Accelerating Precision Strike Technology for Stability Operations and Protection of Coalition Forces

Penetrating Effector Systems from EADS / TDW

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President & CEO
EADS / TDW
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Precision Strike Technology Symposium
PSTS – 05
Kossiakoff Conference Center
The Johns Hopkins University
Laurel, Maryland
Who we are

TDW

is

Europe’s No. 1

in

“Penetrating Effector Systems for Guided Weapons”

and is on the way to the

U.S.
TDW = Three decades of Penetrating Effectors

Kormoran 1  Kormoran 2  NAVAL SUPERIORITY  ANS

TECHNology & EXperimental Program  PENETRATING SUBMUNITIONS

RUNWAY CRATERING  STABO for MW-1

PRECISION GROUND ATTACK, HDBT DEFEAT  MEPHISTO for TAUROS  NSM  NAVAL STRIKE
TDW Gesellschaft für verteidigungstechnische Wirksysteme mbH

TDW = An EADS Company

EADS

DEFENCE AND SECURITY SYSTEMS

MISSILES

EFFECTORS

TDW Gesellschaft für verteidigungstechnische Wirksysteme mbH is the acknowledged "Center of Excellence" for "Lethal Packages" within EADS with more than 47 years of expertise at Schrobenhausen/GERMANY
Business Unit "Missiles" within DS: EADS / LFK
Actual Transatlantic Cooperations

MEADS

Patriot

Stinger

RAM

ESSM
Penetrating Effector Systems from EADS / TDW
Presentation Outline

Accelerating Precision Strike Technology for Stability Operations and Protection of Coalition Forces

- Introduction: Short Company Background
- The Need: Effective Defeat of Hard Targets
- One Solution: Penetrating Effector Systems from TDW
  - Q: What does it take to build effective penetrating effectors?
  - A: Penetrating Effector Capabilities from TDW!
    - Requirement Analysis and Effector System Design
    - Penetration Simulation and Performance Prediction
    - Penetrator Charge Design (Casing and High Explosive)
    - Penetrator Fuzing (Smart Hard Target Fuzing)
- Examples, Tests, Video Clips
Penetrating Effector Systems from EADS / TDW

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The Threat: Hard and Deeply Buried Targets

Plus a complete variety of additional hard targets, like:

- Hardened Command and Control Bunker
- Biological Production Facility
- EW/GCI Center Hardened Building
- Air Defense Command Center
- Multi-Story Building with Basement
- Elevator-Served Radar Bunker
- Aircraft in Revetments
- Aircraft Storage Bunker Interior
Hard Target Example: *Ladeburg* Bunker Replica at Meppen Federal Proving Ground, GERMANY

US/GE
Hard Target Defeat Project Agreement
The Threat: Hard Sea Targets and Land Targets: Naval Strike Missile Targets (KONGSBERG, NOR)

- **Primary:** Surface vessels
  From small FPB to large vessels

- **Secondary:** Land targets
  Strike missions against SAM sites, C^3^I Buildings, Ships in harbour
Weapon Systems with TDW’s Penetrating Warheads
Actual Examples

Taurus KEPD 350

Naval Strike Missile NSM

EADS TDW MEPHISTO MWS

EADS TDW New NSM Warhead NNW
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What does it take to build effective penetrating effectors?

- Requirement Analysis and Effector System Design
- Penetration Simulation and Performance Prediction
- Penetrator Charge Design
  - Casing (Mechanical strength & Structural loads)
  - High Explosive (Performance & Insensitivity)
- Penetrator Fuzing
  - Target Detection Device (Smart Hard Target Fuzing)
  - Safe & Arm Device w/ Firing Unit
TDW

- is a “Full Service Company“
- (from the first idea to series production)
- is working on Effectors (warheads and fuzes) since 1958
- was formerly known as MBB, DASA
- works on one integral site (Schrobenhausen, GERMANY)
- has its own qualified high explosives
- uses its own proving ground
- is reknown in Europe
- is on the way to the U.S.
Requirement Analysis and Effector System Design:
e.g. Unitary Warhead vs. Dual Warhead Trade-Offs

- System Energy Comparison

<table>
<thead>
<tr>
<th>Kinetic Energy Pen.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unitary Warhead</strong></td>
</tr>
<tr>
<td>KE 22.5 MJ</td>
</tr>
<tr>
<td>PEN</td>
</tr>
<tr>
<td>300 m/s</td>
</tr>
<tr>
<td>500 kg Unit. W/H</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MEPHISTO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dual Warhead</strong></td>
</tr>
<tr>
<td>KE 48 MJ</td>
</tr>
<tr>
<td>PC JET</td>
</tr>
<tr>
<td>66 MJ TOTAL</td>
</tr>
<tr>
<td>KE 18 MJ</td>
</tr>
<tr>
<td>PEN</td>
</tr>
<tr>
<td>&lt;8,000 m/s</td>
</tr>
<tr>
<td>300 m/s</td>
</tr>
<tr>
<td>20%</td>
</tr>
<tr>
<td>500 kg MWS</td>
</tr>
<tr>
<td>80%</td>
</tr>
</tbody>
</table>

- Impact Velocity and Impact Angle Dependency

6,000 psi reinforced concrete, 1 m in thickness
Penetration Simulation and Performance Prediction: Homogeneous, structured and / or reinforced targets

- Penetration Simulation
  a) in Concrete (Bunker)  
  b) in Steel (Ship Target)

Penetration Simulation of a 40 cm reinforced concrete slab

Penetration Simulation of a steel plate with crosswise stringers at the back
Penetrator Charge Design:
*Casing (Strength & Structural loads)*

- Structural loads simulation
Penetrator Charge Design:  
*High Explosive (Performance)*

**Results From the US/GE Test 17 Series in the Ladeburg Bunker**  
-- An Update for the March 2004 PA Meeting --

16 March 2004

Alan Ohrt  
Air Force Research Laboratory  
Munition Directorate  
Eglin AFB, FL USA

Distribution as authorized in the US/GE Hard Target Defeat Project Agreement
Penetrator Charge Design: High Explosive (Performance)

- TDW’s KS22a and KS-57 Performance

For details see AFRL report
Penetrator Charge Design:  
*High Explosive (Insensitivity)*

– TDW’s **KS22a** Insensitivity

Sympathetic detonation test of NNW
Fuzing Requirement for Penetrating Warheads
Burst Point Control Fuzing

“Smart“ / Intelligent Hard Target Fuzing =
Burst Point Control Fuzing
Fuzing Requirement for Penetrating Warheads
Burst Point Control Fuzing
### Principle Choices of a Penetrator Fuze: "Traditional" vs. "Smart" Fuzing

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<thead>
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<th>&quot;Smart&quot;</th>
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<tr>
<td>Time delay after impact fuzing</td>
<td>Active decision-making, burst point control fuzing</td>
</tr>
<tr>
<td>(up to 256 different delay times, 1 msec resolution)</td>
<td>\textit{w/ void sensing and layer counting} capability</td>
</tr>
</tbody>
</table>

\[\text{vs.}\]

**Examples:**
- JPF (US), MAFIS (UK)
  (for Storm Shadow \textit{w/BROACH})
- PIMPF (GER, ESP, NOR), (US HTSF Requirement)
Principle Choices of a Penetrator Fuze

"Traditional"
Time delay after impact fuzeing

(up to 256 different delay times, 1 msec resolution)

Examples:
JPF (US), MAFIS (UK)
(for Storm Shadow w/BROACH)
 Principle Choices of a Penetrator Fuze

"Smart"
Event Detection,
Active decision-making,
burst point control fuzing
w/ void sensing and
layer counting capability

Examples:
PIMPF (GER, ESP, NOR)
(US HTSF Requirement)
Key Capabilities of PIMPF

PIMPF =

- active decision-making, accelerometer-based fuze
- detects hard and soft layers within a structure ⇒ event detection and layer counting capability
- senses and counts voids
- detonates the WH at a desired burst point inside buried or reinforced concrete targets
- adjustable backup time delay
- programmable, cockpit selectable
- out-of-line fuze with an electro-mechanical SAD
- Built-in-Test capability
- high reliability
PIMPF - The Hardware
"PIMPF" as in production for the German Taurus S/OM

Fuze Housing
(Mounting Flange ≈ 6“ diam.)

Booster Charge (HNS)  Electro-mechanical Safe & Arm Device (4.3“)  Fuze / Sensor Electronics: Target Detect. Dev. (2.5“)
PIMPF Safe & Arm Device (4.3 inch diam.)

- Compliant to STANAG 4187 (equiv. MIL-STD 1316 D)
- 1\textsuperscript{st} arming event by stepper motor turn (unlock PA)
- 2\textsuperscript{nd} arming event by pyrotechnical actuator (1 W/1 A/5 min)
- Final arming event by stepper motor turn (detonator in line)
- metal layer detonator (100 mA No-Fire, shock-proof)
- 110 mm = 4.3" in diam., but there is room for a low-risk repackaging into a 3" standard fuze well
The way forward – FCT of PIMPF

Rationale

- The Department of Defense currently has no void sensing smart fuze suitable for its penetrating weapons systems.
- The cancellation of the USAF’s Hard Target Smart Fuze (HTSF) Program has forced penetrating weapon developers to search for alternatives.
- This FCT will evaluate the Programmable Intelligent Multi-Purpose Fuze (PIMPF) alternative, a qualified fuze with the ability to detect and count voids in prosecuting hard, deeply buried targets, and in production for several NATO countries.
- In addition to e.g. the CALCM and Tomahawk requirements, also other penetrating weapon systems (fielded and/or in development) will require the capabilities of a PIMPF-type fuze to address emerging threats.
- If successful, this FCT will identify a smart fuze option for these weapon systems as well.
- While not quite a “one size fits all” solution, PIMPF would have many commonalities, retain some necessary differences, and complete an important development toward the needed fuze.
Introducing Penetrating Effector Systems from EADS / TDW

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- Examples, Tests, Video Clips
The MEPHISTO Effector is in Series Production...

for TAURUS KEPD 350

...for the NATO countries GERMANY and SPAIN
The NNW is qualified for the Series Production of the Norwegian Naval Strike Missile NSM
Cannon Testing & Sled Track Testing of MEPHISTO at WTD91, Meppen, Germany
Cannon Testing - Target Set-up

Concrete Layer 3  Concrete Layer 2  Concrete Layer 1

Pre-programmed Initiation

3 Concrete Slabs
Initiation
Impacts
Exits

Catcher Plate

WTD91

Page 37 Penetrating Effector Systems from EADS / TDW – PSTS - 05 - October 18, 2005
Test Results, Cannon Tests with Flash Indicator Charge & Video
Flight Testing, Videos: Taurus FV1 and FOM
Flight Testing, Videos: Taurus FV1 and FOM
The End

EADS / TDW wants to work U.S. and Coalition Forces Warfighters' priorities!

Thank you for granting this opportunity to help you get more from us.

Thank you for your attention!

Dr. Helmut Muthig
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TDW Gesellschaft für verteidigungs-technische Wirksysteme mbH

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