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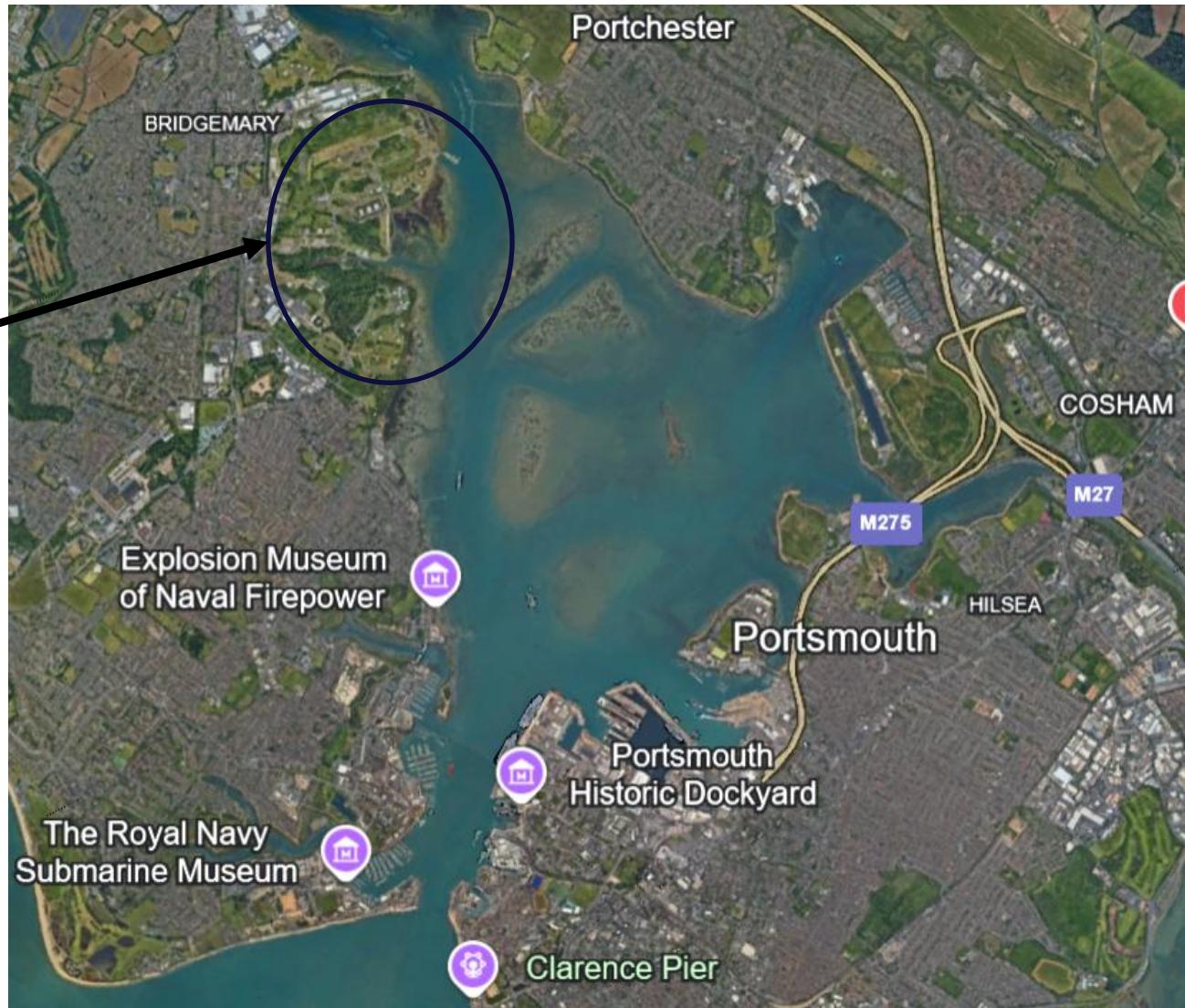
- The ‘Bedenham’ accidents of 1950/51 are:
  - Widely cited as examples of why the Inensitive Munitions policy is beneficial;
  - Real-world data points for the development of the Quantity Distance rules;
  - Why qualification and compatibility testing of energetic materials is essential.
- Two major munitions accidents entirely related to:
  - The same operational conflict;
  - The same munition;
  - The same root cause.
- .....but only coincidentally to the ‘Bedenham’ name.

- Korean War (June 1950 – July 1953):
  - 5 years after WW2 ~100,000 commonwealth troops were deployed;
  - Along with equipment and ammunition.
- Fort Rosalie:
  - Armament Supply Issuing Ship (ASIS);
  - A Canadian Fort Class vessel built to serve the Far East regions;
  - Arrived in Portsmouth Harbour on the 10th July 1950;
  - To be loaded with munitions for supply to the Far East.
- Gosport RN Supply Depot:
  - Royal Navy Supply Depot for HMNB Portsmouth;
  - Re-supply via Lighter Barge from Bedenham Pier;
  - Very Large quantities of munitions had been forwarded from Glascoed, Dean Hill, and other factories / depots to Gosport.

# 'Bedenham' Accident 1



Depot



- **Scene Setting:**
  - Monday 10<sup>th</sup> July to Friday 14<sup>th</sup> July 1950 - munitions and ammunition were being out-loaded to Fort Rosalie from Bedenham Pier;
  - Fri 14<sup>th</sup> July, day of accident, pier being worked to full capacity - 6 cranes in use;
  - 60 men, at least 3 times that normally employed at pier, present and overtime was being worked throughout the week;
  - The prevailing wind was strong and from directly off-shore.
- **At the Pier:**
  - 13 Naval Armament Lighters (NAL) at the pier or on buoys;
  - 9 filled or partially filled with explosives, 3 empty and 1 non-explosive stores;
  - 15 rail trucks, many containing heavy HE stores;
  - Rail trucks typically filled to capacity;

- The Accident Timeline:

- Friday 16:30 - a rail truck containing 55 Depth Charge Mk 7 was moved abreast of 'No 1 Crane South', ready for off-loading into NAL NA130 which was moored on the Southern (Gosport) side of the pier;
- NA130 was ~ two thirds full with 4" Quick Fire (QF) and Bofors ammunition, with hatch covers and tarpaulins in place except for an eight-foot gap between frames 12 and 17;
- Goal - to load 110 Depth Charges from 2 rail trucks to complete NAL130 load;
- Friday 18:00 - loading commenced using a 4-hook sling, No 1 Crane South;
- First 4 were rolled (~15ft) to their approximate stowage position, stood upright and then 'milk-churned' to their final position;
- Friday 18:05 – the second 4 were rolled to their stowage position.

- The Accident:
  - A labourer, grasping the lifting lugs, attempted to stand one of the DCs;
  - He later reported that when halfway upright he heard a 'muffled report' and saw a large flash of yellow or blue flame accompanied by sparks and particles coming out from the Primer Tube;
  - Analysis of his clothing afterwards showed that some of these particles consisted of molten burning TNT / Torpex.
- Localised Fire:
  - Suffering burns about the hands, arms and face, he dropped the DC leaving it with its end approximately 1' from the side of the NAL with flame issuing and playing on some spare cordage and ropes.
  - He and all bar one of the crew escaped the NAL via the ladder and raised the alarm.
  - 1 man remained in the NAL attempting to smother the fire.

- Escalation:
  - 1min – last man evacuated the NAL as the fire rapidly took hold;
  - 10min – column of smoke 200 - 300ft high was coming out of the hold;
  - 15min – Ammunition begins to cook-off, some burning ammunition landing within the Depot causing grass fires.
- Remarkable Action Taken:
  - Some attempt was made to fight the fire from the pier, but hoses had not been connected to the hydrants in readiness for such an incident.
  - Attempts were also frustrated by large explosions and falling debris;
  - Many of the rail trucks were moved from the vicinity;
  - 18:25 – all men had been withdrawn;
  - 18:45 – 5 NAL and 1 rail truck were known to be burning fiercely.

- Detonation:
  - 18:47 - First mass explosion;
  - Demolished the centre portion of the pier, ~40 yard breach;
  - Extensive blast damage caused to many of the buildings in the depot;
  - 2 cranes on the pier had disappeared and 1 NAL sunk.
  - 19:15 - Second mass explosion;
  - Smaller than the first but projected debris was more intense;
  - Starting more small fires in the depot;
  - Most depot staff engaged in fighting small fires in order to protect magazines;
  - Hampered by large number of scattered unexploded Bombs and Shells;
  - 21:00 - Main fires had been extinguished;
  - Civilian fire assistance was withdrawn by 09:00 the following morning.

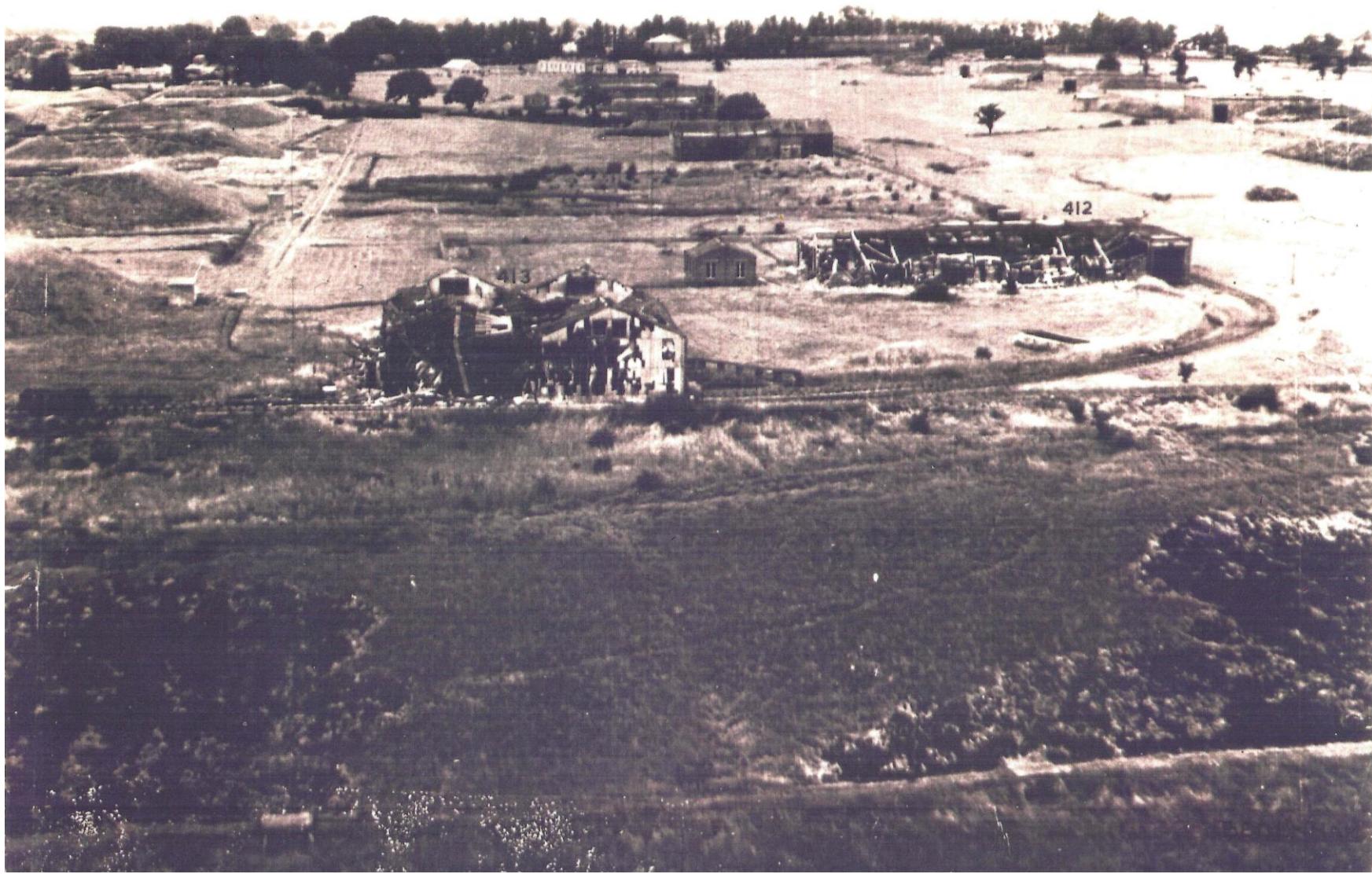
# 'Bedenham' Accident 1



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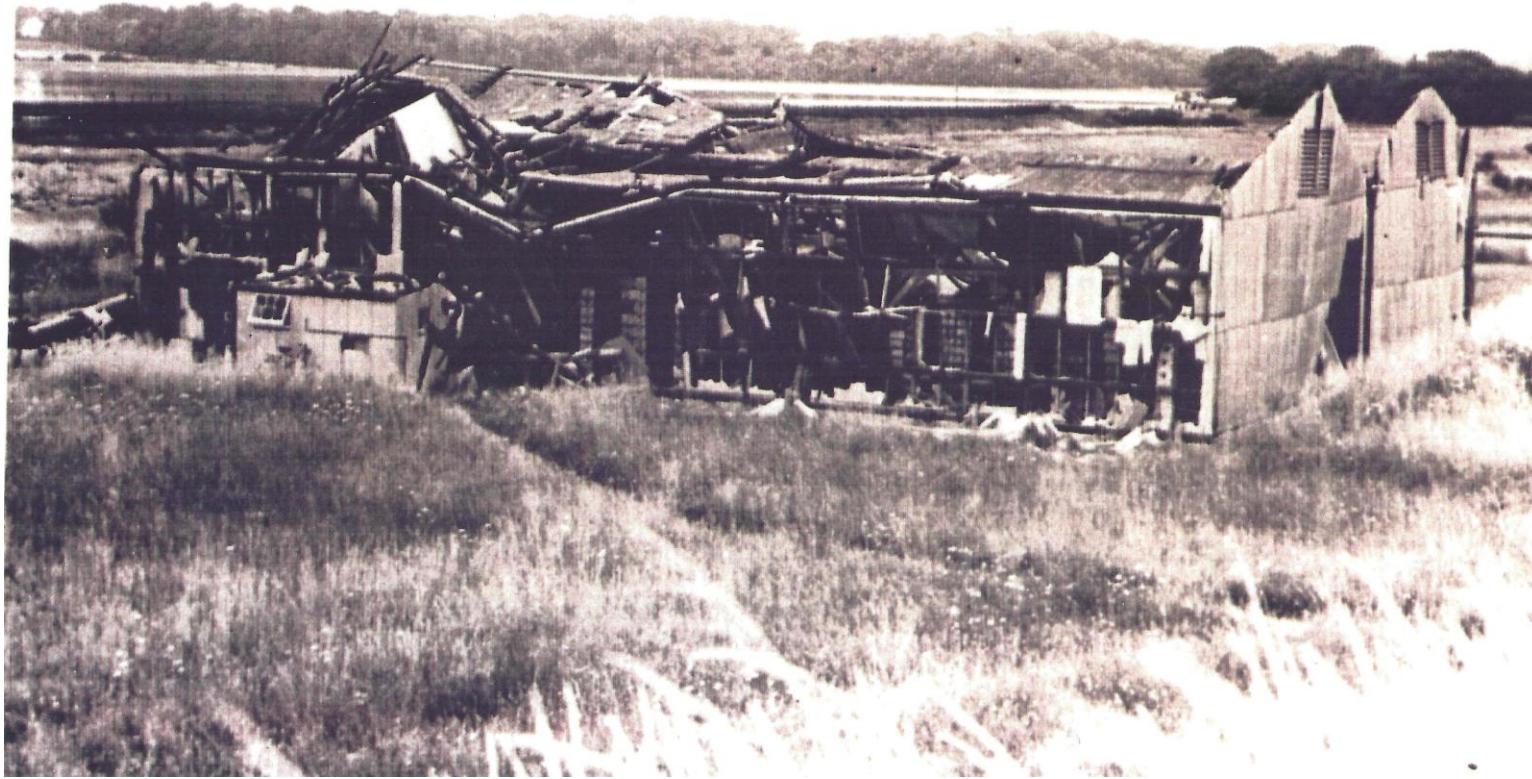
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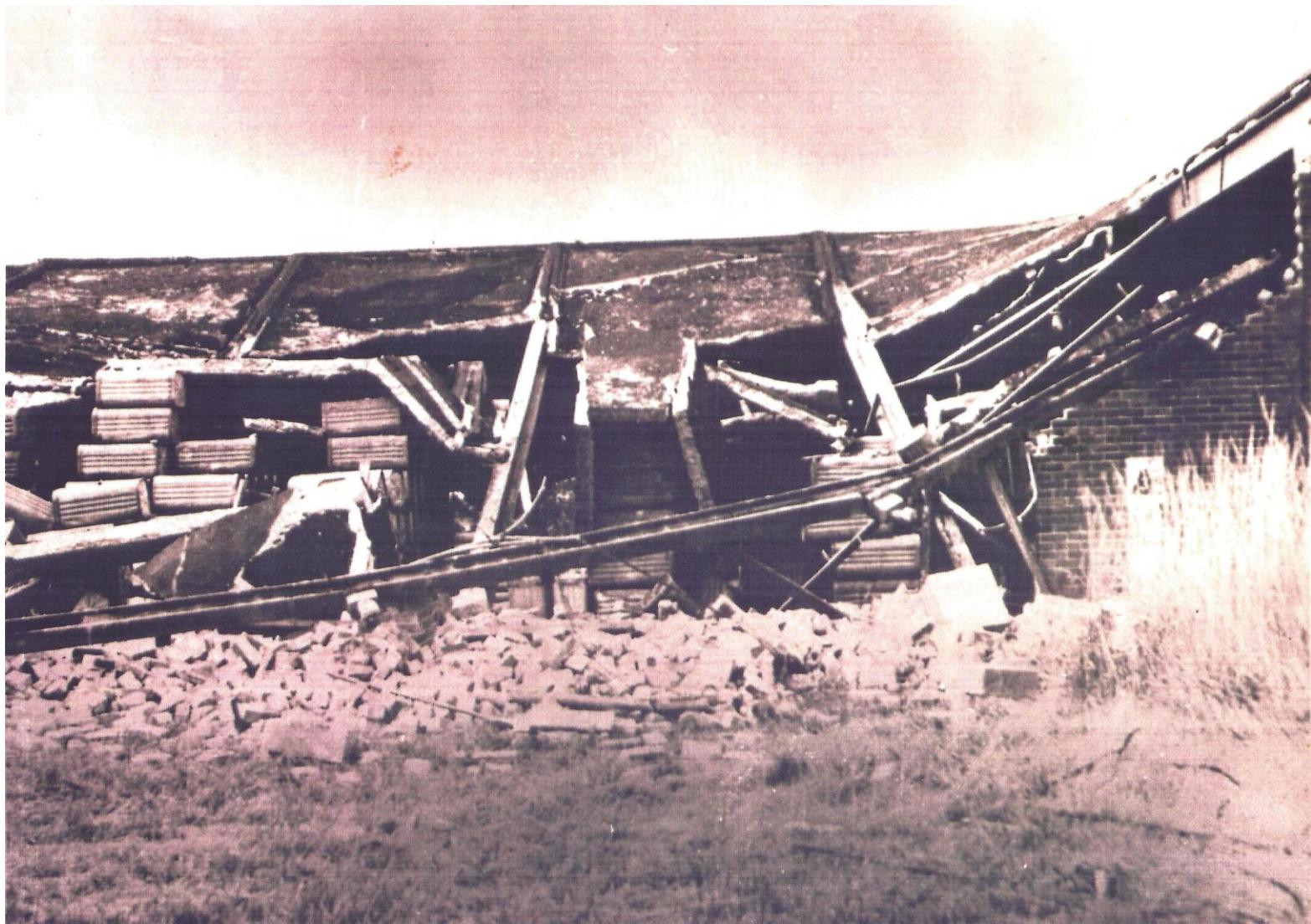
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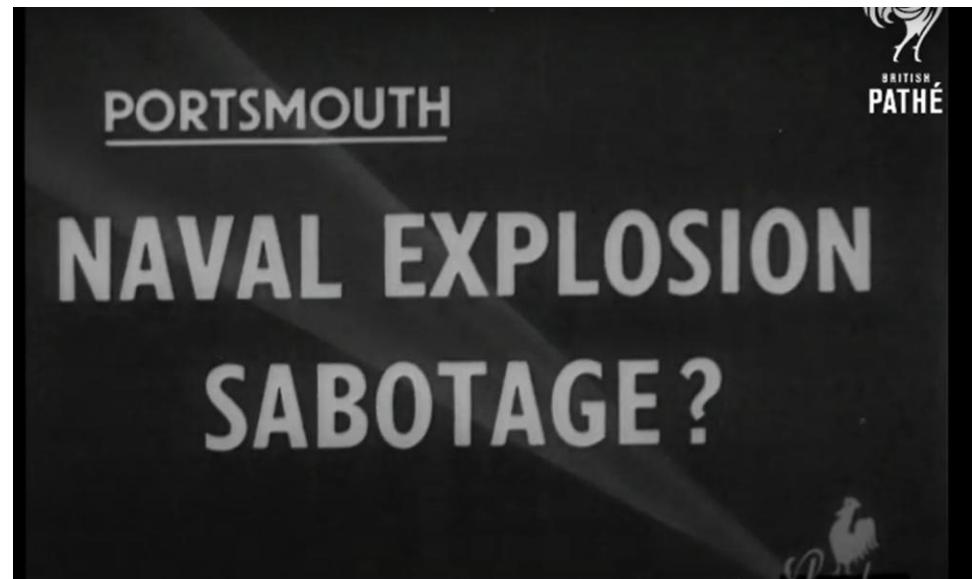
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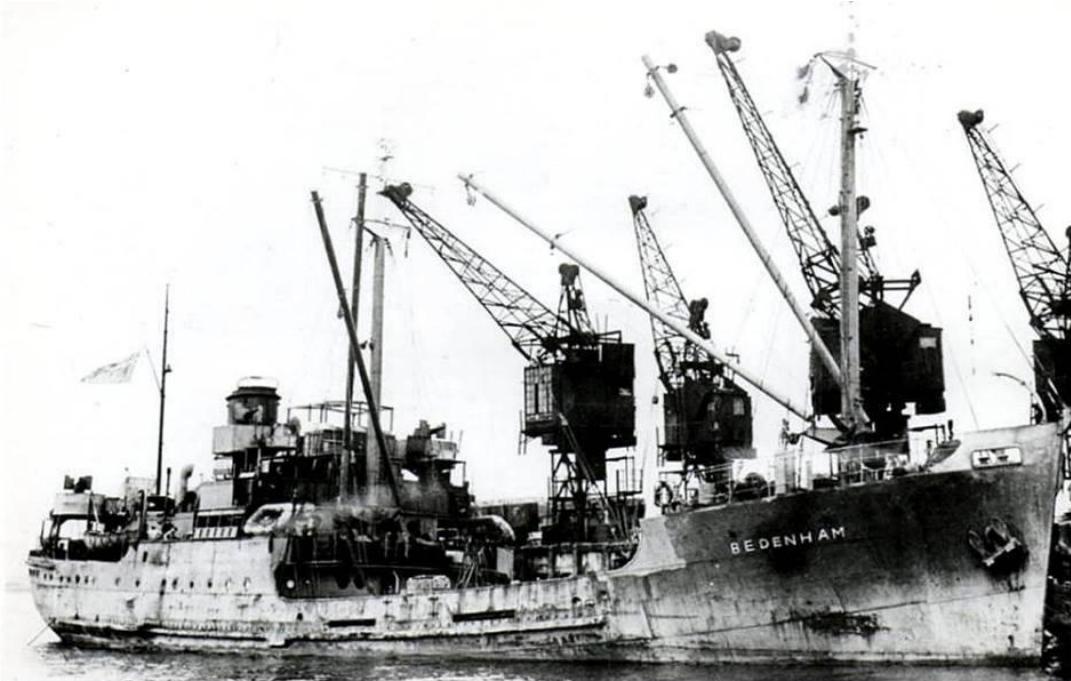
## News Reel Footage:

<https://www.youtube.com/watch?v=TNYP9zHE49c>

<https://www.youtube.com/watch?v=fHZKx2CZq6Q>



- Naval Armament Vessel (NAV) Bedenham:
  - Royal Fleet Auxiliary (RFA);
  - 1191tons;
  - Launched 1938, Troon;
  - 500tons of armaments (approx. 112tons NEQ).



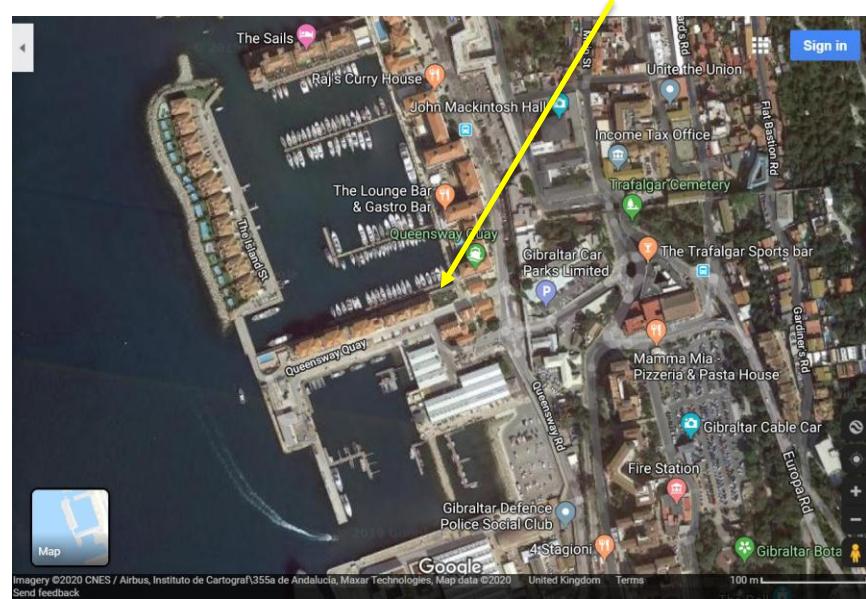
# 'Bedenham' Accident 2



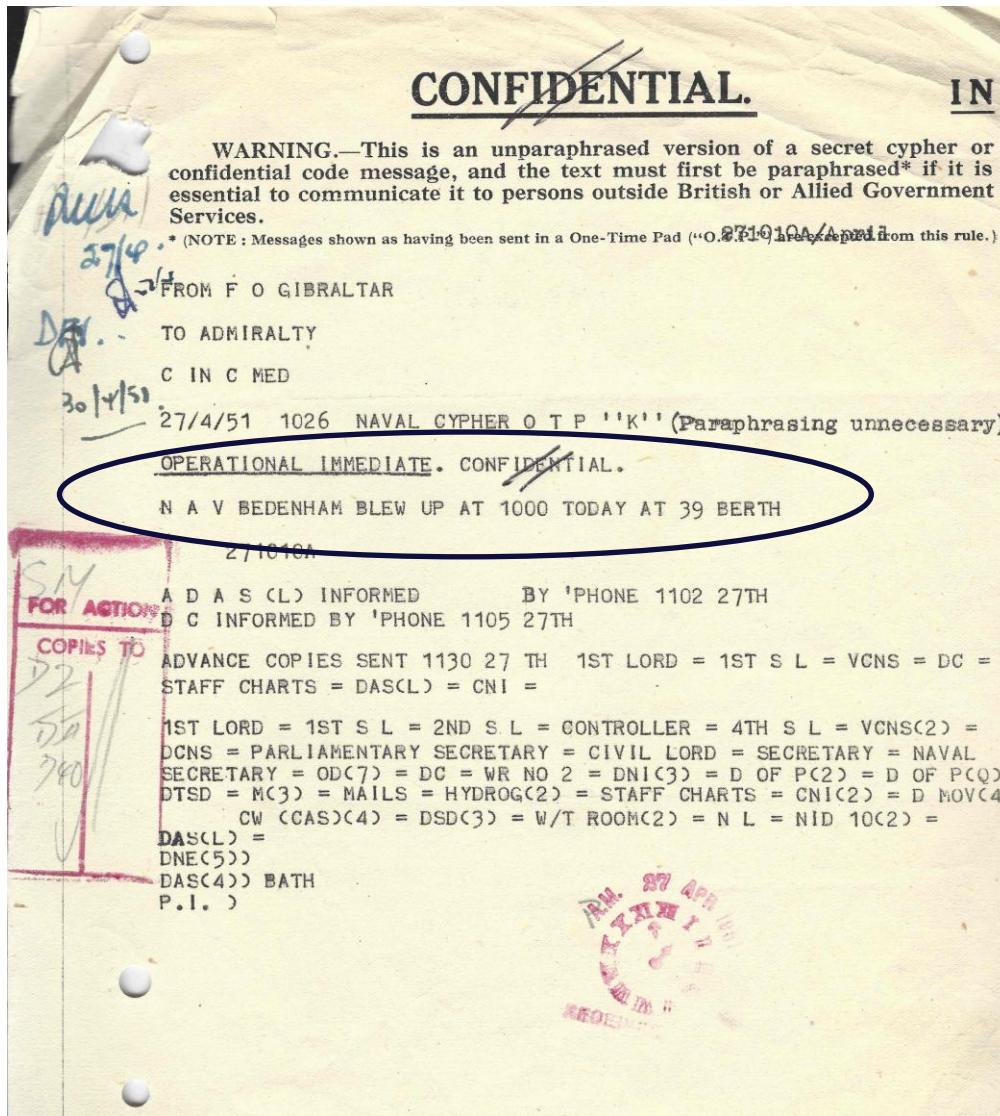
- Scene Setting:

- Tuesday 24<sup>th</sup> April 1951, 21:00hrs;
- NAV Bedenham arrived at No 39 Berth, Ordnance/Gun Wharf, Gibraltar;
- Had been loaded at RNAD Bull Point, Plymouth;
- Departed Plymouth Friday 20<sup>th</sup> April;
- Due to leave Gibraltar for Malta on the 30<sup>th</sup> April.

Note this!



- The Task and Timeline:
  - Tue - Position NAL10 alongside NAV Bedenham;
  - Tue to Thur - Unload cargo for Gibraltar from No 1 Hold;
    - 4.5" QF Mk 16
    - Cartridges of 5.25" QF Separate
    - Cartridges of 4" Mk 16 (stowed at the ends of the Lighter)
    - Various Fixed Ammunition
    - Depth Charge Mk 7 (stowed amidships).
  - By end of day Thur, approx. 13600kg NEQ aboard NAL10;
  - Fri 27<sup>th</sup> April 07:15 - Continue unloading DC Mk 7;
  - Concurrently embark Bofors ammunition from shore to No 2 Hold (for Malta);
  - Fri 09:00 to 09:15 - Tea break - 33 DC remaining to disembark;
  - Fri 09.53 – Next lift of 4 DC into NAL10;
  - Fri 09:54 – Localised fire/explosion in one of the 120 DC in NAL10;
  - Fri 10:00 – Major cook-off detonation event.



- What is Known:
  - 4 men in the barge, 2 handling & 2 sitting on the side nearest the ship;
- Localised Initial Explosion and Escalation:
  - Initial explosion killed 3 of the 4 workers in the barge;
  - Sole survivor jumped overboard, seriously burned, critically injured;
  - Initial explosion followed by major, escalating munitions fire;



- 6 minutes after the initial explosion a major cook-off occurred.

- Consequences:
  - Ship’s crew and many workers safely evacuated/took cover;
  - Scattered debris over wide area;
  - NAV Bedenham was split into two parts;
  - 13 killed, ~200 civilian patients treated for cuts and abrasions;
  - ~500 properties damaged by blast;
  - Two cranes, several vehicles and dockside buildings destroyed;
  - Bofors ammunition (cargo from NAV Bedenham) was scattered onto Wharf and around Naval base;
  - 90% of ammunition in the Depot rendered un-servicable.
- George Cross:
  - Sub-Fire Officer George Campbell Henderson was posthumously awarded the George Cross for staying and attempting to fight the fire. He remained on the NAV Bedenham with a hose trained onto the NAL and was killed when the ammunition detonated.

# ‘Bedenham’ Accident 2



# 'Bedenham' Accident 2



# ‘Bedenham’ Accident 2



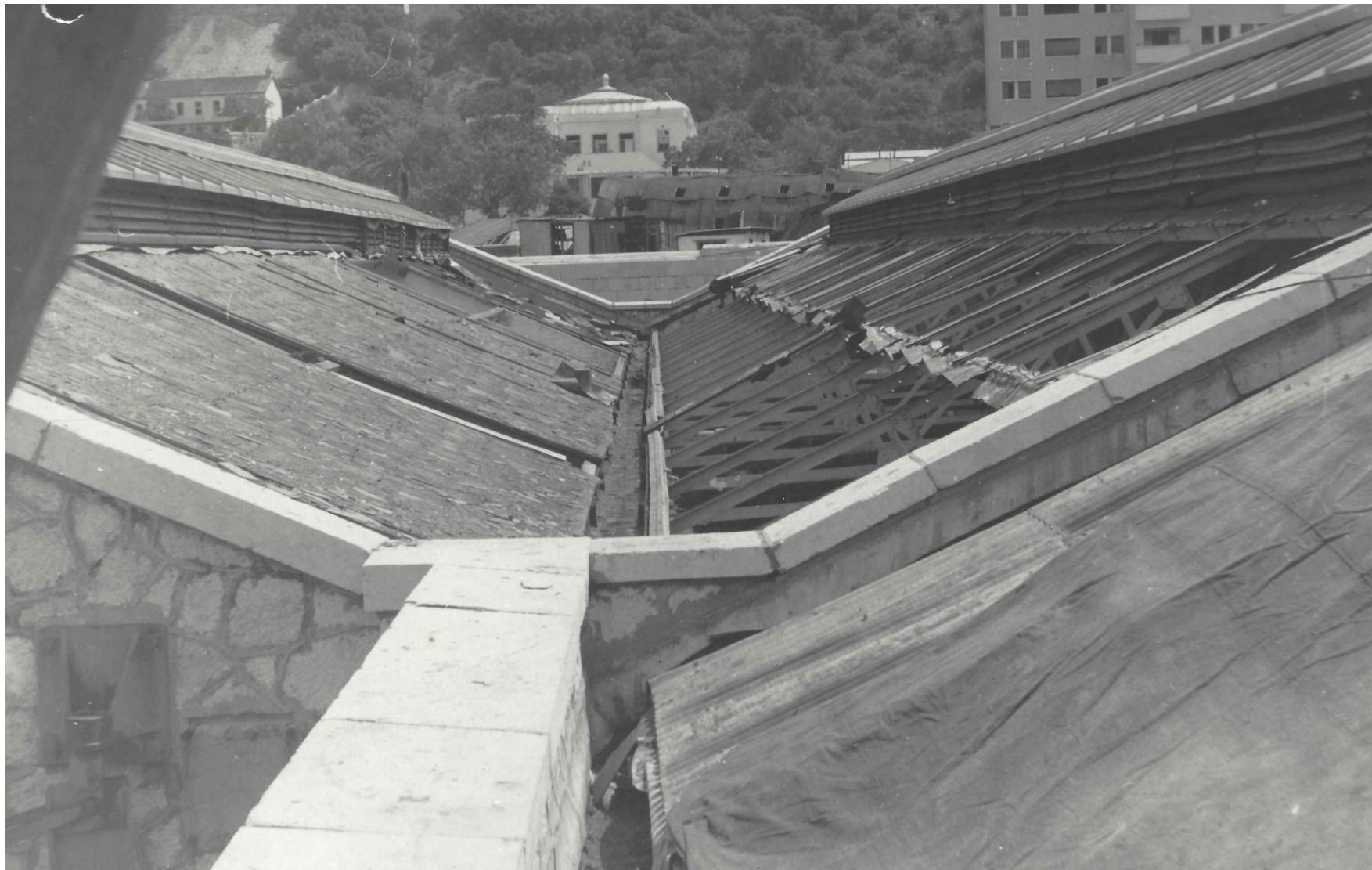
# ‘Bedenham’ Accident 2



# 'Bedenham' Accident 2



# ‘Bedenham’ Accident 2



- 1950 – Bedenham Pier:
  - Sabotage - thermite bombs! claimed as possible cause in the official media;
  - Even Board of Enquiry concluded fire was started by an incendiary device inserted into primer tube of a DC prior to loading into the NAL;
  - Claimed that the nature of the ammunition loading operation was widely known, and 8 possible locations for sabotage activity could be identified.
- 1951 – NAV Bedenham:
  - Following 2nd explosion a more scientific CINO (Chief Inspector Naval Ordnance) investigation took place;
  - Concluded probable cause of both accidents, involving the same DC Mk 7, was as a result of an 'obscure defect in a DC which caused a fire and minor explosion in proximity with other ammunition causing sympathetic explosion of the contents of the Lighter';
  - Concluded - in both cases initiation was by 'inflammation and not explosion or detonation'.

- CINO Observations (10 Dec 1951):
  - No evidence of rough usage;
  - Nothing abnormal found in the Torpex samples that were analysed;
  - A DC was, however, found at Glascoed which indicated that a quenched ignition had taken place. Bulge could be seen in non-filling end of the DC case.
- Three Ignition Mechanisms Proposed:
  - Adiabatic compression of small pockets of cavitation;
  - Friction with finely divided quartz in the RD1A cement;
  - The effect of Naptha, present in both RD1A cement and RD1270 protective coating.
- The first two mechanisms were discounted but the third, the 'action of Naptha', was given the greatest probability as the cause.

- RD1270:
  - RD1270 – bitumen-based coating used since January 1950;
  - Evidence of free Naptha found in DCs subsequently examined;
  - TNT was soluble in the Naptha leaving highly sensitive RDX crystals.
- RD1A:
  - RD1A - used for filling crevices at welds etc.
  - Contained small percentage of quartz as well as Naptha in the raw material;
  - Found that the quartz could settle out in the containers such that 'objectionable' levels of quartz could be present when RD1A was used.
- December 6 – 1951 CINO Statement:
  - "These two substances create conditions in which interior ignition can be started and have been started under experimental conditions closely approximating to those obtained in filled Depth Charges. If they can be eliminated it is reasonably certain that the cause of the incidents under investigation will have been removed."

- **Fort Rosalie:**
  - 11 August 1951 - Told to dispose at sea, 1000 unstable Torpex DCs she was carrying between Japan and Korea. The ship and crew must have been at considerable risk during this activity;
  - Interestingly, Fort Rosalie was reputedly present in support of the first British nuclear weapons test in 1952 and other later tests at the Christmas Islands.
- **Fate of the NAV Bedenham:**
  - Time of severe shortage of steel so aft section of NAV Bedenham made watertight and eventually towed back to UK, leaving Gib on 20 May 1952;
  - Alternative strategy of breaking ship in a dock at Gib was assessed but 5-month job deemed too long to lose a dock for;
  - Crew were kept at Gib for 2-months, none accepted passage back in another ammunition ship! Most were then made surplus, no longer having a ship!

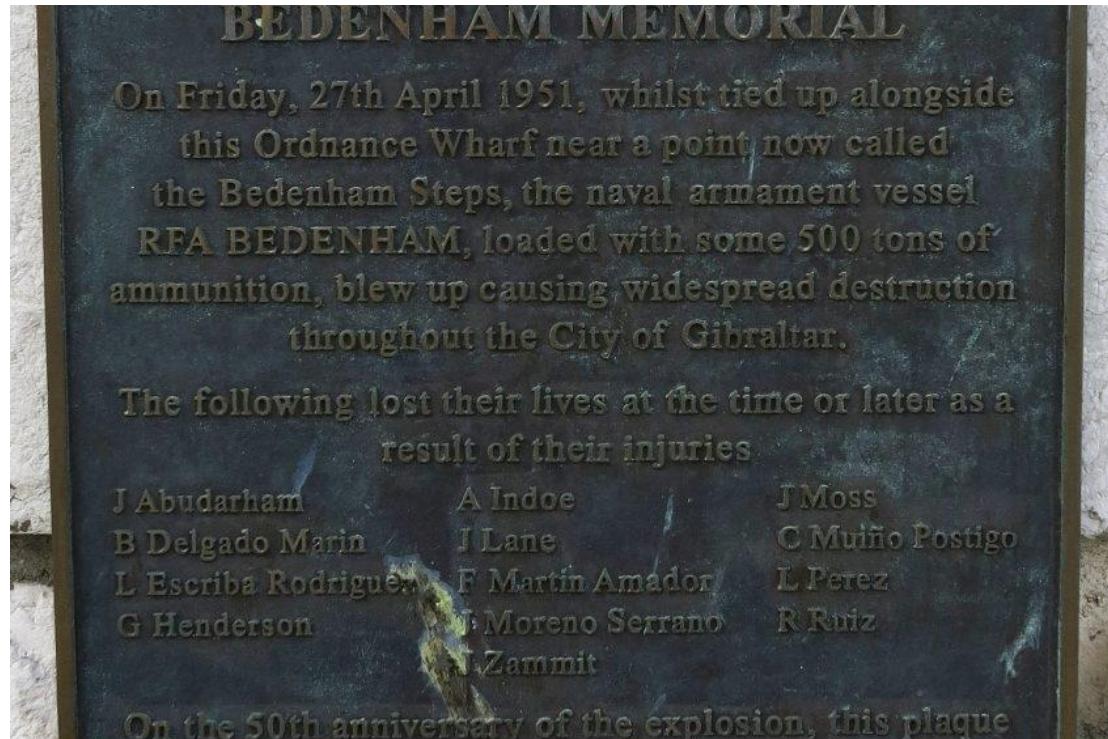
- Depth Charges Mk 7:
  - Large-scale sea dumping operation of all Torpex filled stores filled after 01 January 1950 using RD1270 and/or RD1;
    - 13840 Depth Charge Mk 7;
    - 25 21" Torpedo warheads;
    - 62 18" Torpedo warheads;
    - 257 Mines A Mk9
    - 84 Mines M Mk 3
    - 630 Charge Cases Mk3.
  - Naval authorities in Canada, South Africa, Australia, Pakistan, France, Norway, India and Greece, to whom extensive supplies of Torpex-filled items had been made, also alerted;
  - Re-work of many other cases and filled stores that had RD1270 or RD1A also had to be undertaken under the direction and advice of CINO at the time. Manufacturing practices prior to 1950 could be used or at some later time, replacement protective coatings.

- ‘Bedenham’ Accidents:
  - Possibly unfair on ‘Bedenham’ name?
    - Both cases - explosions in NAL barges, both ‘Bedenhams’ were collateral damage;
    - Both cases - unstable munition at cause was DC Mk 7;
    - So really these are the ‘DC Mk 7 Accidents’.
- Qualification and Compatibility:
  - Real-world evidence of why extensive testing and caution is essential;
  - Evidence of the human, financial and political cost of mistakes.
- Damage Assessment Observations:
  - At Gibraltar, I suggest NAV Bedenham provided significant mitigation for the town;
  - At Gosport, wind strength/direction also played a major part in directionality of damage.

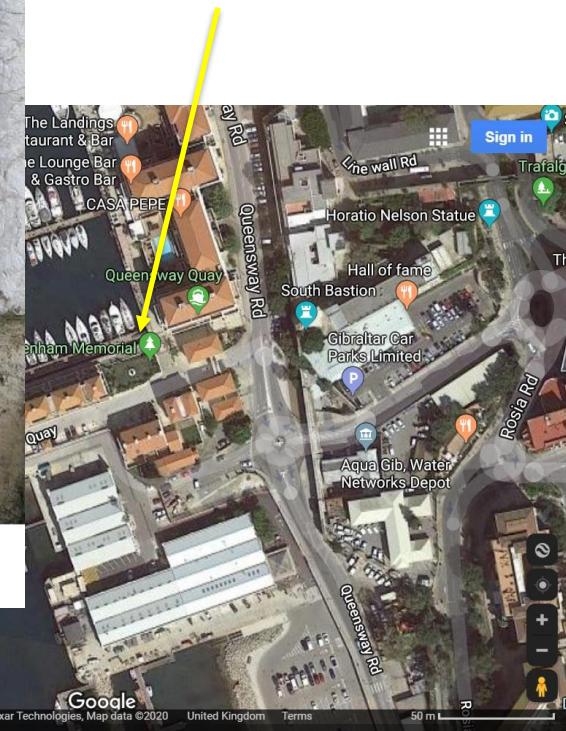
# Closing Remarks



In Memory of those killed in Gibraltar, April 1951:



Remember this?



Thank you.



- **Initiating Event:**
  - 3 labourers (2 Gibraltarians and 1 Spaniard) handling the munitions during the first explosion were missing presumed dead (Leopold Perez, Carlos Muino Postigo and John Lane).
- **Main Detonation Event:**
  - Sub-Officer George Campbell Henderson, Dockyard Fire Service
  - Chief Fire Officer (Albert Alexander Indoe), Dockyard Fire Service
  - Assistant Storehouseman Naval Store Department (Jose Moss), Labourer Armament Department (Joseph Zammit), Labourer Works Department (Bartolome Delgado Marin), and non-dockyard individuals; a taxi driver (Julius Abudarham), a fruit vendor (Juan Moreno Serrano) and a Coalheaver (Laureano Escriba Rodriguez).
- **Post Event:**
  - Spanish Labourer (Francisco Martin Amador) subsequently died on 30<sup>th</sup> April;
  - Skilled Labourer (Florencio Ruiz) subsequently died on 1<sup>st</sup> May 1951;
  - The body of NASO labourer (John Lane), one of the original missing men on NAL was recovered from the sunken aft part of the NAV Bedenham during clean-up and salvage of vessel on 2<sup>nd</sup> May.