



Submarine
Delivery Agency

2024 Naval Damage Control Conference Emergency Buoyancy System

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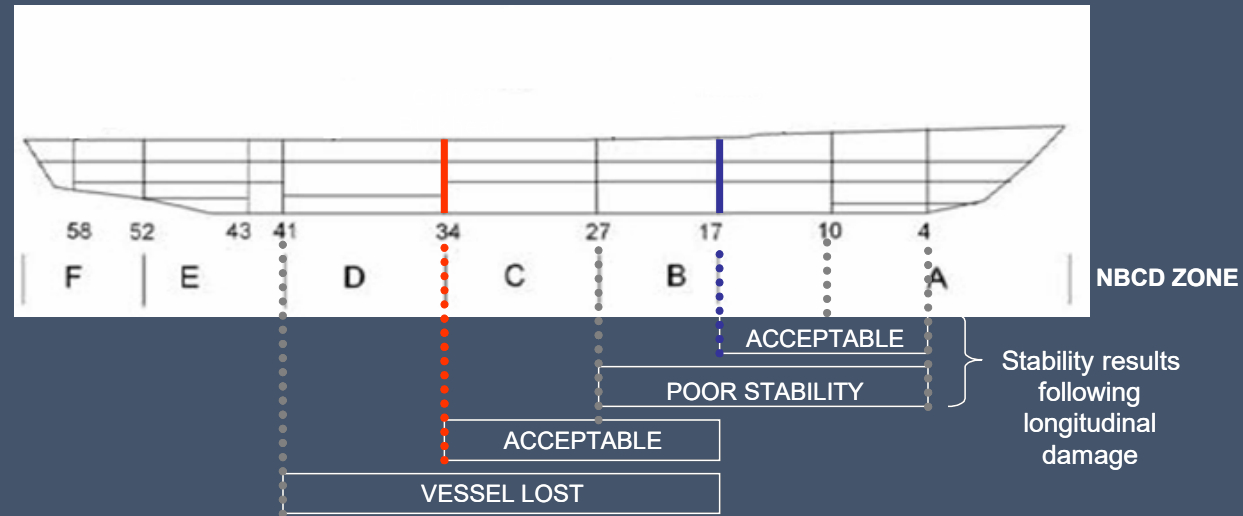


Emergency Buoyancy System

1. The Need
2. Demonstration of Effectiveness
3. System Design & Assurance
4. Physical Demonstrator
5. Applications
6. Summary and Questions

Emergency Buoyancy – The Need

There will be instances where flooding spreads to areas in a ship which will lead to loss through capsizing or foundering.



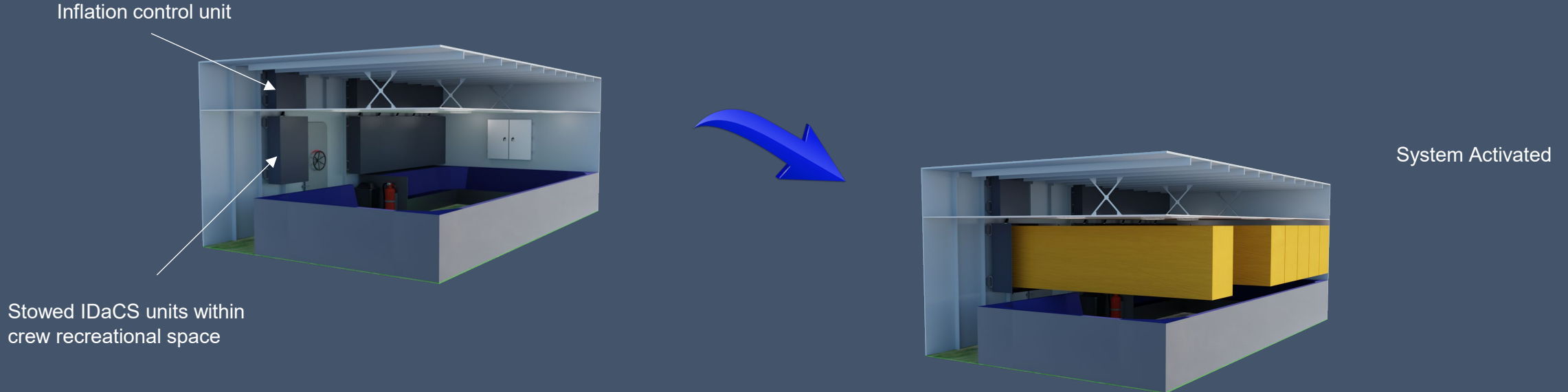
Is there a rapid cost-effective damage control measure that can prevent loss with lean crewed ships ?

Emergency Buoyancy - Development

Defence and Security Accelerator Programme 2021/22



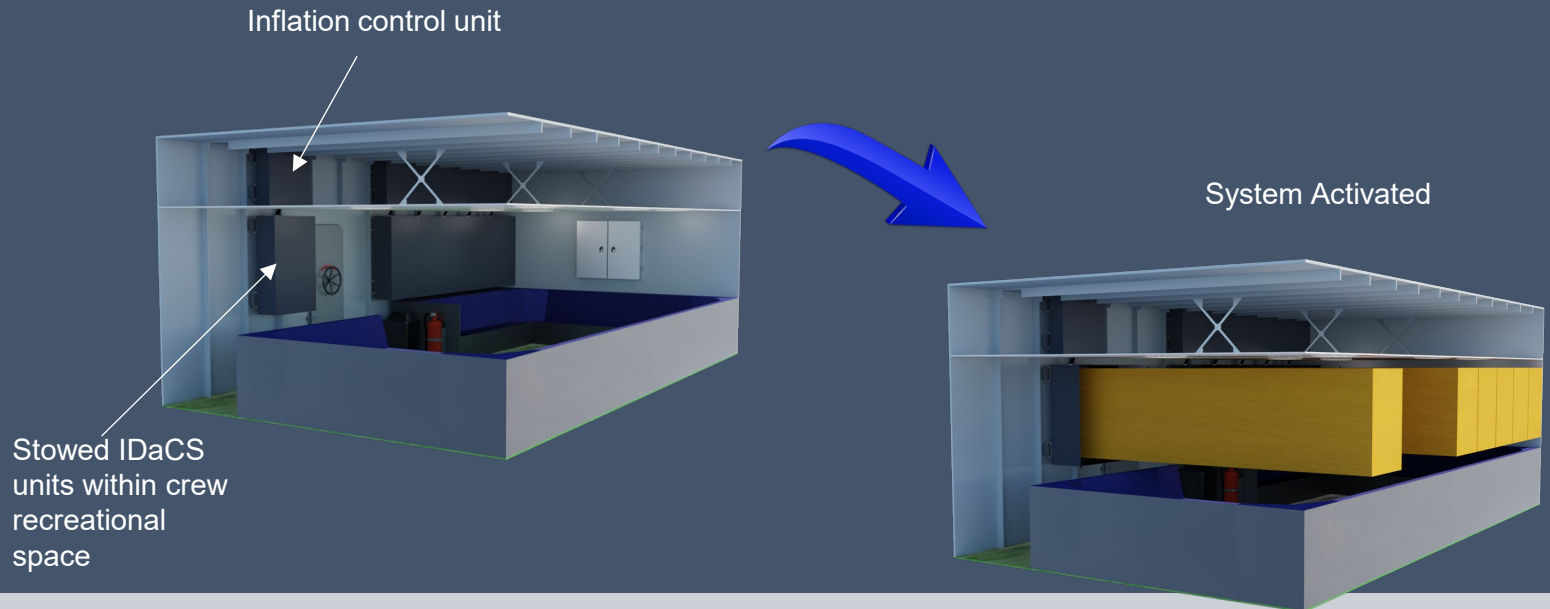
IDaCS (Inflatable Damage Control System) – A concept system designed to provide emergency buoyancy to a damaged vessel by influencing features such as heel, trim, loss of buoyancy/draught and damaged reserve of stability. The IDaCS system is designed to be inflated under the positive control of the DCO, displacing water from a damaged compartment and thus providing emergency buoyancy and increasing the waterplane area.





Emergency Buoyancy - Development

Prove the feasibility of the technology:
Global Design Performance
Proof of Concept
System Design
Design Standards and Assurance
Demonstration



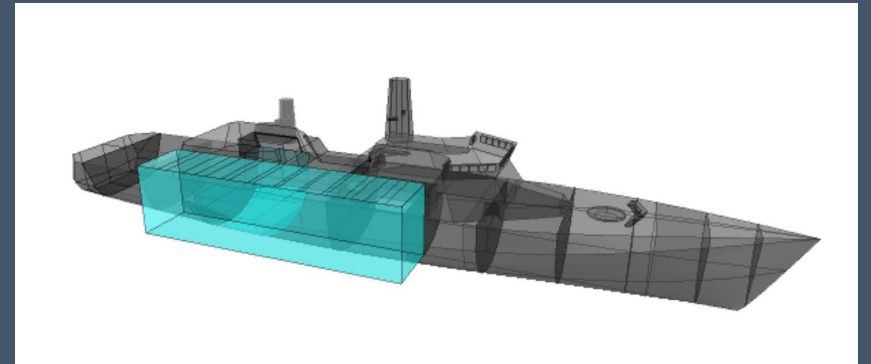
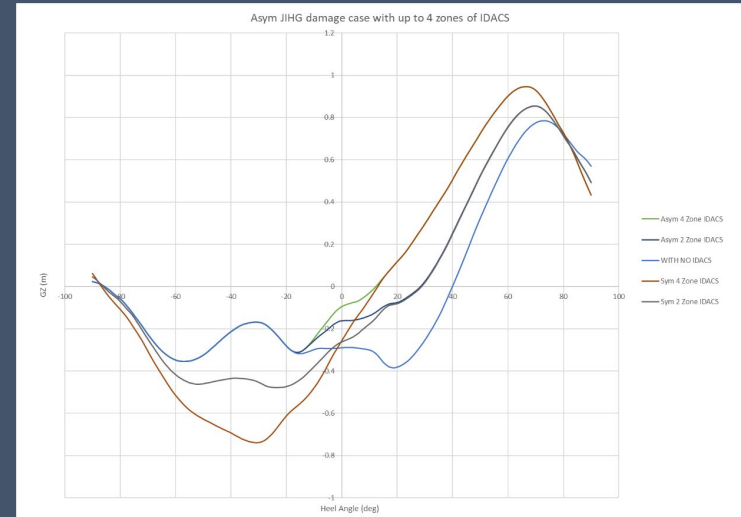


Emergency Buoyancy - Development



Global Design Performance

- Confirm the effectiveness of IDaCS in providing emergency buoyancy for a range of representative vessels;
 - Destroyer - Retrofit approach
 - Frigate – New build approach
 - Patrol Ship – Retrofit approach
- Comprehensive assessment of the ship is required to understand the location and size.
- Two roles, save the ship and or improve the attitude to aid DC activities.
- Key Conclusion – Increase of waterplane area is key



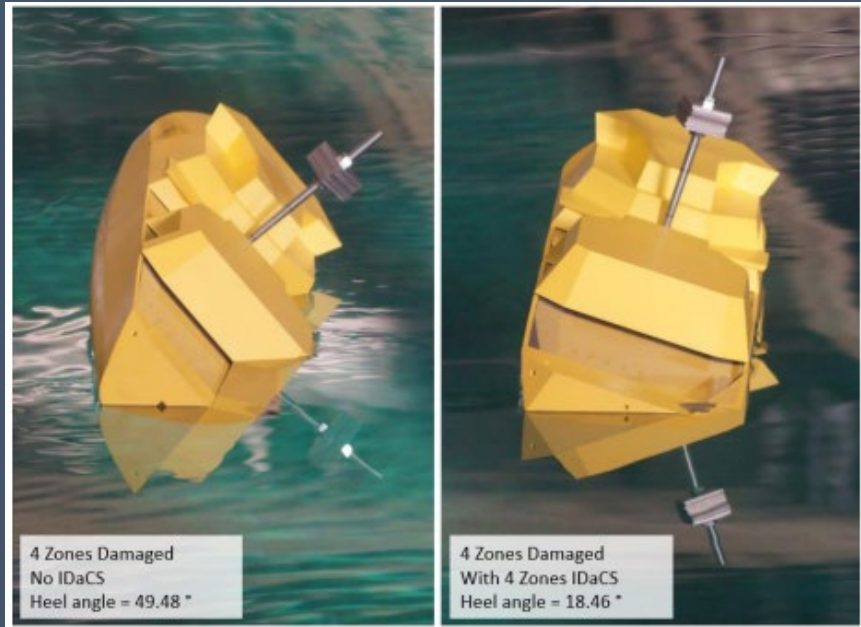


Emergency Buoyancy - Development



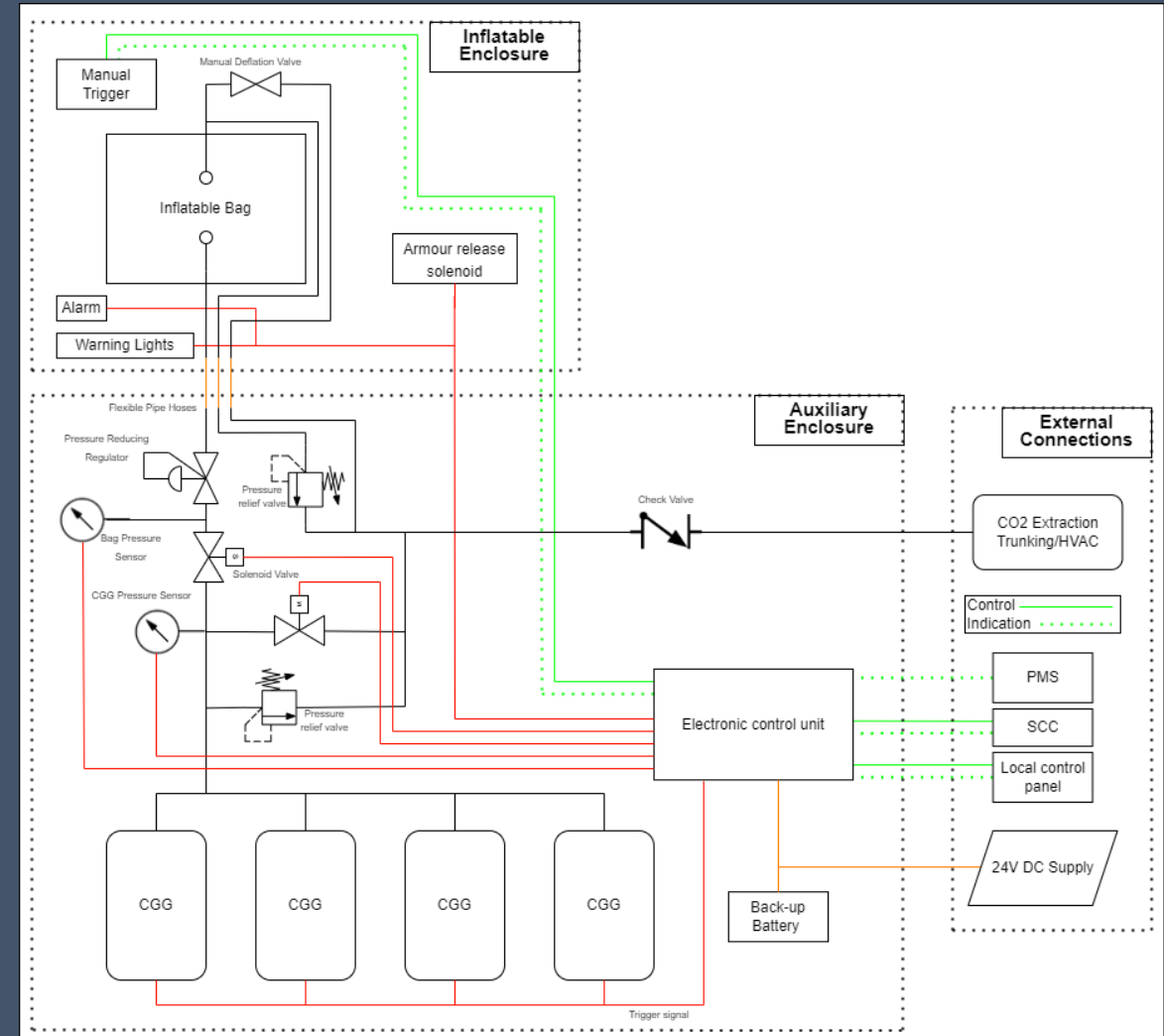
Proof of Concept

- Model Testing of Frigate (using foam inserts to mimic IDaCs)
- 4 Watertight zone flooding with and without IDaCs in waves.



System Design

- The IDaCS system is comprised of multiple self-contained units comprising:
 - Inflatable enclosure – Inflatable bag, alarms etc
 - Auxiliary enclosure – Gas generators, controller, pipework, valves etc
 - Use of nitrogen producing Cold Gas Generators (CGGs)
- Local or remote-control with similar safety features to CO2 drench.
- Battery back-up
- Low Maintenance





Design Standards and Assurance

- Establish a formal process for assurance of a design by the Naval Administration and a Classification Society.
- Key assurance elements
 - Buoyancy Performance
 - System Design & Equipment Selection.
 - Installation & commissioning
 - Through Life Survey & Testing

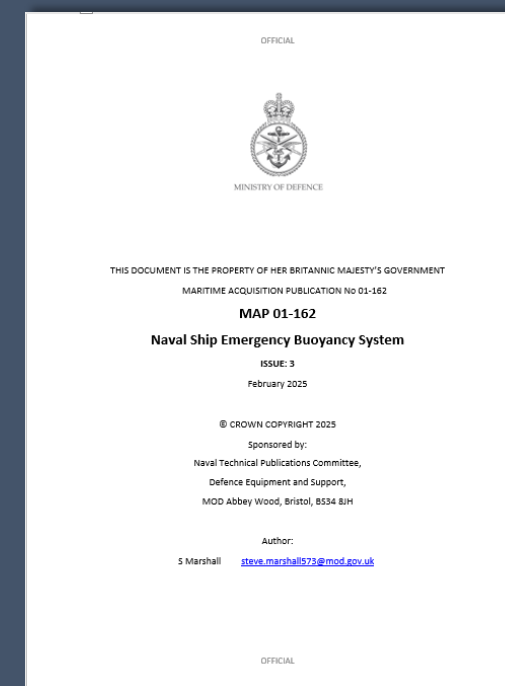


Design Tenets

- Units symmetrical port and starboard.
- Unit volume around 10% of Zone Deck volume as a starting point.
- Not to be used to remedy failures in compliance with the stability safety certification standard.
- Location does not have adverse effects on ships crew.
- No adverse effects on ship essential services.
- No adverse effects on stability structure, fire safety, hull integrity or escape & evacuation.
- Position Bags around the expected damage waterline(s)
- Maximise the righting lever, place as far out board as possible and maximise length of units.

Performance and Construction Requirements

- Development of Maritime Acquisition Publication containing:
 - General Requirements
 - Electrical Control System
 - Gas Supply System
 - Safety – Alerts and Indicators
 - Enclosures
 - Inflatable Bag
 - Installation & testing
 - Maintenance
 - Standard and Emergency Operating Procedures
 - Deflation





Classification Society Assurance

- IDaCS will be treated as a novel life saving appliance.
- If fitted it must work, thus certification of the system is required following MSC.1 Circ 1455(4)
 - Step 1 Engineering Evaluation (design appraisal)
 - Step 2 Witnessed manufacture and testing processes
 - Step 3 Evaluation of manufacturing arrangements
 - Step 4 Management of certification over life.
- Approach by Lloyd's Register will follow their Risk Based Certification procedures
- Approach by Det Norske Veritas will follow their Technology Qualification Pathway

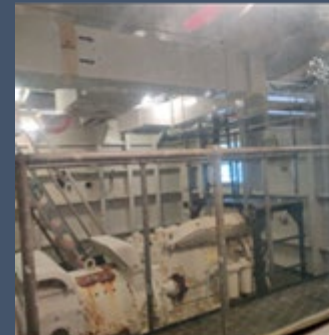


Emergency Buoyancy - Development

Demonstration:

- To design and build a demonstrator IDaCS unit that will be inflated in a representative ship compartment (DRIU)
- Goal to fully test the system in a flooded compartment

[Sinking Ship Simulator: The Royal Navy's Damage Repair Instructional Unit – YouTube 6min](#)



Demonstration:

Bag Casing

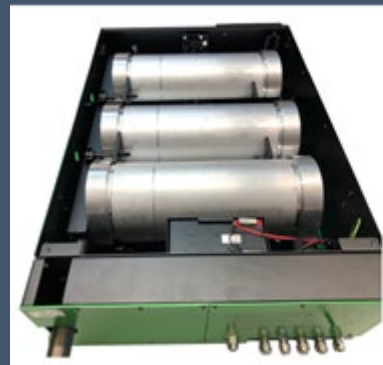
- GRP Case split into two sections
- Magnetic armature attached with adjustable straps
- Attached to bottom of Bag

Bag Release

- Electromagnetic boxes
- IP68 rating
- Energised to release

Cold Gas Generator

- 25kg
- Pressure <5 bar



Function

- Energise-to-hold and energise-to-release versions
- DC, or AC supply with rectifier plug

Construction

- Fully sealed assembly
- Monoblock IP68 pole faces
- High temperature, zero halogen cable
- Die-cast aluminium box, grey finish painted

Applications

- Suitable for marine and wet environments
- Fire doors, shutter, grills, smoke vents, access security

Standards

- Electromagnet designed and tested to VDE 0580
- Manufactured to ISO 9001

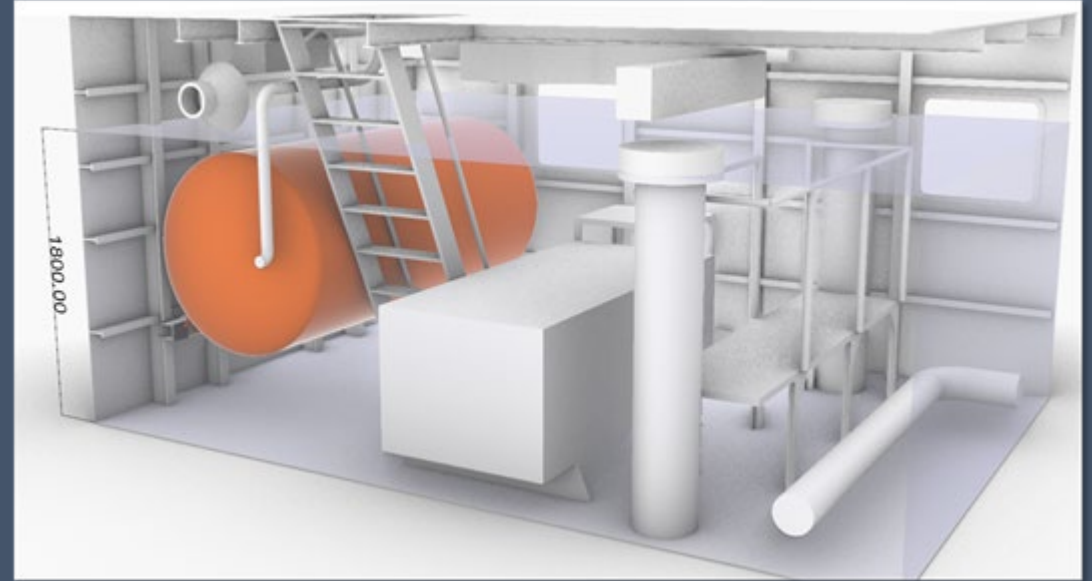
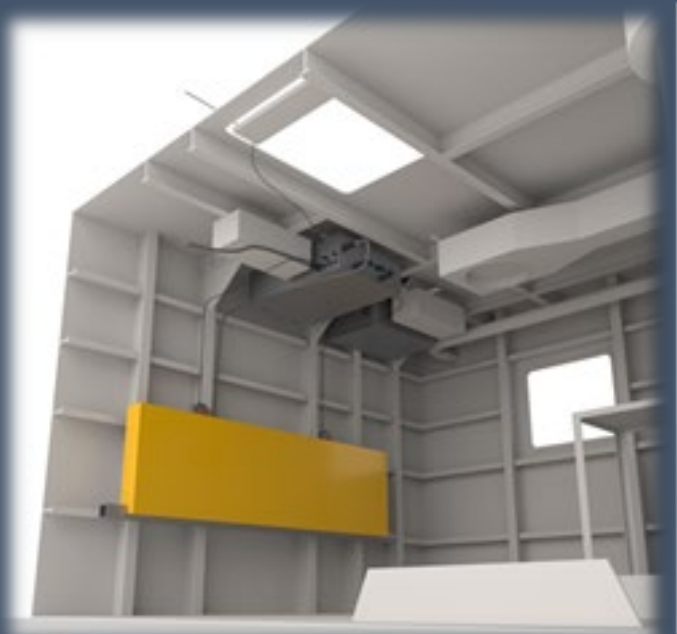


Fig. 1 Boxed Magnet



Emergency Buoyancy - Development

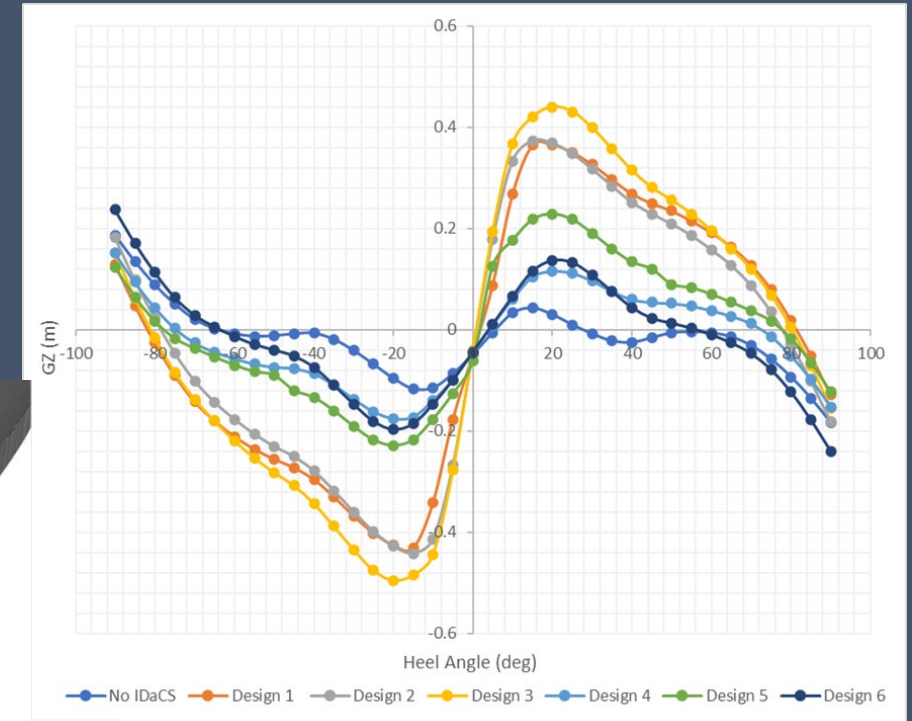
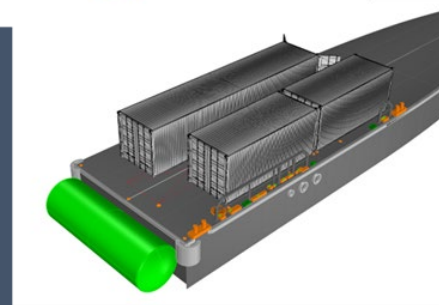
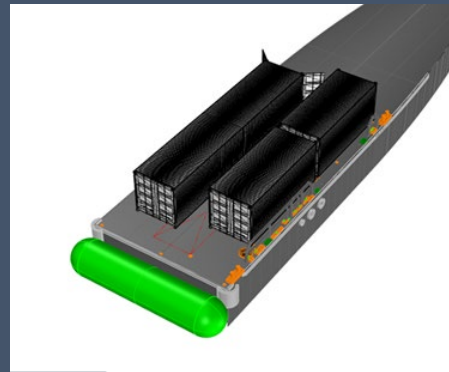
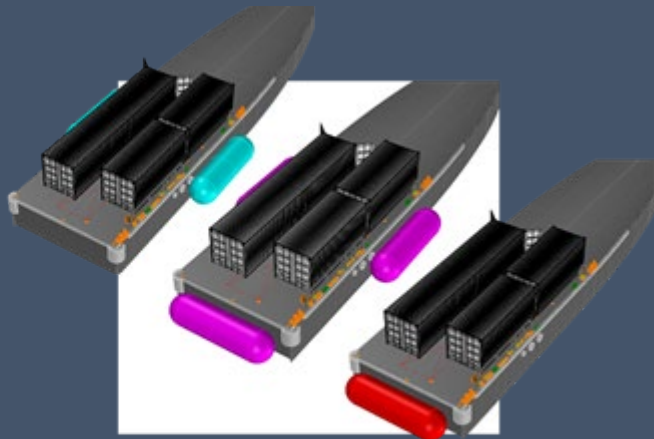
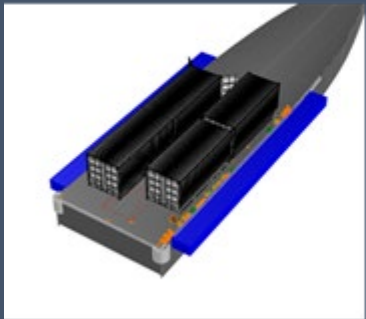
Demonstration mid 2025:



Patrol Ship Application

Location and Sizing:

- No room in key compartment
- External mounting only with variety of options



Patrol Ship Application

Location and Sizing:

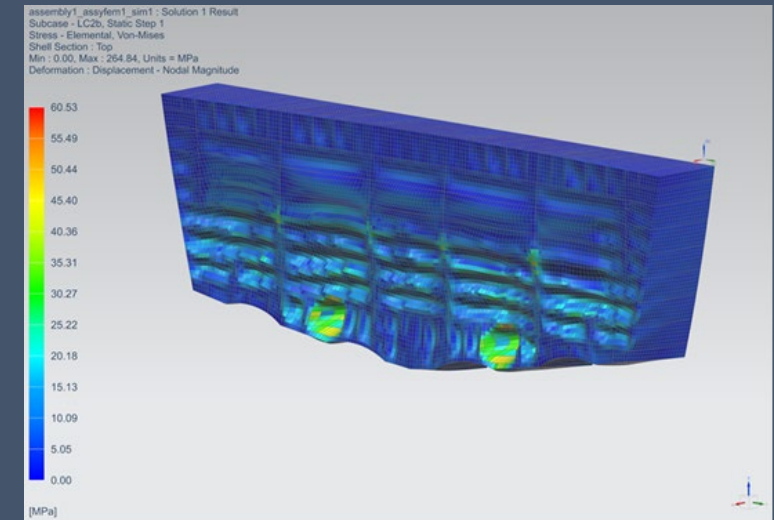
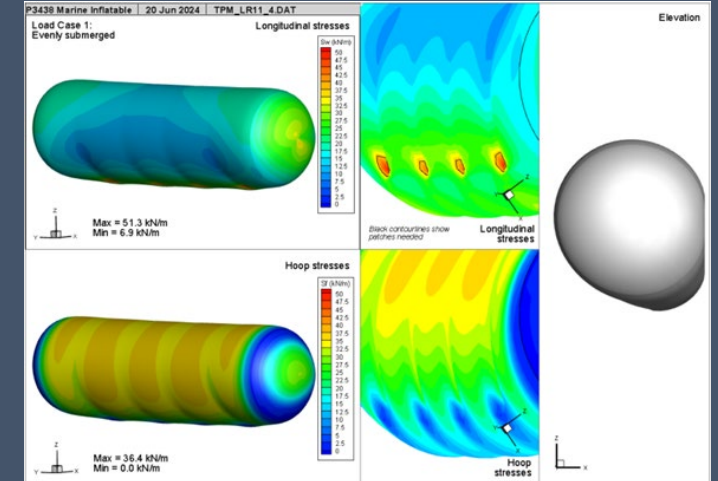
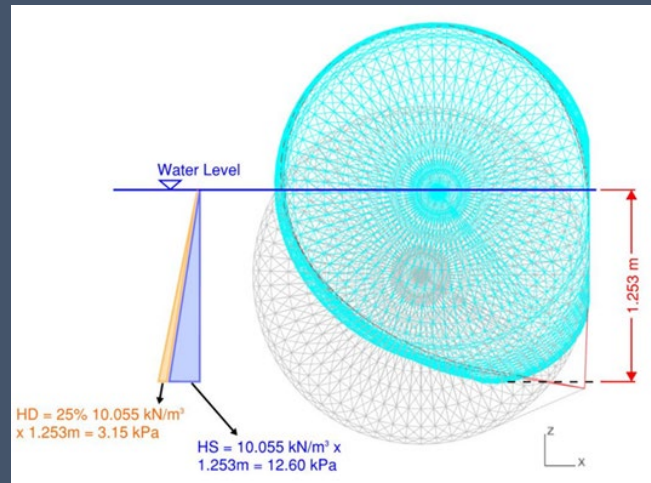
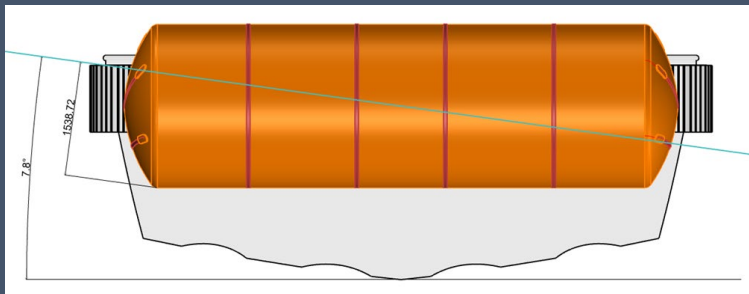
- Transom mounting – effective in all damage cases
- Hard Plastic Cover to provide clear evidence of damage
- 3% packing ratio
- Release options are interference fit, mechanical fuse, actuated release
- Overpressure / deflation vent – non-return valve



Patrol Ship Application

Design Detail :

- Load cases – Symmetrical and Asymmetrical
- Wave & hydrostatic pressures
- Temperature ranges -30C to 50C
- Bag internal pressure 0.5bar
- Bag Stress Safety Factor of 5
- Verification of mounting structural capacity



Summary

Overall Benefits of IDaCS;

- Reduces the risk of losing the platform – increase in platforms reserve stability
- Increases in the survivable damage extents
- Postpones abandon ship order allowing more time for damage control activities
- Reduces heel and trim allowing crew to move more efficiently around the ship
 - Improved crew ability to respond to a damage scenario
 - Improved launch of life saving equipment
 - Reduction in crew evacuation time
- Increases the probability of a platform surviving in a seaway without a crew conducting damage control activities
- Facilitates reductions in crew numbers
 - Reduced operational cost
 - Removing crew from harm's way
 - Reducing the crew space requirements allowing for further IDaCS
- Cost of system versus impact of warship loss.





Emergency Buoyancy

Questions?

