Managing the Wreck of HMS Royal Oak

Dr Polly Hill
Salvage and Marine Operations (SALMO)
UK Ministry of Defence
HMS *Royal Oak*
HMS *Royal Oak* - History

• One of five Royal Sovereign Class Dreadnought Battleships;
• Displacement 29,000 tons, 600 feet in length;
• Designed pre First World War, initially for coal but part way through design process decision taken to switch to oil;
• Took part in the Battle of Jutland in 1916;
• Some modifications in inter-war period including fitting of anti-torpedo bulges.
• While anchored in Scapa Flow in the early hours of 14 October 1939 HMS Royal Oak was struck on the starboard side by four torpedoes fired by U-47;
• The ship capsized, over 800 crew were lost;
• Wreck lies upturned in 30 metres of water with her starboard side down at 145° from upright.
• **Sunk fully fuelled** – **3,000 tonnes** of furnace fuel oil
Wreck Location

United Kingdom

ORKNEY
Wreck Location
Scapa Flow, Orkney
Oil Leak Timeline & Early Containment Efforts

- **Oct 1939**: Large amount of oil lost at time of sinking.
- **1945**: Oil flush-out ceased.
- **1960**: First signs of oil leak apparent.
- **Early 1990’s**: Concerns become more serious.
- **1995**: Minister accepts MOD has moral responsibility – statutory liability not tested.
- **1996**: Patch fitted over prime leak.
- **Jan 1999**: Canopy installed over prime leak – torn off within two weeks taking patch with it.
- **1999**: Salmon cage put in place by Orkney Harbour.
Oil Leak 1999
Salmon cage over worst of oil leak
Salmon cage over worst of oil leak
Oil Removal Timeline

2001
- Independent risk assessment
- Pilot operation (and permanent boom vice salmon cage)

2002
- High-resolution sonar survey
- Survey, marking (reference grid)
- Sampling and selective hot-tapping
- Permanent boom reinstated after repairs
- ROV survey

2003
- Boom wrecked in storm and removed
- Hot tapping operations
- Designated under Protection of Military Remains Act 1986
Ammunition

- At time of loss the ship was carrying its full complement of 15 inch, 6 inch and smaller calibre ammunition;
- 248 tonnes of TNT equivalent thought to remain onboard;
- Concern for magazine stability as the wreck settles into the seabed;
- Unpredictable effect of a sudden collapse of superstructure on the magazines/ammunition.
Hot Tapping

- Gate valves fitted
- Hole drilled through hull
- Oil pumped out into tanker
Hot Tapping
Gate valves fitted and oil removed
Oil Removed 2001-2009

Up to 783 m³ remaining

1,315 m³ removed
HMS *Royal Oak* – The Future

- On-site environmental survey, 2019
  - Sediment sampling
  - Fluorometry
  - Beginning of long-term study
- Oil pump off, summer 2021
The Wreck Management Programme
Post-1870 Ministry of Defence Wrecks
Why Spend Money on Them?
## Estimated Clean-up and Compensation Costs

<table>
<thead>
<tr>
<th>Vessel Name</th>
<th>Vessel Type</th>
<th>Year Lost</th>
<th>Location</th>
<th>Depth</th>
<th>Fuel Type</th>
<th>Project Year</th>
<th>Oil Removed</th>
<th>Total Cost of Operation</th>
<th>Estimated Clean-up and Compensation Cost if Oil Leaked*</th>
</tr>
</thead>
<tbody>
<tr>
<td>USS Mississinewa</td>
<td>Tanker</td>
<td>1944</td>
<td>Micronesia</td>
<td>22 m</td>
<td>HFO</td>
<td>2003</td>
<td>5676 t</td>
<td>£7.5 Mil</td>
<td>£66.6 Mil</td>
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<tr>
<td>T/B Cleveco</td>
<td>Tank barge</td>
<td>1942</td>
<td>Lake Eerie</td>
<td>21 m</td>
<td>HFO</td>
<td>1995</td>
<td>1095 t</td>
<td>£4.5 Mil</td>
<td>£12.9 Mil</td>
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<tr>
<td>Norvard</td>
<td>Unknown</td>
<td>1944</td>
<td>Norway</td>
<td>30 m</td>
<td>HFO, Diesel</td>
<td>2007</td>
<td>441 t</td>
<td>£4.0 Mil</td>
<td>£5.2 Mil</td>
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<tr>
<td>HMS Bittern</td>
<td>Destroyer</td>
<td>1940</td>
<td>Norway</td>
<td>152 m</td>
<td>HFO</td>
<td>2011</td>
<td>90 t</td>
<td>£0.5 Mil</td>
<td>£1.1 Mil</td>
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<tr>
<td>RFA Boardale</td>
<td>Tanker</td>
<td>1940</td>
<td>Norway</td>
<td>67 m</td>
<td>HFO</td>
<td>2012</td>
<td>204 t</td>
<td>£0.4 Mil</td>
<td>£2.4 Mil</td>
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<tr>
<td>KMS Eric Giese</td>
<td>Destroyer</td>
<td>1940</td>
<td>Norway</td>
<td>66 m</td>
<td>HFO, Diesel</td>
<td>2012</td>
<td>192 t</td>
<td>£1.3 Mil</td>
<td>£2.3 Mil</td>
</tr>
<tr>
<td>RFA Darkdale</td>
<td>Tanker</td>
<td>1941</td>
<td>St Helena</td>
<td>45 m</td>
<td>Light Crude</td>
<td>2015</td>
<td>1730 t</td>
<td>£7.3 Mil</td>
<td>£20.3 Mil</td>
</tr>
</tbody>
</table>

* Based on a global average cleanup and compensation cost of £11,738 per tonne of oil spilled – derived from Etkin, D.S ‘Estimating cleanup costs for oil spills’ and the International Oil Pollution Compensation Funds (IOPC FUNDS)
Current Wreck Management Methodology

Desk-based Assessment → On-site Survey → Intervention
Stage One – Desk-based Assessment: Sources
Stage Two – On-site Survey: Methods
Stage Three – Intervention
Questions?
HMS Queen Mary - Ammunition