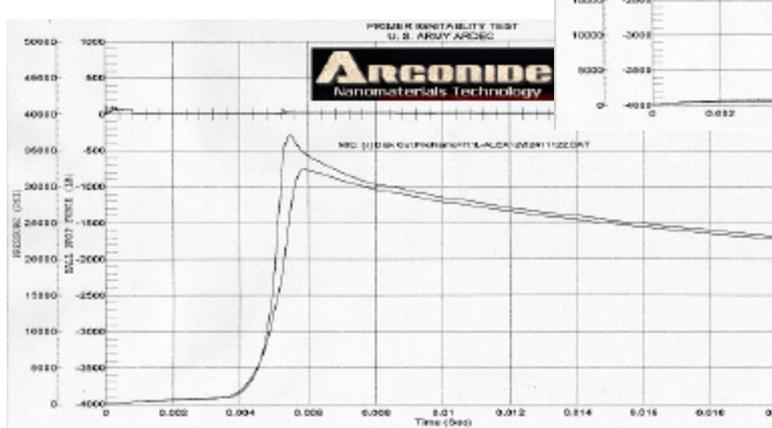
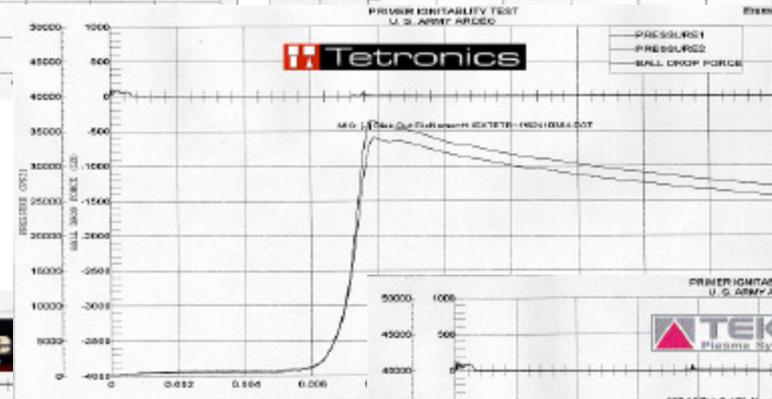
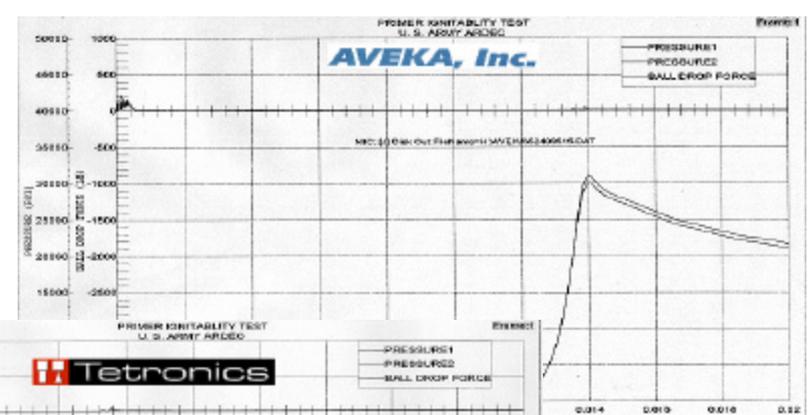
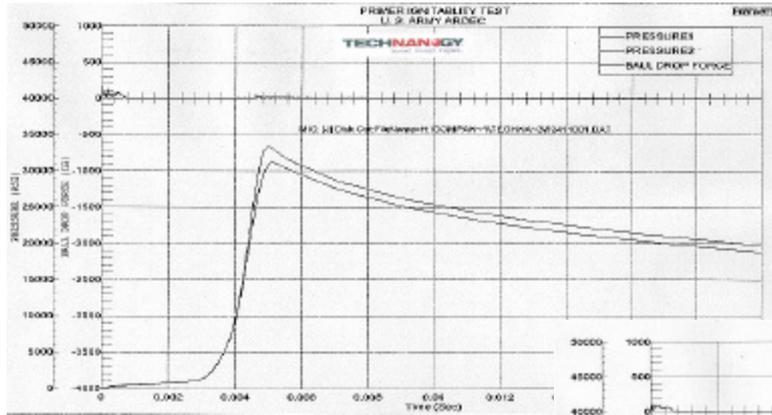
### Conclusion:

- Requires continued Development

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# Characterization Commercial Nano Aluminum



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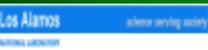


# Green Primer Replacement Effort

## COTS Industry Solutions



- **FY01:** JWG Decision to formally evaluate Commercial Alternatives to MIC by Group.
- **CY 01:** Two CBD Announcements for proposed COTS candidates; several responses received.
- **Present:** Three (3) COTS samples purchased and received at CRANE; being shipped to ATK, LCAAP for loading.
- **Near Future:** ‘Fast Track’ test to determine if the previously identified COTS performance deficiencies have been resolved, with Go/NoGo for a follow-on qualification program.

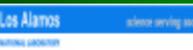


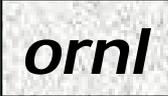
# Green Primer Replacement Effort



## The Challenges:

Requirement	MIC	COTS
Action Time	<i>x</i>	<i>TBD</i>
Cold Temperature	✓	<i>TBD</i>
Hydroscopicity	✓	<i>TBD</i>
Process Safety	<i>TBD</i>	✓
Process Scaling	<i>TBD</i>	✓





# GREEN AMMO



# QUESTIONS

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