## BAE Systems Land & Armaments

## Development and Verification of the DDG-1000 Anti-Fratricide Munitions Container for 155mm LRLAP

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Navy

# Development and Verification of the DDG-1000 Anti-Fratricide Munitions Container for 155mm LRLAP

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GENERAL DYNAMICS Ordnance and Tactical Systems



## DDG-1000 Zumwalt Class Destroyer

Characteristics Length 600 ft Displaceme Beam 80.7 ft Installed Po Draft 27.6 ft Crew Size Speed 30 kt (incl. Aviation

Displacement 14,564 LT Installed Power 78 MW Crew Size 142 (incl. Aviation detachment)

#### Weapons

(80) Advanced vertical launch cells for Tomahawk, ESSM, Standard Missile
(2) AGS 155 mm guns
(600) 155 mm rounds
(2) 57 mm Close In Guns
Torpedo Defense (Space Reservation)
Anti-Terrorism (Space Reservation)

#### Sensors

- Dual Band Radar
- S-Band VSR
- X-Band MFR
- HF & MF Bow Sonar Arrays
- Multi-Function Towed Array
- EO/IR System
- ES System

#### Superstructure

Composite structure

#### Aviation

Integrated Power System

(2) Main Turbine Generators (MTG)
(2) Auxiliary Turbine Generators (ATG)
(2) 34.6 MW Advanced Induction Motors Integrated Fight Through Power MH60R and (3) VTUAVs (Capacity for 2 MH 60Rs)

#### Boats

(2) 7m RHIBs (sized for (2) 11m RHIBs)

Wave-piercing tumblehome

1000

## 155mm Long Range Land Attack Projectile

#### **LRLAP System Overview** Warhead GNC Aft Assembly Section Section Section GN&C • DII Propulsion Tail Payload Radome Case and Housing · ESAD with Thermal Battery • Hinge plate bulkhead(s) PD sensor DIGNU2 Insulation Fin locks HE Warhead • CCU Motor ESAD-ISD Fin cap Warhead GPS Antennas Interconnect Obturator ESAD-ISD Canard covers Blast Interconnect • SES (2) tube/nozzle HOB Sensor Initiation train • DII • ISD GNC Networks Tail Fins



## **Unitary Charge Warhead**



## **Munitions Container**

- Designed for automated handling in ship magazine
- 8 LRLAP projectiles
- 8 propelling charge
- 2700 kg fully loaded container gross wt.



#### **BAE SYSTEMS**

## Initial Trade Study and Inert Acceptor Test



#### **Hydrocode Simulation**



### C4 Filled Donor and 3 Instrumented Inert Acceptors

#### BAE SYSTEMS

## Anti-Fratricide System Development



**Initial Munitions Container Anti-Fratricide Liner** 



**Engineering SD Demonstration of Initial Concept** 

#### Engineering test scored as failure, acceptor WH detonated

## Alternate Concept

- Failure Review Board (FRB) was formed
- Multiple failure paths evaluated and examined
  - CTH hydrocode analysis at NAWC, China Lake, CA
  - HULL hydrocode analysis at GD-OTS, Niceville, FL
- Modified diamond bar from initial trade study showed greatest potential
- Repeat engineering test at NTS, Camden, AR Oct 2007
  - Success!





## IM and Hazard Class SD Test

- Tactical donor and two acceptor warheads in container
- Mass equivalent steel GNC and RM sections used for confinement
- Conducted SD-1 test at NTS, Camden, AR June, 2012





## **SD-1** Results



- Above: Aft Container, post test
- Upper Right: Forward view, post test
- Right: Acceptor WH case





## Hydrocode Modeling



#### Initial Concept at 20 µ-second Intervals



#### Simulation of Diamond Bar at 20 µ-second Intervals

## Conclusions

- Munitions container well positioned to pass SD test with Warhead, Rocket motor, and Propelling Charge
  - Munitions Reactions Evaluation Board (MREB) scored SD-1 as a PASS in October 2012
- IPT FRB collaborative effort with U.S. Navy and contractors was a success
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