



System Design Evaluation Ltd

# Maritime Explosives Safety Assurance

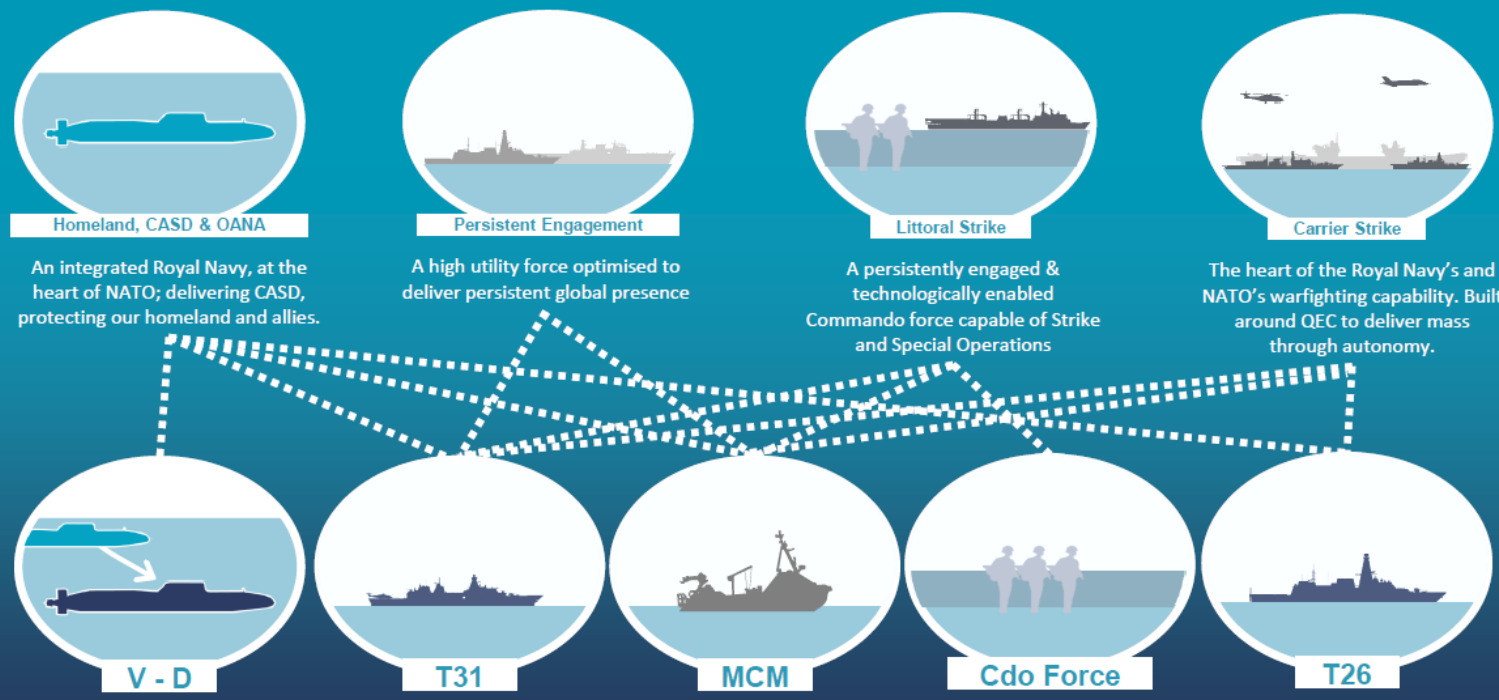
**Gareth Bex and Phil Pitcher**

**18 April 2023**

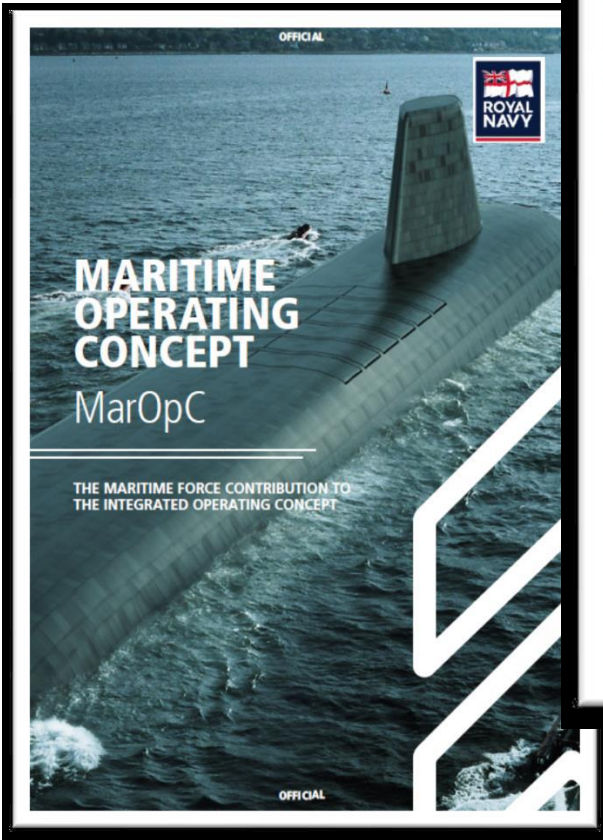
## Strategic Context – Transition to a Future Force



### Force Level Outputs



### 5 Key Transitions

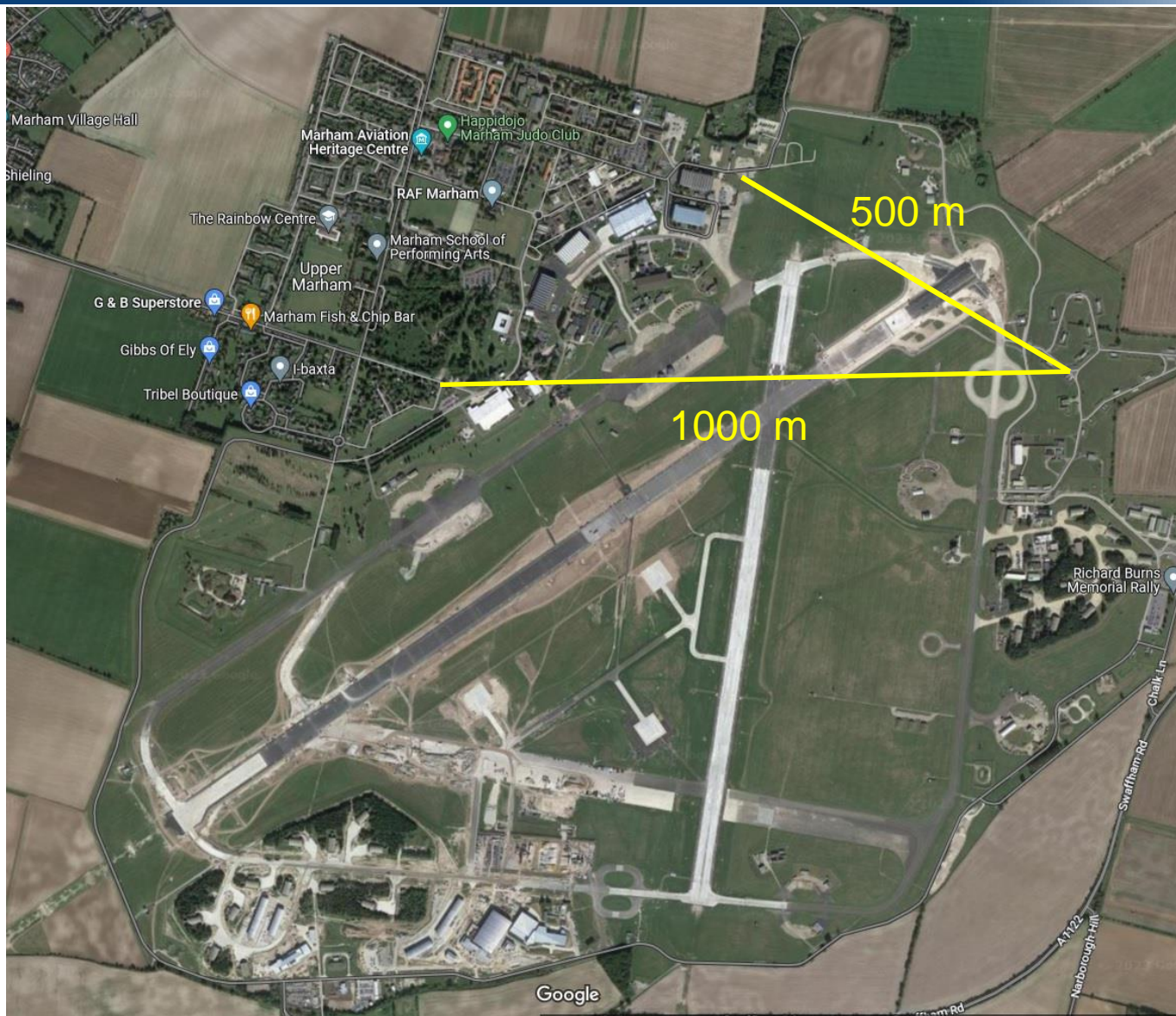


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# Why is maritime afloat different?

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Magazine to Fuel Tank

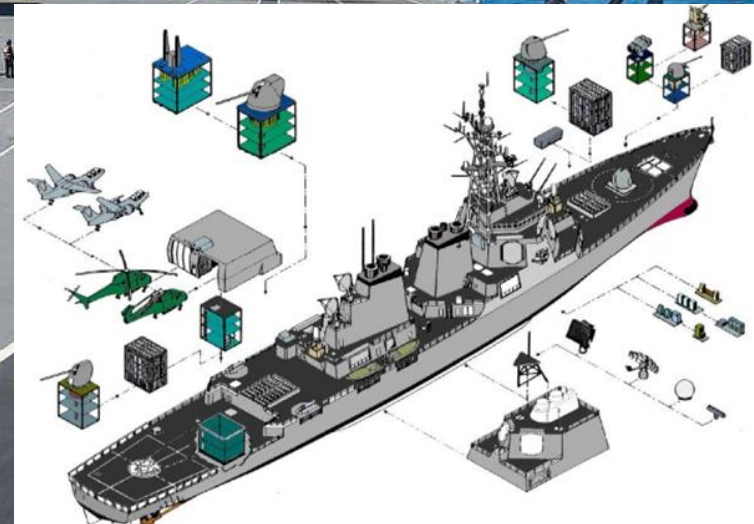
- ~2 m (water) plus ~25 mm (steel)

Magazine to Accommodation Spaces

- ~1 m (air) plus ~10 mm (steel)

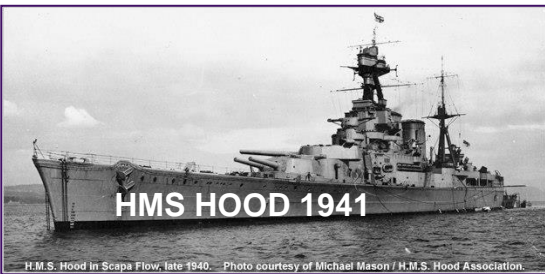
Simple' Quantity Distance rules cannot be achieved – complicating factors:

- Saltwater Environment
- Proximity to Hot Machinery
- Proximity to High Voltage Electricity
- Proximity to rf emitters
- Bad Weather – Ship Movement
- Proximity of other vessels
- Grounding
- Terrorist/Enemy Action



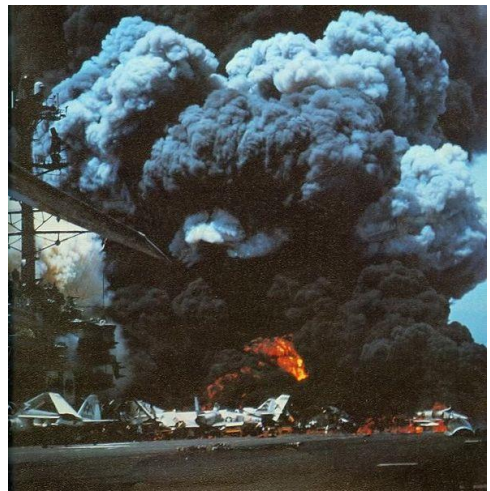
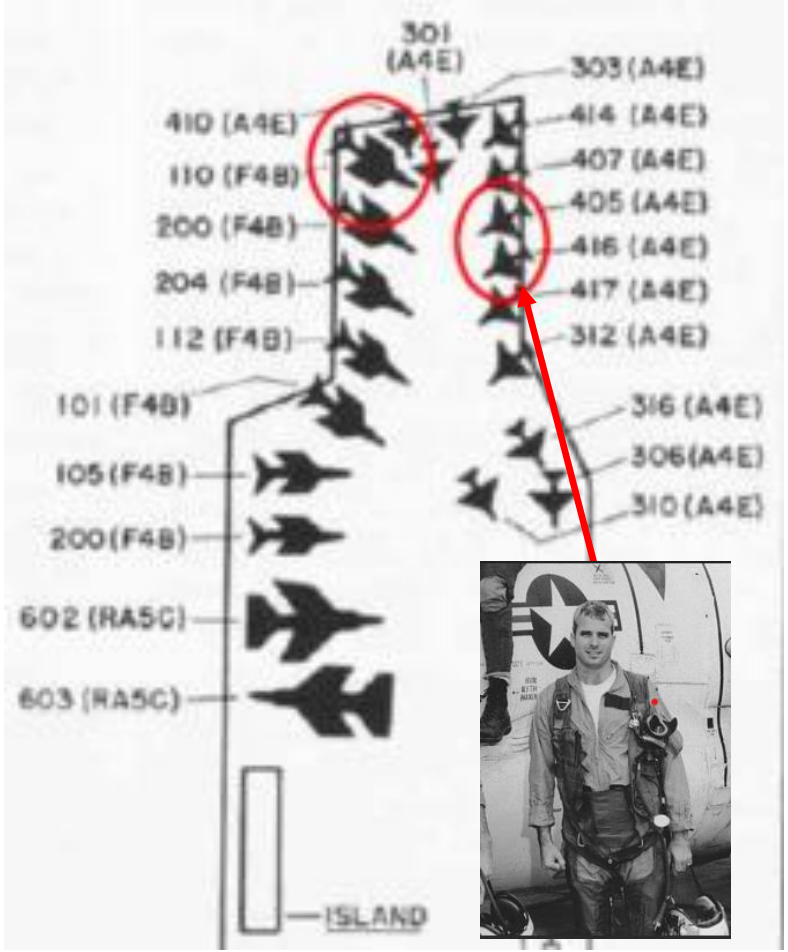


# When it goes wrong....it can really go wrong!



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# USS Forrestal - 1967



- 134 Dead
- 161 Injured
- Cost \$72M (excluding aircraft)
- 20 aircraft destroyed

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# USS Forrestal – two key findings to avoid a catastrophic disaster



- **Investigators identified issues with stray voltage in the circuitry of the LAU-10 rocket launchers and Zuni missiles.**
  - The board of investigation stated, "Poor and outdated doctrinal and technical documentation of ordnance and aircraft equipment and procedures, evident at all levels of command, was a contributing cause of the accidental rocket firing".
- **Aging 1,000 lb "fat bombs" carried for the strike, which were discovered to have dated from the Korean War in 1953.**
  - Specialist munitions staff and Captain were reluctant to take delivery of the Korean War era 16 AN-M65A1 bombs from USS *Diamond Head* but when faced with the prospect of having to cancel the next day's sorties, and pressures from Washington pushing the mission tempo, accepted them.
  - The damage control team specializing in on-deck firefighting for Forrestal had been shown films during training of Navy ordnance tests demonstrating how a 1,000 lb bomb could be directly exposed to a jet fuel fire for a full ten minutes and still be extinguished and cooled without an explosive cook-off. However, these tests were conducted using the new Mark 83 1,000 lb bombs, which featured relatively stable Composition H6 explosive and thicker, heat-resistant cases, compared to those embarked from USS *Diamond Head*.

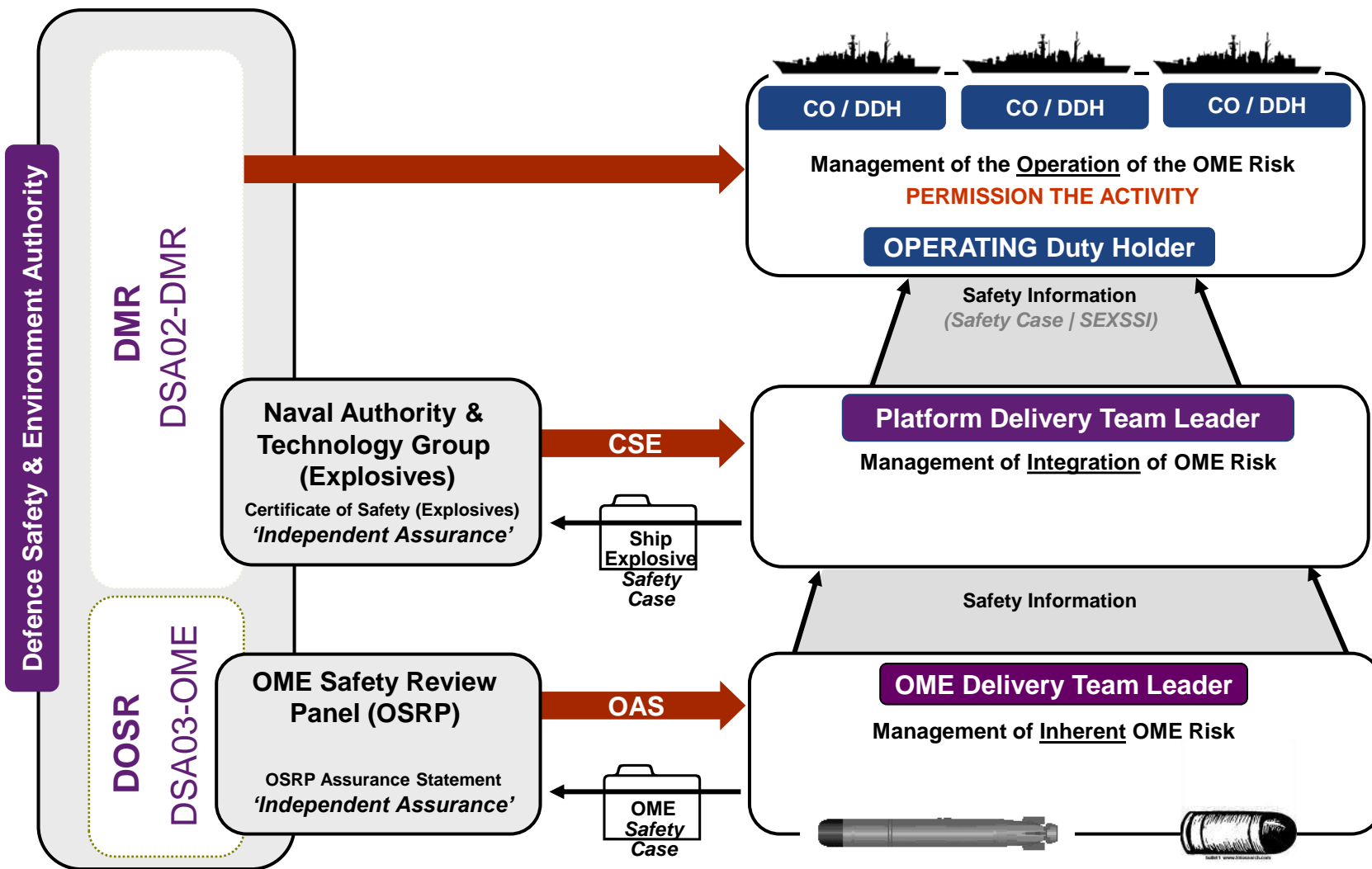


# Regulatory Evaluation, Approval & Certification

REGULATION  
*Regulate*

CERTIFICATION  
*Assure*

DUTY HOLDERS  
*Ensure*



OPERATE SAFELY

SAFE TO OPERATE

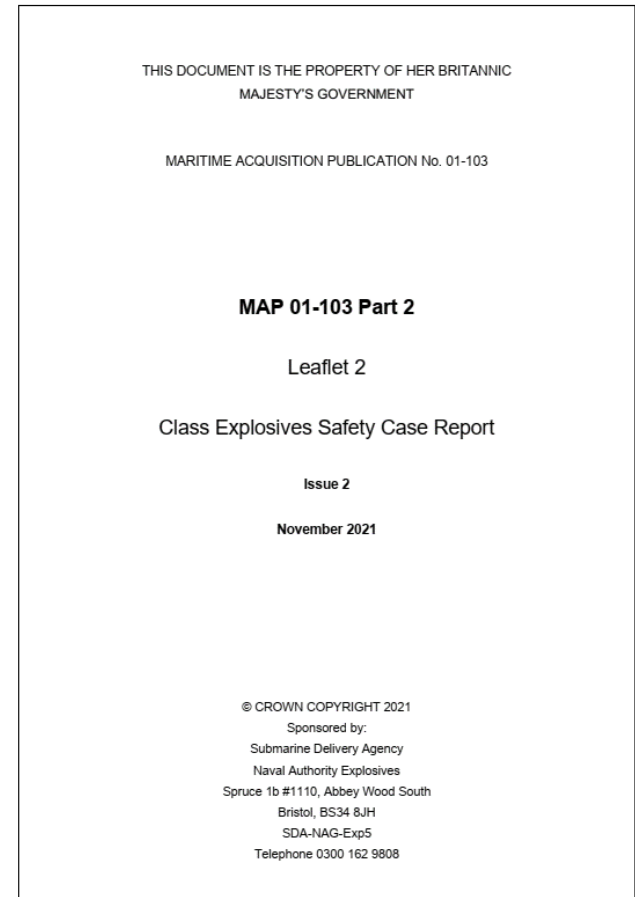


# So how do we provide assurance that WOME can be managed safely in the Maritime Domain?



## Multi-pronged approach:

- **Ensure our WOME is intrinsically safe and cleared for embarkation**
- **Build Warships and Auxiliaries to comply with appropriate Design Standards**
- **Evaluate the threats to and from those embarked WOME**
- **Assess the Risks (ALARP & Tolerable)**
- **Compile a compendium of Safety Evidence (the Safety Case)**
- **Present the results of the above in a Ship/Class Explosives Safety Case Report**



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## MAP 01-103 Part 1

### INTEGRATION OF OME IN MOD SHIPPING (GUIDANCE FOR PLATFORM AUTHORITIES)

Issue 5

June 2022

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Submarine Delivery Agency

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## MAP 01-103 Part 2

### INTEGRATION OF OME IN MOD SHIPPING (GUIDANCE FOR PLATFORM AUTHORITIES)

Leaflets

Issue 3

June 2022

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## MAP 01-103 Part 2

Leaflet 1

Ship Explosives Threat Hazard Assessment

Issue 3

June 2022

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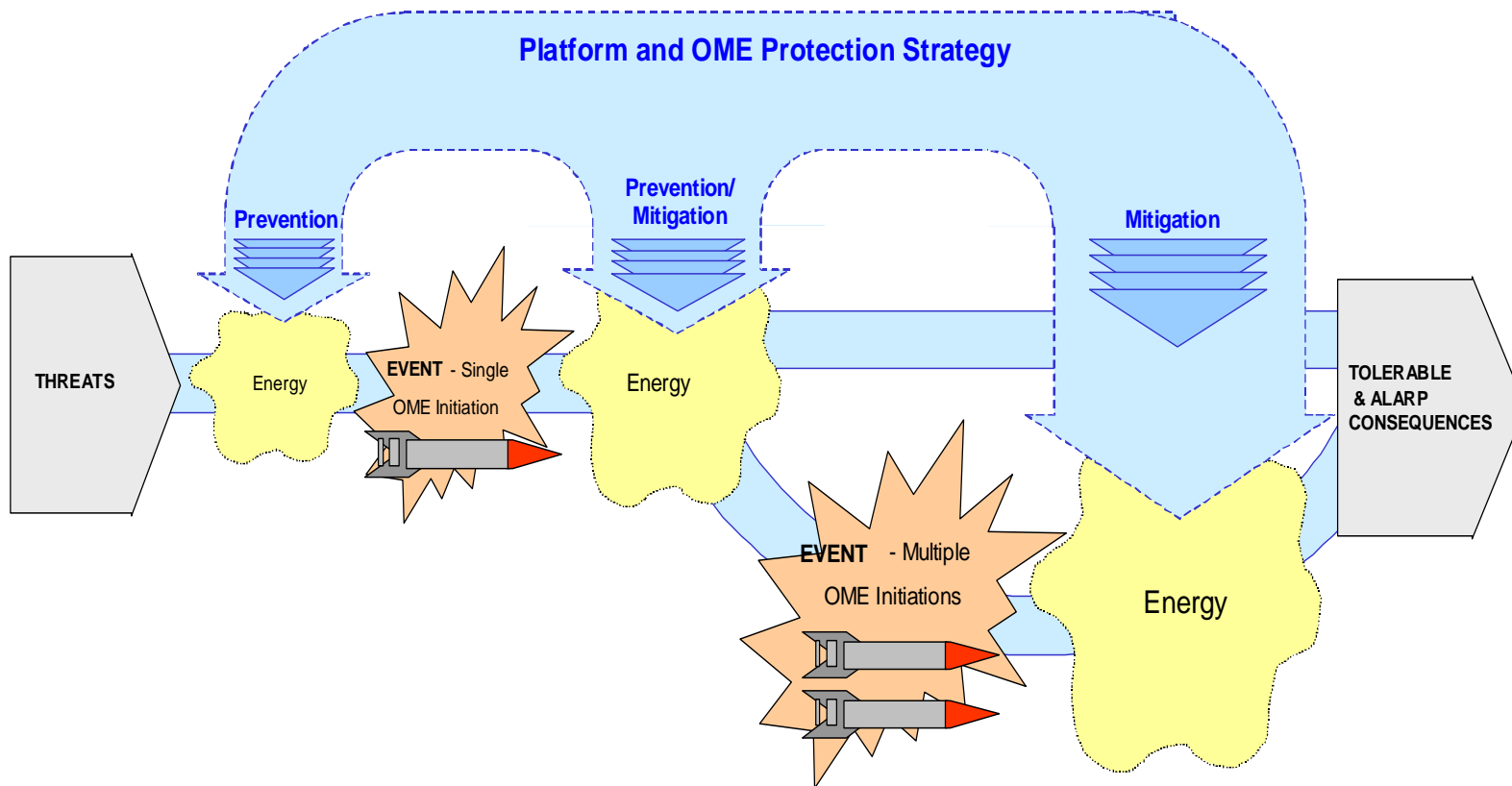
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**Ship Explosive Threat Hazard Assessment (SETHA) methodology**



Basic example of SETHA methodology - detonation of the high explosive shell on left hand side (1<sup>st</sup> Shell).



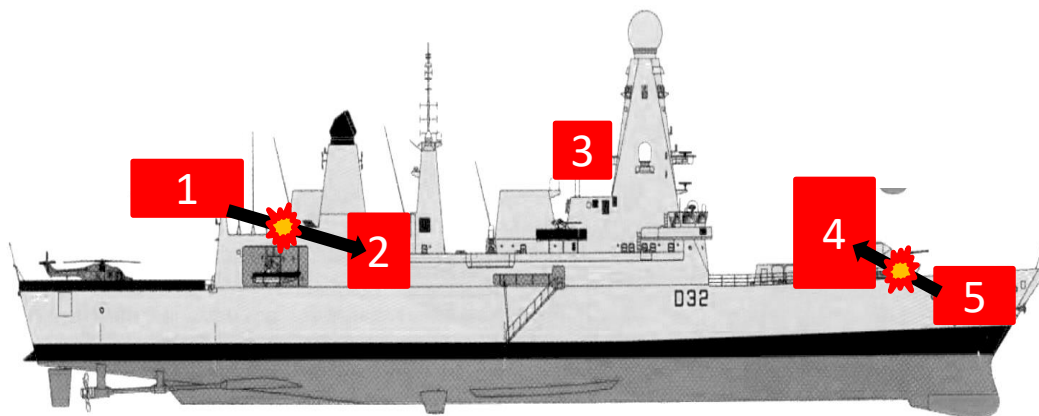
Net Explosive quantity (NEQ) or TNT Eq for each shell is 5kg. The NEQ of three shells detonating sympathetically is 15kg

With mitigation the Effective Net Explosive Quantity (ENEQ) is reduced to between 6 – 10kg



# Advantages platform NEQ vs ENEQ assessments for Warship in Harbour (WiH) hazard statements

Total NEQ for licencing assessment = 6550kg  
 Worst case ENEQ for Warships in Harbour assessment = 1600kg

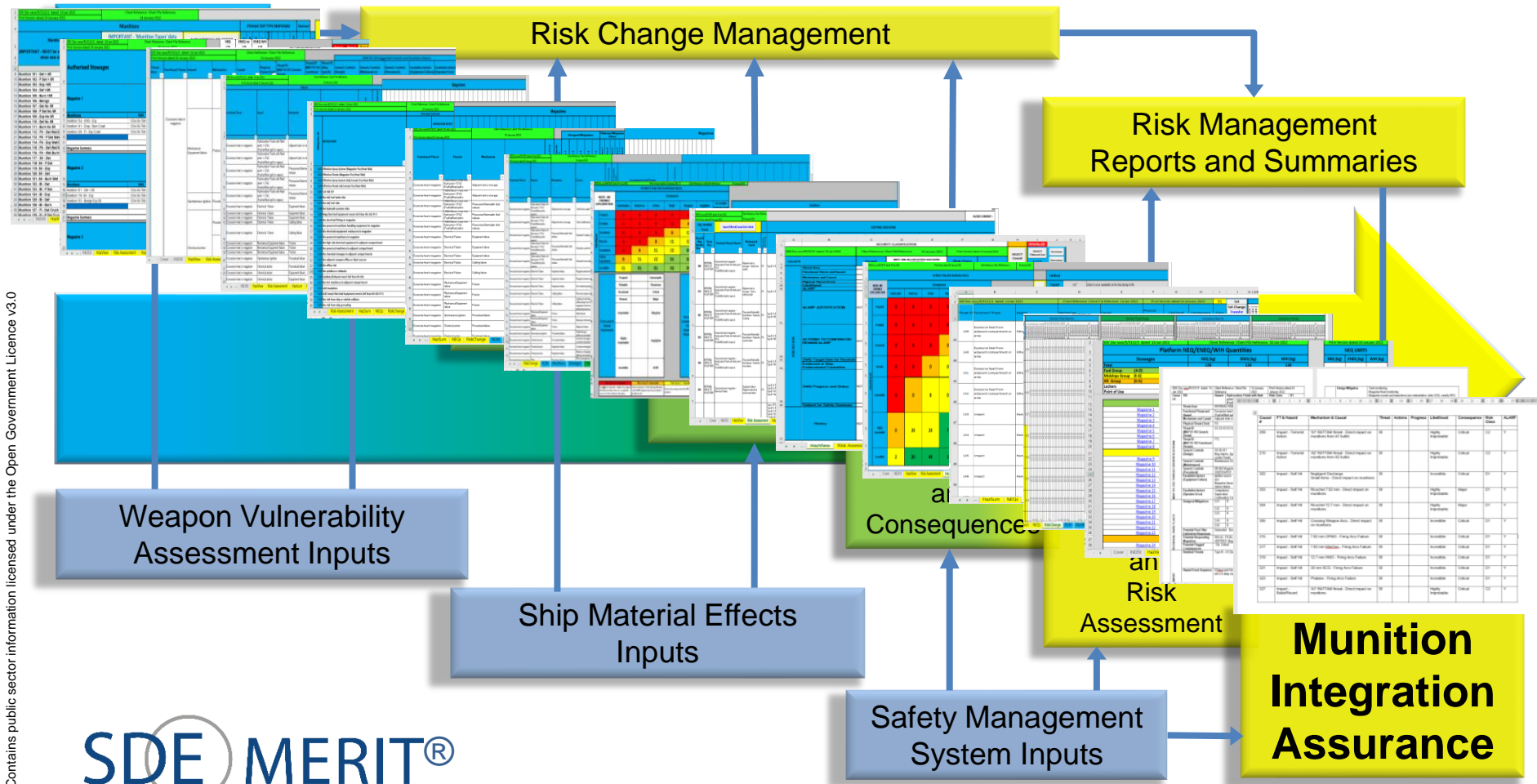


| Magazine | NEQ    | ENEQ   | Communication | Aggregate ENEQ |
|----------|--------|--------|---------------|----------------|
| 1        | 600kg  | 750kg  | Magazine 2    | 900kg          |
| 2        | 250kg  | 150kg  | None          | 150kg          |
| 3        | 200kg  | 100kg  | None          | 100kg          |
| 4        | 5000kg | 1000kg | None          | 1000kg         |
| 5        | 500kg  | 600kg  | Magazine 4    | 1600kg         |

# Whole MOD Assurance Process (MAP 01-103)



A fully auditable end to end process:



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**Maritime Explosive Risk Integration Tool**

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# Questions & Discussion

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