# RAIndrops

Robert Allan Ltd. Information & News Issue 4

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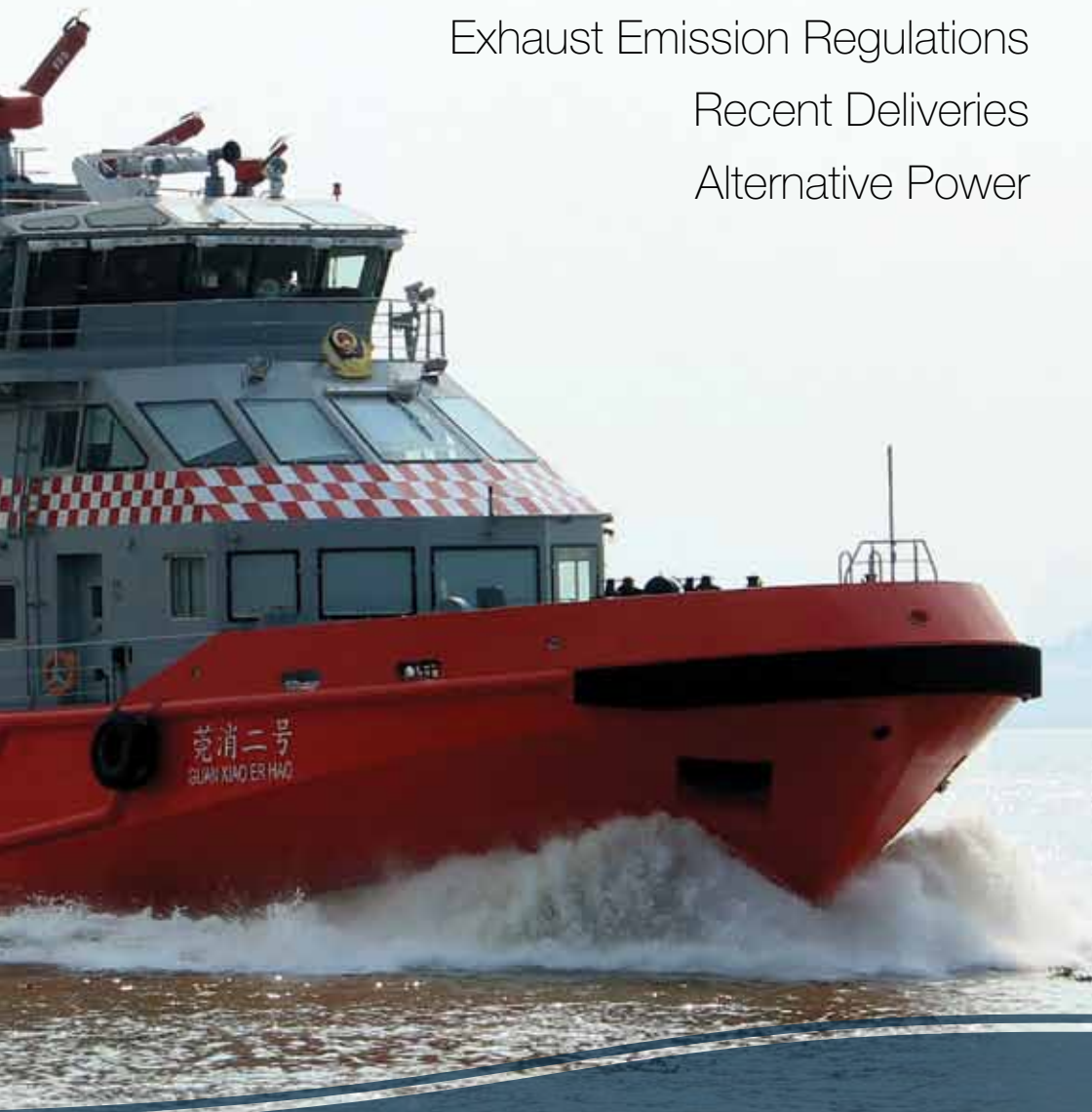
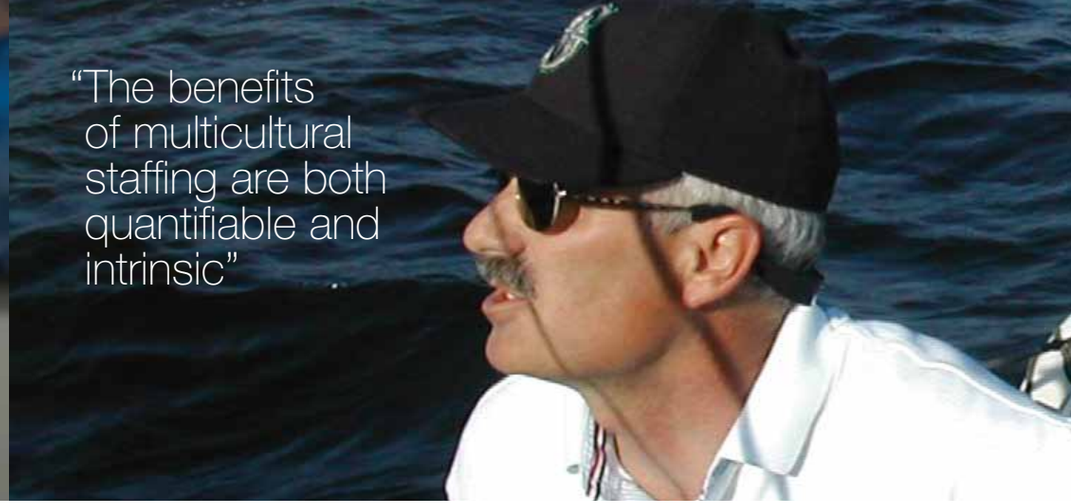



ROBERT ALLAN LTD.

NAVAL ARCHITECTS AND MARINE ENGINEERS


# Design Challenges

*by Derek Noon*
*Manager, Marine Engineering*

Innovating thinking and some clever use of space have been necessary as we look ahead to the new after-engine treatment equipment needed to meet the upcoming IMO and EPA emissions requirements described in this newsletter. Working closely with engine manufacturers and looking at the equipment they propose for high speed engines, we have been successful in arranging the new equipment within our standard vessel designs in a way that meets its service and maintenance requirements without compromising the overall arrangement of the vessel. For instance, simply making the engine room or funnels larger would not be acceptable: Larger funnels will impede sightlines and bigger engine rooms could reduce working and accommodation areas and impact negatively on subdivision requirements. However, as engine rooms become more complex and tightly–packed with equipment including the new after-engine treatment equipment, we see more of a need for space modelling in 3D as part of the normal design process in order to better plan and optimize the available space.

The Ballast Water Convention regulations are close to being ratified and will have a significant impact. With talk of the regulations coming into force in 2013, while at the same time concern being expressed that the sheer number of ships affected would exceed the equipment available on the market, it may be necessary to phase in the requirements. We await further developments.

We are also monitoring the implementation of the IACS (International Association of Classification Societies) rules "Recommendations for the Safety of Cargo Vessels of less than Convention Size". This document considers SOLAS requirements (vessels over 500 GT) and recommends a "generally applicable code of safety" for vessels less than 500 GT, which include many of our tugs and workboats. The recommendations have some serious consequences on stability, fire boundaries, loadline and lifesaving.

Challenging times ahead as we endeavour to design ever more compact and powerful workboats in the face of new and changing regulations.

***RAindrops*** Issue 4
January 10, 2012

On the cover is the ***RAnger 4600*** Class fireboat ***Guan Xiao Er Hao*** owned by Dongguan Fire Services Department, China.



# Diversity: Cultures, Qualifications and Experience

*by Grant J. Brandlmayr*
*Manager, Naval Architecture*

Over the last 80 plus years, Robert Allan Ltd. has been well known for the diversity of the designs that have been penned by this office. This diversity in design is due in large part to the diversity in the cultures, qualifications and experiences of our employees.

Robert Allan Ltd. is a wonderful compilation of individuals with an abundance of experience, skills, knowledge and perspectives from a vast variety of countries and cultures. Each day brings a new shared experience that highlights the benefits of working with very diverse, capable and interesting co-workers.

The benefits of multicultural staffing are both quantifiable and intrinsic. The cultural diversity at Robert Allan Ltd. provides us with a better understanding, awareness and appreciation of our cultural differences. Some differences are subtle, however others are (or should be) obvious. Learning from each other while working enhances our collective strength and ability. This also benefits our clients as they draw on such a wealth of experience.

English is the language used to carry on business within the office. However, many of Robert Allan Ltd. employees are bilingual and some are able to converse in three or more languages. Our inventory of linguistic talent consists of: Chinese-Cantonese and Mandarin, Latvian, French, Romanian, Russian, Italian, Spanish, Portuguese, German, Turkish, Gujarati, Hindi, Korean, Farsi, Croatian, and Bulgarian. The capacity to communicate with our clients in the language of their choice helps to ensure accurate technical communication.

Staff members hailing from different parts of the world have a lot more to offer than just cultural and national diversity- they bring with them their unique 'toolbox' that includes influences from their chosen alma mater and work experience. The sampling of skills that add to the collective diversity and strength of Robert Allan Ltd. includes:

- Academic qualifications represented by degrees in Naval Architecture and Ocean Sciences, Marine Engineering, Mechanical Engineering (and more) with a Bachelor, Master, or Doctoral degree from universities around the globe.
- Experience at sea with senior Marine Engineering duties and Bridge responsibilities. The sea time experiences that these individuals bring to a design office are invaluable on all projects and benefit our clients and younger staff.
- Experience in Classification Societies, vessel inspection and approval experience from various countries.
- Experience in Production design working in Shipyards, which helps in reminding the designers to place a high priority on buildability.
- Shipyard senior management knowledge and experience.

The combination of these strengths continues to provide innovation and diversity to Robert Allan Ltd. designs to the worldwide marine industry.

# Recent Deliveries

## *Seaways 20*

The ***Seaways 20***, built by Keppel Singmarine Pte Ltd. in Singapore has been delivered to its proud owners, Seaways International of Singapore. This unique vessel (shown below) is the latest of the Robert Allan Ltd. ***RAmpage*** series of Offshore Support Tugs which were initially conceived to fill a gap in the Offshore market for high-performance, multi-functional tugs for towing, anchor-handling and for many other critical offshore support duties. This "Swiss Army Knife" class of tugs is designed to perform a wide variety of tasks, including long range offshore towing, anchor handling operations, positioning of heavy tankers at FPSO installations, diving support, ROV support, oil spill response, off-ship fire fighting operations, and delivery of cargo to offshore drilling and production rigs.

The propulsion machinery on the Seaways tug comprises a pair of MaK 9M 25C diesel engines; each rated 2970 kW at 750 rpm and each driving a Schottel SRP 3030 Z-drive with a 3400 mm diameter CP propeller. This combination delivered a Bollard Pull of more than 100 tonnes on trials. A free running speed of 14.4 knots was also achieved.

The vessel is equipped with a DP2 system. Manoeuvrability is enhanced by two controllable pitch bow thrusters, Schottel model STT2 FP, electric motor driven, rated at 500 kW each.

***Seaways 20*** is equipped with a Fi-Fi 1 system supplied by Jason Engineering comprised of 2 fire pumps, each rated 1600 $m^3$/ hour and driven by the main engines through front PTO's. There are two combination water/foam monitors, each rated 1200 $m^3$/hour, as well as a complete deluge system. A 27 $m^3$ foam tank is served by two electrically driven foam pumps.

Electrical power is generated by:

- Two shaft alternators; DSG 86 KI-4W each with a capacity of 1500kVA @ 690V and 50Hz.
- Three diesel gensets- CAT C18 rated 275kW each, 380V, 50Hz.
- One emergency genset- CAT C9 rated 143kW, 380V; 50Hz.

The forward hydraulic anchor windlass/towing/ship assist winch has a side-by-side configuration with a rated maximum pull of 90 tonnes and brake holding of 250 tonnes. The aft hydraulic anchor handling/towing winch is a waterfall configuration with a rated maximum pull of 200 tonnes and brake holding power of 350 tonnes. The vessel is also equipped with a large deck crane which has a 30.5 metre maximum outreach.

## *Guan Xiao Er Hao*

***Guan Xiao Er Hao*** (which means "Dongguan Fireboat Number 2" and is shown on the cover) has been delivered to the Dongguan Fire Services Department, China by the builder Wang Tak Engineering & Shipbuilding Co. Ltd., Hong Kong. It is a 46 metre, twin screw, diesel-powered fireboat, specifically designed for marine and shore-side fire fighting and offshore rescue in the Pearl River Estuary, the Pearl River and the Dongguan region harbour environment in China. This fireboat has been designed to perform a wide variety of tasks, including safety service and fire-fighting standby in the PetroChemical Industrial Zone on Dongguan Lisha Island; supply of land fire mains; search & rescue operations, initial salvage response, and to act as an incident command centre.

***RAstar 2800*** *Class* ***Seaspan Osprey***

The ropulsion machinery consists of a pair of Caterpillar 3516B-HD diesel engines, each rated 1864 bkW at 1600 rpm, driving a 2000 mm diameter fixed pitch propeller.

Electrical power is supplied by a pair of Caterpillar C18 DITA diesel gensets, each rated 350 kW.

The Fi-Fi system includes:

- Combined remote and manually operated fire-fighting monitors
- Foam system: 2 x foam injection pumps and 6 x foam proportioners
- Deck outlets: 14 x 80 mm deck hydrants for water/foam delivery; and 2 x 300 mm outlets for delivery to landside (when vessel functions as a pump station)
- Water deluge system using FFS nozzles

On trials, the new fireboat achieved 16 knots and exceeded all performance expectations.

## *Seaspan Osprey*

The ***Seaspan Osprey*** (above) is the third of four ***RAstar 2800*** Class tugs delivered to Seaspan, Vancouver, from SANMAR shipyard, Istanbul. (A journey of over 10,000 nautical miles, on her own bottom!)

## ***Posh Humility*** and ***Posh Helper***

This pair of ***RAmparts 3200*** class tugs were completed at Yuexin shipyard in China for delivery to POSH SEMCO, Singapore. (***Posh Humility*** shown below)

***RAmpage 5500 Z-M*** *Class* ***Seaways 20***


***RAmparts 3200*** *Class* ***Posh Humility***

***RAstar 3400** Class **Hanyurah***

***RAmparts 3000** Class **St Elmo***

# Recent Deliveries
*(continued)*

## *Taikoo* and *Whampoa*

These first two of a series of four ***RAmparts 3000*** Class Terminal Support Tugs are specifically designed for ship assist and coastal towing operations in and around Hong Kong. These tugs were built by Cheoy Lee Shipyards, Hong Kong for Hong Kong Salvage & Towage. This particular version has an extended deckhouse with additional accommodation for the crew and cadets that will be aboard.

Particulars of this series are as follows:

- Length Overall - 30.00 m
- Beam, moulded, extreme - 11.60 m
- Depth, Moulded (hull) - 5.38 m
- Maximum draft (DWL) - 5.40 m

Tank Capacities are as follows:

- Fuel Oil - 164 $m^3$
- Fresh Water - 29 $m^3$

On trials, ***Taikoo*** (seen below) met or exceeded all performance expectations, with the following results:

- Bollard Pull, ahead - 74 tonnes
- Bollard Pull, astern - 67 tonnes
- Free running speed, ahead - 13.0 knots

## *Hanyurah*

This is the third ***RAstar 3400*** (top of page) of four completed by Astilleros Balenciaga, Spain for IRSHAD, UAE.

## *St Elmo*

This ***RAmparts 3000*** (opposite page) was built by Astilleros Zamakona of Spain in their Pasaia Shipyard for Tugs Malta, a subsidiary of Rimorchiatori Riuniti of Genoa, Italy


***RAmparts 3000** Class **Taikoo***

# Alternative Power

*by Robin Stapleton, P.Eng.*
*Electro-Mechanical Engineer*

Green design is very much at the forefront of designers, builders and operator's minds when considering vessel designs. One key element which can have a huge influence of the environmental impact of the vessel as a whole is the propulsion and power generation configuration. In the past few years, alternatives to the classic diesel mechanical powering configuration have increasingly been developed and implemented on workboats to increase their efficiency.

Robert Allan Ltd. is actively investigating hybrid powering configurations and developing innovative designs to leverage these new technologies and provide real benefits to their clients.

We have a number of ongoing projects where alternative powering systems are proposed. These include series hybrids and variable speed genset diesel electrics, both with or without energy storage, dual fuel and gas mechanical drive and even pure battery vessels. One noteworthy project is the proposed new hybrid version of the US Navy's YT series of ***Z-Tech***™ tugs. These harbour tugs would operate primarily from shore power stored in significant battery banks but also have diesel electric generators giving the vessels the capability to perform their regular operations indefinitely as with the existing vessels.

For any given client, our approach is to assess potential configurations based on actual or prospective operations using our internally developed analysis tool ***RAptures***. This allows us to predict the potential fuel and emissions savings and select the configuration that will give the greatest benefit with least cost for the application.

# Two Contracts for Transport Canada

*by Robert G. Allan, P.Eng.*
*Executive Chairman of the Board*
*and Rollie Webb*
*Senior Project Director*

Robert Allan Ltd. has recently been awarded two synergistic contracts by the regulatory arm of Transport Canada. This agency, known in the industry as TC, has embarked on a major updating and rewriting of the current versions of regulations and standards used to define and enforce safety standards on Canadian ships.

The first of these contracts is to "Develop Guidelines for the Construction, Certification, Operation and Inspection of Tugs."

The towing industry in Canada has been struggling for many years with a plethora of statutory regulations scattered amongst many different sections of the Canada Shipping Act (CSA) and supplemented by a large number of non-statutory but equally regulatory "standards". It is extremely difficult for those involved in the design, construction, operation and inspection of tugs even to know where to look for the requirements for any specific class of tug. For the most part these regulations are also those that apply to "cargo ships", which, for lack of an alternate pigeon-hole, is where tugboats tend to get categorized! The task of Robert Allan Ltd. under this new contract will be to first compile a complete cross-referenced index of all the applicable Canadian regulations which apply to tugs. The mandate is strictly to look only at the rules applicable to vessels under 24 metres (non-SOLAS), but our efforts will undoubtedly cover everything at least under 500 GRT. The next stage of the study is to prepare recommenda-

tions for streamlining, modifying or adding to the regulations to reflect current trends in tug design and operations worldwide, and to ensure that any trends developing from recent casualty information are reflected in proposed new standards. The study involves researching comparable regulations in other countries and the evolving design and inspection standards amongst IACS members. One major impact of these recommendations is anticipated to be in the realm of towing stability, an element of safety regulations which is unfortunately totally missing from the current Canadian regulatory environment.

The second contract is to prepare an Update of Standards and Guidelines for Barges Carrying Bulk Oil or Dangerous Chemicals.

The waterborne movement of oil and related products by barge has been normal practice on Canada's West Coast and Northern rivers for many years. In recent times the use of barges for the same service on Canada's East Coast and Great Lakes has increased significantly.

In 1995 to regulate this aspect of Canada's coastal transportation network TC published TP 11960E, "Standards & Guidelines for the Construction, Inspection and Operation of Barges that carry oil in bulk" which reflected the anticipated changes coming to oil carrying vessels following the Exxon Valdez oil spill. Since that time many new rules, standards and guidelines have been developed and implemented by IMO and others that have surpassed the content of that standard, thus reducing its relevance.

In some cases these new international regulations impact or ignore unique Canadian practices which must now be brought into line with current best practices. A very relevant aspect of this gap is the use of combined bulk oil/deck cargo barges that carry low flash point oil to supply remote locations on the West Coast and in the Canadian Arctic. Part of Robert Allan Ltd.'s task is to develop modern guidelines and standards that manage risks while recognizing years of safe & efficient operation for this type of vessel.

A significant number of single hull barges will be retiring in the very near future and need to be replaced. This updated standard will recognize relevant international regulations while maintaining effective and clear standards and guidelines for owners, designers and builders.

Together these two contracts will result in the first update of regulations and standards relevant to Canada's tug & barge industry in many, many years. It will certainly be the first time that there has been a single reference document under which all requirements for these vessel types will be defined. Robert Allan Ltd. has played on this field before. In the 1970's, following a rash of fatal accidents in the west coast towing industry, Robert Allan Ltd performed a major study of the relationships between tugs and tows with a focus on towing safety. In 1990-92 that study was re-visited and updated, and the resulting document (TP 11173E – The Canadian Towing Industry: Tugs, Barges, and their Relationships") is perhaps the most comprehensive review of the Canadian Towing Industry in existence: Since that time our company has performed numerous similar studies on tug and barge safety, and led or participated in many investigations focused on improving the safety record of this critical industry. We are proud to have been awarded this work and to continue our involvement with this unique and key part of the Canadian transportation system.

## Exhaust Emission Regulations

*by Allan B. Turner, P.Eng.*
*Mechanical Engineer*

With the pending introduction of EPA Tier 4 and IMO Tier III engine exhaust emission regulations starting in 2014 and 2016 respectively, there is considerable concern how these regulations will affect tug design and operations. Over the last year Robert Allan Ltd. has been cooperating with a number of high-speed diesel engine manufacturers on their proposed emission solutions and how these will affect tug and larger vessel designs.

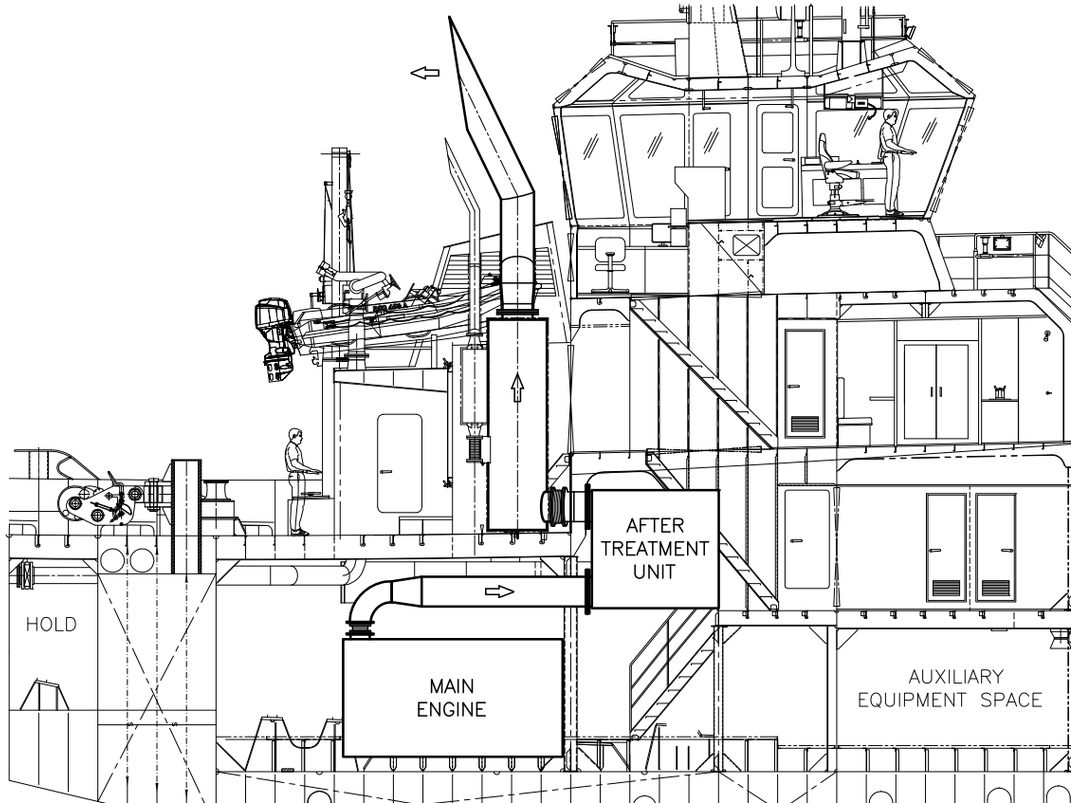
From discussions to date, exhaust after-treatment technologies will be required to meet EPA Tier 4 and IMO Tier III. Both impose major reductions on NOx emissions limits, and in addition EPA Tier 4 addresses stringent new limits on particulate emissions. Current indications are reasonably positive that the EPA particulate emissions requirements can probably be met with in-engine technologies on high-speed engines. This is most encouraging as, if achievable, it would avoid the need for oxidation catalysts/filters to control particulates. There are a number of after-treatment technologies that are being considered by engine manufacturers to meet the NOx limits of the new emission regulations. The main two being considered are Selective Catalytic Reaction (SCR), and Exhaust Gas Recirculation (EGR). Both technologies will require additional equipment to be fit on the vessel and for SCR technologies additional fluids to be stored.

The introduction of these NOx reduction technologies in the marine industry and particularly the tug industry will have significant design implications. However based on the proposed emission solution information provided by the engine manufactureres to Robert Allan Ltd. to date, the level of required design changes will be minimal and easily accounted for with minor modifications in existing ***RAmparts***, ***RAstar***, ***Z-Tech***™ and ***RAmpage*** Class designs when fitted with high-speed diesel engines.

Although not fully understood at this date from information provided, and given the inherent limitations of medium-speed diesel engines, Robert Allan Ltd. currently anticipates somewhat greater design challenges for tugs required to meet the new emission regulations when fitted with medium-speed engines. These design challenges may restrict the use of medium-speed engines in smaller tug designs.

There are other challenges to overcome with the introduction of these new emission technologies in terms of vessel operations and logistics. However as other industries are going through these same challenges prior to the marine industry, there will be a great deal of technology, operation and logistic transfer that will most likely ease the transition greatly for the marine industry.

Robert Allan Ltd. is confident that with introduction of EPA Tier 4 and IMO III emission regulations and when fitted with a high-speed diesels, future tug designs will operate and function much as they currently do with very little influence from the new regulations. We will continue to provide more in-depth information on this topic as applicable in the run-up to emission regulations introductions.



# Awards

Robert Allan Ltd. is pleased to once again be recognized for our work in the field of Naval Architecture.

At the 2011 International Workboat show in New Orleans, Robert Allan Ltd. was awarded two "Significant Vessel" distinctions for the following recent designs:

***Z-Tech 7000*** Class Tugs ***Tristan K*** and ***Hercules***
- Builder - Washburn & Doughty
- Owners - Suderman & Young Towing Co. / Bay-Houston Towing Co.

***RAnger 2700*** Class Fireboat ***Christopher Wheatley***
- Builder - Hike Metal Products Ltd.
- Owners - Chicago Fire Department

**SNAME Paper Award:**
At the 2011 SNAME Annual Meeting in Houston, a team of authors from Robert Allan Ltd. and their client, the Fire Department of New York were awarded the American Bureau of Shipping - Captain Joseph H. Linnard Prize. The winning paper was titled "Concept Development, Detailed Design and Construction of the ***Three Forty Three*** – North America's Most Powerful Fireboat"

The contributing authors were:
- R.G. Allan, RAL
- K.D. Harford, RAL
- D. Noon, RAL
- J. Bjerkeset, Site Contract Engineer, RAL
- Chief J. Dalton, FDNY
- Chief (ret.) W. Siegel, FDNY

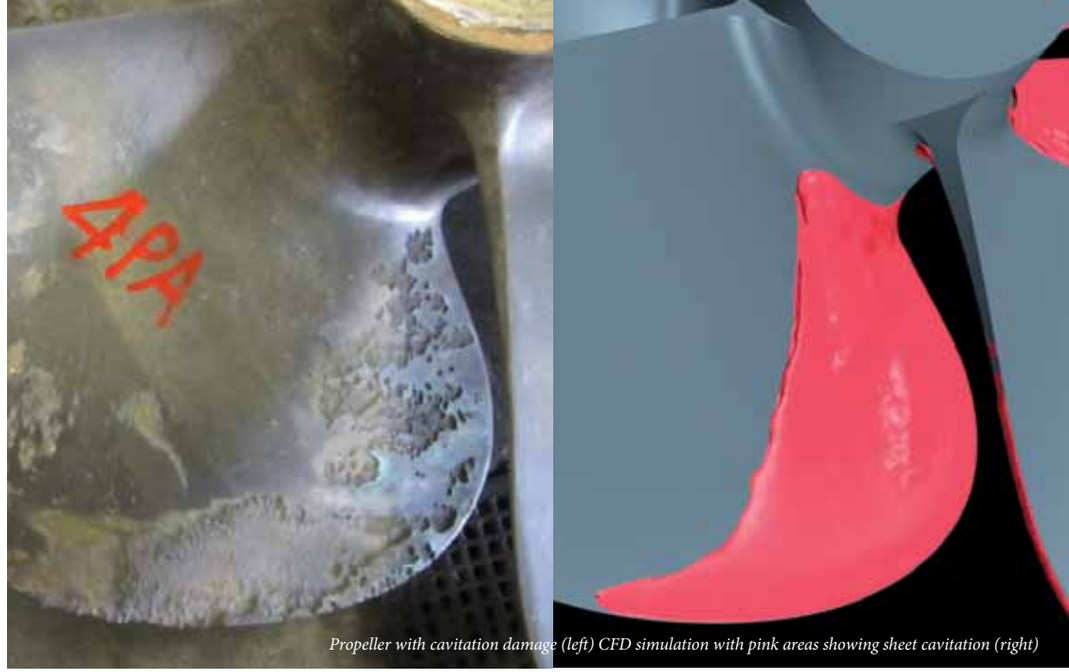
# Propeller Cavitation Analysis with CFD

*by Bart Stockdill, M.A.Sc., P.Eng.*
*Mechanical Engineer*

Water will boil at room temperature if the pressure is low enough. In fact, the pressure has to be very low, about 2% of standard atmospheric pressure at sea level.

Just like a wing generating lift, marine propellers use pressure differences across their blades to generate thrust. The pressure distribution on a propeller blade depends on its shape and how that shape influences the speed of the water flowing around the blade. As the flow speeds up, the pressure drops and conversely when the flow slows down, the pressure rises. Thus the blade is shaped to promote higher speed on the forward or suction side and lower speed on the aft or pressure side. If the blade shape is too aggressive, very low pressure can result. Indeed, this pressure can be low enough to reach the boiling point of water which then leads to cavitation.

In the figures above, the pressure distribution on the propeller of a semi-displacement hull is shown at 18 knots and 1200 rpm. The low pressure areas on the forward side of the propeller are shown in blue in the left figure. The high pressure areas on the aft side of the propeller are shown in orange on the right. Since the hydrostatic pressure increases with depth below the water surface, the pressure on the bottom half of the propeller is slightly higher than the top half.



*Propeller with cavitation damage (left) CFD simulation with pink areas showing sheet cavitation (right)*

The pressure plots show a problem with this propeller near the leading edge of the blades. There is a narrow band of high pressure (red area, left) on the suction side and a narrow band of low pressure (blue area, right) on the pressure side. This is undesirable since it means that the leading part of each blade is generating thrust in the wrong direction!

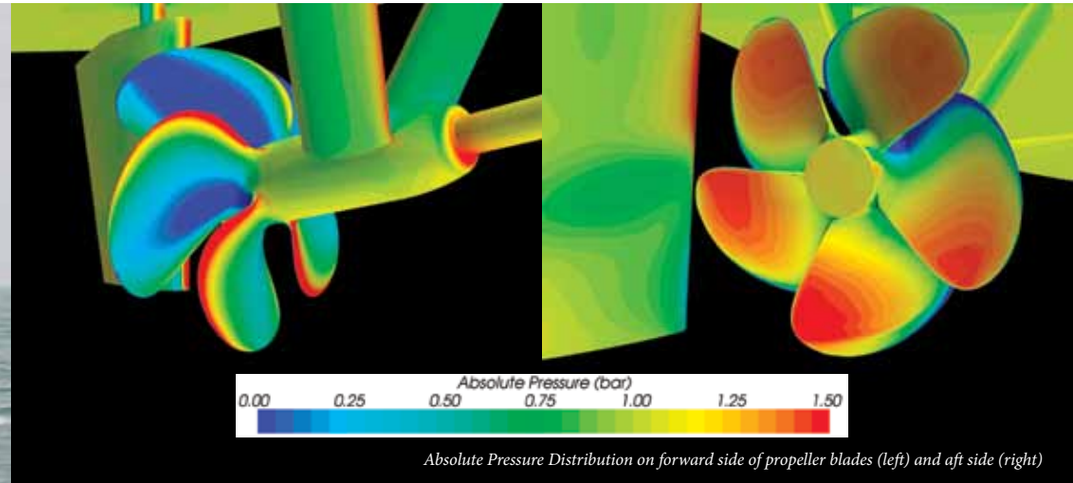
There is one catch though: these pressure plots do not include the effect of cavitation. The dark blue areas show pressure below the vapour pressure of water which means cavitation should occur in those areas.

By turning on the cavitation model, the phase change from water to water vapour can be captured. This is shown in the figure at the right where the pink area represents the interface between water and water vapour. The remarkable accuracy of this cavitation prediction can be seen by comparing the areas of erosion on the actual propeller (left) with CFD results (right).

The model shows that sheet cavitation is occurring near the leading edge on the pressure side of the blades. This indicates that effective angle of attack near the leading edge must be negative, resulting in an area of very low pressure on the aft side of the blade.

The erosion damage to this propeller occurred after only 500 hours of service. By using CFD analysis, the nature of the cavitation and the hydrodynamic conditions that are causing it have been identified. Now the propeller design can be modified and the performance of the new propeller verified using the same approach. This reduces the potential for additional propeller modifications that are sometimes necessary when using traditional design methods.

***RAnger 2700*** *Class fireboat* ***Christopher Wheatley*** *for Chicago Fire Department*



*Absolute Pressure Distribution on forward side of propeller blades (left) and aft side (right)*

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