ERDC
Engineer Research and Development Center

Benefit of ESTCP/SERDP Research Program on Underwater Explosive Safety

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NAVSEA
CRANE
Surface Warfare Center Division

Problem Statement

- DoD has very few options for disposing UXO recovered from underwater
- DoD has no options for disposing UXO in sensitive marine environments
- DoD probably has a really, really big underwater UXO liability, and
  - ► It hasn't come to grips with it…yet, or,
  - ► It's waiting for an economical way to deal with it

2B THE GAINESVILLE SUN LOCAL & STATE THURSDAY, JULY 5, 2007

Around the Region

HAVE A NEWS TIP? ■ Call 374-5093 Mon.-Fri. and 374-5085 weekends. | A QUESTION ABOUT COVERAGE? ■ Call 374-5035 or 374-5040. | CALL SOUND OFF WITH YOUR OPINION ■ 337-0368

POLICE BEAT

Area man charged with assaulting senior citizen

■ A Gainesville man was arrested Wednesday for hitting a 70-year-old man with a BB gun and robbing him, Gainesville Police reported.

Police reported that Avery Tyrone Godbolt, 20, approached the man about 8:30 a.m. as he was walking on the 1400 block of East University Avenue.

Godbolt pointed what appeared to be a semiautomatic handgun at the man and demanded money, police reported.

After the man refused to give him money, Godbolt hit him over the head with the gun. He then took $87 from the man's pocket and fled, police reported.

The victim was later being treated in an ambulance when he saw Godbolt walking past and told police "that's the man who robbed me," according to the report.

An officer conducted a pat down of Godbolt and found a BB gun that resembled a semi-

AP Photo/St. Augustine Record, Caron Dean

Bomb on beach detonated in Jacksonville

Members of the Explosive Ordinance Disposal team of the St. Johns County Sheriffs Department and the Navy detonate a bomb that was discovered Wednesday on Crescent Beach. The bomb, estimated at 100 pounds, forced evacuation of the beach and nearby residents. The bomb, believed to have washed ashore Wednesday morning, was found by a woman walking her dog.

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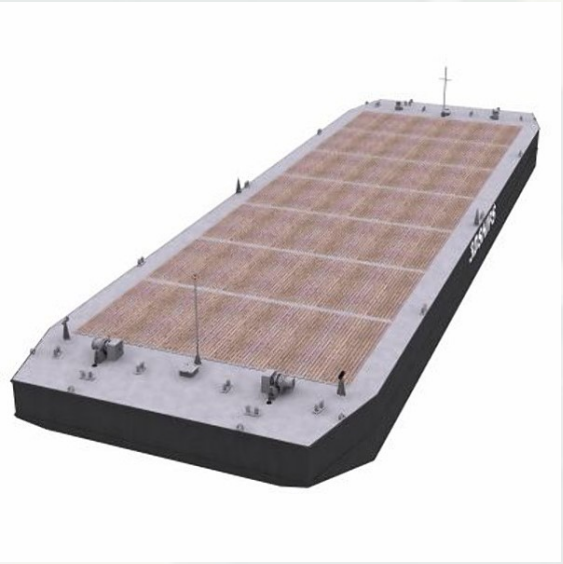
Problem Statement

- There are two currently available UXO and DMM disposal options:
  - Tow them to shore or out to sea and blow them up
  - Blow them in place (BIP)

- BIP is *not* an option in sensitive habitats
- BIP or blow at sea are not an option when protected or marine mammals may be present
- These operations are inherently *dangerous!*

Proposed Solution

- Develop mobile, reusable blast box that can be deployed on standard work barges for use in demolition of found underwater UXO
  - Design box for multiple (potentially infinite) uses
  - Reduce potential for barge damage to near zero
- Reduce hazard potential for personnel involved in demolition efforts.
- Minimize negative impacts on marine environment.
- Define positive mitigation efforts to offset environmental impacts.



Technical Approach

- Field Experiments
  - Conducted to collect data pertaining to transmission of sounds waves from the source of the explosive, through both the open air and the box and barge system, into the water column.
  - Will provide information related to expected impacts on marine environment
  - Will provide V&V data for numerical modeling efforts
  - Used as a sanity check for the 1/3-scale blast box design
  - Can potentially be used to develop relationship between airblast at surface and recorded decibel levels recorded by hydrophones (ERDC capability exists)
  - Can potentially be used to develop relationship between accelerometer data and hydrophone data to correlate pressure and particle velocity to decibel level recorded by hydrophones (Instrumentation needed)

Technical Approach

- Numerical Modeling
  - Uses field data to correlate expected parameters beyond the range of net explosive weights that can be tested in field experiments
  - Can provide expected full-scale loadings and impacts on V&V is complete
  - Used to double check structural adequacy of the blast box
  - Used to guide experimental process
    - Able to identify predict increased load from airblast transfer into water
  - Can be used qualify/quantify potential mitigation effects on pressure transferred to marine environment
  - Can potentially be used to develop relationship between airblast at surface and recorded decibel levels recorded by hydrophones (more field data needed)
  - Can potentially be used to develop relationship between accelerometer data and hydrophone data to correlate pressure and particle velocity to decibel level recorded by hydrophones (more field data needed)

Technical Progress - Experiments

- 55 Experiments conducted to date (2016 – 2017)
  - Blast box has not shown any signs of damage – scaled explosive weight has far exceeded anticipated prototype weapon sizes
- Two separate experiment setups conducted
  - HE in blast box, on work barges
  - HE suspended from cable above water; no structural interaction from blast box and barge system
- Hydrophone data collected on every event
  - Original experiments did not provide conclusive evidence regarding the modes of soundwave transfer from demolition into marine environment
  - Second experiment set designed to isolate the airblast itself; remove vibration of the box & barge system
  - We are progressing towards a quantifiable result, but we have more work to do

Technical Progress - Experiments

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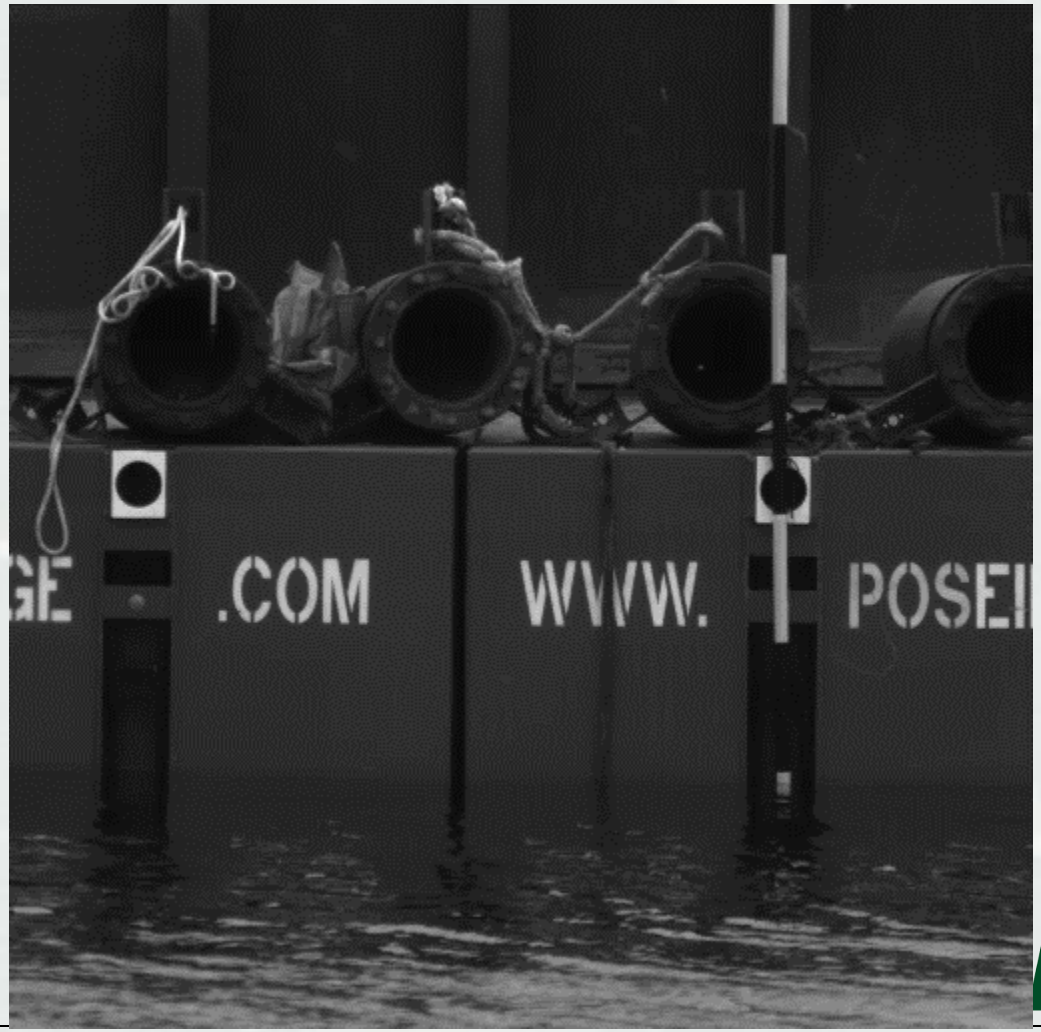
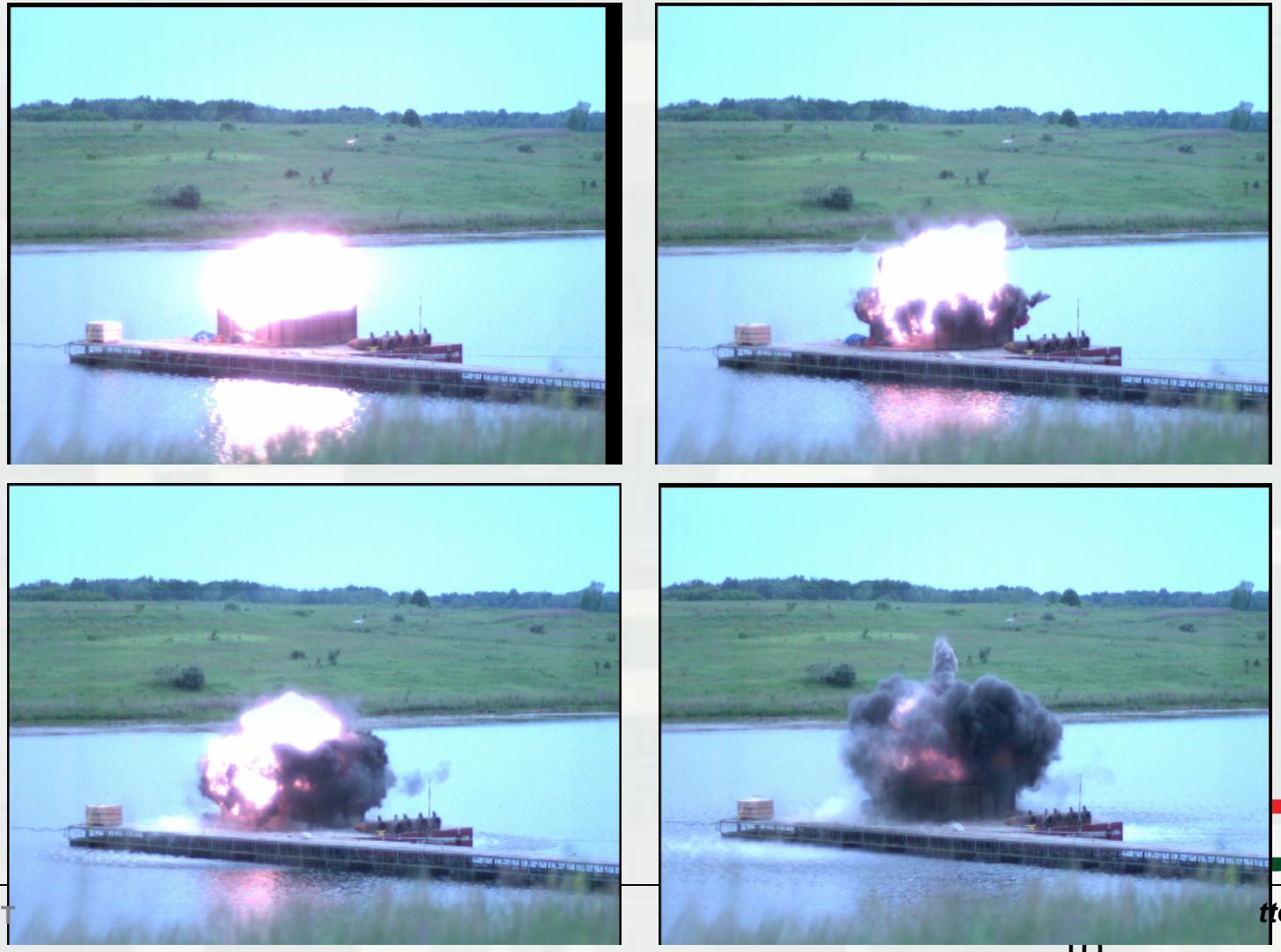


Technical Progress - Experiments



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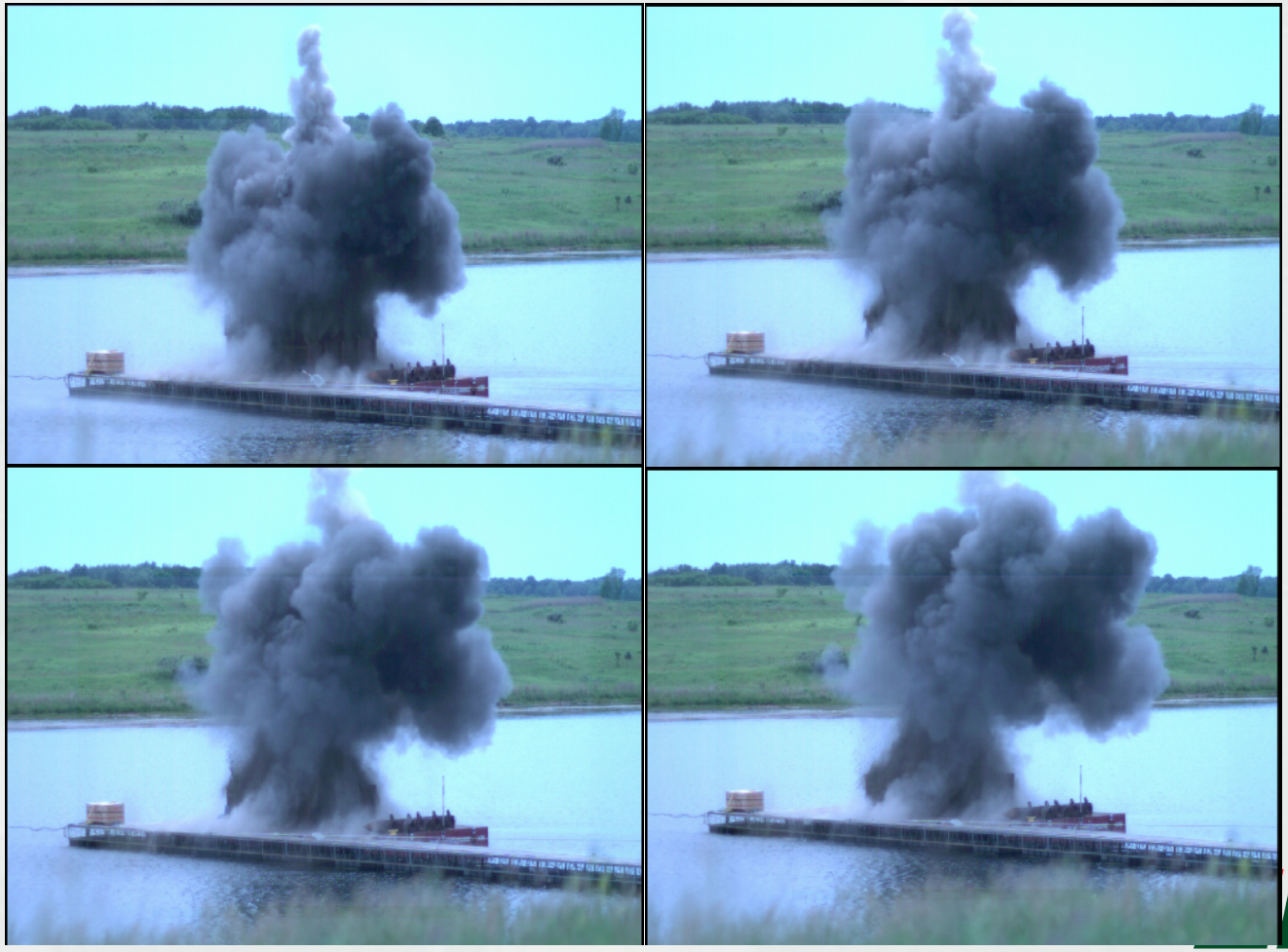

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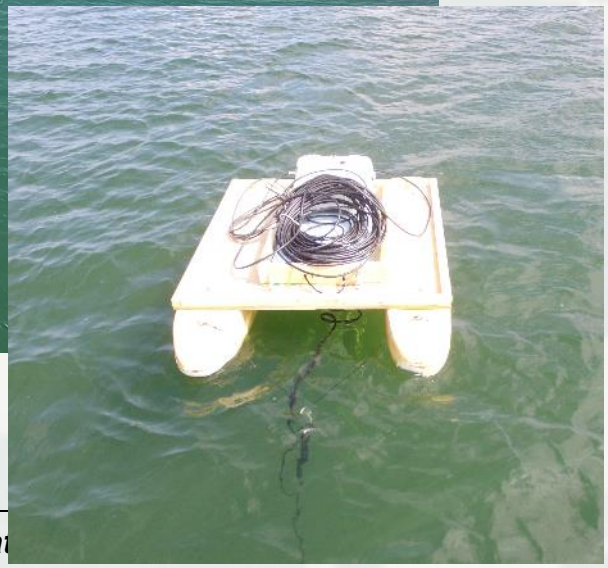

Explosives Effects on Marine Animals

- Anthropogenic noise is of great concern to marine species
  - Primary focus is on marine mammals
  - Invertebrates and fish will be consider for long-term success

- Three level of effects
  - Sub-lethal effects that create or alter hearing, behaviour, social interactions, fecundity (fitness) and performance
  - Lethal effects that cause direct harm that results in indirect or direct mortality
  - Indirect effects such as changes in food web

Assessment of Explosive Effects on Marine Animal

- NOAA 2016 “Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing”
  - No biological data on above surface explosions coupling to water
  - Limited biological data for model incorporation
  - Limited biological data on low-frequency effects
  - Key metrics: weighted SEL & unweighted peak SPL thresholds

- Actions for FY17 Q4 and FY18:
  - Consult within DOD, DOE, partnering companies and stakeholders
  - Collect data on detonation signals and effects on tissue
  - Model underwater propagation of surface explosions
  - Examine alternative protective mechanisms

Technical Progress

- In-air experimental design and analyses
  - Locations 100, 250, 500, 750 feet from C4
  - Depths 15 and 30 feet
  - FFT transformations
  - Power spectral density
  - Spectrogram
  - Peak sound pressure levels (SPL_{pk} dB re 1µPa)
  - Cumulative sound exposure levels (SEL_{cum} dB re 1µPa-s)
  - SPL by Audiogram

- Teledyne/Reson hydrophones
  - Receiving voltage sensitivity -206 dB re 1V/µPa (± 3dB)
  - Usable frequency range 1Hz to 120 kHz
  - Sampling rate 44 to 96 kHz

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Future Anticipated Associated Research

- Develop “Locate and Recover” system that would be remotely operated
- Develop remotely operated, barge-mounted crane to lift UXO onto barge system after surfacing

- End Result – Significant reduction in personnel risk

Findings

- Structurally, the box and barge system is sound
  - Repeated scaled experiments
  - No structural damage, even with scaled munitions up to 1000 lbs, prototype
- Environmental Impacts still be investigated
- Additional experimentation and modeling is required to determine sound level introduced in marine environment

Questions?

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