

Requalification of Demilitarized HMX for DOD/DOE Applications

A Joint Program Between:



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Why Requalify?

- ❑ Environmentally responsible
- ❑ DOD (Gansler memo of Dec. 00) endorses/promotes military reuse
- ❑ Available HMX resource
- ❑ Lower cost
- ❑ HMX is HMX



Based Around LX-14 Process

- ❑ TPL patented nitric acid degradation
- ❑ 150 - 200 lb / batch
- ❑ No waste generated
- ❑ By-products recycled into blasting agent



HMX Recovery



TPL Contribution

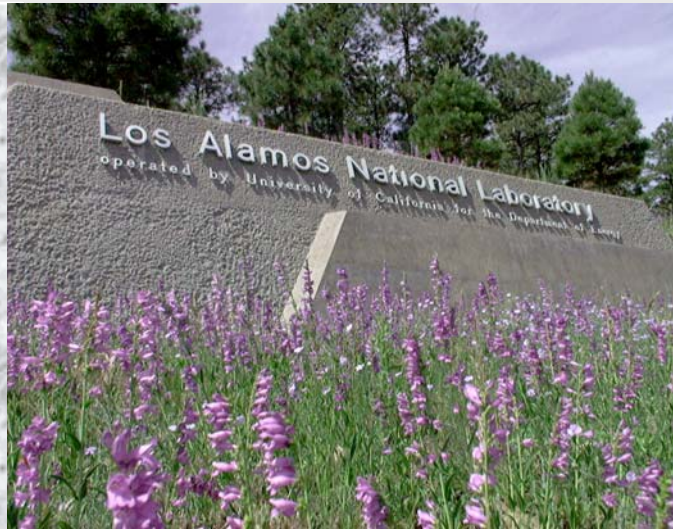
- ❑ Prepared & provided classified HMX from LX-14.
- ❑ Processes established for demil of PBX-9501, PBXN-9, and PBXN-110. Samples provided for analyses.
- ❑ Tested & established scale-up of classification.
- ❑ Provided larger samples of Class 1 and Class 5 LX-14 HMX for formulation testing to IH, LANL, and ATK.
- ❑ Scale up recovery processes for other explosives.

Analysis and Testing

Los Alamos

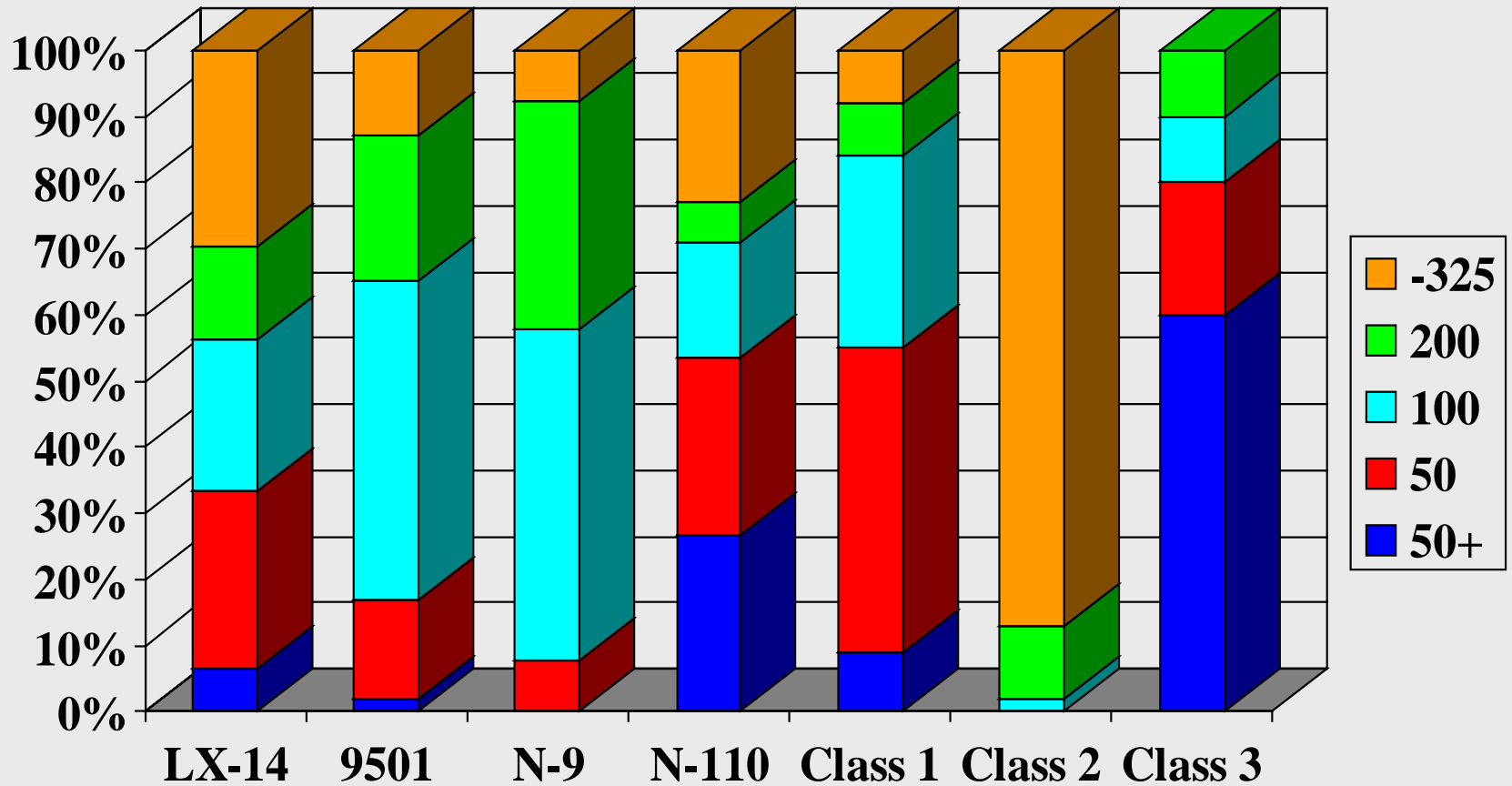
versus

Indian Head

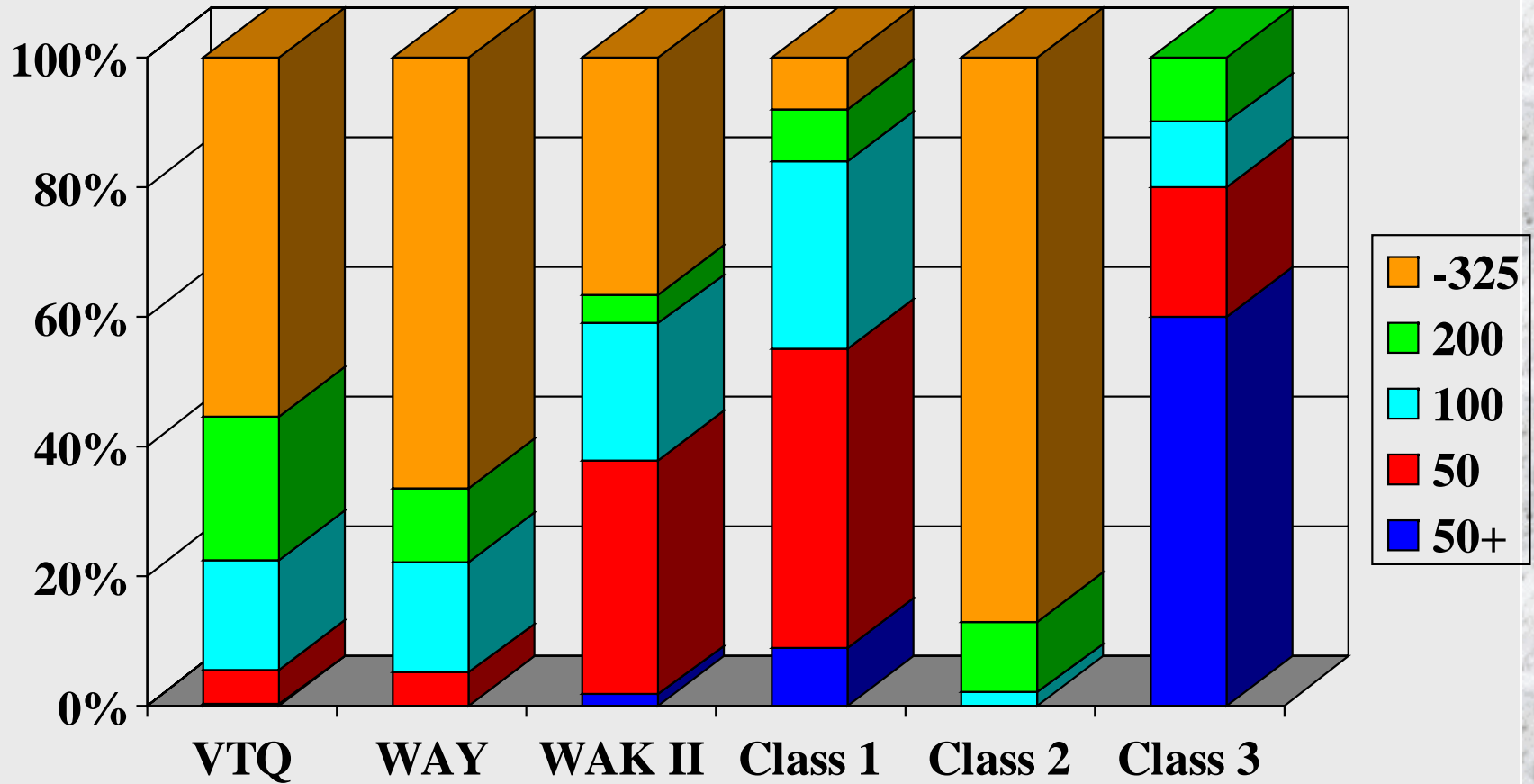


- ❑ **Supplied explosive formulations for demilitarization**
- ❑ **Mil Spec qualification analysis for each sample**
- ❑ **Formulation analysis**
- ❑ **Formulation testing**

Particle Distribution of Recovered HMX



Particle Distribution of Recovered HMX (2)

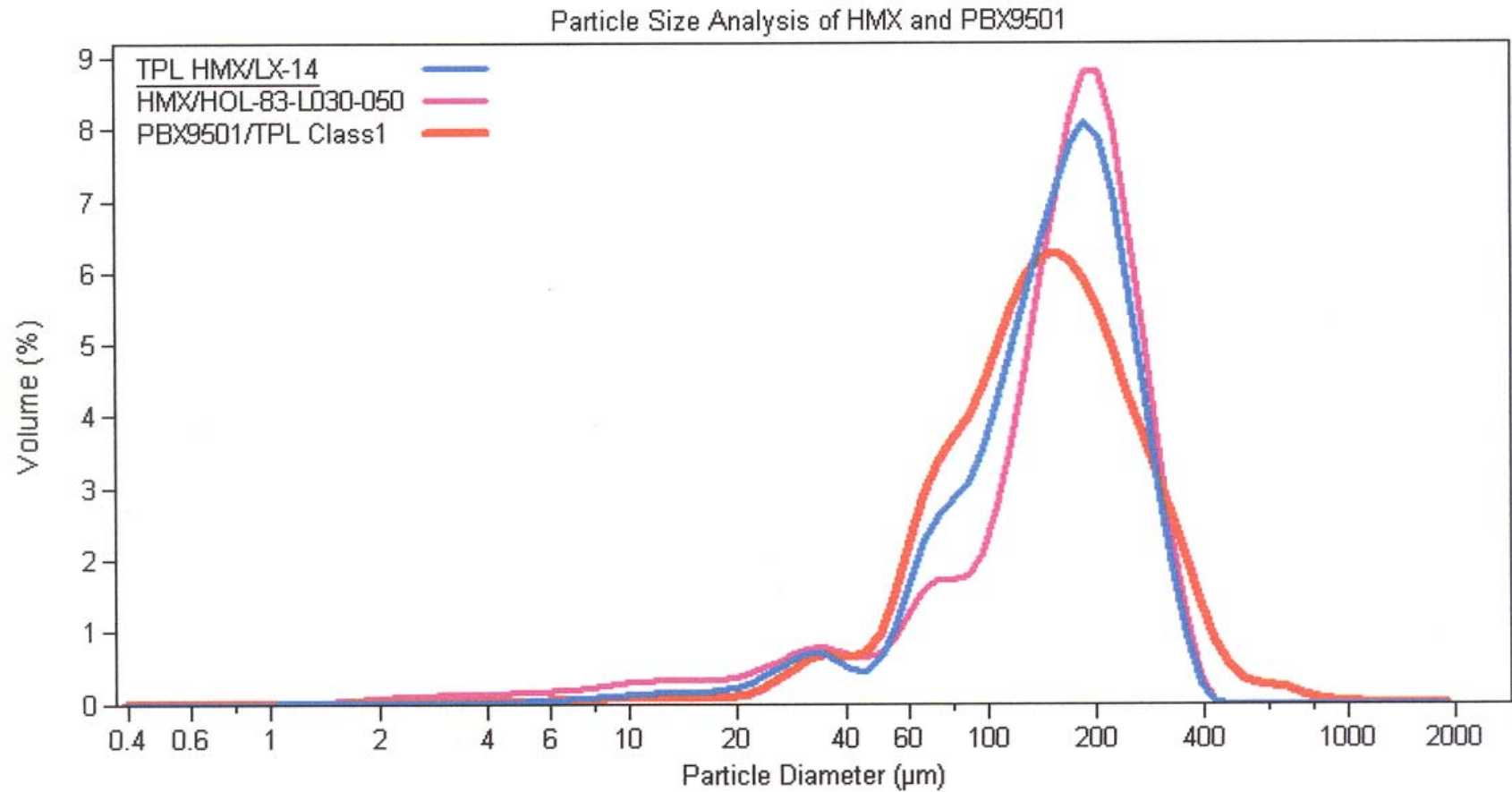


Size Analysis

- ❑ Material from TPL sifted and blended into classes.
 - All met mil specs, but Classes 2 & 5 larger.

Particle Size Analysis

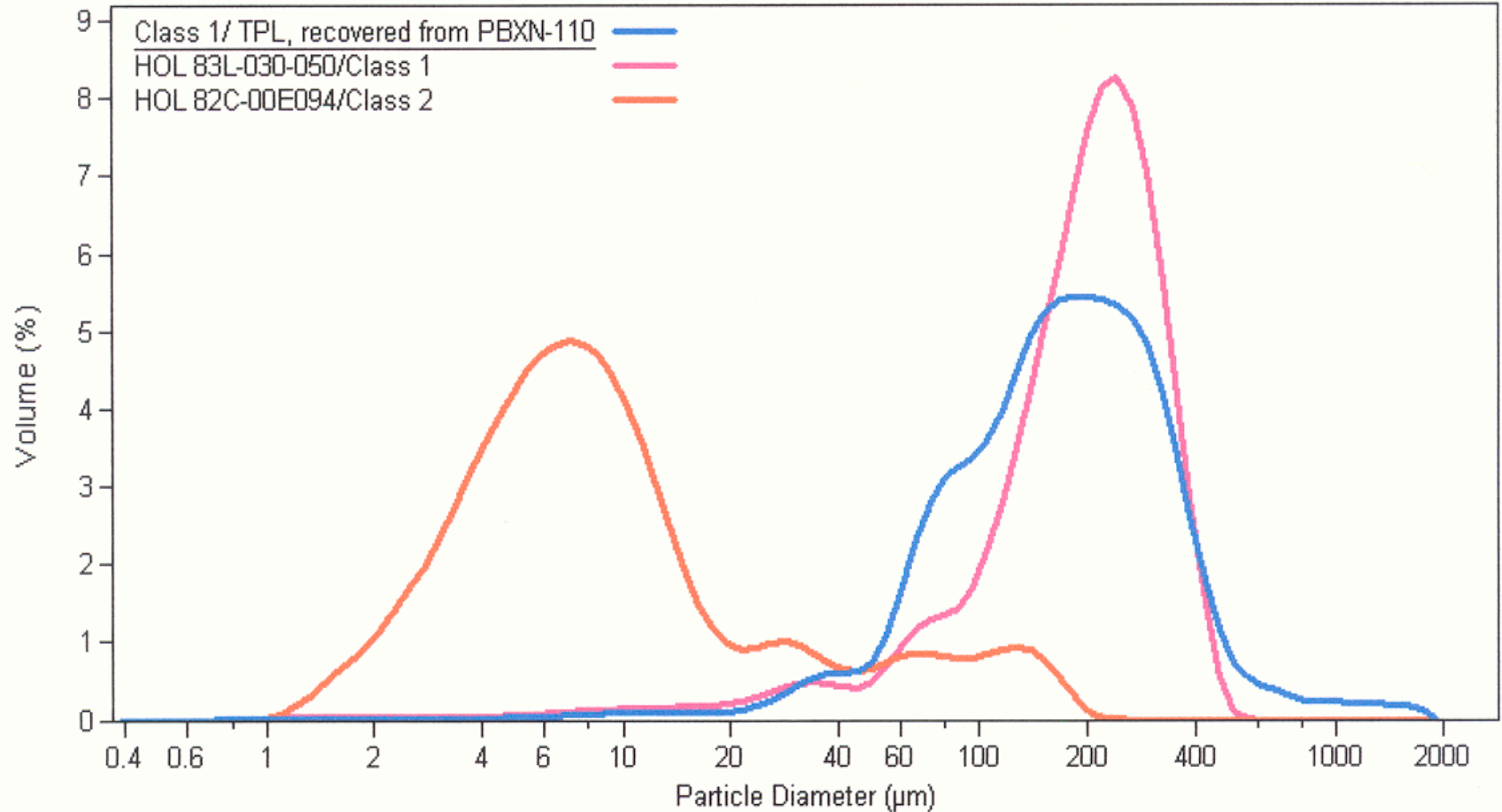
Class 1



Particle Size Analysis

Class 1, N-110

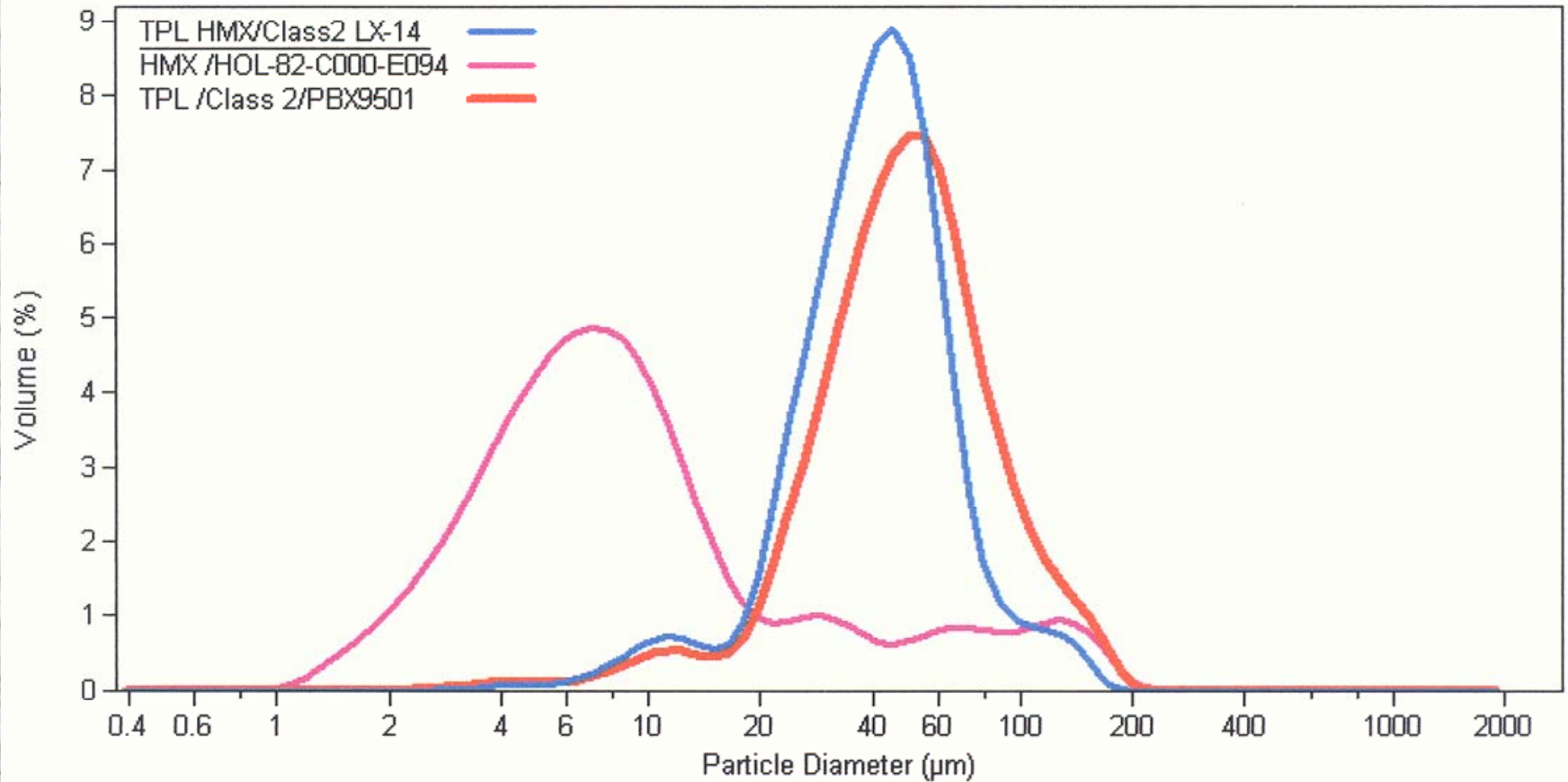
Particle size distribution of HMX samples



Particle Size Analysis

Class 2/5

Particle Size Distribution of HMX and PBX9501

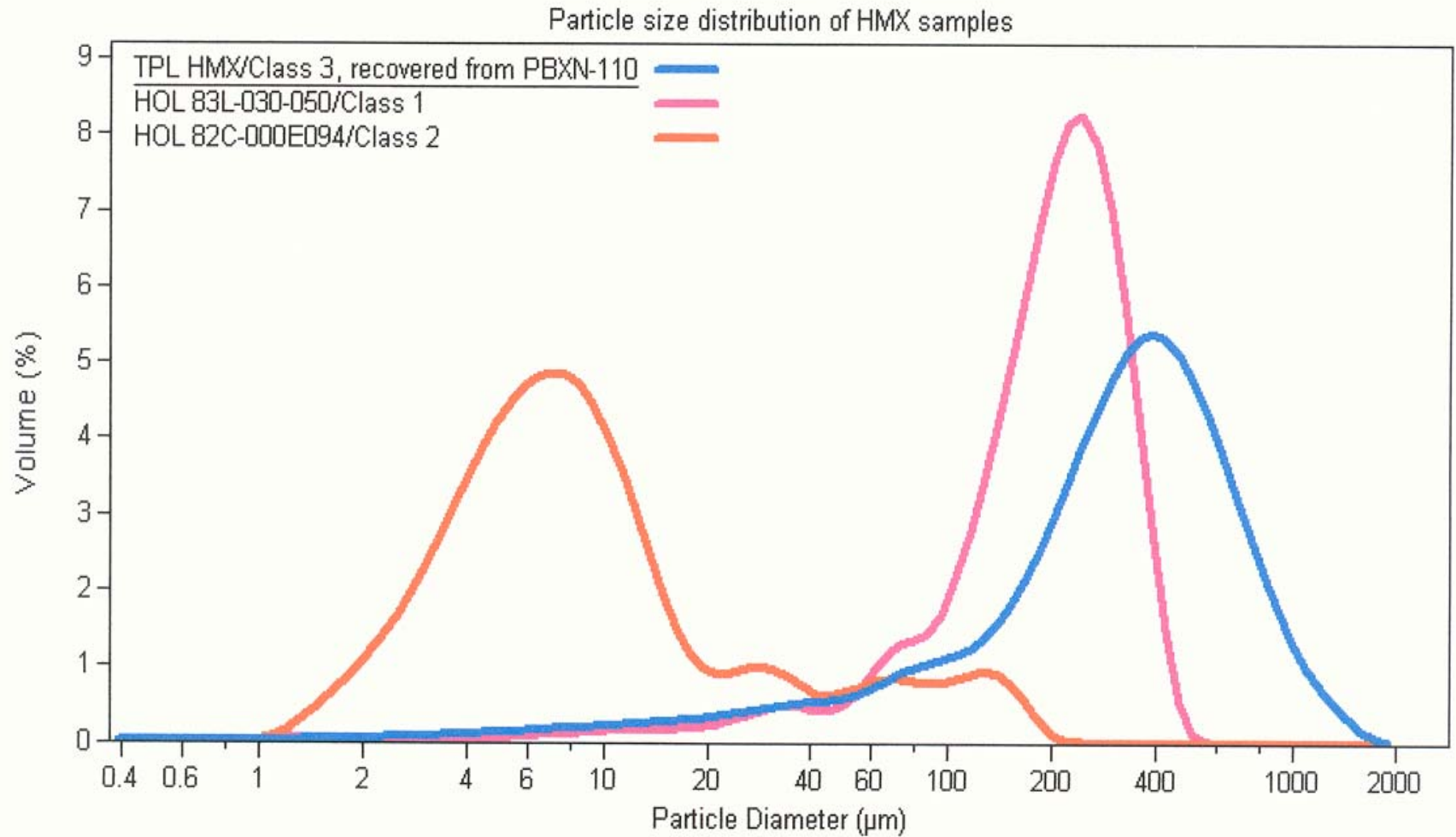


Size Analysis

- ❑ Material from TPL sifted and blended into classes.
 - All met mil specs, but Classes 2 & 5 larger.
- ❑ Class 3 material isolated from N-110.

Particle Size Analysis

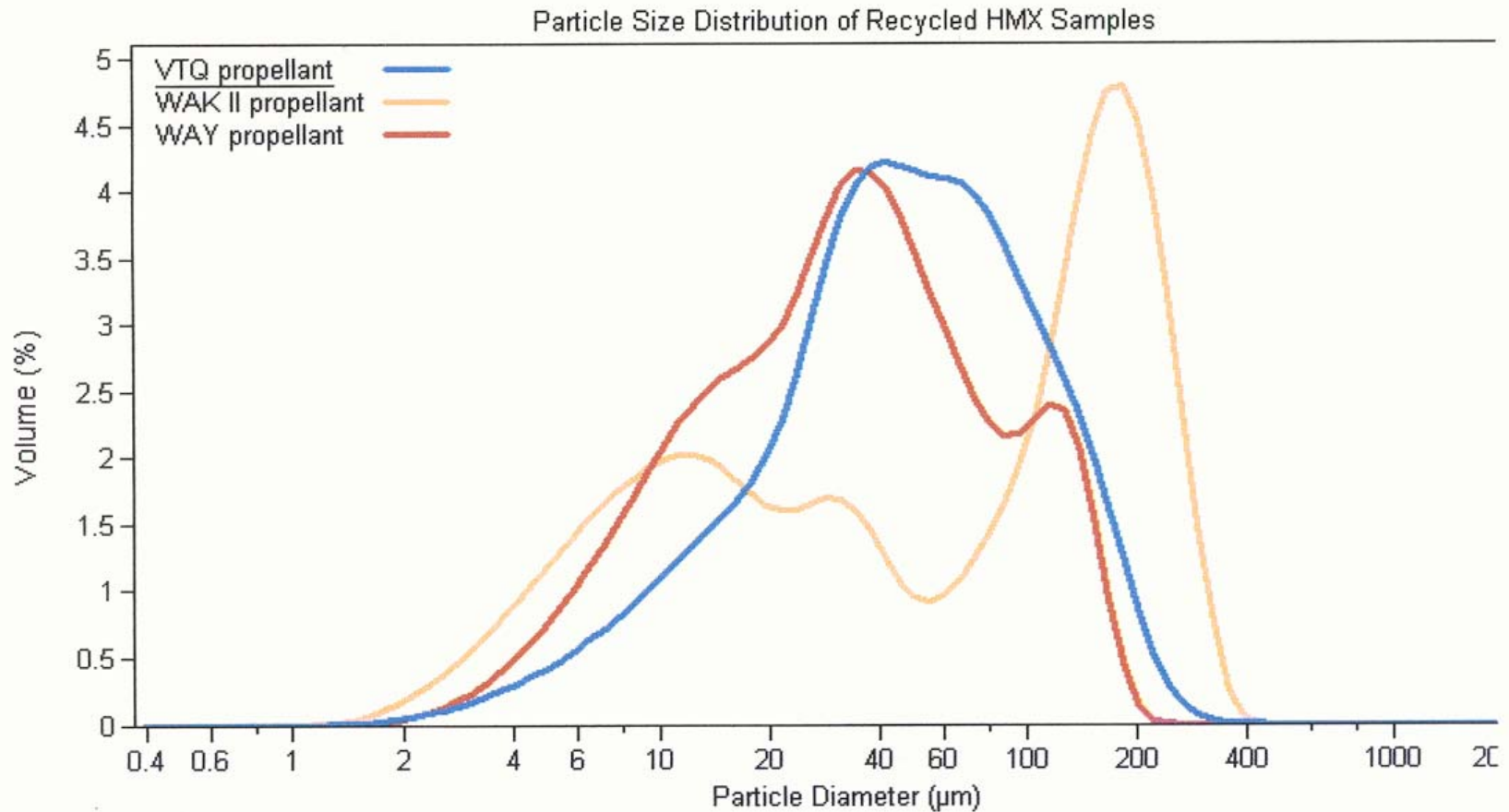
Class 3, N-110



Size Analysis

- Material from TPL sifted and blended into classes.
 - All met mil specs, but Classes 2 & 5 larger.
- Class 3 material isolated from N-110.
- HMX from propellants not sifted by ATK.

Size Distribution of Propellant HMX



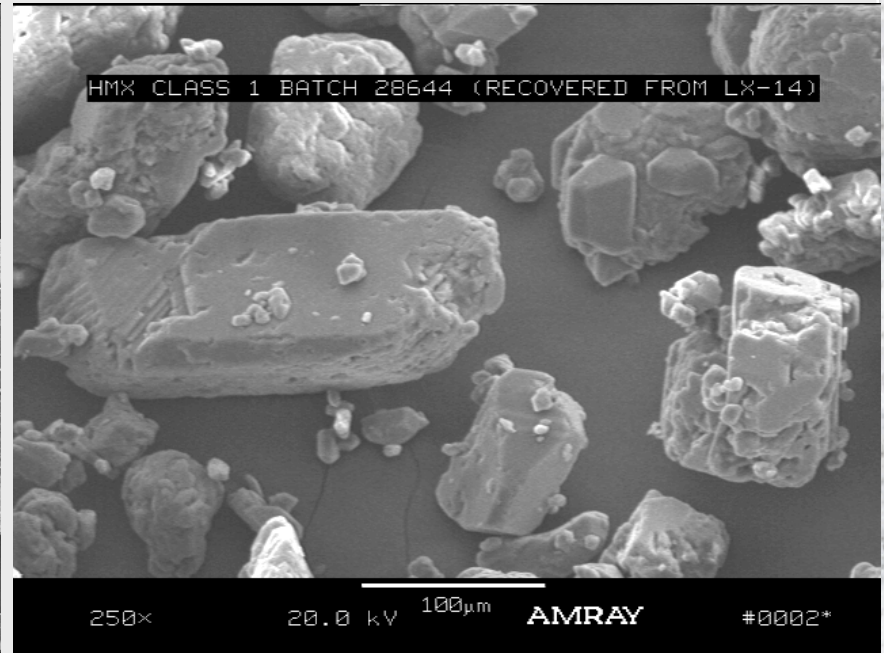
Size Analysis

- ❑ Material from TPL sifted and blended into classes.
 - All met mil specs, but Classes 2 & 5 larger.
- ❑ Class 3 material isolated from N-110.
- ❑ HMX from propellants not sifted by ATK.
- ❑ Microscopic differences in appearance.
 - Larger TPL particles rounded & fractured.
 - ✓ Additional fines noted.
 - ATK material less fractured, but still rounded.

HMX Class 1 EM Pictures (IH)



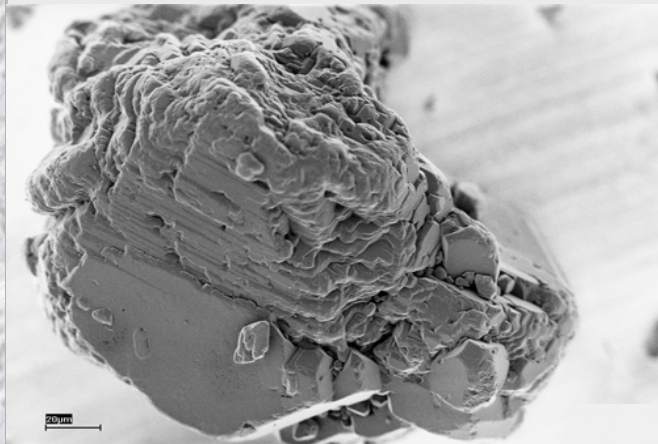
Holston Sample
250x



TPL Sample
250x

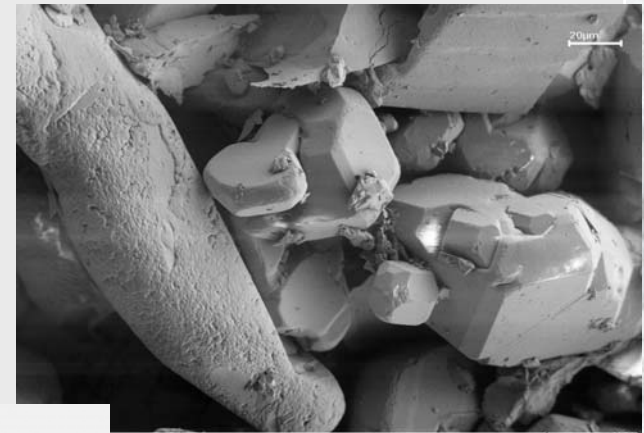
HMX Class 1 EM (LANL)

LX-14 at 500x

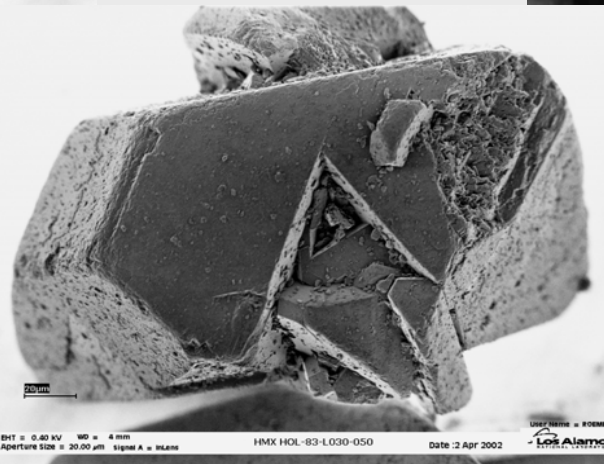


BHT = 0.40 kV WD = 8 mm
Aperture Size = 20.00 µm Signal A = INLANS HMX TPL CLASS I Date : 2 Apr 2002

9501 at 500x



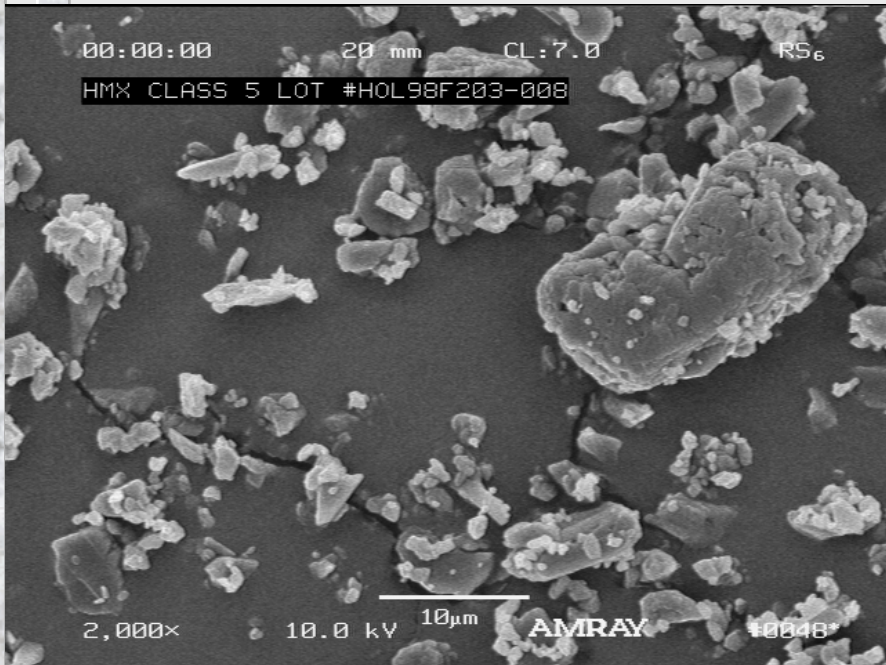
03 20µm Lab # 50072
File Name = TPL Recycled HMX, Class 1_b.tif Los Alamos NATIONAL LABORATORY



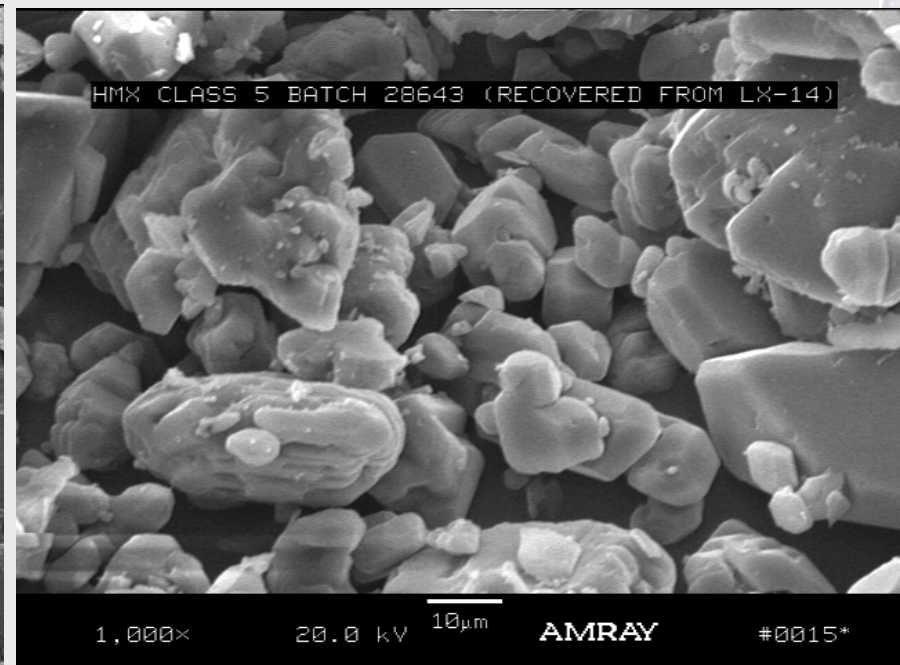
BHT = 0.40 kV WD = 4 mm
Aperture Size = 20.00 µm Signal A = INLANS HMX HOL-83-L030-050 Date : 2 Apr 2002 Los Alamos NATIONAL LABORATORY

Holston at 500x

HMX Class 5 EM Pictures (IH)



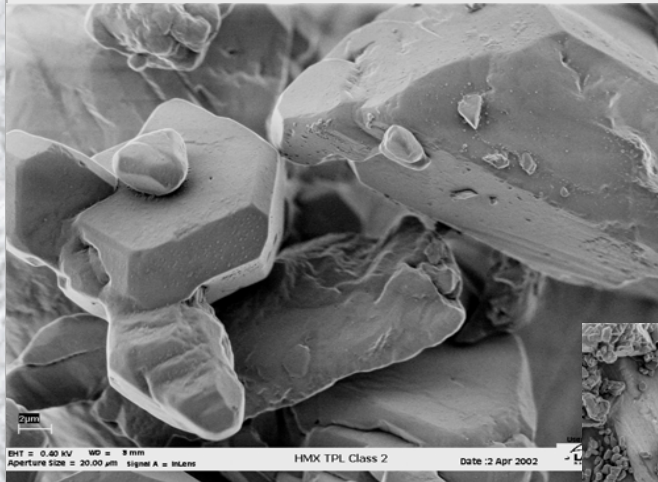
Holston Sample
2000x



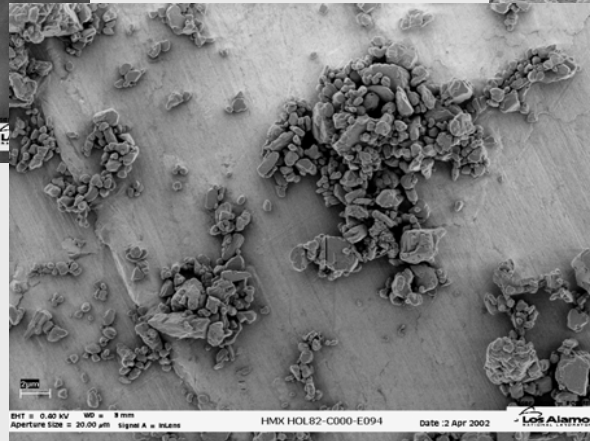
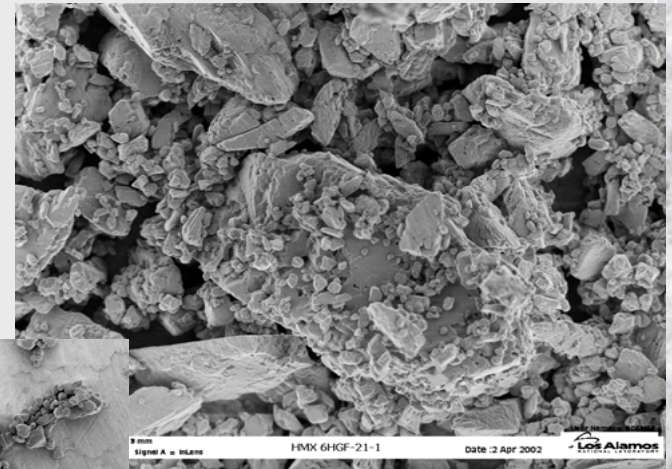
TPL Sample
1000x

HMX Class 2 EM (LANL)

TPL at 3000x



BAE at 3000x



Holston at 3000x

Other Testing

☐ Acetone Insolubles

- ATK material from propellants contained possible Al silicates (0.1%).
- TPL material all within mil spec.

☐ Acidity

- All within mil spec except one TPL LX-14 sample measured at LANL.

☐ Melting Point & DSC

- All comparable to standards and within mil spec.

☐ Residual Estane

- No estane detected in any sample.

☐ HPLC Purity

- Comparable to standards and within mil spec. – very low RDX (with exception of one sample from WAKII propellant at 1.4%).

☐ FTIR – α -HMX

- No α -HMX detected in any sample.

Other Testing

Ion Chromatography

- Evidence of small amount of perchlorate and nitrate ions in propellant samples.

Surface Area (Quantachrom Autosorb-1, BJH - LANL)

- Consistent with particle analysis

Elemental Analysis (Leco CHN900 - LANL)

- No significant difference from standards

Drop Weight Impact Sensitivity (LA type 12, NOS, ERL)

- Comparable to RDX and HMX standards

Friction Sensitivity (BAM)

- No significant difference from RDX or HMX standards

ESD Sensitivity

- No significant difference from HMX or PETN standards.

Vacuum Thermal Stability

- No significant difference

ATK Qualification Testing

- ATK shipped recovered HMX for testing in proposed program.
 - 200 Pounds unsifted HMX from LX-14.
 - Milled to desired size.
 - Same flow characteristics as virgin material.
 - Formulation and performance characterization planned for near future.

Indian Head Formulation and Qualification

- ❑ Recovered Class 1 HMX milled and processed in PBXIH-135 formulation.
 - Particle size of milled material identical to Class 5 virgin BAE/Holston material.
 - Milling and processing characteristics indistinguishable from virgin BAE/Holston material.
- ❑ Performance testing currently underway.

Summary

- ❑ Recovered HMX generally meets military analytical specifications after reclassification.
- ❑ Only significant difference from virgin material is particle size.
- ❑ Milling and processing characteristics indistinguishable from virgin material.