

# 155mm M795 IM HE Projectile Qualification Program



**October 13, 2010**

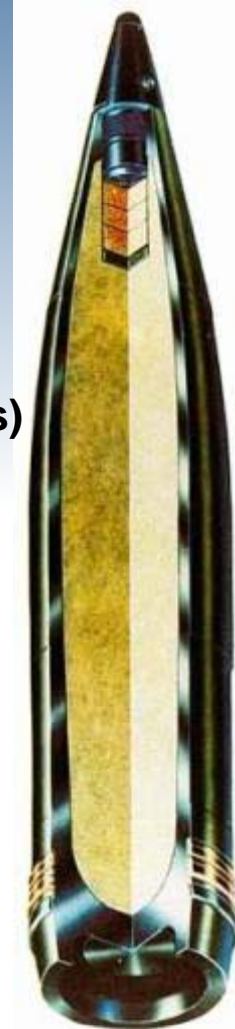
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# Program/Project Description

## 155mm M795 IM

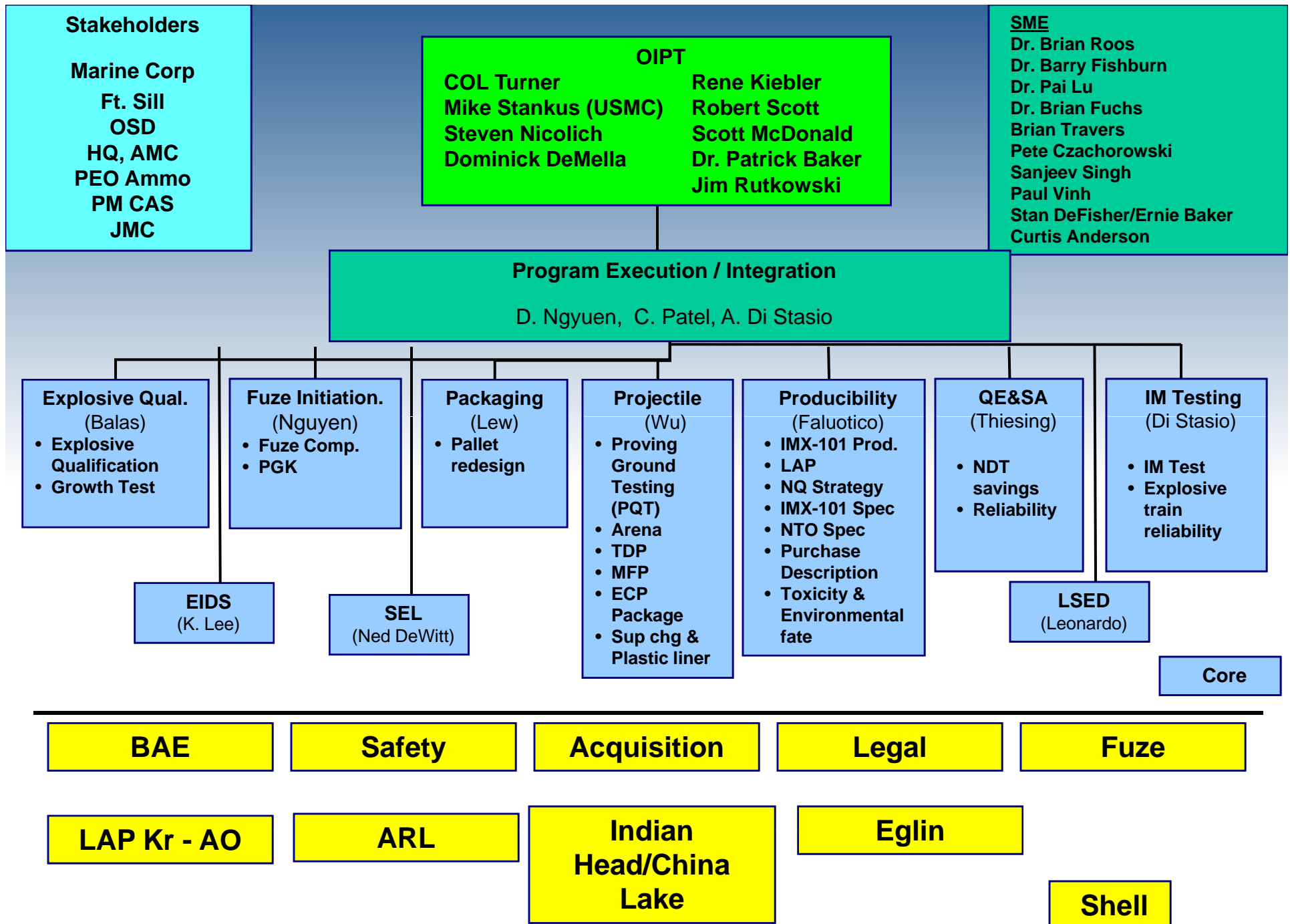
- **Objectives:**
  - ✓ Reduction in Hazard Division
    - 1.2
    - Full IM Compliance
- **M795 IM Design**
  - ✓ Hi-Fragmenting Steel Body (78 lbs)
  - ✓ IMX-101 Main Fill (24.3 lbs)
  - ✓ PBXN-9 Supplementary Charge (0.34 lbs)
  - ✓ Warhead Venting
    - Meltable Liner
    - Meltable Fuze Plug
    - Modified Pallet Design
- **Transition to production**
  - ✓ CY11

	CY08	CY09	CY10
Producibility assessment			
Explosive Qualification			
Gun Qualification of Projectile & Transition to Production			



## Program Stakeholders:

- ❖ OSD-TTI
- ❖ JIMTP
- ❖ PEO-AMMO
- ❖ PM CAS/U S Army
- ❖ USMC



# M795 IM Projectile Qualification Objectives

- **Product Qualification Test per ITOP 4-2-504 (1) and MIL-STD-2105C**
  - ❖ **Effective**
    - ❖ **Ballistic Match M795**
    - ❖ **Match M795 Lethality**
  - ❖ **Suitable**
    - ❖ **IM**
    - ❖ **Reliable**
    - ❖ **Human Factors**
  - ❖ **Supportable**
    - ❖ **Logistics**

**Requested Independent Safety Confirmation from  
Development Test Command**

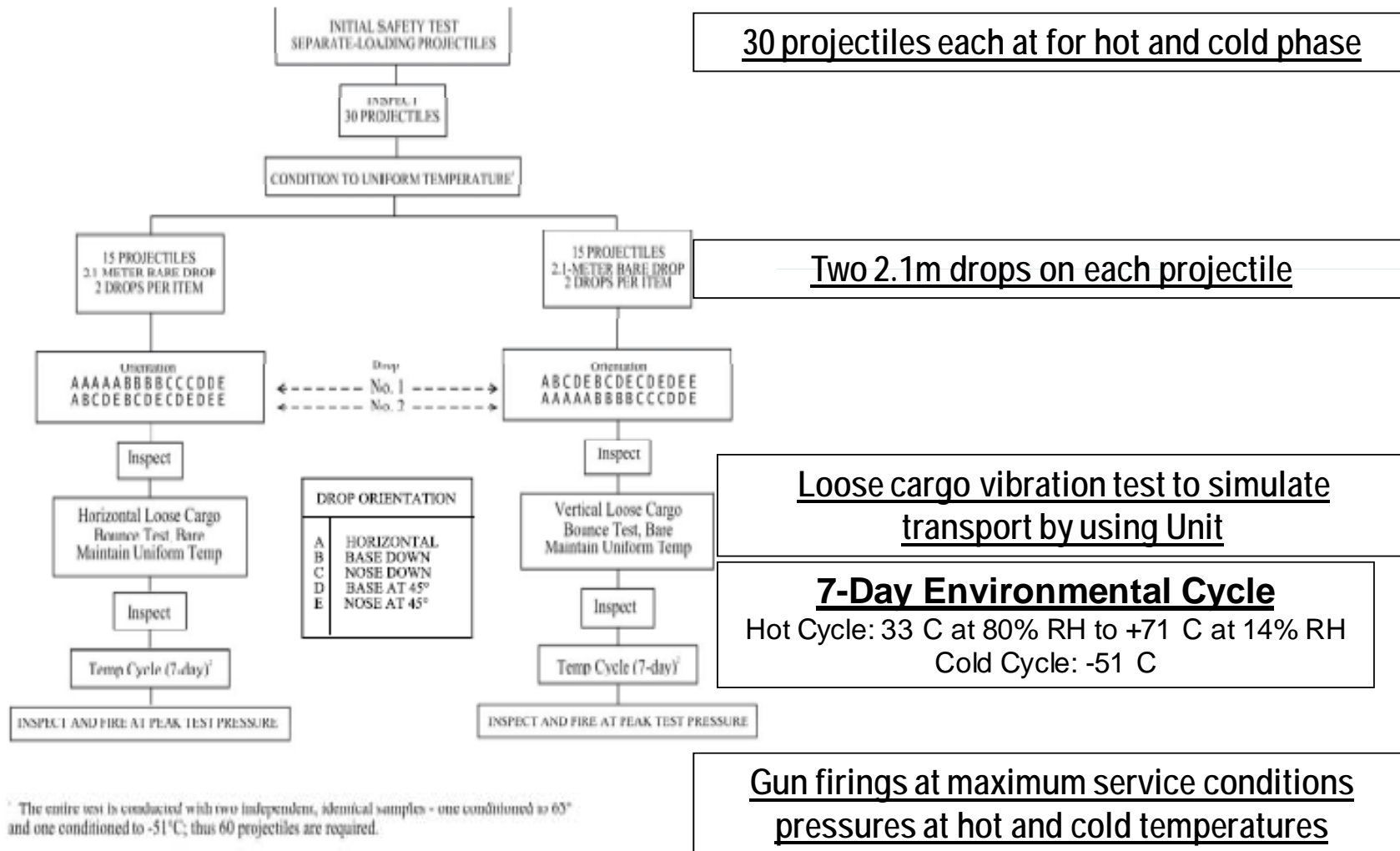
# M795 IM Qualification Plan

TESTS	M795 IM TEST RDS
VELOCITY PRESSURE CHECK	30
12-METER DROP	10
INITIAL SAFETY TEST	
HOT/DRY CYCLE (7 DAYS)	30
COLD SOAK (7 DAYS)	30
SEQUENTIAL ENVIRONMENTAL TEST	
HOT/DRY CYCLE (28 DAYS)	60
COLD SOAK (14 DAYS)	60
SHOCK ATTENUATING LIFTING PLUG	40
WORN TUBE	40
EOD	16
ADVERSE ENVIRONMENTS	
SOLAR RADIATION	8
HIGH HUMIDITY & TEMPERATURE	16
FUNGUS	8
LONG TERM STORAGE – UNCONTROLLED	16
PERFORMANCE	
FIRING TABLES	45
ARENA FRAGMENTATION	3
INSENSITIVE MUNITION	
FAST COOK-OFF	9
SLOW COOK-OFF	2
SYMPATHETIC DETONATION	16
FRAGMENT IMPACT	2
SHAPED CHARGE JET IMPACT	2
BULLET IMPACT	3

# Initial Safety Test

ITOP 4-2-504(1)  
22 September 2005

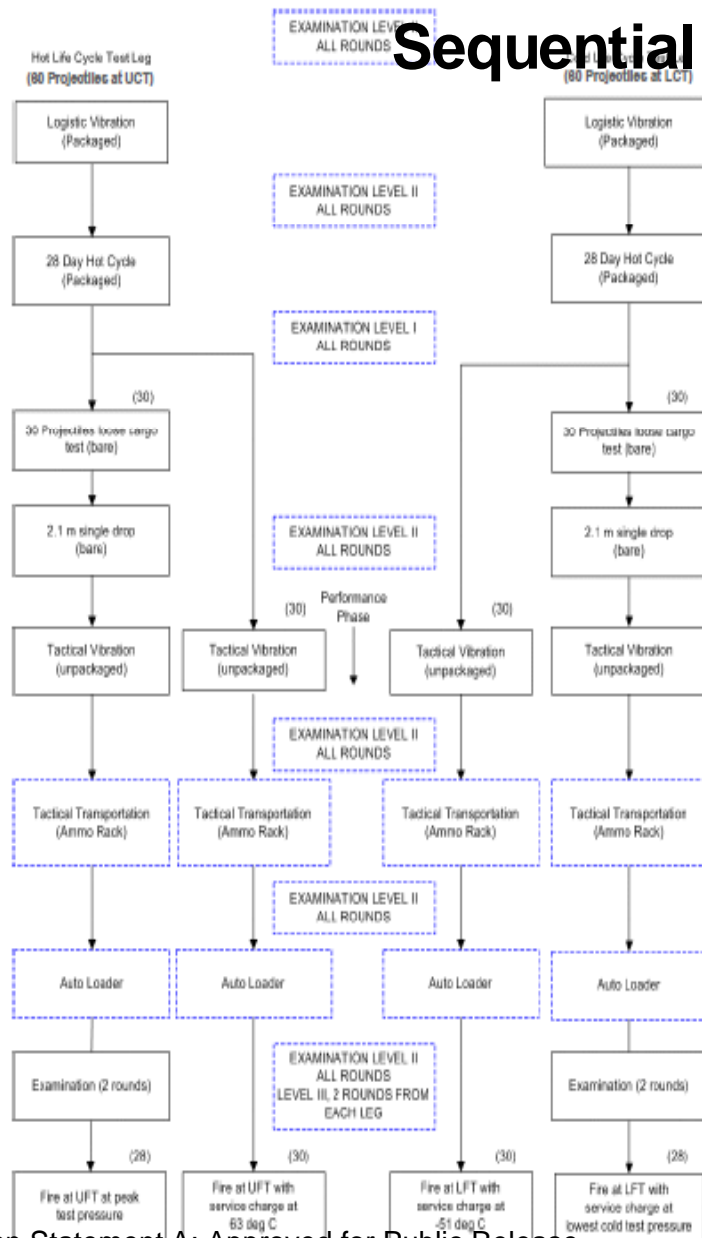
## Safety Test – Phase 1



**Pass**

# Performance & Safety Tests

# Sequential Environmental Test



60 projectiles each at for hot and cold phase

## Logistic Vibration

Transportation (land, air, and sea) from the factory to overseas storage depot and to the Ammunition Supply Point

## Environmental Cycle

28 Day Hot Cycle: 33 C at 80% RH to +71 C at 14% RH  
14 Day Cold Cycle: -51 C

## Loose Cargo Vibration Test

## Transport by using Unit

One 2.1m drops on each projectile

### Accidentaly drop during unloading by using Unit

## Gun firings

Subject the items to severe interior and exterior ballistic environments by firings at maximum service conditions pressures at hot and cold temperatures

# Pass

# Adverse Environment & Logistics Tests

## Supplementary Environmental Tests

### High-humidity and Fungus

Humidity: 10 cycles at 30 C to 60 C at 95% RH

Fungus: 28 days at 30 C at 95% RH

16 rounds

Gun firings at top service charge

**Pass**

### Solar Radiation

Cycle represents peak conditions of 1120  
W/m<sup>2</sup> solar radiation and 43 C (110 F)

8 rounds

Gun firings at top service charge

**Pass**

### Thermal Stability

48 hours at 75C

**Pass**

### 12 Meter Drop Test

10 rounds each at hot and cold temperatures

**Pass**



## FHC/1.2.3 Criteria per TB700-2

- Liquid Fuel/External Fire
- Slow Heating
- Bullet Impact
- Sympathetic Reaction (confined & unconfined)
- Thermal Stability
- 12m drop
- IM
  - SCJI
  - Fragment Impact

# Summary of M795 IM Test Results for IMX-101 JSIMTP/AIMB Scores

Test	Official Tests Scores	Notes on test results
Fast Cook-off	V	Single round and pallet configuration
Slow Cook-off	V	Heating rate is 3.3° C/hr
Bullet Impact into HE	IV	Type V if scored to current criteria
Fragment Impact into HE	V	2,532 m/s
Sympathetic Reaction	Pass	Confined and unconfined
Shaped Charge Jet Impact	Pass	LX-14 conditioned jet

# M795 IM Fast Cook-off Results

## ➤ Single Round



- No blast overpressure
- No hazardous fragments beyond 15m.

Type V

## • Palletized





# M795 IM Slow Cook-off Results



**Type V**



**MFP Inside oven**



# Bullet Impact Results

- **Three 0.50 caliber AP bullets into HE**

**Type V to AOP-39 Ed 2 Feb 09**

**Type IV to future criteria**

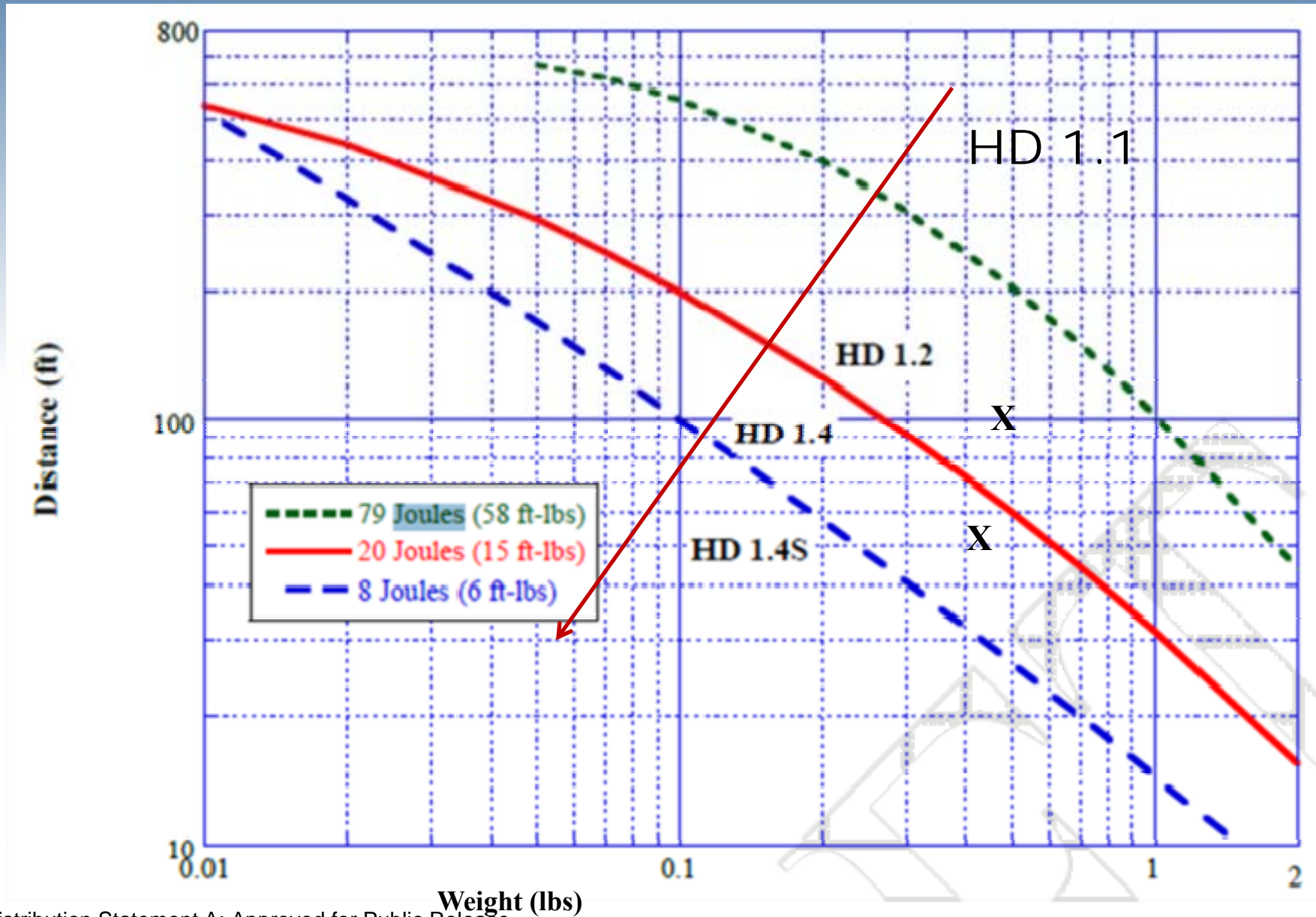


- Smoke on impact from first bullet
- Fireball on impact of second bullet, round broke in 3 large pieces
- Lifting plug (263.6g) and s/c (211.8g) thrown at 31m and 18m respectively
- Large amount of unreacted explosive collected





# Hazardous Fragment Analysis from TB700-2 (Aug 2008)



# Fragment Impact

18.6 gram fragment fired 2,471 m/s into HE  
Round intact, no fragments past 15m



Type V



Supp Chg



# M795 Unconfined SR Results

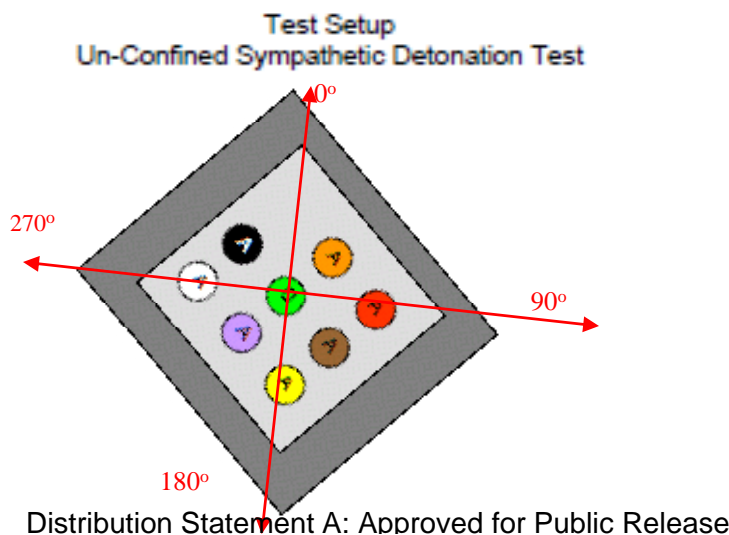


Post Test Acceptors



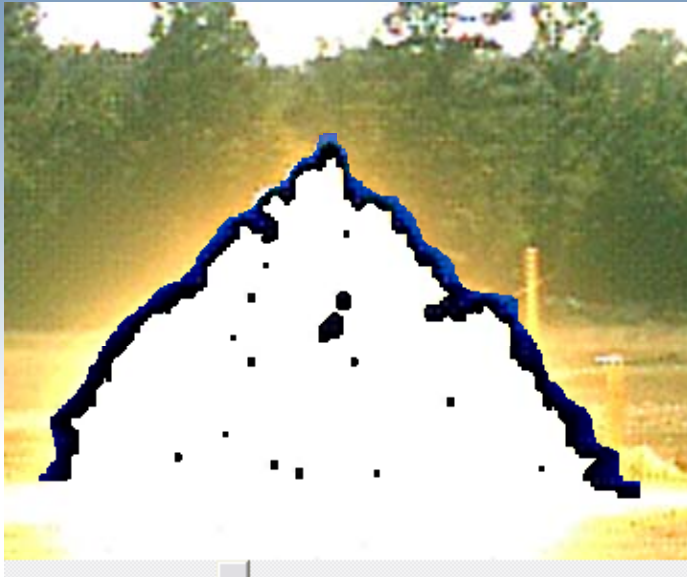
Single dent from donor

Single round calibration





# M795 Unconfined SR Results



Unconfined SR 1ms after  
trigger



Detonation Calibration  
1ms after trigger

Acceptor Rounds do not contribute to dynamic  
reaction!!

# M795 SCJI Results

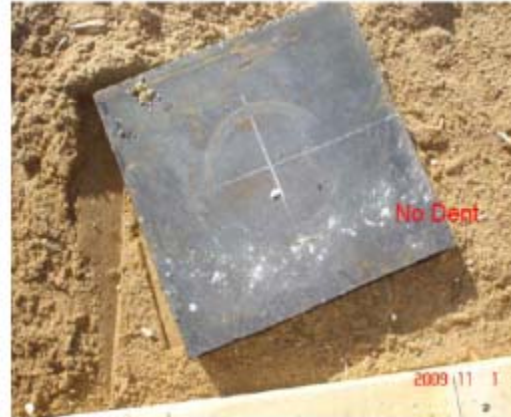
- 81mm Shaped Charge Jet Impact
- Round broke into large pieces some beyond 15m
- No dents on witness plate
- No increase in SC blast overpressure
- Unconsumed Explosive



**1<sup>st</sup> shot**



**2<sup>nd</sup> shot**



**Pass**

# Thermal Stability Test

- One round was placed in an environmental chamber
- The temperature was ramped to 75C over one hour
- When the round skin temperature stabilized at  $75C \pm 2C$  48 hour soak was performed.
- Visual inspection revealed no anomalies.



Thermal Stability Test  
Post Test Results

**Pass**



# 12m Drop Test

- Three rounds subjected to 12m drop tests.
- Three orientations, horizontal, nose down, nose up.
- Visual inspection revealed that the metable fuze plug broke off of each round. No reaction.

Pass



# Conclusions

IM Test:  
M795 IM Scores\*

FCO	SCO	BI	FI	SD	SCJI
V	V	IV	V	Pass	Pass

Test	Status
Initial firing tests	✓
12m Drop	✓
Initial Safety Test	✓
Sequential Environmental Safety & Performance	✓
Shock Attenuating Lifting Plug	✓
Worn Tube	✓
Explosive Ordnance Disposal	✓
High Humidity & Temp /Fungus	✓
Solar Radiation	✓
Initiation Reliability	✓
Final Firing Table Confirmation	✓
<u>Arena Testing</u>	✓
<u>IM Testing</u>	✓

\* Reaction from IMX-101

- ✓ **Effective**
  - ✓ Confirmed Ballistic Match
  - ✓ Met M795 Lethality rqmts
- ✓ **Suitable**
  - ✓ IM
  - ✓ Reliable
  - ✓ Human Factors
- ✓ **Supportable**
  - ✓ Maintained same palletization

- ✓ Received Safety Confirmation from Development Test Command
- ✓ Tech Data Package signed 06/2010
- ✓ Achieved HC 1.2.1

# Questions