The South African Institute of Marine Engineers and Naval Architects

SAIMENA

The

Two Oceans Journal

Annual Edition 2017

National Council 2016/2017

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Iain Armstrong and Org Nieuwoudt

2017 Annual Edition

www.saimena.org.za

Durban Branch Report December 2016

The year 2016 will soon be but a memory, having seemingly passed rapidly. The coming year should be interesting , particularly with Donald Trump entering the political scene.

During the year, the Durban Branch was fortunate to have been able to host monthly papers with overseas presenters. These were done in conjunction with local company representation. Attendance unfortunately was at times very poor, seemingly with the company guests outnumbering SAIMENA members on occasion.

The future of SAIMENA house still remains uncertain. Berea Rovers have little interest in advising SAIMENA of any new proposals as regards the development of the site. They appear to be of the opinion the sooner, the better. The chairman has said construction will start soon, but various tenants on the site have still to be relocated, and it appears business as usual for them, including the Metro Police horse unit.

Also in limbo is the financing of the proposed Commonwealth Games – reports suggest that financially this will not be viable, which may affect the proposed construction on the Berea Rovers site.

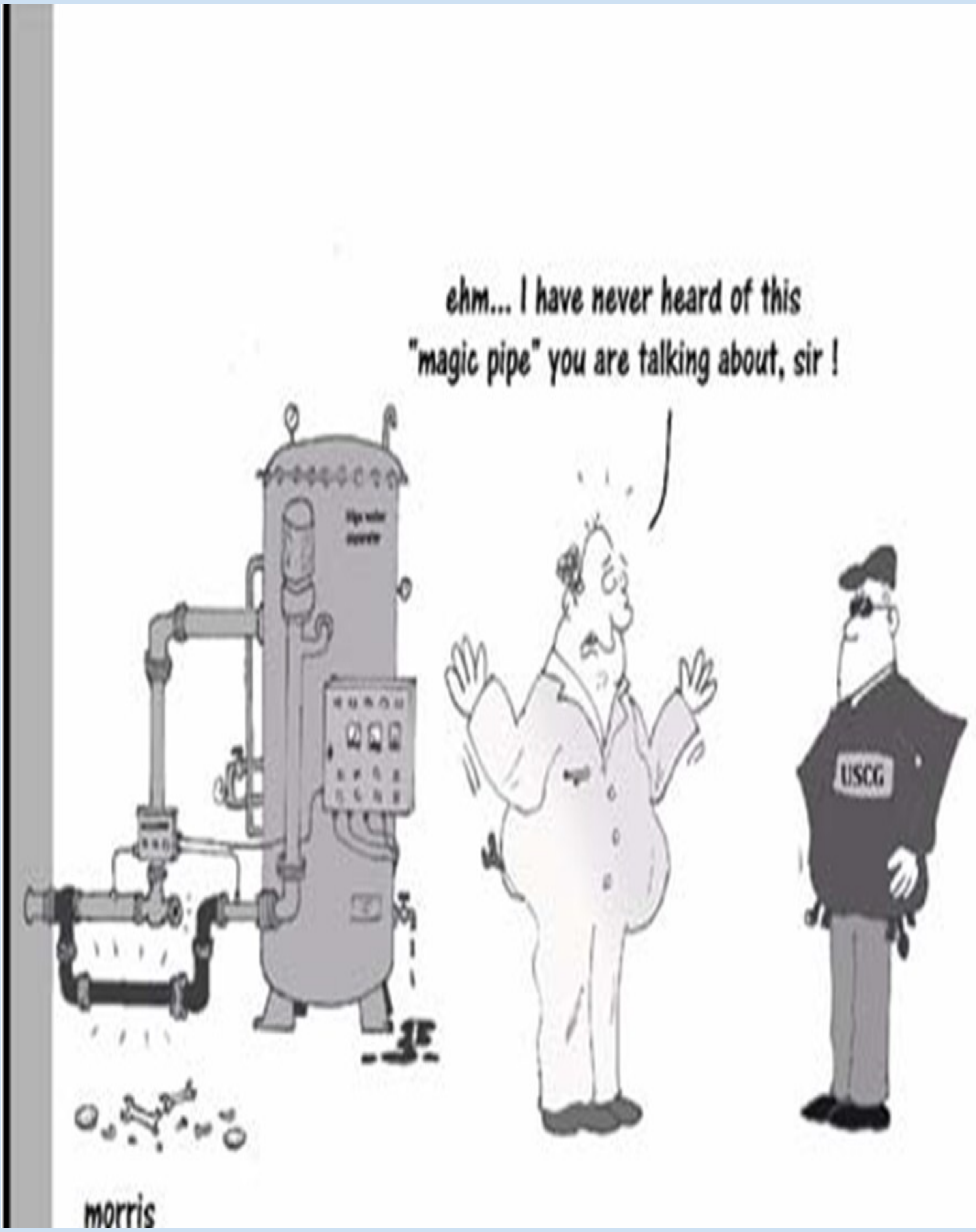
On the social side, the Christmas lunch will be held at Royal Durban Golf Club and hopefully will be well attended. The annual golf day was held in November.

Arrangements were made for the annual dinner dance to be held at the Blue Waters Hotel on the 4th of November. Unfortunately, due to poor response for bookings, this had to be cancelled before the event. The poor economy was cited by a number of regular guests as being unaffordable this year. May 2017 be more prosperous in order to be able to host a successful dinner dance.

Wishing all a peaceful festive season, and a bright future for 2017.

Rogan Troon – Durban Branch Chairman

YOUR FAVOURITE OILY WATER SEPERATOR



Reciprocating Steam Engines

During my time at sea I was fortunate or sometimes unfortunate to have sailed on vessels with steam turbine, diesel electric, motor and reciprocating steam as their means of propulsion .

Reciprocating steam engines have been around for a very long time (first workable one 1683), but the marine steam engine did not mature into the more common vertical triple expansion engine until 1891. The paddle steamer used the side lever type and are not the subject of this article

Many of you will have heard or even have sailed on the old Liberty ships that were given to governments and companies as compensation after World War Two (Safmarine had some). In fact all the Liberty ships were fitted with steam reciprocating engines..

The most common engine is the vertical, triple expansion, double acting type.. As the name suggests this engine consisted of three cylinders vertically arranged going from the high pressure , to Intermediate pressure and finally the low pressure cylinder with steam pressure applied on the top side and bottom side of the pistons sequentially and exhausting appropriately.

The circumferential size of each piston is calculated from the small high pressure to the proportionaly sized low pressure piston so that the same force is applied on each piston,

The downward stroke of the pistons is transmitted and transformed via the piston rod and crosshead to a circular motion of the crankshaft and then to the gear box or direct to the propeller shaft.

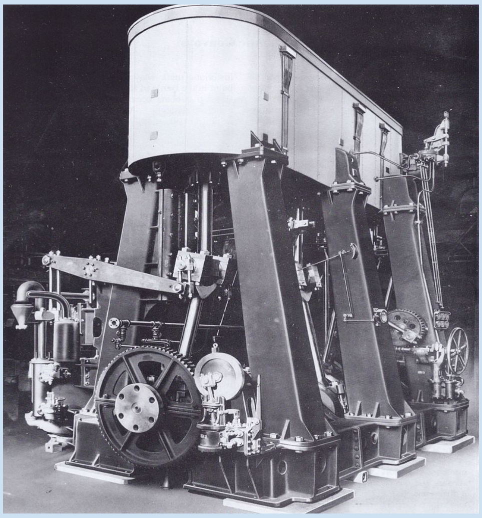
To keep the piston rod from flopping around guides were fitted to the "A" frame and slippers to the piston rod.

Fitted to the crankshaft besides the main bearings and big ends was an eccentric which transformed the circular motion of the eccentric via a rod to a reciprocating motion . This motion determined via a valve what port to open allowing steam to enter either the top or bottom of the concerned piston and to exhaust from each cylinder. The position of the eccentric rod could be altered over an arc changing the port positions to reverse the engine.

Mineral oil is used to lubricate the cylinders and vegetable oil used in the sump . The vegetable oil is supplemented with water immulsifying it and by splash feed lubricates all the lower sliding surfaces and bearings.

This is not a comprehensive detail or inclusive study of this type of engine, but is just to give you the reader an idea of how it works..

Should you ever go to Texas U.S.A. in the Houston area, go and visit the USS Texas which is a conserved battleship fitted with a marine steam reciprocating engines. Should you wish to see a working full sized engine, there is one at a museum in BRENTON UK.



Triple expansion marine steam engine

Steam Reciprocating Engines Cont'd..

In order to test the temperature of the big ends you would lean over the sump and let the big end slap your palm as it came round. Scraping bearings would horrify the modern engineer with white metal bits flying around all over the place. (You used a industrial hacksaw blade ground to a sharp edge and gripped by both hands on the blunt side to take of lots of metal per scrape).. Still used industrial blue to find the high spots but small tolerances were not the way to go).

As with any marine propulsion engine there are essential auxiliaries and to get a better understanding of how the system works I add the following. Again not comprehensive.

Obviously steam generation is needed for this type of engine and in merchant vessels this was achieved by using scotch boilers either single or double ended. When I worked on a coal fired ship it was amazing to watch the fireman feeding the furnaces , drawing ashes and disposing them overboard. Would never be allowed in todays health and safety regimes. Coal was shoveled directly from the bunkers to the boilers furnace.

In more modern vessels heated fuel oi is used to fire the boilers with a F.O. Feed pump providing fuel pressure direct to the burner nozzles . Steam was generated to between 200 to 250 PSI

Basic engine room auxiliaries besides the standard bilge pump, Fire pump ,and other domestic pump requirements were the vacuum pump, boiler water feed pump, condenser, cooling water pump, evaporator and hot well

The steam once exiting from the low pressure cylinder progressed to the condenser where the steam was turned into condensate by seawater via tubes in the condenser. The vacuum pump ensured a constant vacuum in the condenser.

Once past the condenser the condensate was kept in a hot well, topped up by water from the evaporator, whenc the boiler water feed pump fed the water to the boiler.

It's been a long time since I sailed on a ship propelled like this but am sure there must have been a process to measure and control the dissolved solids ppm and alkalinity. In steam turbine vessels we used hydrazine to keep the oxygen and CO2 content down (although I have heard of a tray type deaerator), and periodically blew down the boilers to keep the salt ppm down plus reduced the alkalinity by chemicals.. Hardness was also a factor.

Perhaps there is an old salt out there who can remind me.

Recip Vacuum Pump

Recip General Service Pump

Acknowledgments Iain Armstrong

The Commissioning of Durban's First Steam Tug

Following the grounding on 22nd November 1858 of the 198 ton schooner "ANNE WHITE" while being piloted through the entrance to Durban harbour, the attention of the Natal Legislative Council was drawn by the Lieut.-Governor to the advantages likely to arise from the employment of a small Government steamer. This would be used to keep down the Bar and act as a Tug. It was ascertained that the cost of a steam vessel of 150 tons, with engines of 40 H.P. would not exceed £4000, payable over 2 years. Mr Albert Robinson, a travelling member of an engineering firm, succeeded in placing the order for the first steam tug as well as the first railway line, after finding a satisfactory solution to the question of where the money was to come from.

The vessel ordered by the Natal Government arrived under sail on 14th November, 1859, having left London on 26th July. She was named the "PIONEER" and had proved herself a first class sea boat, sailing directly into the harbour without anchoring. She was a paddle boat of 92 tons register, with 2 engines working to 40 H.P. Built of iron and drawing 6 feet of water, she was reputed to be the first steam tug in South Africa. The "Mercury" gave the tug much praise, saying

> "Her size being quite large enough to cope with seas which may disturb our Bar, while her 1ight draught renders her ingress and egress at all times and in all weathers a matter of certainty.....for beauty of proportion and gracefulness of lines, competent authorities admit the "PIONEER" is probably unexcelled, and looking at her as belonging to the tug genus she is unusually elegant."

It was not until 26th December that:

"The beautiful litt1e Port Steamer having had her machinery put in working order, and her paddles fixed, went under steam for the first time in these waters. Mr Albert Robinson, to whom the Colony is indebted for the general design and specifications of the vessel, gave an impromptu invitation to a number of ladies and gentlemen to :

> "witness the performance of the steamer, and enjoy an aquatic trip. The company would have been larger but for the Christmas holidays. At 2:30 the "PIONEER" moved gracefully from her berth near the Custom House, passed swiftly down the Bluff Channel across the Bar and out to sea, where she disported in gallant style."

After returning, she tied up and a complimentary speech was made of the vessel, although nothing was mentioned of the Skipper, Mate or Engineer who sailed her out and fitted her up. Though it was Boxing Day, and a Public Holiday, among all the kind sentiments there was no sign of cakes or ale.

However on 19th January, 1860 the "Mercury" published the following which preceded a public meeting to consider the state of the Bar and the cause of the detention of 8 vessels outside:

"When last outside the Port Tug carried away her mainmast by running foul of the "SELINA", whose bow-spit was also broken. Her machinery is evidently not in good working order, rendering her at present useless, and complaints are made of her general management. We cannot say where the blame lies, but it is obvious that a better system must be established if her cost and maintenance are not to be a dead loss to the Colony".

After the meeting, at which the tug master, Captain Bell, was verbally attacked "as being unfit for the mastership of a steam tug due to lack of experience, being too kind hearted to insist on discipline, and being at any time humbugged by the Engineer", the Governor personally visited Durban to superintend and direct the refitting of the "PIONEER".

The immediate cause of the steamer's defective working was the spindle of the throttle valve being broken, which resulted in steam being cut off to one engine. Among other problems were that none of her valves were steam or air tight, and the paddle wheels had been incorrectly put together.

It was suggested that she might be better suited for river service than the rough work and weather of a port such as Durban.

The original rake provided for the tug for dredging purposes had been tried on the Bar, but was found to insufficient in size and otherwise unsuitable. A new rake was made and after raking the Bar there was 7 feet of water on it at quarter ebb.

After the refitting, the performance of the tug was much improved and successfully brought in the "ROTHAY", schooner, and "SALINA", brig, and took out the barque "GOOD HOPE" all in a day.

Acknowledgements "A History of Old Durban" by George Russell, 1895 .

The Voicepipe

With the concerns of price and the damage to the environment the use of heavy fuels on merchant vessels has come under heavy scrutiny and is the subject of a number of new IMO recommendations, regulations and codes.

Given that what alternative are there? Let's examine the nuclear one.

First there are two types of nuclear energy known to man at this time and they are the energy release by nuclear fission and the release by nuclear fusion..

So what are they?

Nuclear fission is what is commonly used in power stations and various warships principally operated by the United States Navy, and icebreakers. It is the energy release of an atom when split.. Nuclear fusion is what takes place in a star and is a consequence of extreme temperature and gravity fusing hydrogen atoms together, the end result being Helium . This process results in a loss of Hydrogen which is converted into pure energy

Fission has the drawback of emitting radioactivity which is not good for anything whereas fusion is clean . So why don't we use fusion? Simply put it is so difficult to do although there is hope that fusion could be a commercial commodity by 2020

Four merchant vessels have been built with the main steam production being fission nuclear generated and they are the Savannah of the U.S.A. the Otto Hahn of Germany, the Mutsu built by Japan and the Sevmorput built by Russia.

Of these only the Sevmorput is still around having been reported as carrying cargo to a military base in 2016.

The Savannah was deactivated in 1971 having been in service for 10 years initially as a passenger/cargo ship and finally as a cargo ship.

The Otto Hahn operated from 1968 to 1979 when her reactor was removed and conventional diesels installed. She was scrapped in 2009.

The Mutsu did her trials in 1974 and then was decommissioned in 1992 due to protests and a leaking reactor shield.. She never carried a cargo.

The Sevmorput was launched in 1986 to serve northern ports of the soviet union and is still in service but it is not sure if still nuclear powered.

Given all the above and what appears to be successful builds of at least three of these ships plus they remained in service as nuclear powered vessels for over 10 years, why have more not been built?. The answer to that is simply they are too expensive to build and are too controversial environmentally.

All the ships mentioned in this article were built under the auspices of a government or a government agency. Any interest shown by commercial concerns disappeared early on or was not there at all.. Another drawback was the shape of these ships which was not conducive to commercial cargo carrying.

The environmental aspect is a bit strange to me as there does not seem to be the same amount of fear by the public in general when it comes to nuclear powered warships including submarines, and icebreakers.

However if the fusion power gets conquered and the plants can be fitted into ships economically and size wise, then I can see all merchant ships being nuclear powered before the end of the century. With the inevitable rush for Marine Engineers to get their certification endorsed for steam and nuclear., although I envisage the possibility of said ships having certificated steam engineers for the engine room and certificated steam generation nuclear plant engineers for the nuclear plant.

The Editor

Sevmorput

Otto Hahn

Savannah

Mutsu

News Snippets

1.Shanghai-based Wison Offshore & Marine has unveiled a range of solutions for floating power supply. With a design philosophy of "plug-in power", all products which are named W-FSRP series (Wison-Floating Storage Regasification and Power generation) feature integrated functions of LNG loading and storage facilities, regasification and power generation. The smallest unit starts at 10MW capacity, while the largest accommodates an 800MW power plant.

2. For the first time in nearly two decades Japanese shipbuilders have overtaken rivals in South Korea in terms of new build order backlog.

3. A former Louisiana maritime instructor has been indicted on federal charges for allegedly accepting cash payments to fraudulently certify individuals on critical maritime infrastructure equipment for which they never actually completed training. The charges were handed down earlier this month in the Eastern District of Louisiana follow an investigation by U.S. Immigration and Customs Enforcement's (ICE) Homeland Security Investigations (HSI) and the U.S. Coast Guard Investigative Service.

4. The 'NPT' propeller, or New Profile Technology propeller to give it its full title, is now in service. Its promise of lower fuel consumption and emissions is proving to be fact, both on ships fitted with slow revving engines, and on those with conventional equipment which are slow steaming.

5. The ability of concrete armour units for breakwaters to interlock and form an integral single layer is important for withstanding severe wave conditions. In reality, displacements take place under wave loading, whether they are small and insignificant or large and representing serious structural damage. In this work, a code that combines finite- and discrete-element methods which can simulate motion and interaction among units was used to conduct a numerical investigation. Various concrete armour layer structures were built using a carefully researched placement technique and then subjected to a boundary vibration. By analysing the displacements and assessing the number of units that were displaced by more than one-third their nominal size, the numerical test programme indicated clearly that the initial build packing density was the most important parameter influencing the stability of concrete armour layers under vibration. The size of the underlayer rock and the type of unit also affected the numerical performance of the single-layer concrete armour systems under vibration. The results presented are for full-scale systems and therefore add further insights into simple laboratory 'shake tests', although the oscillatory loading in this study is acknowledged to be profoundly different to wave action.

6.A new mandatory code for ships using gases or other low-flashpoint fuels has entered into force on January 1, 2017, along with new training requirements for seafarers working on those ships, according to International Maritime Organization (IMO).

7.On December 27, a U.S. Coast Guard hearing officer fined Washington resident Mark Raden $9,500 for allegedly shining a high-powered blue laser beam at the bridge of the Washington State Ferry *Tokitae*.

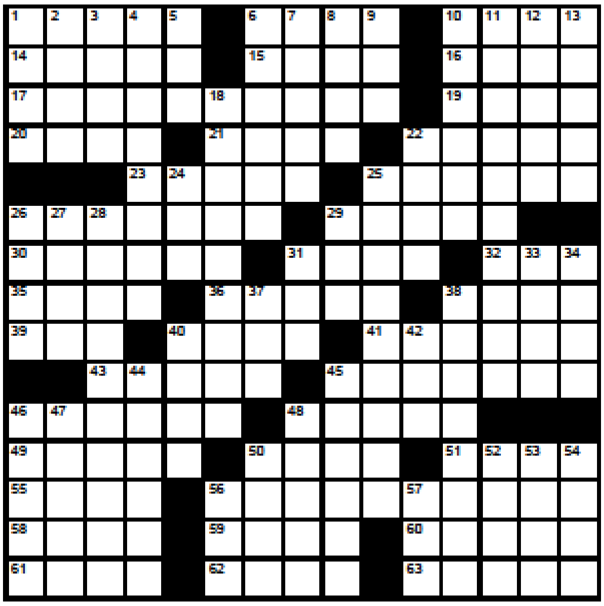
8.**With more and more ships navigating in polar waters, IMO has moved to address international concern about the protection of the polar environment and the safety of seafarers and passengers with the introduction of new regulations that all ships operating in these harsh and challenging waters must comply with.**

9.Next-generation Smart 3D ship design software combines innovative technologies that have the potential to change forever the way marine and offshore structures are engineered and designed according to Ocean Hub.

10. The USS Enterprise one of the first of the US Navy's nuclear aircraft carriers is the first nuclear powered carrier to be de commissioned. Built in 1960 the ship was involved in just about all the conflicts the US was involved in from 1961 to February 2017 . When deployed in 2011 to conduct exercises with the South African navy off Cape Town, she had to turn around and get on station south of Pakistan due to the twin towers terrorist attack

The TOJ Crossword

by Peter A. Collins / Will Shortz ©The New York Times



Across
1. Olympic stadium centerpiece
6. Kemo ___ (the Lone Ranger)
10. Assns.
14. Kind of treatment
15. Word of woe
16. Prefix with graph
17. In the course of many weeks
19. Sign from above
20. Tijuana table
21. Laugh-a-minute type
22. Lunden and Crawford
23. Water conduits
25. Illinois city
26. Weaken from disuse
29. Spoken for
30. Event where people hold hands
31. Salad veggie
32. Ypsilanti sch.
35. Wing ___ prayer
36. Name hidden in 17- and 56-Across and 11- and 28-Down
38. Hertz competitor
39. Letter after chi
40. Powerful auto engine
41. French physicist after whom an electric unit is named
43. Midway alternative
45. Was weak in the knees
46. British author ___ Currie
48. Throws in the towel
49. Sir Francis who circumnavigated the globe
50. Where truckers sit
51. Snack with a shell
55. Said uncle
56. Reserve
58. Tennis serving whiz
59. Building girder
60. Thin
61. Politico Perot
62. Land north of Chile
63. Chelmsford's county

Down
1. Gift tag word
2. All you need, according to the Beatles
3. "Up" votes
4. Argentine soccer star of the 1980's-90's
5. Nightmarish street
6. Reasonableness
7. Some choristers
8. Thai currency
9. Half a figure eight
10. Peter of "Lawrence of Arabia"
11. Stay tied
12. Former astronaut/senator
13. Reasonableness
18. Theater seating choice
22. It's best when cracked
24. Scanner's scan, for short
25. Comment around a birthday cake
26. P.D.Q.
27. Gymnasts' coups
28. Broadcast signal carriers
29. Egypt's "boy king"
31. Optimist's word
33. Muck
34. Car category
37. Pipe joint
38. Followers
40. Barn topper
42. Clever comment
44. Some park users
45. Maker of the Forester
46. Business exec Bronfman
47. Constellation near Ursa Major
48. Gulf state
50. 27, to 3
52. Summer drinks
53. Secret message
54. Stone used for chess sets
56. Domino spot
57. Valuable rock

What is Bollard Pull ?

One of the worst days that a designer or builder of a tug can have is when the bollard pull test does not meet expectations. After month, even years, of work and anticipation, this is an unwelcome outcome for all involved in the design, construction, or operation of tugs.

Why does this happen? There are principally two reasons:

The term “bollard pull” is misapplied or misunderstood, even by seasoned professionals.

An overly simplistic prediction for bollard pull is used in the design stage.

This brief article hopes to help clarify the nature of bollard pull, and to describe what makes up a tug’s real ability to generate towing thrust.

What is bollard pull?

This term describes a very precise function – the static pulling force of a tug when its hawser-line is connected to a fixed position on shore. (The shore-side attachment is called a “bollard”, hence the name for the operation.) In other words, it is the <u>attainable</u> towing force on the hawser at <u>zero vessel speed</u>. The two underlined terms are important to properly understanding the scope and limitations of bollard pull.

Bollard pull is not tow pull

Anything different from this narrow scope of operation, such as the towing force at any speed other than zero, <u>is not</u> bollard pull. The tug’s pulling force across its entire speed range is its “tow pull”.

The figure below illustrates delivered thrust, vessel resistance, and resulting tow pull across a speed range for a particular vessel, engine, gearbox, and propeller. The upper curve is the maximum potential delivered thrust, which is the useful force that can be applied to the towed or pushed object. The tug’s own resistance is the lower curve, and the difference between the two – that potential force over-and-above the thrust needed to move the vessel itself – is the tow pull. The bollard pull point is found on the delivered thrust curve at zero speed (approximately 230 kN for this example), and the tug’s own free-run top speed (without any additional tow) is where the curves cross (at 13 knots).

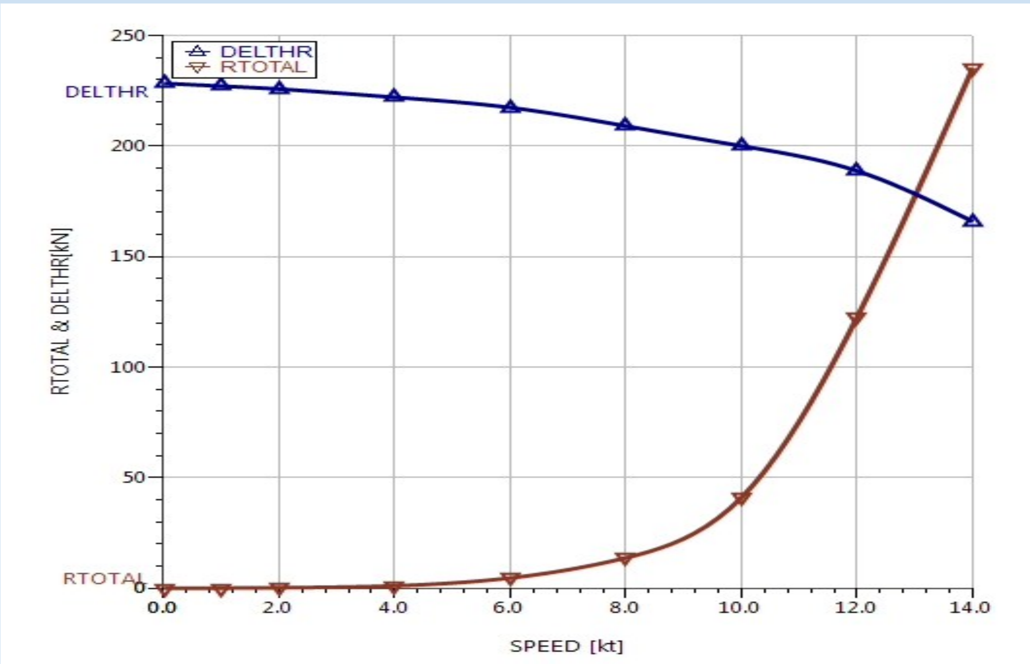


Figure 1 – Delivered thrust and resistance

What is Bollard Pull Cont'd.

Bollard pull requirements

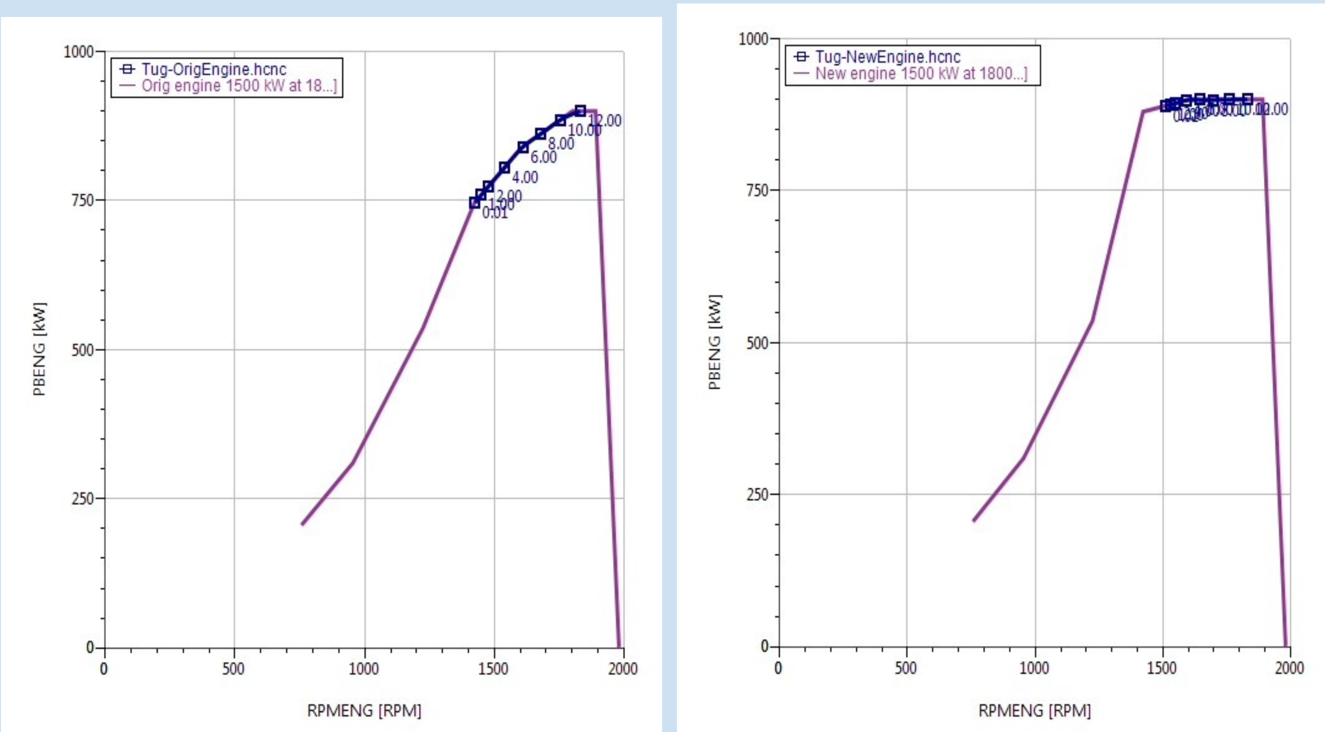
It is important to correctly understand that a statement of the thrust needed to tow an object at some particular speed <u>is not</u> its "bollard pull" requirement. The above plot illustrates the problem that can be caused by this confusion. Say the towing speed for a barge was 6 knots, and one of the many publications or online calculators so titled for "required bollard pull" predicted 230 kN for this speed. This is the thrust requirements at 6 knots, not at the bollard pull specification of zero speed.

The tug described by the plot does indeed comply with a 230 kN ."bollard pull" requirement, but it <u>does not</u> produce 230 kN of tow pull at 6 knots. Rather it is some 5% short. The broad misuse of the term "bollard pull" to mean "tow pull" too often leads a well-meaning designer to a conclusion that is not fulfilled in service.

Integration of propulsion system components

As stated previously, tow pull is a system result. It requires that the components be properly matched, particularly the propeller pitch, reduction gear ratio, and engine power curve. While most readers will have experience in the importance of proper pitch matching, the shape of the engine's power curve can also be a valuable contributor to optimum tow pull.

The plots below are for two engines of identical rated power and RPM, but with different power curves. In the same way that bollard pull is just a single point on the tow pull curve, an engine's rated power and RPM is also just a single point on the power curve. It is used to describe a capability, but it does not tell the whole story.



Figures 2a & 2b – Engine power curves

An increase in engine power along its curve provides more than 10% increase in bollard pull (with a diminishing increase in tow-pull), as shown in the plot below. It is easy to see how selection of a suitable engine model with a propeller matched to that engine's power curve is absolutely vital to achieving maximum tow pull.

An increase in engine power along its curve provides more than 10% increase in bollard pull (with a diminishing increase in tow-pull), as shown in the plot below. It is easy to see how selection of a suitable engine model with a propeller matched to that engine's power curve is absolutely vital to achieving maximum tow pull.

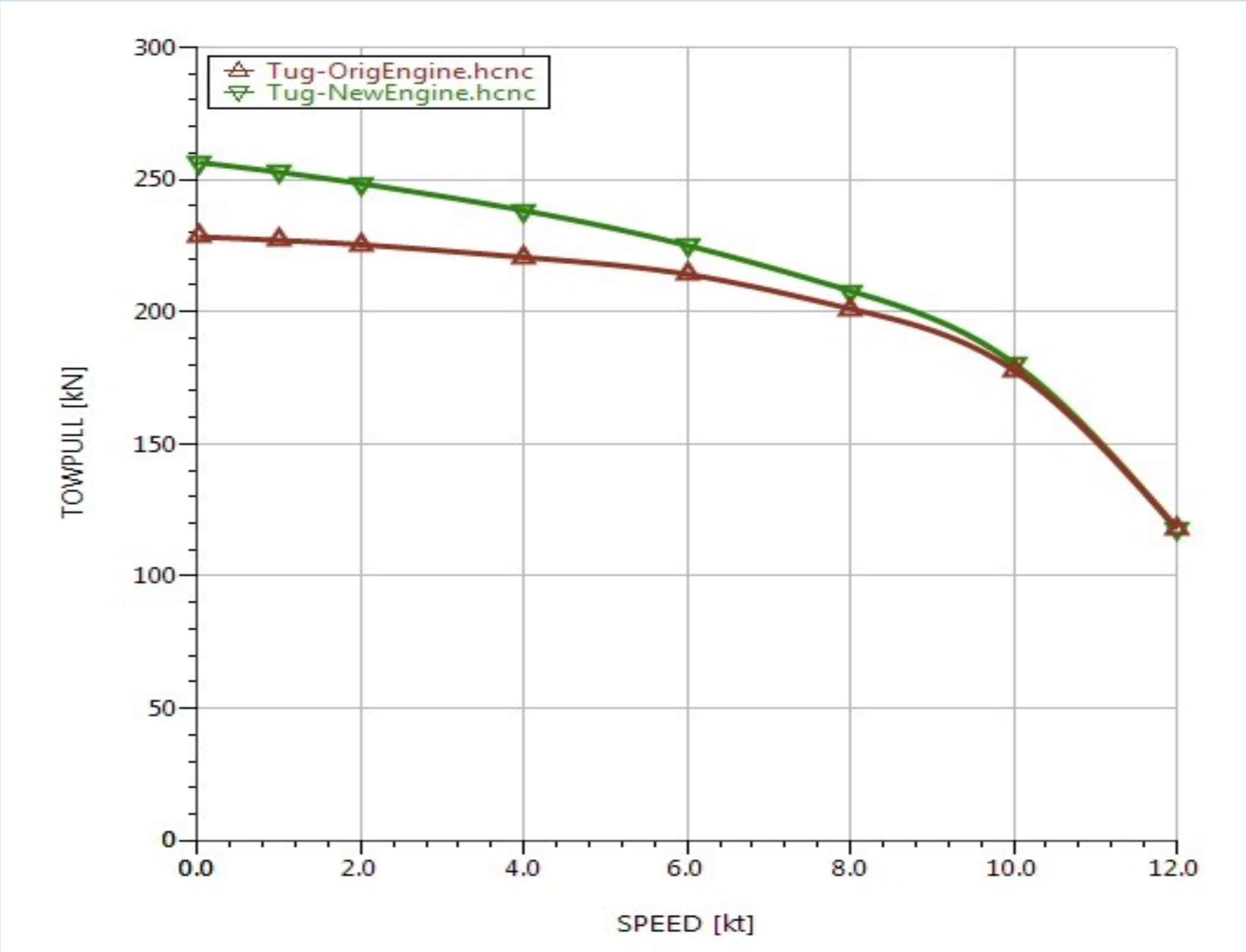


Figure 3 – Increase in tow pull with a change in engine power curve

Predicting tow pull and bollard pull

The recipe for generating tow pull, and therefore to reliably predict tow pull, is composed of three principal parts:

Propeller thrust at a particular RPM.

An engine with the power-making ability to reach that RPM.

Interaction between the propeller and hull.

The only method to fully model a system that considers all ingredients is an "equilibrium torque" calculation. Properly configured commercial propulsion analysis software provide this calculation. propeller design and analysis software can further refine tow pull predictions for ducted propellers by allowing consideration of the influence of headboxes and inflow disruption on nozzle effectiveness. All of these tools are commercially available and appropriate for any design office.

A systems-based analysis can further reveal another widely held misconception – that bollard pull will always be the highest value of the tow pull curve. Not so. Depending on the shape of the engine curve, a propeller with too-high pitch can reduce bollard pull below tow pull. The following plot shows the tow pull curves for <u>identical</u> systems, except for a small difference in propeller pitch. In this example, an over-pitched propeller will result in a bollard pull test that is some 15% less than its peak tow pull.

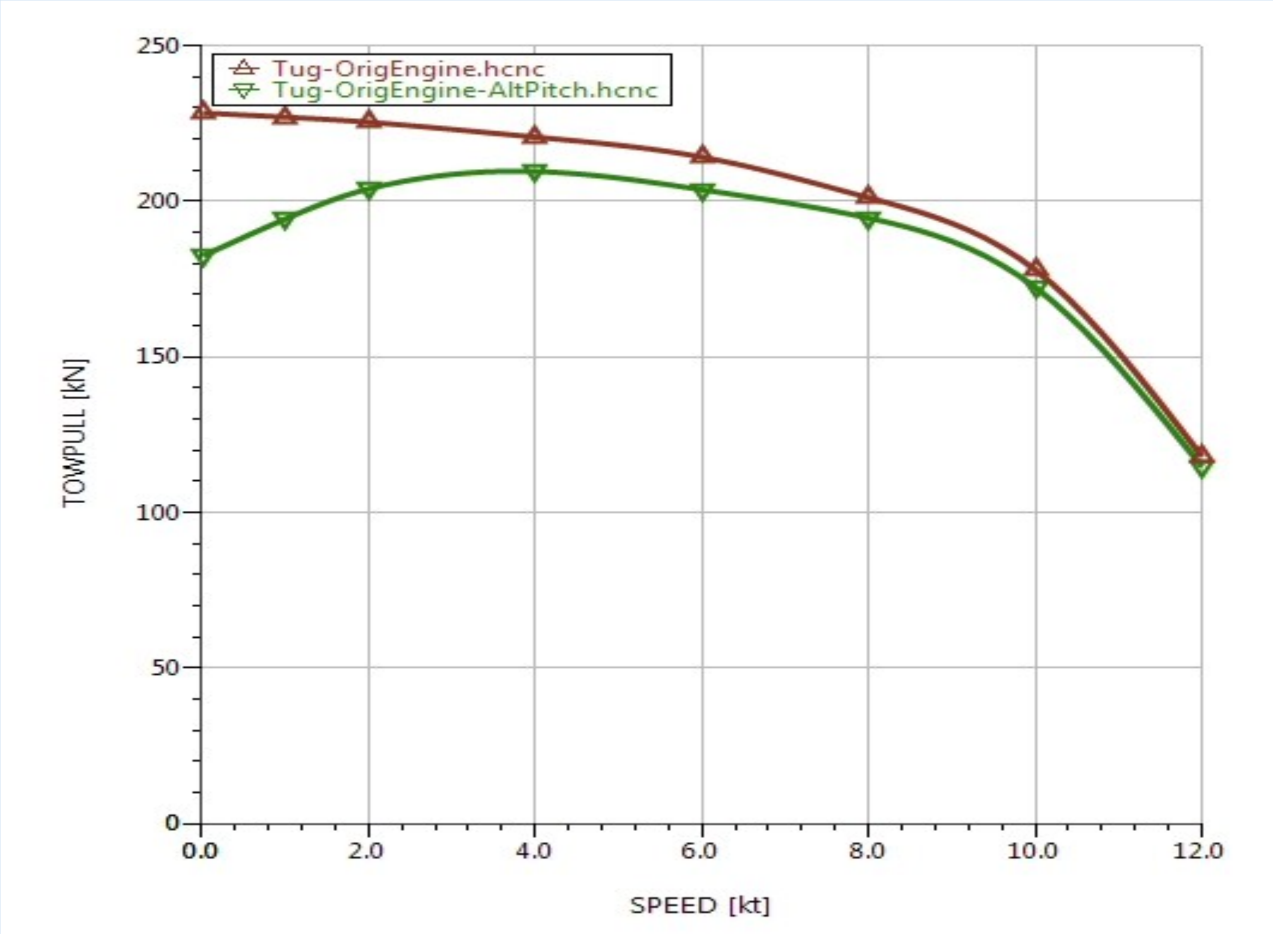


Figure 4 – Bollard pull reduction with over-pitched propeller

Unfortunately, it is still a practice in some companies to use simplistic calculations for the prediction of bollard pull, whereby the propeller thrust is calculated at zero boat speed and full rated engine RPM. There is no consideration if the engine has sufficient power to be capable of reaching that RPM, or any evaluation of the real deliverable tow pull! Further, simplistic calculations do not consider the effect of cavitation breakdown during bollard pull operation. It is critical to use a calculation tool that not only predicts the thrust breakdown on the propeller, but also provides a criteria check for the potential of thrust breakdown on the nozzle of a ducted propeller system. A simplistic calculation can result in too-optimistic prediction of bollard pull, and the measurements from the bollard pull test would greatly fall short of the expectations proposed to the owner or operator by the designer or builder.

Summary

Even though it is not a complete measure of a tug's comprehensive towing abilities, the measurement and calculation of bollard pull still has commercial value. Right or wrong, it is often the one metric that determines which tug gets the job. Therefore, a clear understanding of the nature of "bollard pull" and how it relates to the broader tow pull of a tug is critical to successfully meeting expectations. One step that any design office can take is the use of accurate bollard pull and tow pull prediction methods. These must properly characterize the integrated physics of the propulsion <u>system</u> – hull, propeller, gearbox, and engine.

Acknowledgements: Tug and OSV, Donald MacPherson, Hydro Corp.

Past Presidents of SAIMENA

AGM No	Year	President Name
Founded	1974	Harry Smith
0	1975	Harry Smith
1	1976	Harry Smith
2	1977	Johannes Richard Nortier
3	1978	Johannes Richard Nortier
4	1979	R.J. Wilson
5	1980	R.J. Jenkins
6	1981	P.F.H. Brebnere
7	1982	Don Utley
8	1983	Don Utley
9	1984	Ralph Baker
10	1985	Ralph Baker
11	1986	C.W.B. Singleton
12	1987	C.W.B. Singleton
13	1988	R.J. Jenkins
14	1989	R.J. Jenkins
15	1990	R.B. Hughes
16	1991	R.B. Hughes
17	1992	R.H. Gorman
18	1993	R.H. Gorman
19	1994	I. Lloyd
20	1995	I. Lloyd
21	1996	William Haig Rice
22	1997	William Haig Rice
23	1998	R.T. Burnett
24	1999	R.T. Burnett
25	2000	Roy Hitchings
26	2001	Roy Hitchings
27	2002	Iain Armstrong
28	2003	Iain Armstrong
29	2004	Neill Leeming
30	2005	Neill Leeming
31	2006	Willem Deyzel
32	2007	Willem Deyzel
33	2008	Paul Coxon
34	2009	Paul Coxon
35	2010	Richard Shaw
36	2011	Richard Shaw
37	2012	Kevin Watson
38	2013	Kevin Watson
39	2014	Louis Gontier
40	2015	Louis Gontier
41	2016	David Fiddler

Hybrid Systems

While this article would like to point out that there is no free lunch in the proposal to operate in a genset free mode – the energy required for the hybrid equipment must still be sourced onboard –

.

TACTFUL ARRANGEMENT

A unique genset-free propulsion system design for hybrid tug boats by a Japanese engine and propeller manufacturer could hold the key to reducing both capital and operating expenditure, as well as mitigating engine load fluctuations to reduce exhaust gas emissions

Hybrid system designs are falling foul of generalized assumptions - one being that they're too expensive. This belief is held by some organisations that hybrid vessels can in fact be cheaper than conventional designs –just so long as you're willing to get to grips with the numbers.

"In this low oil price economy, it can be a struggle to make a convincing argument for hybridization,. Most people in the industry would agree that the operational expenditure reduction is something between 10% and 20%, however this isn't such a large amount, especially when payback - which is tied to the low oil price - recedes far into the future."

So, while a hybrid solution may make for a cleaner, more environmentally friendly vessel, it may not make complete sense financially. As a result, some people have worked through a couple of scenarios that outline the potential benefits and errors of hybridization.

Take, for example, a 70-ton bollard pull tug. Here, according to some, the case for hybridization is fairly clear: "A tug's active operation is mostly either push or pull, which means that the engine load fluctuates hugely, so onlookers tend to see a lot of black smoke from the shore. However, the boost mode from a battery bank will take the edge off these load peaks, and thus improve a tug's environmental impact and, perhaps even more importantly, its image.

But it seems not all hybrid configurations will result in similar efficiencies.

"With a standard hybrid tug, power during standby or very slow speed operation usually comes from the battery," according to a manufacturer, "but at slightly higher speeds - roughly between 4 kts and 10 kts -electrical propulsion is most often used. And in this instance, a genset charges the batteries and powers the motor generator while the main engine remains off for as long as possible."

The manufacturer explains that a standard hybrid tug looks to make its operational efficiency gains through the use of downsized main engines and upsized gensets, which are matched with motor-generators to translate the energy into drive motion. The salient point, is that "the sizes of both the motor generator and the genset are mostly decided by this 10 kts speed. However, we have run some calculations, and think we've found an error in the standard hybrid tug propulsion system configuration that specifically relates to that 4-10 kts speed region when electrical propulsion is used."

Consider this. If a tugboat uses fixed-speed propellers and variable-speed main engines, the efficiency of the vessel's mechanical propulsion is still pretty good, even if the load factor is low.

But by contrast, the electric propulsion efficiency suffers from the combined losses of the motor-generator and inverter."

When it comes to this particular scenario, it is alleged that calculations show that direct-drive engines will run at around 36% efficiency under 18% load, while at the same point the electric propulsion system – which includes the genset, motor generator, and inverter achieves no better than a 31.5% level of efficiency.

As such, the solution to improving electrical propulsion efficiency is to ditch the genset.

In fact, a company has already developed a convincing genset-free propulsion system design. As before, at up to 5 kts propulsion power comes from a battery bank. However, above this speed the main engines then kick in with a power take-off in order to supply the onboard electrical demand. Then, for full bollard pull or faster transits (above 11 kts), the battery cuts back in to give the main engines a boost while also supplying the onboard electrical demand.

This daring concept was apparently applied to a real, concrete operation profile, in the form of a tug customer.

Within this genset-free configuration, while the battery bank remains at the standard hybrid tug 190kWh, the main engines are rated at 2,240kW each which is the same as those that power a comparable, non-hybrid tug, and 475kW higher than those used to power a conventional hybrid tug. However, rather than using a pair of 550kW gensets, only a small backup unit is necessary, and likewise the motor -generators decrease from 500 kW to 100 kW each.

"While a lot of people worry about battery life, in this particular case study we have projected that the batteries will only need to be replaced twice in 30 years of service”, say the suppliers”. Furthermore, we have seen that the hybrid part of the overall propulsion system has replaced the hours of mechanical propulsion. Also, the cost of the 190 kWh battery bank evens out against the main engine maintenance, since replacing moving, mechanical parts is expensive".

Another key advantage of this genset-free configuration over a conventional genset-type hybrid, is that its better suited to the demands of the tugs diverse working patterns. Because the operational efficiencies depend so much on what's being towed, where its being towed, and for how long. A gensettype hybrid, which is dominated by high-power operation, simply won't give you the savings needed.

Furthermore, the genset-free solution doesn't guzzle fuel even when on higher-power duties, so it's able to retain its efficiency savings. While the genset-free configuration's initial cost is higher than that of a conventional tug's, it is claimed it's still lower than that of a standard hybrid tug.

Also, when taking into account the lower capital expenditure and 10 – 20 % operation expenditure reduction, a genset-free configuration should make a bigger return on investment faster than a genset-type hybrid. Over a 30-year service period, the system should result in an operational saving of 18%, which is markedly higher than the 11% achieved by standard hybrid tugs.

Manufacturers claim that its genset-free hybrid propulsion system fits well with its Engine, as this type of hybrid arrangement consumes a low level of diesel fuel and the maximum amount of liquefied natural gas (LNG). For a typical tug operation, The manufacturer calculates that a mechanical engine would consume around US$446,000 of fuel a year, whereas a gas engine with a Hybrid function would cost US$209,000 a year, a saving of around US$237,000 annually, for a tug with a 70-ton bollard pull. The company also claims that, when combined with its genset-free hybrid system, the gas engine can achieve the same level of performance as a conventional diesel.

Of course, all of this means that prospective buyers need to do their homework but it's clear that there are savings to be made just so long as you're willing to get to grips with the numbers.

Acknowledgment: Electric and Hybrid Marine Technology International , Kawasaki Heavy Industry.

Ship Disasters

The investigation report as in this article is not supposed to be inclusive but to give salient points of the investigation.

The vessel "Marine Electric" capsized on the 12th of February 1983 with a loss of 24 lives, seven missing and 3 survivors.

She was a collier of 13757 GRT, LOA 605 ft and was plying between Norfolk and Brayden Point in the USA at the time of the incident. She was US flagged.

Overview

The subject vessel capsized and sank by causes unknown in accordance to the enquiry.

The evidence submitted by ships crew, various surveyors and the company indicated that the hatch covers were in bad condition with excessive corrosion, doublers fitted and holed in places. It was noted that the ships crew were afraid to report these faults as they felt their employment would be in jeopardy.

Both the Classification society and the USCG approved the hatch covers static loading but took the information of the manufacturers rather than carry out the calculations themselves, but the covers are accepted as having conformed to the standards of that time.

The Classification Society issued an international Load Line Certificate on behalf of the USCG which was valid at the time but did not arrange to survey the vessel after major repairs were carried out on the hatch covers.

The hatch covers were noted by the Chief Officer as being in poor repair as was the main deck which was noted as being thin and holed in places.

The defects noted on the ship were not reported to the USCG.

The USCG inspectors were found on two occasions to have not carried out their full responsibilities but were found that nevertheless were not at fault regarding the inspections.

The Third mate noted that the main deck was cracked between hatches 3 and 4 and reported it to the Chief Mate.

The Chief Mate did not report the defective hatch covers or the main deck faults to the USCG as he should have done.

Stability calculations for this voyage had not been done as the Master used a set of stability calculations carried out previously and it was not the procedure of this ship to calculate hog, sag and stability for each voyage.

The vessel was fully loaded with a cargo of coal.

The Event

The vessel had been engaged in an emergency with a fishing vessel but had been released from that duty by the USCG and was proceeding to her destination in a severe gale.

Prior t o capsizing and sinking the vessel was noted as being down by the head and started listing first to an angle of 3 degrees and later to 10 degrees at which point the crew abandoned ship.

The ship at that angle then took a violent roll to Stbd. throwing the crew still on board into the sea and capsizing shortly after.

The USCG had been given a mayday emergency call prior to this and rescue craft and helicopters were activated but due to the weather conditions this resulted in 24 deaths, three survivors and 7 missing presumed dead

Conclusions

The enquiry concluded that the Classification Society does not have an impartial relationship with the owners.

The Classification Society had failed to note and require correction of the hatch cover condition.

The Class surveyors were noted as to their questionable professional integrity due to their failure to recognize safety hazards.

That a shell expansion plan be maintained on board .

That the actions of the Master be referred to the US Attorney General for prosecution in that he took the ship to sea in an unseaworthy condition and on numerous occasions with no effective cargo hold bilge pumping system and that he took the ship to sea on two occasions with a hole in the Port side shell..

That the actions of the Marine Superintendent be referred to the US Attorney General for prosecution with respect to his duties regarding the repair and maintenance of the vessel.

Several other recommendations were concerned with proposing various USCG regulations and modifying others.

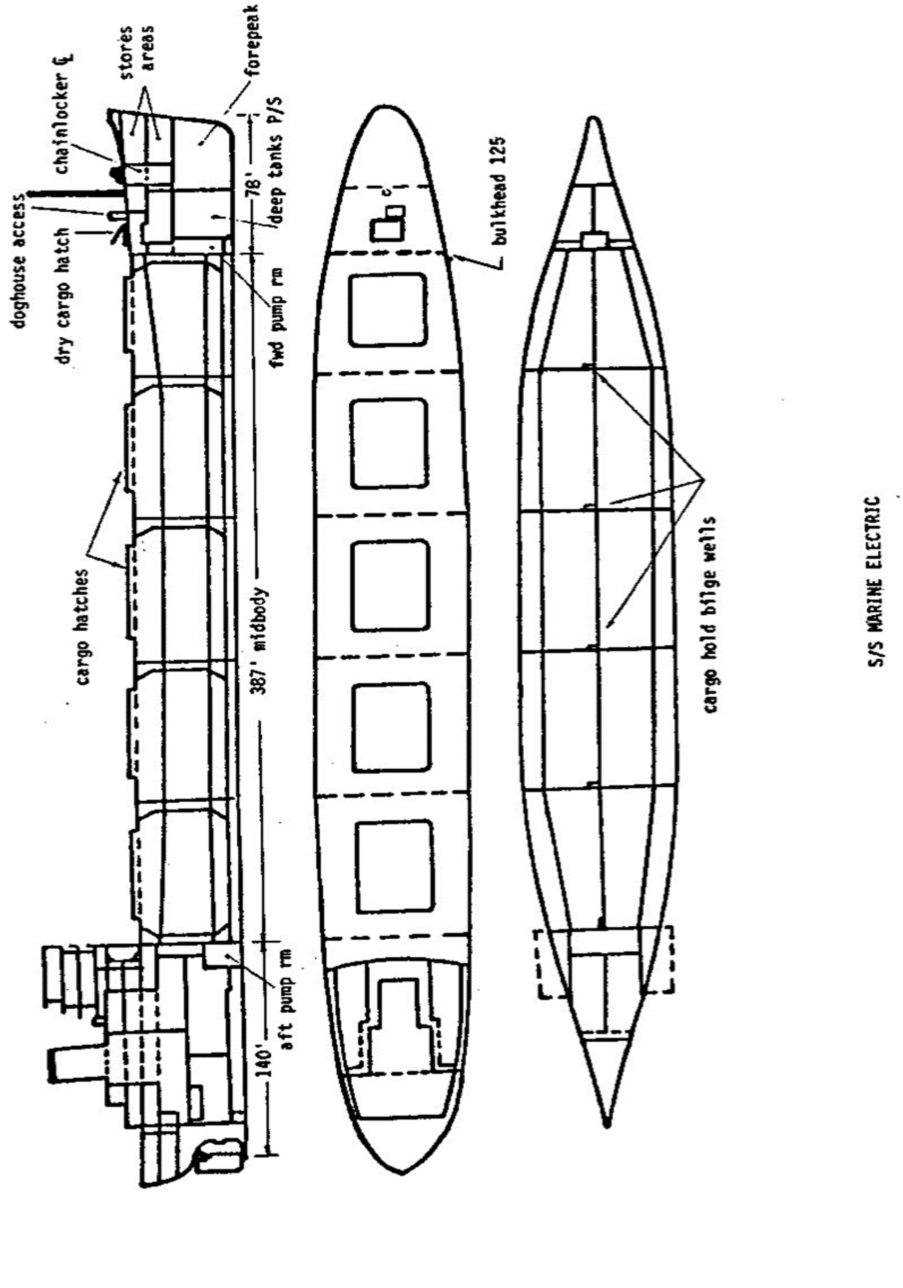
Observations of the writer

This incident occurred some time ago before many of the present regulations and codes came into force, but it is of note that even then the question of quality is paramount and it took many years before codes like ISM and MSC came into force.

Should those codes have been in force as well as the Classification Society enhanced survey requirements for a vessel such as this, it is very unlikely that this incident would have happened.

The Editor

Plan of SS Marine Electric



6

From Coal to Oil

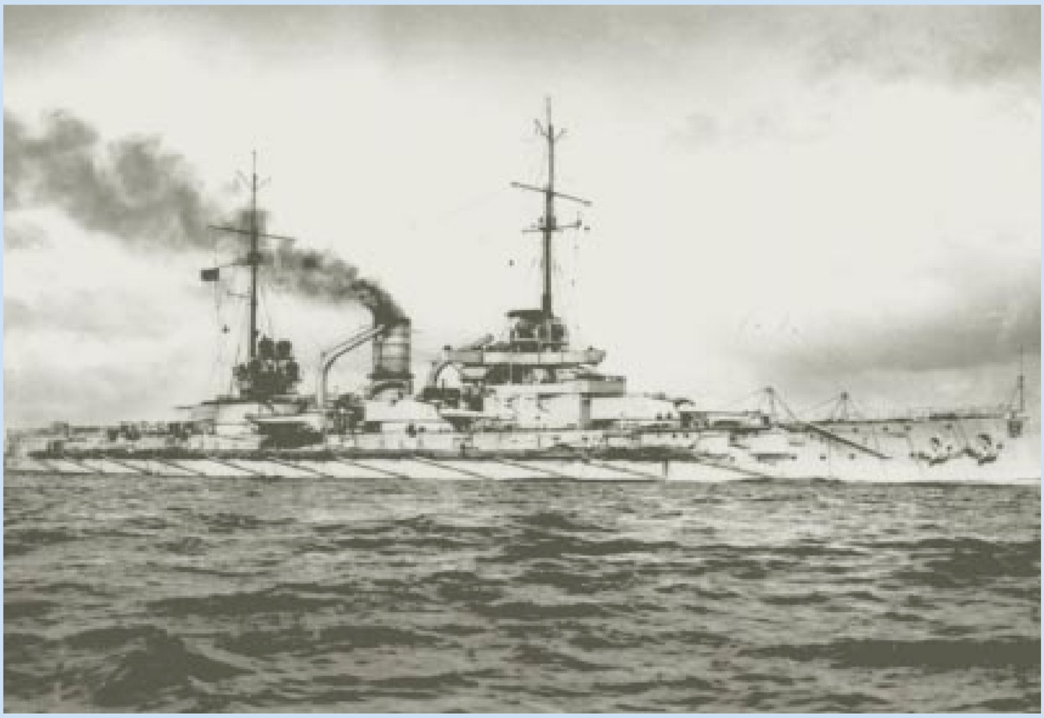
***HMS Illustrious*, coal-fired cruiser launched in 1896.**

When Churchill went to Whitehall in 1911, coal was still the primary source of power for naval vessels. The Royal Navy had adopted oil for submarines and destroyers, and in most ships it was sprayed on coal to increase its combustion. But coal remained the principal fuel, especially for larger vessels like battleships. It was widely available, especially in Britain, where Cardiff coal mined in Wales was preferred by navies worldwide. Coal was accepted by marine engineers, and Britain had a global network of coaling stations. In addition, coal was inert and thus supplemented armor by reducing damage from shells exploding in coal storage bins. But coal also had disadvantages. Moving it from shore to ship, and aboard ship, was dirty and strenuous work that required extensive manpower. As Churchill noted, "the ordeal of coaling ship exhausted the whole ship's company. In wartime it robbed them of their brief period of rest; it subjected everyone to extreme discomfort." It was virtually impossible to refuel at sea, meaning that a quarter of the fleet might be forced to put into harbor coaling at any one time. Providing the fleet with coal was the greatest logistical headache of the age. Oil offered many benefits. It had double the thermal content of coal so that boilers could be smaller and ships could travel twice as far. Greater speed was possible and oil burned with less smoke so the fleet would not reveal its presence as quickly. Oil could be stored in tanks anywhere, allowing more efficient design of ships, and it could be transferred through pipes without reliance on stokers, reducing manning. Refueling at sea was feasible, which provided greater flexibility. Oil erased the drawbacks of a solid fuel. As Churchill noted, "the advantages conferred by liquid fuel were inestimable." But he also recognized that a switch would be difficult to implement: "To change the foundation of the navy from British coal to foreign oil was a formidable decision in itself." Finding and securing sources of oil threatened to be the most difficult part of the venture:

The oil supplies of the world were in the hands of vast oil trusts under foreign control. To commit the navy irrevocably to oil was indeed to take arms against a sea of troubles. . . . If we overcame the difficulties and surmounted the risks, we should be able to raise the whole power and efficiency of the navy to a definitely higher level; better ships, better crews, higher economies, more intense forms of war power—in a word, mastery itself was the prize of the venture.[2]

Opposing the transition was the weight of naval tradition, magnified by loss of the strategic advantage of large coal supplies in Britain. This position was voiced in 1904 by Lord Selborne, the First Lord of the Admiralty: "The substitution of oil for coal is impossible, because oil does not exist in this world in sufficient quantities. It must be reckoned only as a most valuable adjunct." Supporting change was Admiral Fisher, the First Sea Lord from 1904 to 1910, and friend and advisor to Churchill during his tenure as First Lord of the Admiralty. Fisher, who dominated the Royal Navy in his day, was renowned for many innovations in administration and engineering .including *Dreadnought* class battleships. An early supporter of oil as fuel, he wrote in 1902, "It is a gospel fact .that a fleet with oil fuel will have an overwhelming strategic advantage over a coal fleet." Fisher admitted with pride that he was known as an "oil maniac" as early as 1886.

Fisher described such advantages as the ability to replenish at sea and the smaller amount needed to produce the same amount of energy as coal. He reported that a new Russian battleship burned oil alone and that "at one stroke, oil fuel settles half our manning difficulties! We should require 50 percent less stokers." Personnel savings were also critical to the Royal Navy, which regarded the shortage of trained sailors as its worst long-term problem. Although Fisher was unable to push the senior service over the precipice during his tenure as First Sea Lord, he found Churchill an important ally since their first meeting in 1907. When Churchill became First Lord, Fisher wrote to a friend describing Churchill in the extravagant terms common in his correspondence: "So far every step he contemplates is good, and he is brave, which is everything! Napoleonic in audacity, Cromwellian in thoroughness." Fisher regularly peppered Churchill with advice on a variety of naval matters. One requirement, Fisher told Churchill, was that the *Queen Elizabeth*-class battleships be built as a fast division, able to outmaneuver and cross the T of the German fleet. In 1912, Fisher wrote to Churchill, "What you do want is the superswift—all oil—and don't fiddle about armour; it really is so very silly! There is only one defence and that is speed!"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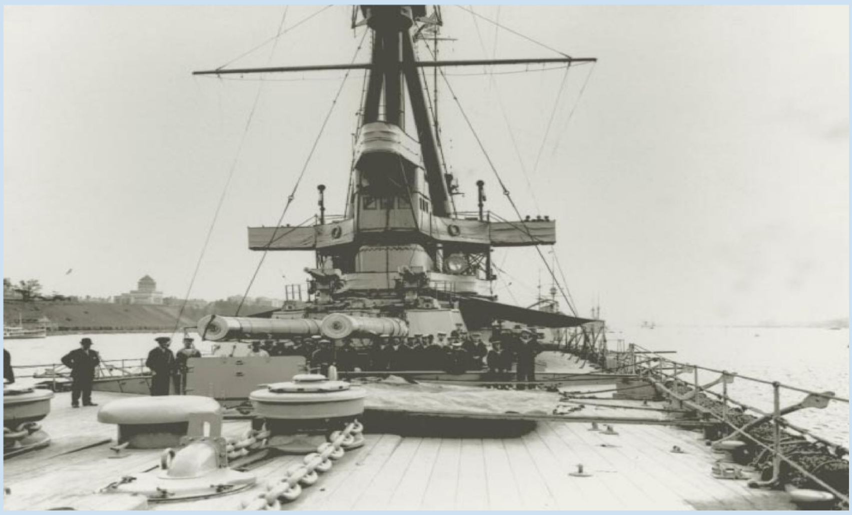
German battleship *Posen*, powered by mixing coal and oil



***HMS Inflexible* on Hudson River, 1910**

The war college was asked how much speed a fast division would need to outmaneuver the German fleet. The answer was 25 knots, or at least four knots faster than possible at the time. Churchill concluded, "We could not get the power required to drive these ships at 25 knots except by the use of oil fuel." This was enough for him.

Queen Elizabeth-class battleships were built to burn oil only. Once this decision was made, Churchill wrote that it followed that the rest of the Royal Navy would turn to oil:

The fateful plunge was taken when it was decided to create the fast division. Then, for the first time, the supreme ships of the navy, on which our life depended, were fed by oil and could only be fed by oil. The decision to drive the smaller craft by oil followed naturally upon this. The camel once swallowed, the gnats went down easily enough.

But building oil-fired ships was only part of the exercise, it was also necessary to secure a supply and solve storage and transport problems. To meet these challenges Churchill established a royal commission. With Fisher as chairman, the commission eventually published three classified reports confirming the benefits of oil. It judged that ample supplies of oil existed but urged that a storage capacity be built in peacetime to ensure sufficiency in time of war. The final step was finding a source, and toward that end a delegation went to the Persian Gulf to examine oil fields. Two companies were the likely choice of supply: the powerful Royal Dutch Shell Group and smaller Anglo-Persian Oil Company. After considerable maneuvering, and largely through Churchill's encouragement, the government decided to maintain competition in the oil industry and ensure supplies by investing directly in Anglo-Persian. The government acquired 51 percent of company stock, placed two directors on its board, and negotiated a secret contract to provide the Admiralty with a 20-year supply of oil under attractive terms.

U.S. Fleet at Guantanamo Bay

Other factors were involved in the switch to oil beyond the efforts of Fisher and Churchill. Private industry helped develop ships and engine designs. As Hugh Lyon wrote, "The use of oil fuel would not have been possible without the pioneering work of such British firms as Wallsend Slipway on the design of suitable and economic burners. The Admiralty did do some research itself, but the main bulk of the investigations that were conducted in Britain were the work of private industry." This argument is similar to that advanced by William McNeill, who described the period from 1880 to World War I as a "runaway technological revolution." It was largely the result of "command technology" in which government planners urged industry to innovate. In the case of the Royal Navy, for example, the Admiralty—largely due to Fisher—set specifications for engineers but did not actually design the ships and guns.

The growing oil industry also played an important part. Peter Padfield sees the efforts of private firms, especially Anglo-Persian, as "a good example of the way in which British command of the sea, exercised through her world system, allowed her to exploit commercial opportunities which in turn increased her command." Padfield argues that Anglo-Persian, acting as part of the British Empire, pushed the switch to oil, which drove the Royal Navy to seek higher speeds.

Although Fisher and Churchill had close personal and professional relations with senior oil executives, their correspondence reveals that military and strategic concerns, and not commercial motives, were at the root of the switch. Fisher, for example, worked closely with leaders of major companies but rejected offers to sit on corporate development boards. He also did not have favorites, praising and supporting each competitor at different times. The Burma Oil Company, for example, was an early supporter in 1904 when Fisher was First Sea Lord, and was the fore-runner to Anglo-Persian. Fisher also wrote flattering accounts of the chiefs of Anglo-Persian's archrival, Shell, including a description of Henri Deterding as "Napoleonic in his audacity and Cromwellian in his thoroughness". Beyond the efforts of the main actors and pressures of industry and commerce, it appears that several broader historical factors in the years leading up to World War I made the time right for Britain to adopt oil. One factor was the growing Anglo-German naval race. But just as critically, by this time several decades of widespread experimentation and development of fuel oil had shown that the technology was feasible. It appeared Britain ran the risk of being left behind. The Italian navy led the way in experimenting with oil starting in 1890, and by 1900 most of its torpedo boats were oil burning. The mixed-firing method of spraying oil on coal was routine by the early 1900s, and a liquid fuel board in the United States recommended using oil as a standalone fuel in 1904. The first oil-burning American destroyer, *USS Paulding*, was commissioned in 1910, and by 1911 the *USS Nevada*-class battleship was planned for solely oil as fuel.

By 1912 oil technology was relatively well understood. But there was no particular race to develop oil-fueled warships, and in 1914, despite the advantage of oil, only America joined Britain in moving far in that direction. The United States had ample supplies. But Fisher received regular reports that the Germans were developing oil.

National

H.M.S. Dreadnought

To innovate and maintain a lead over an enemy was Fisher's goal. He cautioned Churchill in 1912: "The luxuries of the present are the necessities of the future. Our grandfathers never had a bathroom . . . you have got to plunge for three years ahead!" A letter from Fisher demonstrates both his concern over German developments and excessive rhetoric:

"The one all pervading, all absorbing thought is to get in first with motor ships before the Germans! Owing to our apathy during the last two years they are ahead with internal combustion engines! They have killed 15 men in experiments with oil engines and we have not killed one! And a . . . fool of an English politician told me the other day that he thinks this creditable to us."

This combination of concerns expressed by Fisher—that development was inevitable, an enemy was working on it, and Britain must stay in the lead—had been present in the earlier development of the *Dreadnought*-class battleship. In 1910 he wrote "Like the planet Neptune, the discovery of the dread-nought was inevitable, but luckily we saw her in the heavens before the other chaps and got our un-paralleled lead! Thank God!"

Ironically, Fisher's information was faulty in the case of oil, and Germany did not develop oil as quickly as Britain or the United States. Germany used mixed firing in a major combatant for the first time in 1909 and did not use all-oil firing for surface combatants until after World War I. Nonetheless, it was a combination of the general level of oil development and the threat of German advances that pushed Britain to change despite the loss of the coal advantage. The transition itself quickly became recog-nized as the right decision, and the new fuel became universally used in naval design in a few years. In 1919 *Jane's Fighting Ships* announced that "the geared turbine and 'all oil' fuel system have secured a distinct success."

Although the British navy did gain a speed advantage, particularly since Germany did not develop oil until after World War I, the change did not appear to be a deciding factor in the conflict. At the same time, the Royal Navy suffered from oil shortages, particularly in 1917 when attacks by submarines on tankers began to tell. For a time British ships were forced to stay in harbor as much as possible and destroyers were held to a speed of 20 knots.

German battleship *Nassau*, launched 1908.

National Archives

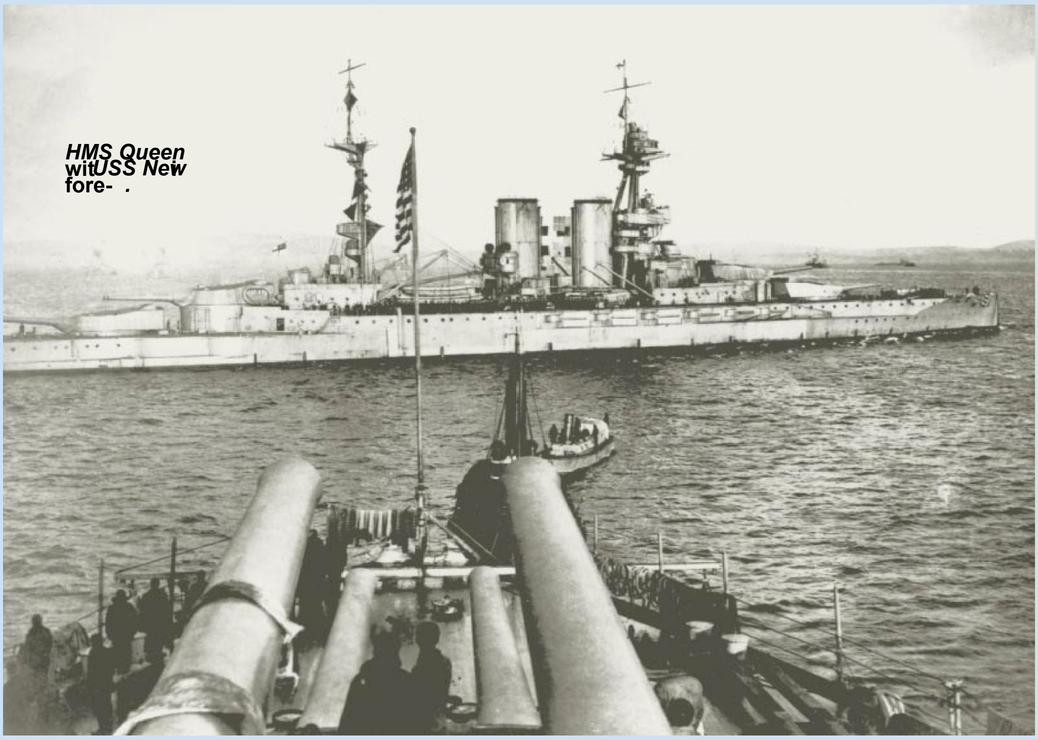
From Coal to Oil Cont,d.

The switch to oil neither sparked a naval revolution nor delayed Britain's naval decline. In part its historical significance may have been overshadowed by development of the dreadnought. It may also be that World War I gave little opportunity for innovation, and by World War II every navy had adopted oil, neutralizing gains. This explained, as Michael Handel stated, why technological advantages may be short-lived. "The general availability of new technologies to all participants in a war cancels out the advantage that might otherwise be realized from greater knowledge and control. When both sides have telephones, radios, radars, high-speed computers, or [remotely piloted vehicles], no one has the advantage (that is to say, when all other things are equal)."

Moreover, limitations may relate to a common complaint leveled by historians, that Fisher focused on the material over the strategic. He is blamed on one point in particular. Paul Kennedy, discussing the lose of ascendancy by the Royal Navy over the army before World War I, explained that "energetic and farsighted though the First Sea Lord was in so many ways, he was no great strategist and had crushed all moves to create an effective naval staff."

The transition from coal to oil was symptomatic of the broader limitations of leadership of the navy by Fisher and Churchill: it was a significant innovation but not a strategy. It improved the warfighting capability of the Royal Navy but didn't change the way wars were fought.

The transition from coal to oil in the Royal Navy came about through a variety of factors. Fundamentally, it was a technological phenomenon waiting to happen. Britain, the United States, and a few other nations had been experimenting with oil, and its advantages were generally known. In the event, Britain and the United States made the change at about the same time. But in Britain the strategic risks were great enough to require the skill of both Fisher and Churchill to accomplish the change. The Anglo-German naval race—particularly reports that Germany was developing oil as fuel more quickly—provided the final impetus.



H.M.S. Queen Elizabeth with USS New York in the foreground

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