Tugs Towing & Offshore Newsletter

LEKKO All about tugs

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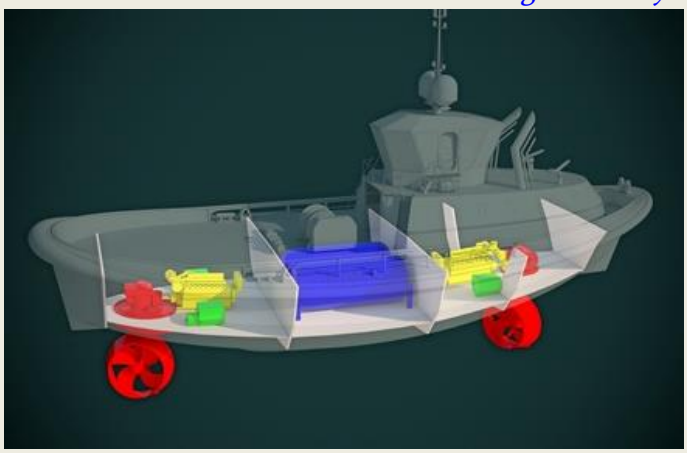
BUYING, SALES, NEW BUILDING, RENAMING AND OTHER TUGS TOWING & OFFSHORE INDUSTRY NEWS

SPECIAL *EDDY 1* TUG

"COMPILATION OF PREVIOUSLY ISSUED NEWSFLASHES, SHOWING THE PROGRESS OF EDDY TUG FROM MAY 2012 TO MAY 2014"

The choice between 'ASD' and 'Tractor' tug made easy by Eddy (TT&O issue 15; 15 April 2012): The

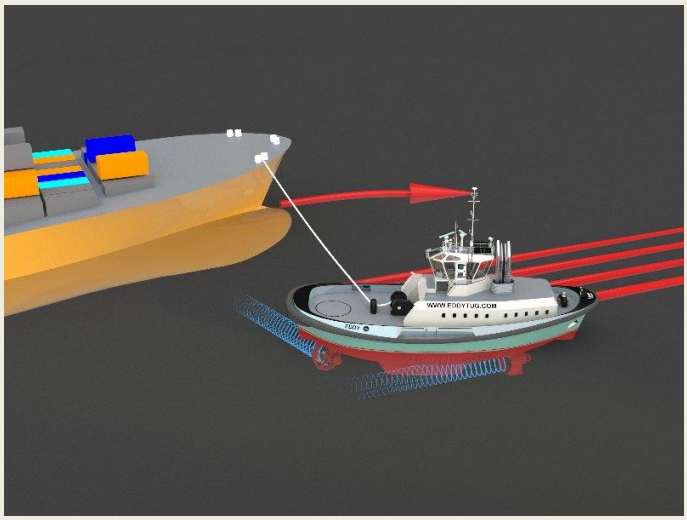


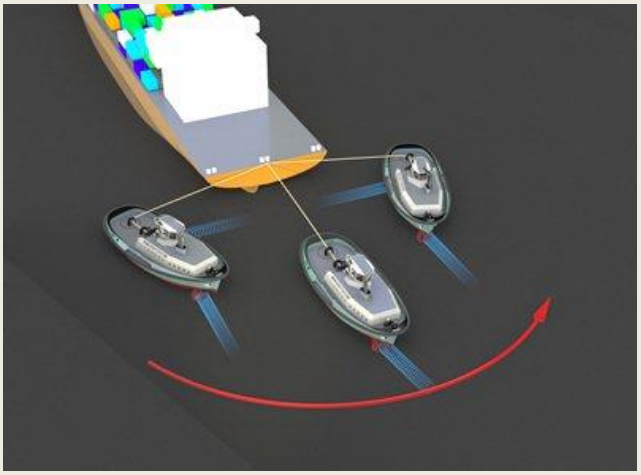
vast majority of today's tugs are of the 'ASD' type, also called the 'reverse tractor' type. Most companies understandably prefer to standardize their fleet and therefore opt for one type of tug only, which generally is an ASD. ASD tugs are versatile and capable tugs, although it is generally acknowledged that tractor type tugs are significantly more suitable as bow tugs. Increased performance expectations for bow tugs also suggest the use of tugs which are more effective at the bow than ASD tugs. With the recent introduction of EDDY tugs, it is no longer necessary to choose between ASD and tractor tugs. Tug operators can now standardize with one tug type only, which is both 'tractor' and 'reverse tractor'. These '**E**fficient **D**ouble-ended **Dy**namic' tugs (abbreviated as '**EDDY**') are based on an advanced double-ended low-drag hull, with a towing point in between two azimuthal propulsion on the centreline, one forward and one aft. Industry-wide feedback by tug experts all around the world resulted in a mature concept after four intensive years of development. Baldo Dielen Associates Ltd is leading the design and development. Marvox bv focusses on the latest propulsion technologies and shipyard production. **EDDY** tugs are unique in another aspect: they simultaneously offer superior safety, performance and economy. Improving performance, safety or emissions 'as a rule' needs to cost money, but **EDDY** breaks this rule by changing the concept. Not only are **EDDY** tugs economical to buy, they also operate economically. Reduced fuel consumption and reduced emissions are realized without the need for complex propulsion systems. LNG or hybrid solutions however can be integrated to realize further reductions in running costs and harmful emissions. Selection of the most suitable propulsion option for each particular situation is made on a case-by-case basis to ensure optimized efficiency and cost. The portfolio of **EDDY** tug designs is rapidly expanding due to high

industry interest in this economical tug type. The smallest family member is a ten meter long multi-purpose workboat. Its principal purpose is line-handling, but since it embodies identical operating principles as the full size tugs, it also is an ideal training craft. The largest version available today is a 37 meter, 105 TBP terminal escort tug, capable of generating escort towline forces of at least 150 mt. Handling of each **EDDY** workboat or tug is entirely intuitive and independent from the direction the tug master is facing. This simplifies training and increases safety considerably.

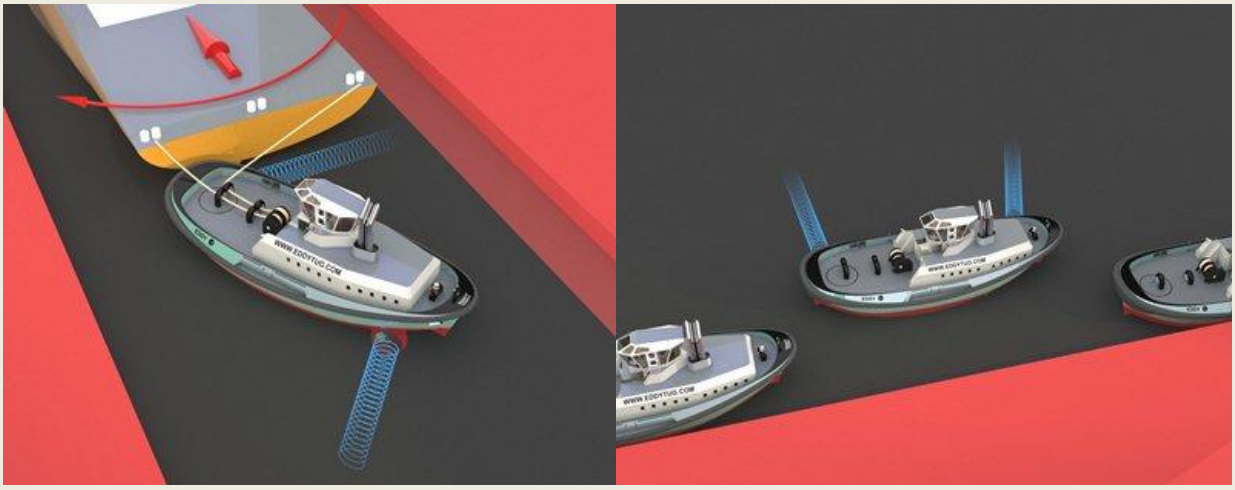
Eddy Explained – part 1 (TT&O issue 16; 22 April 2012): Each **EDDY** tug has an advanced, yet simple to construct, truly double-ended hull-form. It has slender ends and high freeboards fore and aft which improve seaworthiness and operability. Each end classifies as bow and the tug performs well in either direction, also in adverse weather. For unambiguous terminology, the **EDDY** bow is defined as that end which is forward when the tug is in motion. When static, we refer to the winch end (there is only one), and the anchor end. A central skeg gives good directional stability and a substantial increase in line-pull when operating in the indirect towing mode. The spacious deck is fitted out with a double-drum towing winch and two staple style towing fairleads, one for close quarters ship handling and one for (indirect) escort towing. Fender loads can be reduced to 15 mt/square meter by installing a second cylindrical fender. The single deck level accommodation for up to nine persons offers maximum clearance when working under the flare of large ships and has generous 'walk-round' space. During transits, running 'winch first' is the most efficient direction with regard to fuel consumption for speeds up to 12 knots. The tug can achieve this economical, low wake, 12 knot speed while running on a single engine at its optimum load. It can generate push and pull forces in any direction, with minimum need for reposition, always immediately ready to apply force. When assisting under speed, high dynamic forces of up to twice the tug's bollard pull can be generated both by the stern- as well as by the bow tug. This makes the **EDDY** tugs unique in the fact that they are as effective at the bow as at the stern. Safety of the assisted ship is thereby greatly enhanced and it allows for faster assist cycles. It also enables the operators to standardize their fleets without the need to choose between 'ASD' or 'tractor' type tugs. In the following issue of 'Tugs Towing & Offshore Newsletter, the manoeuvring basics of **EDDY** tugs will be explained.

Eddy Explained part 2 - Maneuvering basics (TT&O issue 17; 29 April 2012): Four series of self-propelled 1:35 scale models and one manned self-propelled 1:10 scale model were evaluated with the participation of a number of leading European and American tug captains, naval architects, engineers and managers. Perhaps the most striking conclusion of the trials was that anyone (including the inexperienced) was able to perform a wide variety of operations within the first day of training, including indirect-towing, side-stepping, bow-connect and docking. Handling is entirely intuitive and independent from the direction the tug master is facing. This simplifies training and increases safety considerably. The basic maneuvering principles can be explained in a nutshell as follows: *) Turn the bow thruster to starboard to move the bow to starboard. *) Turn the stern thruster to starboard to move the stern to starboard. *) Turn both thrusters 90 degrees and you're side-stepping. *) Turn both thrusters in the opposite direction and you're turning on the spot. Obviously there is more to it and crew needs to be trained properly, but the basics are not any more complex than this. Critical maneuvers like making fast-at-the-bow and the indirect-mode are largely simplified and safer. The need for repositioning as a bow or stern tug is minimal and towline tension can be maintained at all times. EDDY tugs combine good ship assist characteristics with escort performance exceeding that of many larger escort tugs. *Eddy explained part 3 - Bow Operations (TT&O issue 18; 6 May 2012):* The above figure shows a bow steering operation under speed. Due to the tug's low drag, the forward thruster can be utilized to propel and steer the tug while the aft thruster is available to push full force against the towline direction. By increasing the tug's yaw angle, the towline force can be further increased. Unlike ASD tugs, the steering and braking effectiveness of **EDDY** tugs increases (rather than decreases) with towline angle. As a bow-tug, towline forces can exceed 150 per cent of installed BP while effectiveness increases with speed. **EDDY** bow tugs can also effectively brake the assisted vessel, or perform a combination of braking and steering with minimum need for repositioning. Having both thrusters on the centerline and minimum 35 degrees tumblehome, the risk of steel-to-steel contact

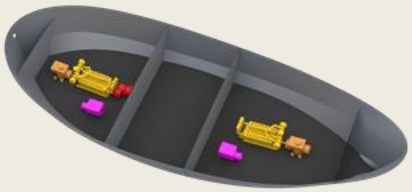




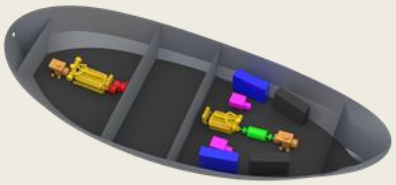
with the assisted vessel is minimized. The fisheye figure shows a situation where the tug's fender is touching the ship's side. Normally the master will keep a safe distance from the bow, but this to illustrate the remaining clearances. The ability to move and push sideways also facilitates safe pilot and crew transfer to vessels running with speeds up to 12 knots. *Eddy explained – part 4 Stern Operations (TT&O issue 19; 13 May 2012)*: The left figure shows an **EDDY** stern tug in the indirect mode. Depending on the vessel's speed and desired towline forces, the tug can perform this operation either with a single thruster or with both thrusters. Towline forces in excess of 130 tons can be realized with a tug of only 60 TBP. Also under lower speeds, high towline forces can be generated due to the fact that the bow thruster can provide full effective thrust against the direction of the towline. This manoeuvre is simple and very fast to execute by making only minimal adjustments to the thruster settings. Towline forces can be maintained at all times. In case of a full blackout, the tug automatically moves to a safe position. The second figure shows one of the options to perform braking and steering assistance in very narrow fairways and locks. A twin-towline arrangement is most effective in this case, although this manoeuvre can also be executed with a single towline made fast on a centerline bollard on the vessel's stern. Again, the bow thruster force can effectively be used to generate towline tension while the stern thruster can be used to increase the tug's yaw angle for a further increase in towline force. Very accurate manoeuvring with full control is possible in a totally intuitive manner. The below figure shows the level of complexity of



docking and undocking in very tight spaces, with wind and current. *Eddy explained – part 5 Propulsion systems (TT&O issue 20; 20 May 2012):* Diesel-direct, diesel-electric, hybrid, dual-fuel on LNG-electric propulsion systems can be installed. The diesel-direct drive is the simplest, lowest-cost and lightest-weight solution. Due to the **EDDY** operating concept and a number of design features, this basic solution already offers 25-35 per cent fuel consumption reduction in comparison with state-of-the-art tugs of equal installed power.



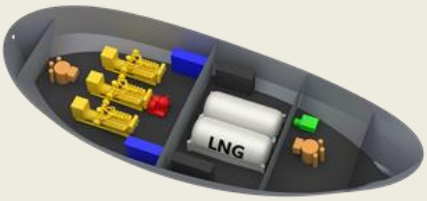
Diesel-Direct drive



Single-line Hybrid drive

A single line Xeropoint hybrid system by AKA can be installed to reduce fuel consumption by another 10-20 per cent, thereby also improving operational flexibility. A zero-emissions mode can be realised by adding battery banks. This hybrid drive adds cost and complexity when compared to the diesel-direct drive, but it is lighter, less complex and approximately 30 per cent cheaper than the equally functional twin hybrid systems typically used. LNG is becoming an increasingly important alternative fuel. The successful application on board tugs however largely depends on having adequate, well protected, LNG storage tanks. EDDY tugs can accommodate multiple LNG tanks right in the centre of the hull. It is a location which offers the most protection and one where LNG consumption does not alter the tug's trim. The two independent engine rooms offer full redundancy in case of a gas leak or other calamity. A low pressure Dual-Fuel (LNG/MDO) system offers good near-term potential to further reduce overall operating cost and emissions at a moderate capital cost for certain operating profiles. For operators who do not want to install such and DF systems at this stage, but consider working with LNG some years from now, this system can be retrofitted on diesel-direct propulsion systems fairly easily if planned during the design stage. Another promising alternative is a LNG-electric propulsion system for those locations where the supply of LNG is guaranteed, such as at LNG terminals. A configuration as shown in Figure 10 allows for transits and low BP operations on a single gas-generator running at optimum load, driving both thrusters. For most assist and escort operations it will be sufficient to have only two of the three gas-generators on-line.

Dual-Fuel Diesel-Direct drive



LNG-Electric Drive

This is one of the most environmental friendly alternatives available, while still offering full on-line system redundancy. Depending on the tug's operating profile, bollard pull requirements and future LNG prices, it can be an economically viable and interesting alternative. While the diesel-direct version offers best overall economy with significant emissions reductions, the slightly more expensive LNG and hybrid variants offer further emission reductions and more flexibility in energy choice. Selection of the most suitable propulsion option for each particular situation is made on a case-by-case basis to ensure optimized efficiency and cost.

Eddy explained – part 6 Portfolio (TT&O issue 21; 27 May 2012): The **EDDY** range starts with a length of 10 meters. With increments of 5.5 meters between versions, the largest model is 43 meters long. The principal purpose of the smallest multi-purpose workboat is line-handling, but since it embodies identical operating principles as the full size tugs, it also is very suitable as training craft. The **EDDY** 27/60 or 27/70 versions are ideal 'all-round' cost effective harbour tugs, having a length of 27 meters and bollard pull of 60 or 70 tons. An **EDDY** Terminal tug measures 32 meter, delivers 85 tons bollard pull and is capable of generating escort towline forces of 130 mt. The single level accommodation and a tumblehome of at least 35 degrees all round (with the mast electrically lowered) offers maximum clearance when working under the flare of large ships. The ample space available below decks and an easy to control weight distribution offer high flexibility in propulsion system selection. All engine exhaust pipes are arranged in-line to ensure optimum all-round vision from the tug master's control position. The hull form and other features, such as positioning of engine room openings, allow for safe and effective operations in even the most severe weather conditions. Besides the operational economies, **EDDY** tugs require lower capital expenditure when compared to other tug types of equivalent installed power. This was realized by simplifying the operating concept as well as the design. There are fewer components, such as a single winch, and there is less steel. The hull is simple to construct, while expensive and complex propulsion systems can be omitted or justified, depending on operating profiles, geographic location and fuel cost trends. The increased pressure to improve overall safety, performance, economy and emissions of tug operations has led to a number of recent innovations in tug design. EDDY tugs however are the first to integrate all above aspects in a single concept. The result is a tug which is extremely manoeuvrable and configured for effective ship-assist operations as well as high performance escort towing. Stern tug performance exceeds that of state-of-the-art tugs of equivalent power. As bow tug it performs equally well, which allows operators to effectively standardize their fleet with just a single tug type. Safety is improved by making handling simple and intuitive, and by integrating a number of safety features in the design. Emissions are reduced by changing the operational concept, improved hull shape and alternative propulsion systems. Overall economy is mainly realized by drastically reducing operating cost, but also by lowering capital cost.

THE FIRST EDDY TUG UNDER CONSTRUCTION

(TT&O issue 63; 30 October 2013); After an extensive 5 year development and testing programme, the first **EDDY TUG** is finally under construction in the Netherlands.

*Left: Scale model of the EDDY 30-65 which was on display during **EUROPORT 2013, at stand 1404 of Holland Shipyards.***

Since the launch of the **EDDY** concept in 2012, this novel tug design was extremely well received by the towage industry, but the inevitable question was always "where can we see an **EDDY TUG** operating?" To overcome this hurdle, Holland Shipyards recently joined **EDDY TUG** and started with the the construction of the first full scale version of this unique tug.

Holland Shipyards is known for delivering on-time solutions to clients, a high level of quality and excellent customer care. Their involvement in **EDDY TUG** underlines the shipyard's commitment to become an innovative player in the towage market. Detail- and production engineering was entirely done in-house by **EDDY TUG**. This resulted in a very well thought-through design which is ready to face tomorrow's challenges in the towage market. The main particulars of the "**EDDY 30-65**" are: 30,30 long x 13.40 m wide, with a draft of 4.75m and a Bollard Pull of 65t. The vessel will be classed under Bureau Veritas with the following annotations: BV I +HULL • MACH ESCORT TUG, AUT UMS, Unrestricted Navigation. The hybrid propulsion system consists of two Schottel SRP 3000 thrusters, each fitted with 460kW electrical motors, two Mitsubishi S16R main engines of 1610kW each and two 568 kW generators. In free sailing condition, the tug can easily reach speeds of 9 knots purely on its electrical motors, leading to significant fuel and maintenance savings. A spacious accommodation is provided for a complement of 7 persons in 5 cabins, all with en-suite sanitary facilities. All **EDDY TUGS** are designed and built around three simple key-criteria: performance, economy and safety. *Performance* The enhanced, yet simple and slender hull form is easily driven, easy on gear, highly seaworthy and course stable in any direction. The balanced design, comprising compact centerline drive-trains with azimuthal thrusters forward and aft, results in very simple operations. Free sailing- and towage behaviour are totally predictable and intuitive, which will surprise any tug captain, whether highly

experienced or novice. High dynamic stability results in high dynamic escort performance under all weather conditions. The unique propulsion arrangement allows for high push and pull forces in any direction and makes an **EDDY TUG** effective as bow- as well as stern tug. When operating under speed, towline forces of twice the bollard pull can be generated. *Economy* An **EDDY TUG** accelerates effortlessly and moves swiftly in any direction with the capability to maintain continuous line tension. High towline forces are generated by making optimum use of hydrodynamic forces, instead of fossil fuels. Pure simplicity is transformed into pure economy by making the most efficient use of the minimum number of parts. The hybrid drive train, which is standard on an **EDDY TUG**, ensures a drastically optimized fuel economy in all operational modes, thereby re-defining the benchmark for all hybrid tugs currently on the market. *Safety* Each **EDDY TUG** is intrinsically safe. The high dynamic stability, reduced motions in seaway, the watertight subdivision and dry, spacious and clutter less decks guarantee a safe working platform. Safety in manoeuvring and ship-assist operations is established by the ease of operations, total predictability and good sea-keeping behaviour. A double-drum render-recover Kraaijeveld Safe-Winch mitigates the risk of having slack towlines and towline overload. Minimum 35 degrees tumblehome, massive all-round fendering and low draft further improves safety, also when working under any ship's flare. The **EDDY 30-65** will be ready for service by June 2014. For those who earlier asked the question "where can I see one operating?" **EDDY TUG** b.v. is now taking appointments for demonstrations.

BUILDING PROGRESS OF THE EDDY TUG 30-65

(TT&O issue 02; 12 January 2014): At the Holland Shipyards in Hardinxveld-Giessendam is the **Eddy-tug** building still in progress which is seen on the pictures. The **Eddy tugs** are designed and

built around three simple key-criteria; Performance, Economy and safety. *Performance:* The enhanced, yet simple and slender hull form is easily driven, easy on gear, highly seaworthy and course stable in any direction. Free sailing and towage behavior in totally predictable and intuitive. The balanced design, comprising compact centerline drive-trains with azimuthal thrusters forward and aft, results in very simple operations, which will surprise any tug captain, whether highly experienced or novice. High dynamic stability results in high dynamic escort performance under all weather conditions. *Economy:* The essentials are elegantly engineered, making the most efficient use of the minimum number of parts. Pure simplicity transformed into pure economy. The hybrid drive train, which is standard on the **Eddy tugs**, ensures optimized fuel economy in all operational modes. **Eddy tugs** accelerate effortlessly and move swiftly in any direction with the capability to maintain continuous line tension. High towline forces are generated by making optimum use of hydrodynamic forces, instead of brute force. *Safety:* Each **Eddy tug** is intrinsically safe. The high dynamic stability, the watertight compartments and spacious dry decks without obstructions guarantee a safe working platform. Safety in maneuvering and ship-assist operations is established

by the ease of operation and good sea-keeping behavior. The double-drum render-recover Safe-Winch mitigates the risk of having slack towelines and towline overload. A large tumblehome of minimum 35˚, massive all-round fendering and low draft further improves safety while working under a ship's flare.

The continued progress of the tug is seen with the above showed pictures. With a driven team that has only one thing in mind; developing and building a new generation of ship-assist / tug boats. **Eddy tug** offers you a revolutionary tug boat that will change the towage market. In a time where operational economy, quality, safety and cost reduction are spear-points of many organizations. The

Eddy tug designs are made to live up to all these requirements, without compromising the quality and versatility of the tugs. **Eddy tug** offers a full range of services, from product development, prototyping and testing up to providing full turn-key delivery of **Eddy tug** workboats and tugs to a worldwide client base. With an organization that has experience in all relevant fields, the **Eddy tug** designs are made to excel not only on paper, but also in the water.

EDDY 1 LAUNCHED

(TT&O issue 29; 11 May 2014): On the 5th May 2014 the very first new design tugboat was launched at the Holland Shipyard at Hardinxveld, Netherlands. The **EDDY 1** is a hybrid harbour & terminal type 30-65 tug with escort capability with an azimuthing thruster fore and aft. The tug's design is for a maximum efficiency and a maximum safety, resulting in an unusual hull form fitted with a hybrid diesel/electric system whereby the azimuthing.

Photo: Ferry van Rijsbergen via Holland Shipyard

thrusters can be driven electric, diesel, or combined. The tug was launched with the aid of two of the well-known Bonn & Mees floating sheerlegs. The tug has a length o.a. of 30.30 mtrs (28.95 mtrs) a beam o.a. of 13.40 mtrs (12.43 mtrs) and a operational draught of 4.75 mtrs. She performed a maximum speed of 14 knots, a transit speed@single main engine of 12 knots and a transit speed on hybrid modem of 9.5 knots. Her bollard pull is expected 65 tons. The two Mitsubishi S16R main engines develops a total output of 3,220 kW drive to two Schottel SRP3000 thrusters. She has an accommodation for 7 crew at 5 cabins each with individual sanitary facilities. The towing winch is a Kraaijeveld Safe-Winch electrically driven, double drum with a holding capacity of 175 tons on the 1st layer and a pull of 30 tons @ 9m/min. The tug will be presented during the 23rd International Tug, Salvage & OSV Convention & Exhibition 16th & 20th June 2014.

Photo: Ferry van Rijsbergen via Holland Shipyard

EDDY COMMENCED TRAILS

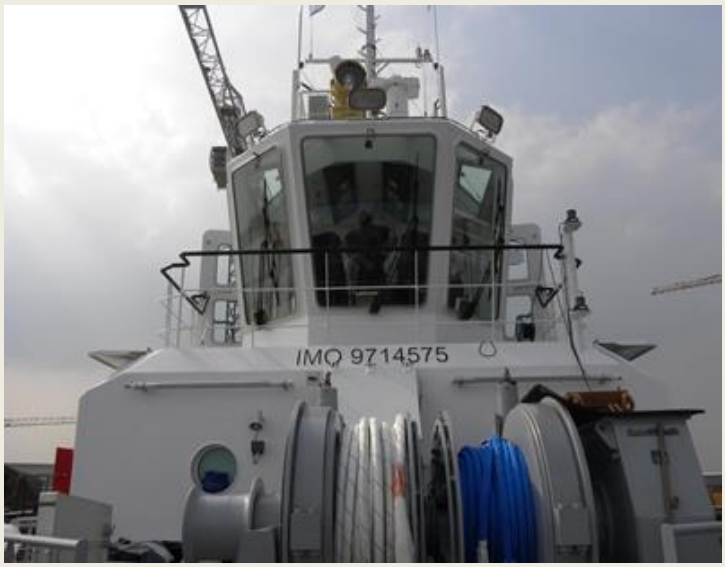
Photo: Ferry van Rijsbergen via Holland Shipyard

(TT&O issue 36: 8 June 2014) Late in the afternoon of 2nd June the new concept tug **Eddy 1** (Imo 9714575) left the builders yard Holland Shipyards, Hardinxveld for Europort to commence yard and official technical trials before heading for ITS, Hamburg on June 16 – 20. The new Eddy 30-65 design tug is a Hybrid Harbour & Terminal Tug with escort capability and pusher stern. She has a length o.a of 30.30 mtrs a waterline length of 28.95 mtrs a moulded beam of 12.43

mtrs a beam o.a. of 13.40 mtrs and an operational draught of 4.75 mtrs. The two Mitsubishi S16R develop a total output of 3,210 kW. She has two Scania DI 16 generators of 568 kw each for sailing in electric Hybrid mode. The two Schottel propulsion units are SRP3000 type. Her maximum speed achieved during the trails is 13,5 knots and transit speed on @ single engine 12 knots. In the hybrid mode 9.5 knots. She achieved a bollard pull of 65 tons. The tug has an accommodation for a crew of 7 in 5 cabins each with individual sanitary facilities.

EDDY 1 PHOTO IMPRESSION

Wheelhouse



Front view

The front view of the wheelhouse. The wheelhouse has a split level design, providing excellent all-round visibility. The forward control station, of typical split parallel console type, afford the helmsman maximum visibility to both fore and aft deck working areas.

Bridge console

View to forward ship

The bridge consoles has all propulsion controls and steering units for the Schottel thrusters. All navigation equipment is delivered by Alphatron Marine and consist the following; - Two JRC JMA-5312-6 X-band radars; – one Alphatron Alphawind MF wind system; – one JRC JFE-380 Echo sounder; – one JRC JLN-205 Speed log; – one Alphatron Alphaseapilot MFC Autopilot; – one JRC JRL-7500 GPS; – one JRC JHS-183 AIS; - one Alphatron Alphabinnacle H Magnetic compass; - one JRC JLR-21 GPS compass; - one McMurdo E5

EPIRB; - two McMurdo S4 SART; - four Sailor SP3520 Portable GMDSS VHF; - one JRC JSS-2150 MF/HF; - two JRC JHS-770 VHF; - two JRC JUE-87 Inmarsat-C; - one JRC NCR-333 NAVTEX; - one Alphatron Alphacall MF Intercom; - one Dual ECDIS Alphachart T ECDIS; - one Alphatron AlphaBNWAS; - one Kahlenberg KB-30A Electric horn/loudhailer.

View to astern ship

Deck Equipment

The raised main deck aft is fitted with a Kraaijeveld Safe Wich Electrically driven , double drum towing winch. This winch has a holding capacity, on the 1st layer, of 175 tons with a pull of 30 tons @ 9 m/min.

Towing winch

On the foredeck we see the anchor winch with a 5 tons capacity capstan.

chor windlass

Propulsion

One of Eddy's engine rooms

In each forward and aft engine room are a Mitsubishi S16R main engine installed with a output of 1,610 kW and the Scania DI 16 generator of 568 ekW. The main engines are connected to the Schottel SRP3000 PTI (2400 mm) Azimuth Thrusters.

Main generator set

The generators delivers the power to the Schottel PEM Electric motors connected to the Azimuth Thrusters.

Auxiliary generator

The electric plant comprises a SiSu 49 CTAG generator set with a power output of 89 kWe

Main switchboard

Schottel Thruster

Thruster with electromotor

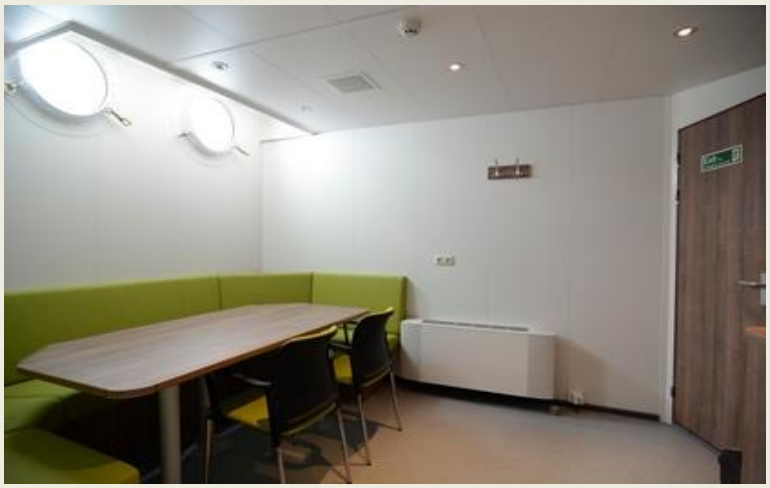
Galley

Acommodation

The vessel has been outfitted to the highest standards for a crew of up to 7 people. 5 cabins each with individual sanitary facilities. The deck house is entered via the aft deck corridor which isolate enginerooms and exhaust noise from the accommodation space.

At the deck level there are three cabins a toilet and laundry. One cabin for the captain and one for the chief engineer

On the accommodation/engineroom deck level there is the galley and a generous mess room/lounge and two crew cabins.



Messroom

The construction of the **Eddy** is made possible by:

Holland Shipyards - Building yard

Bureau Veritas - Classification society

Dutch Shipping Inspectorate - Flag State Society

Schottel - Propulsion builders

Koedood - Main engines

Kraaijenveld – Towing winch

Holland Ship Electric (Oechies) - Electrical

Hoogendoorn Maritieme Betimmeringen - Interieur

The **Eddy** further is outfitted by the following suppliers:

CTC - Fendering system

Hempel - Paint system

MME - Cathodic Protection

Schottel - Manoeuvring Control Systems

Holland Ship Electric - Propulsion Control systems; Communication equipment; Fire detection system; Electrical installation; Electric power management; Battery chargers; UPS; Lighting Fixtures; Central antenna system

Alphatron - Navigation Equipment

Cassens & Plath - Magnetic compass

Den Haan - Navigation lights

IBAK - Search light

Zöllner - Typhoon

Seaparts - Anchors / chains; Anchor winches; Capstan; Fixed mooring equipment

Datema - Life rafts; Lifesaving equipment; Medical equipment; Loose firefighting equipment

Hoogendoorn MBI – Insulation; Panelling; Doors in accommodation; Furniture

Libra - Watertight doors
La Auxiliar Naval, S.A. - Windows / portholes
Miele / Siemens - Galley / laundry equipment
Bergaflex - Wheelhouse sunshades
Windex - Ventilation / air-conditioning
Sihi Maters - Hydrophore
Stiebel Eltron - Hot water boiler
Mitsubishi - Main propulsion engine
Centa - Flexible couplings
Schottel/Ramme - Main propulsion electric motor
Schottel - Azimuth thrusters
Scania - Main generator engine
Sisul - Harbour generator diesel engine
Azcue - Pumps :
Alpha Laval - Plate heat exchangers
Axces - Exhaust gas silencers
RWO - Bilge water separator
MX brandbeveiliging - CO_2 system
Winteb - De-aeration caps
Vacon - Softstarters / frequency converters
Stamford - Generators

Sources: Baldo Dielen
Holland Shipyard

Photo's: Holland Shipyard
Ferry van Rijsbergen
Towingline

For more info:

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