PIG Seminar March 14th 2017

PLUTO–The Pipeline Under the Ocean

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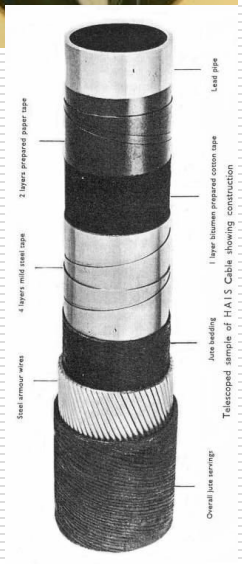
Q - How to ensure large, quick, reliable cross channel fuel supplies after D Day

- Already a 1000 miles of fuel lines under construction in England
- Mountbatten challenge to Lloyd – a submarine pipeline to France April 42
- I -Hartley suggests to Lloyd in late April 42 that a cable based system is possible the "HAIS" pipelines
- II - Later in 42 Hammick and Ellis suggested welded steel pipelines were sufficiently flexible to be reeled the "HAMEL " Pipes Pics and Refs\Pluto clip 2 .avi

HAIS Pipeline Development

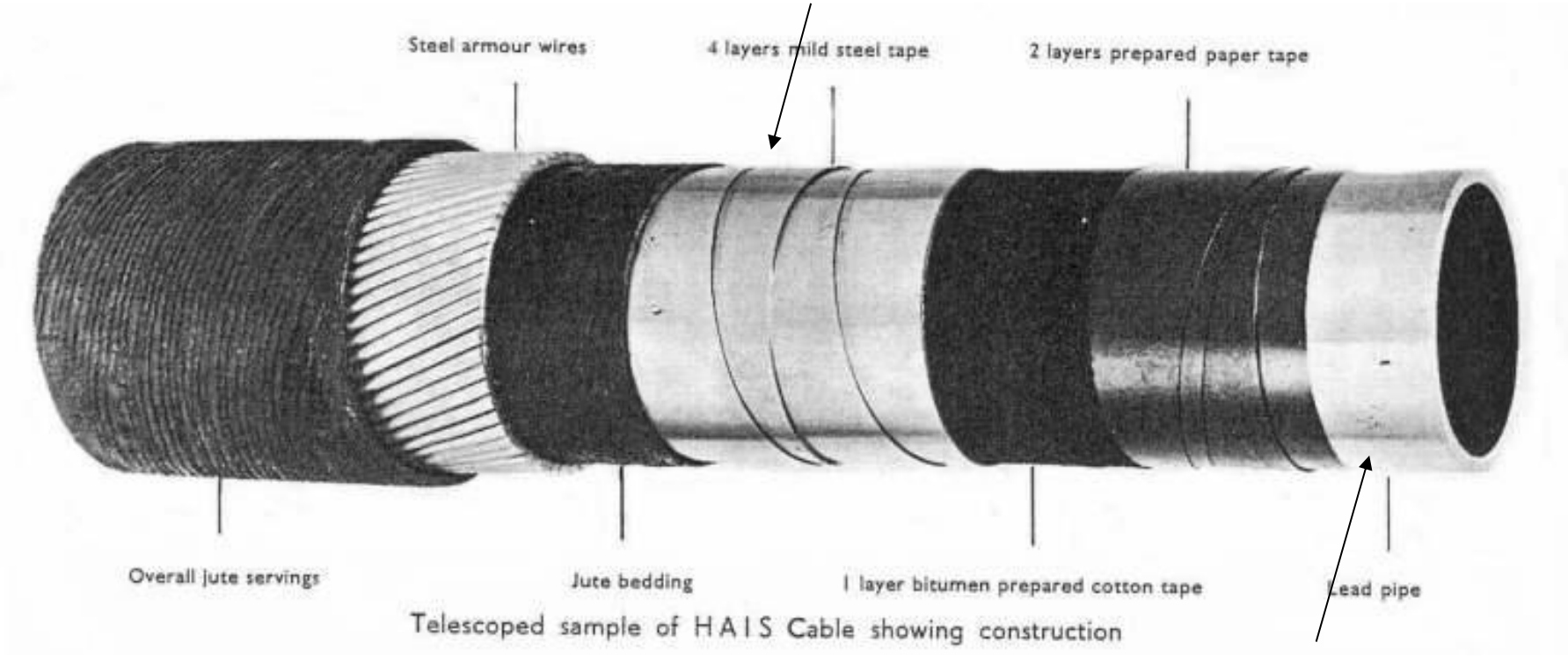
- Clifford Hartley – Chief Engineer Anglo Iranian
- Co Developers H R Wright - Siemens/Erith,
- Based on submarine cable – conductors, lead sheath, reinforced with steel strip, wire and tapes, 2ins to 3ins bore.
- Early May a section manufactured and tested
  - Duty Inside Pressure 1500 psi
  - External seawater at deepest 600 psi
- Medway trial – analysis and mods
  - NPL, Henley's Telegraph, Post Office



Telescoped sample of HAIS Cable showing construction

HAIS PIPE

Steel Tape Layers



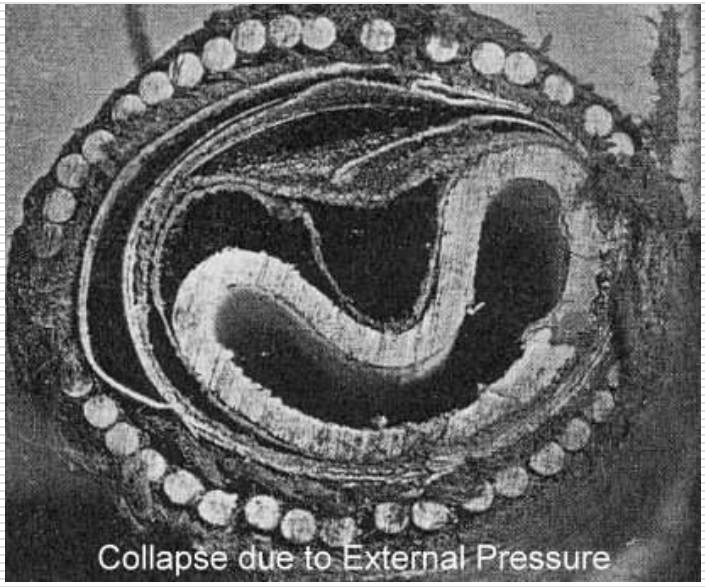
Telescoped sample of HAIS Cable showing construction

LEAD CORE

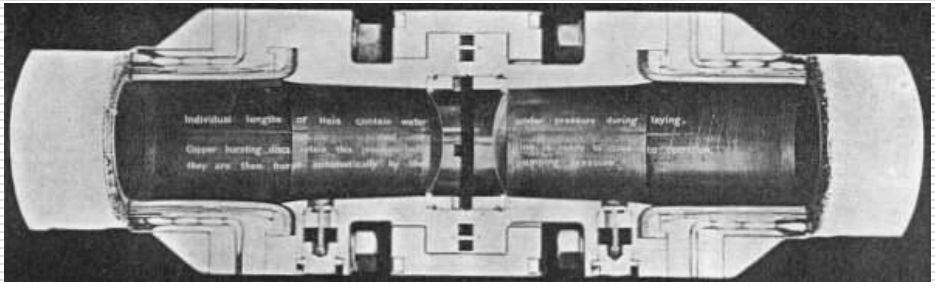
HAIS Trials

- Clyde Trials in 200ft, lay positive pressure to resist external pressure, used novel bursting disc
- Late 42, 30 mile Bristol channel
  - Coupling/ connections and shore approaches?
  - Survived depth charges
  - Successful recover and repair after anchor drag
- Pumping trials commenced April 43 at 750 then 1500 psi – continued in use through war.
- Now Normandy beaches - increase to 70 miles !

HAIS Pipe – Trials Experience



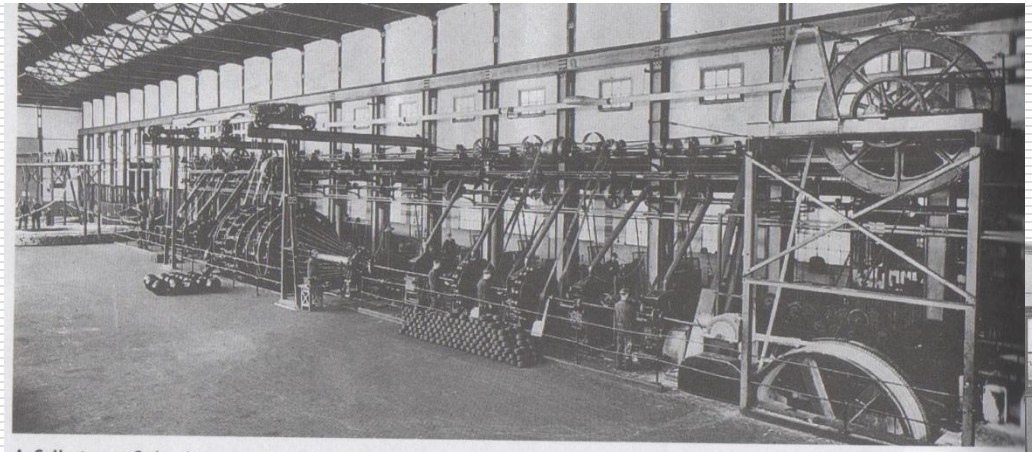
External pressure collapse !
Layed flooded with
multiple inline bursting discs



HAIS Manufacture

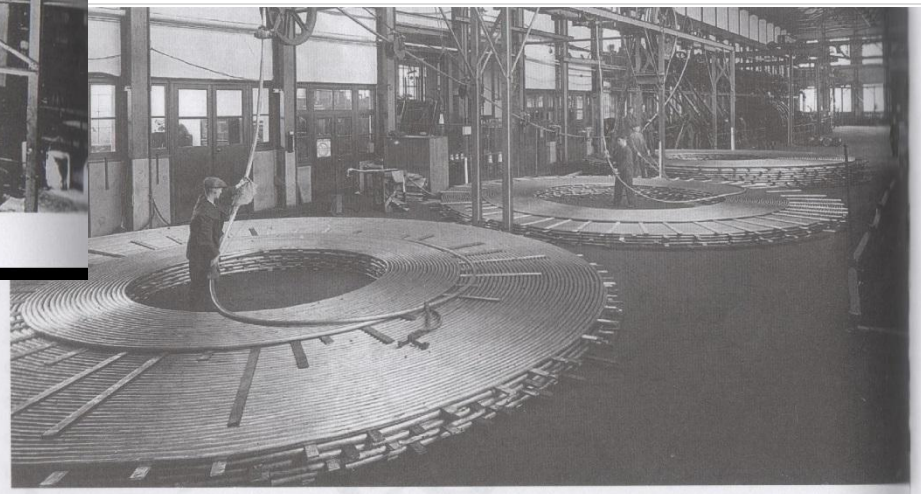
- Massive undertaking , 710 miles
  - Siemens – Erith
  - Callenders
  - Henley's Telegraph
- 140 miles from US suppliers
-

HAIS Pipe Manufacture

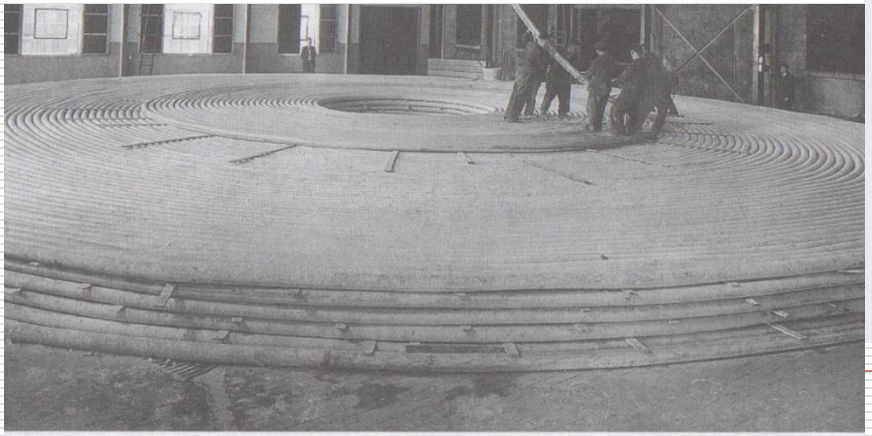


A full view of the heavy-duty Siemens armouring machine producing continuous 30-mile lengths of HAIS cable. (Charles Brown)

SIEMENS Erith



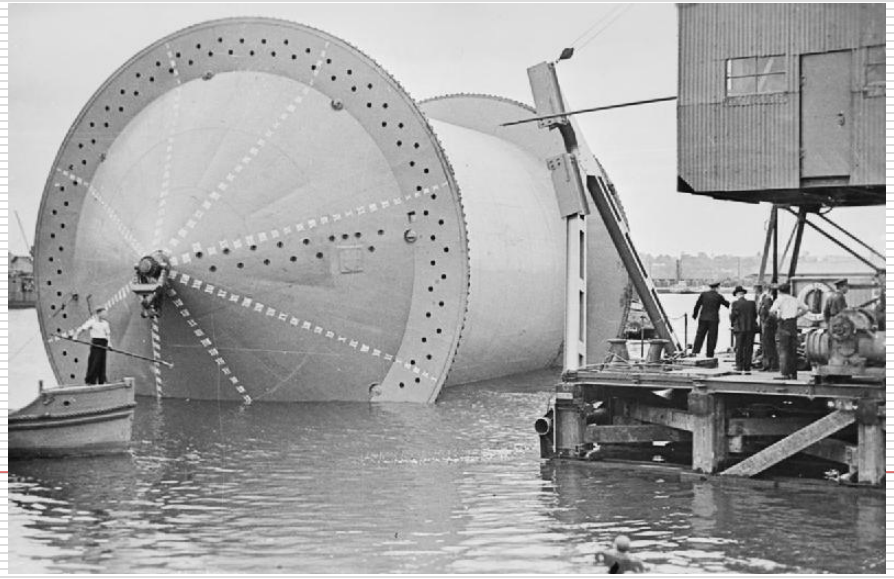
Extruded lengths of lead pipe coiled down to the rear of the armouring machine at Woolwich Works. The coil in the foreground is being fed into the armourer, while the middle coil is taken across the workshop from the 2,000-ton lead extrusion press. Each coil was jointed simultaneously to form a continuous 30-mile length. (Charles Brown)



HAMEL Pipe

- Hammick and Ellis – Iraq Petroleum experience of flexibility of long steel tubes
- Trials Stewart & Lloyds 3ins lines reeled on and off 30ft dia drum – elastic region. Cooperation :-
  - J & E Hall – Dartford
  - A & I Electric Welding machines
- Vertical Reels to avoid coiling twist
- Welding QA critical, 15 sec Flash Butts
- Video Flash butt and QA Pics and Refs\S& L Hamel Fab .avi

HAMEL Reeling Systems

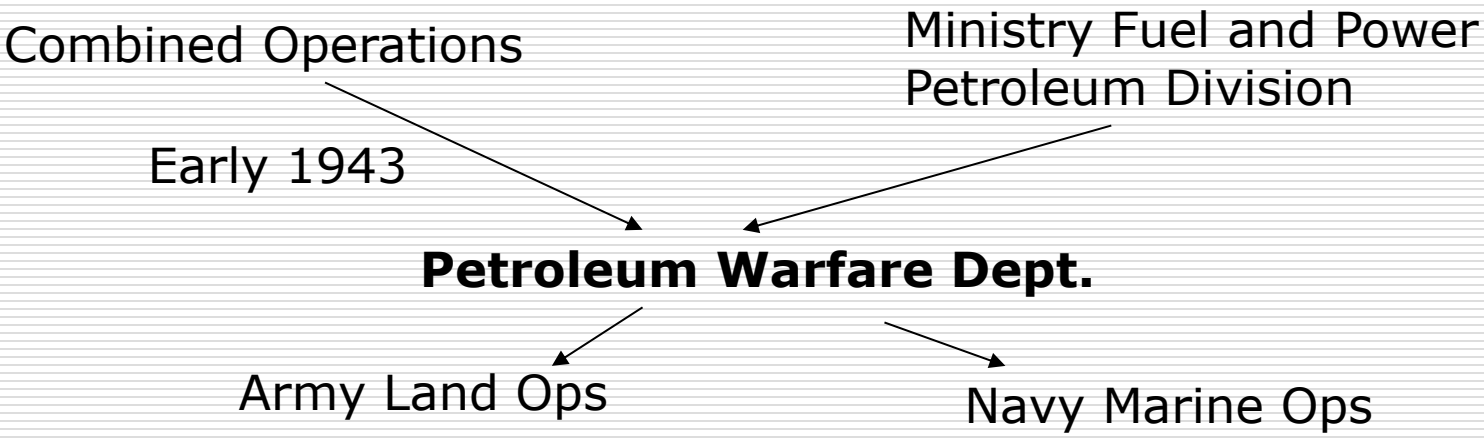
- Wet drum principle - 1943 trials with horizontal drum in hopper barge layed line cross Solent
- "HMS" Conundrum floating drum:-
  - Dia 40ft, 90ft Long
  - Carried 80 miles of 3ins, 1600 tonnes gross
- 

HAMEL Pipe stalks and Reel up

- 40 ft. Lengths fabricated at Corby and transported to Tilbury for welding into 4000ft stalks on racks
- Stalks thrown off racks into storage (at 100mph) before reeling and welding into 70 mile lengths on Conundrums
- Pics and Refs\HAMEL pipe fab and conundrum reel up .avi

Pluto Challenges

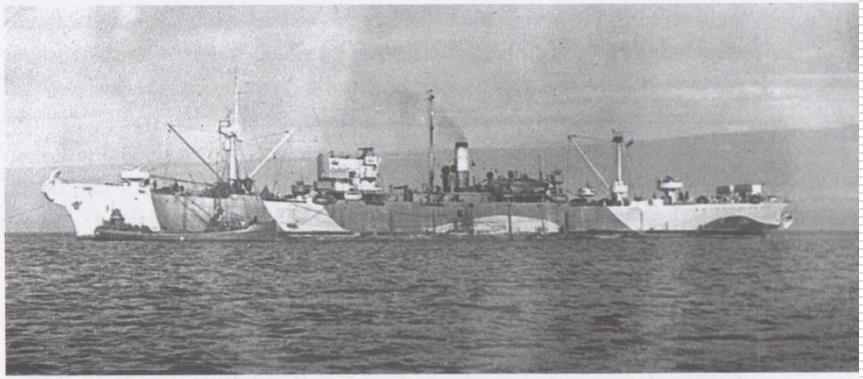
- Huge resources , eg most of UK's lead capacity 23,000 tonnes for HAIS
- Marine operations – particularly shallow shore beach connections
- Coordination and cooperation



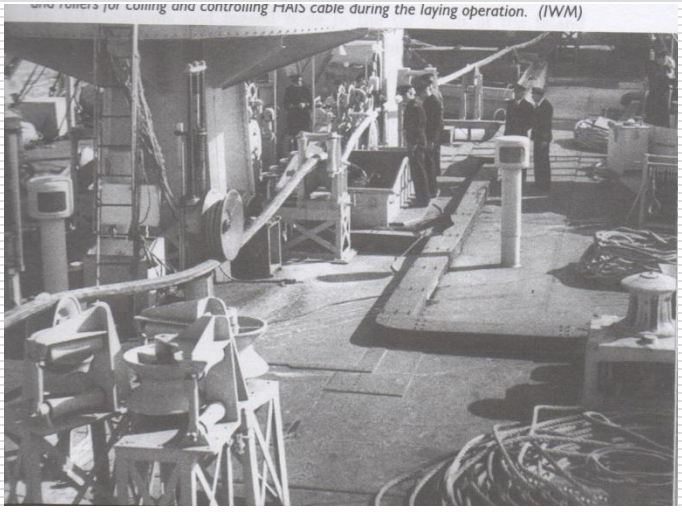
Post D Day Operations

- Installation delayed until capture of Cherbourg to Mid August
- First HAIS line layed by HMS Latimer overnight 10th August from Shanklin to beach nr Cherbourg – failed with dragged anchor !
- Second line 2 days later laid by HMS Scancroft – failed shore connection !
- 3rd Attempt successful on 18th August with flow on 22nd August
- Pics

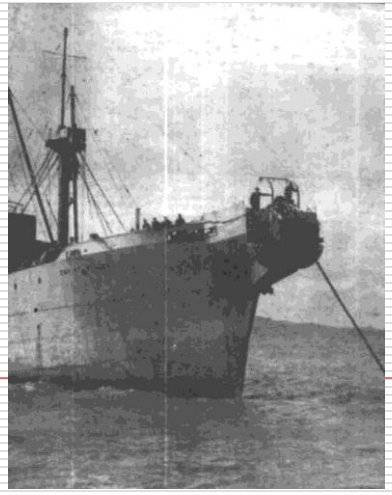
HAIS Cable Lay to Cherbourg



HMS Latimer is pictured during her historic first cable-laying run from Shanklin to Cherbourg on 10 August 1944. (IWM)



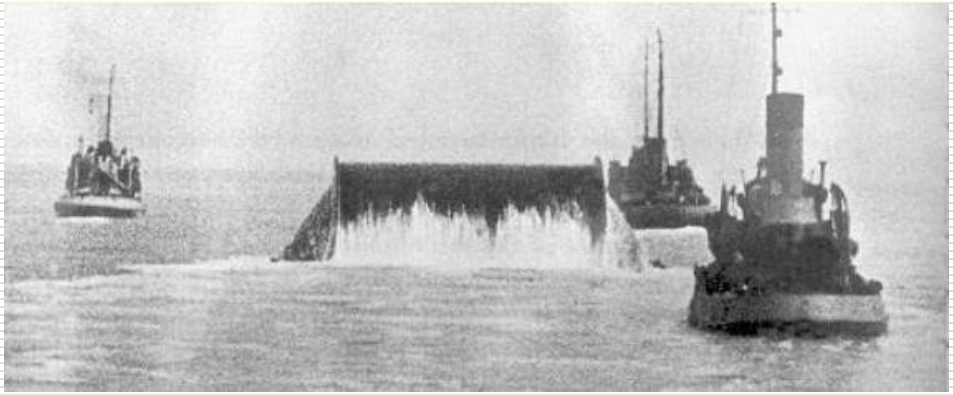
and rollers for coiling and controlling HAIS cable during the laying operation. (IWM)



HAMEL Pipe Installation

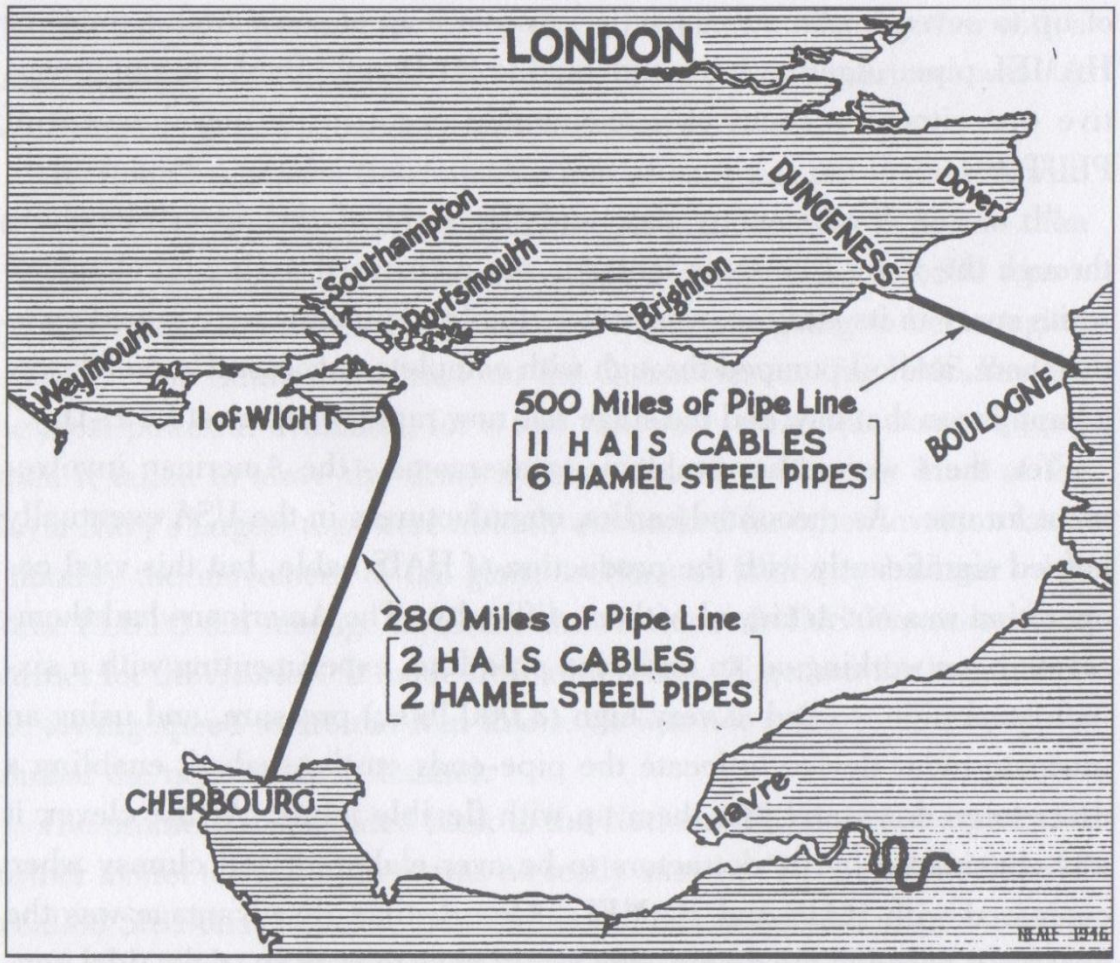
- First attempt 27th Aug aborted due to barnacles!
- 2nd Attempt failed due to break 30 miles from Cherbourg
- 3rd Attempt successful - France to Sandown
- Eventually 2 HAIS + 2 HAMEL lines commissioned and operated (?) but by early October move to Boulogne

HAMEL INSTALLATION



Pics and Refs\hamel pipe installation .avi

Cross Chanel Lines Layed

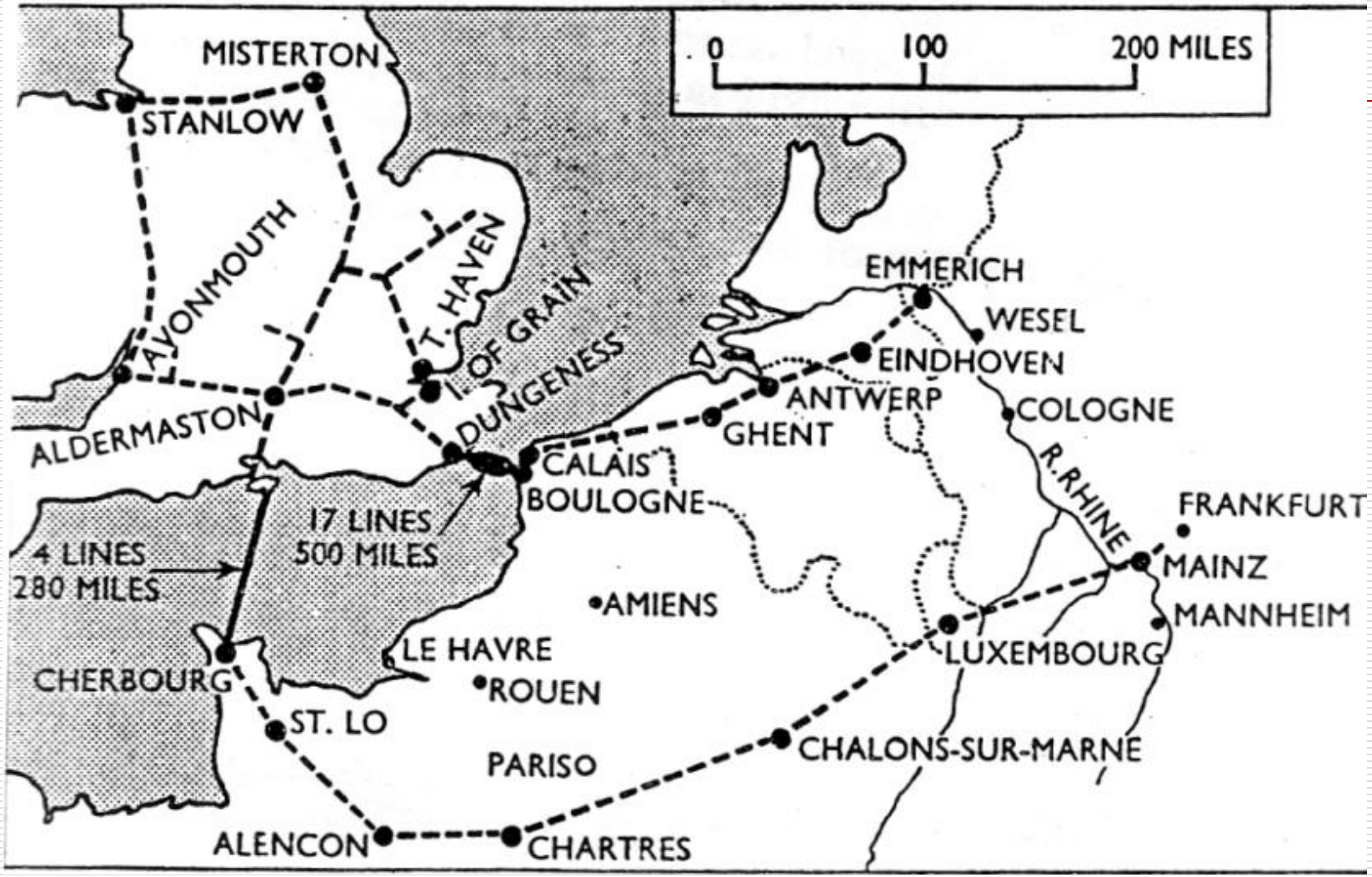


The two cross-Channel PLUTO routes. (GEC)

Dungeness to Boulogne

- HAIS line installed 10th Oct
  - Further HAIS lines installed but shore connection challenges eg Dungeness
  - Pumping delayed until 27th Oct
- 6 HAIS lines installed in 44
- HAMEL shore connection solved by combination with HAIS flex ends with installation in early 45.
- Eventually 17 lines in total were installed with a mixture of 2ins and 3ins HAMEL plus HAIS

PLUTO Links to main land fuel distribution



BUT ??

- Overall contribution to total fuel transported cross channel was estimated to be less than 10% !
- But provided guarantees against lack of port access, bad weather etc
- Enormous commitment of scarce resources and skilled manpower
- Salvage/Recovery:-
  - In 1946 HMS Latimer with Hartley supervising recovered HAIS lines at 6 miles/day
  - In total 23,000 tonnes of Hais lead and 3,500 out of 5,500 tonnes of Hamel Steel recovered

Legacy & Inspiration ?

Cloflexip Risers ?

Reel lay eg Apache