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Technology Enviromax Enviromax ™ © Deepwater OSV

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Abstract:

Technology Associates, Inc (TAI), a New Orleans, USA based Naval Architecture firm with offices also in Vishakhapatnam, India introduced its Technology EnviroMax 300 ™ © Deep water Oil and Gas Support Vessel (OSV) in 2010. As Oil and Gas exploration has gone to deeper waters, reaching depths up to 4,000 meters, the designs of OSVs has changed to suit the more challenging requirement. Several designs have been used in the shipbuilding industry. The Technology EnviroMax ™ © development had a goal to minimize the environmental impact from the vessel during construction and operations, minimize life cycle costs, while maximizing the dead weight, the cargo delivered to site per year, and operational flexibility. These were diametrically opposite and challenging requirements which had to be balanced to create a design which has a goal to be competitive to build and operate, and yet had maximum capacities and speed. The development resulted in a design which has one of the known industry's highest usable cargo volume to cubic number ratio, and the highest deadweight per cargo volume ratio in vessels of its class. It also has a higher maximum speed than most vessel designs in its class, using optimally installed propulsion KW. Since the introduction of the fist of the Technology EnviroMax 300 ™ © series, TAI has introduced a Technology EnviroMax 315 ™ ©, a Technology EnviroMax 275 ™ ©, a Technology EnviroMax 195 ™ ©, and Technology EnviroMax 300 Gen II ™ ©. All of these designs have been contracted by clients and most of them are either under construction or in final stages of design.

1.Introduction

Utilizing a unique Designer/Builder relationship, the first design was developed in conjunction with Thoma-Sea Shipyards. This design resulted in a contract for up to 6

Figure 1: Technology EnviroMAX 300

vessels, the first two of which are under construction at Thoma-Sea Shipyards' facilities in Lockport, Louisiana (see Fig-1-EnviroMax 300). Since then the EnviroMax design approach has resulted in multiple contract awards for TAI and its clients. The first set of vessels being built are for Gulf Offshore Logistics (GOL). Since the first vessel was introduced, TAI has also been contracted to provide a complete ABS and USCG approved USCG sub, I, L and D class design for a 315 ft version of the EnviroMax design for application as a specialty fuel oil carrier, which can also be used as an OSV, for a US Energy Supply Company. Additionally Gulf Mark ordered two vessels from TAI's EnviroMax 275 ft class OSV design. These are also under construction at Thoma-Sea Shipyards. Skansi Marine had a 175 ft version of the EnviroMax OSV concept designed by TAI. Now TAI has been contracted to design the Technology EnviroMax 300 Gen II OSV for another prominent OSV operator. Variants of the Technology EnviroMax are also being considered by shipyards in Mexico, Brazil and Uruguay. A 195 ft adaptation of the EnviroMax design has also been contracted to be engineered for a prominent Geophysical Company for application as a Geotechnical Survey vessel.

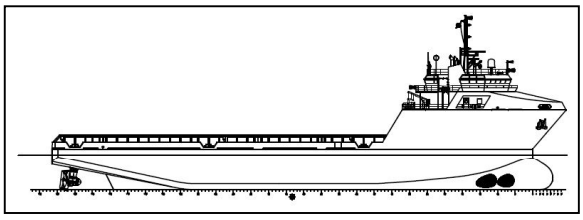

Figure 2 EnviroMax 300 Gen II

2.Sustainability Aspects In Design

This application includes unique considerations like minimizing bubble sweep down, so that the sonars can operate with minimal interference. The first Technology EnviroMax 300™ © hull was developed with the following parameters.

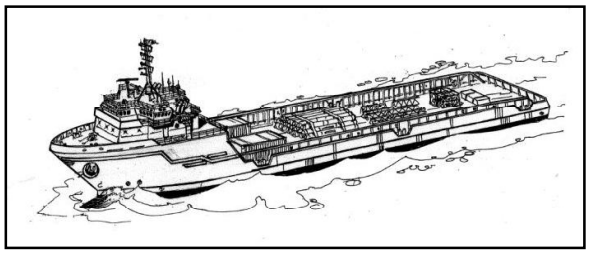

Figure 5: MaxiMiser 300 OSV

- Maximize the dead weight and mix of cargo carrying capability in the hull envelope, while maintaining hull size parameters within American Bureau of Shipping under 90 M rules.
- Maximize the vessel's speed using the application of traditional cargo ship design principals to allow the vessel to provide maximum cargo on location on an annualized basis with maximum turn around trips due to the increased vessel speed.
- Maximize the sea state in which the vessel can operate and dynamically position. This provides the charterer maximum cargo on site in a particular geographic area and the Owner a competitive edge.
- Minimize the installed propulsion BHP in order to minimize the annual fuel consumption and carbon foot print emission.
- Minimize the environmental impact by making the design conform to ABS Green Passport, and IMO, MARPOL and SOLAS requirements to obtain ABS Enviro notation on its certificate.
- Minimize the vessel operating expenses using design techniques.
- Minimize the vessel construction costs using the newly developed and proprietary and copyrighted TAI-Thom-Sea structural method, so that the design can be built and maintained competitively. This method allows reduced construction man hours and also allows the vessel to be built by lower overhead more competitive shipyards which do not always have the latest most modern production equipment.
- Maximize Flexibility: Recognizing emerging legislation in light of the 2010 Macondo oil spill that Oil and Gas Operators will be required to have enhanced and

more capable oil spill response capability this design also has the flexibility so that it can be readily adapted to Oil Spill Collection functions. Other adaptations of the hull form allow it to be used for short sea container shipping, and as a sub-sea maintenance and support vessel.

Thus the vessel design was named MaxiMiser 300 OSV. TAI did an extensive study prior to developing the design goals and philosophy for the MaxiMiser 300 OSV design. This includes a comprehensive analysis of publicly available information of most leading designs in the industry and decided that in order to develop a design which can be successful in a highly competitive market even during business down turn cycles. Thus it will have to be such that it will continue to stay in demand for the next two decades and meet the following criteria;

- The design would need to have maximized hull cargo space to total hull volume space ratio. This is a ratio developed by TAI whereby the volume of the hull devoted to actual carriage of cargoes is divided by the total volume of the hull. Even though all traditional OSV designs have hull cargo allocation which exceeds the vessel's dead weight, the maximization of this ratio is necessary to provide the vessel Owner the maximum flexibility to market its vessel and carry a maximum mix of cargoes at any one time. Coupled with a design which allows the deepest ABS load line allocation for a vessel of this class, this approach maximizes the dead weight volumes available and offers the vessel Owner a competitive advantage in the market place.
- The design would need to have a hull form optimized to achieve an optimal balance between minimum hull resistance and maximum dead weight. Thus achieving a block coefficient ratio and optimal hull form took extensive 3 dimensional modeling of the hull form and continuous iterative improvement of these goals. This required constant vigilance of the hull resistance, while achieving excellent sea keeping and maximizing the block coefficient to provide the maximum dead weight. The increased block coefficient intuitively goes against the least resistance approach. Extensive Computational Fluid Dynamics Analyses were performed in conjunction with Maritime Research Institute Netherlands (MARIN) [4] to optimize the wake flow characteristics and the shape do the bulbous bow. Since deep water oil fields are further away and the transit distances are becoming large, maximizing transit speed is becoming a key

issue in offering more cargo to site with maximum annual turn around trips and thus increasing vessel utility to the charterer. The results of the analysis for various modifications of forward portion of hull form are shown in Fig-6, 7 & 8 below.

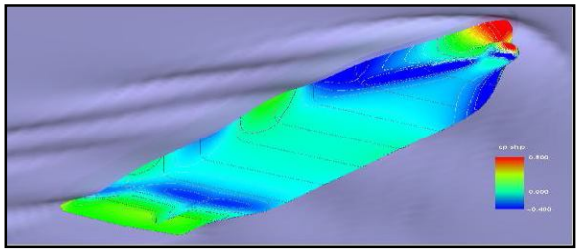

Figure 6: Initial design.

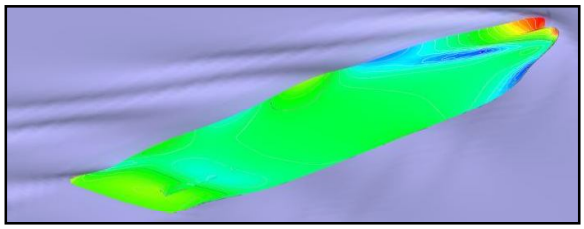

Figure 7: Intermediate optimization

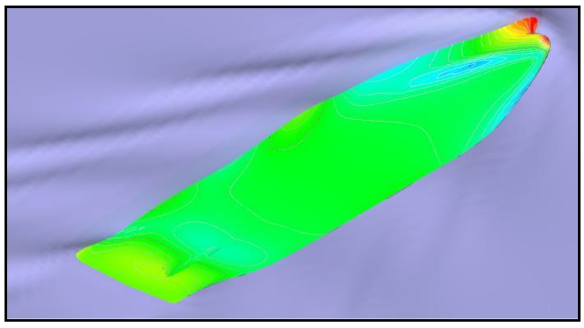

Figure 8: Final optimization

- Within the new environmental ABS, IMO, SOLAS and MARPOL regulations, and the need to obtain Green Passport and Enviro classification, the distribution of cargoes and their relative contiguity within the hull had to be reconsidered in order to obtain maximum use of the available hull space and obtain the hull cargo ratio discussed above in excess of other vessels in the market place. This also includes considerations for emissions.
- OSV vessel designers traditionally have not concentrated their effort towards minimizing fuel oil consumption because in traditional charter hire contracts the Oil

companies, the Oil Companies have provided fuel. This contractual arrangement has not traditionally provided the vessel owner an incentive to minimize fuel consumption. TAI felt that in light of the increasing energy costs, the not too distant future Oil and Gas Operators, who are also becoming extremely environmentally conscious in addition to their strict insistence for safety, will start looking at the fuel consumption aspect very closely. Since there is a direct correlation between fuel oil consumption and carbon foot print emission, by ensuring minimum fuel oil consumption this new design provides a double pay back to the vessel operator and the Oil and Gas Operator. These criteria led to a careful evaluation of the vessel's power plant, propulsion system and to the choice of a carefully designed power and propulsion system for optimal use of fuel consumption in transit and DP modes.

- Retention of the best crews is an important aspect of successful OSV operations. Thus significant effort was expended to ensure that the vessel design is sea kindly, and the accommodations and operational systems are designed with crew comfort in mind.
- To keep life cycle maintenance cost low, simplicity of on board systems, choice of supportable modern systems, ease of on board and shipyard maintenance also were design criteria.

This MaxiMiser 300 is designed to provide offshore services worldwide. It is classed by American Bureau of Shipping, and meets all rigorous requirements of USCG, subchapter I & L, as well as IMO, SOLAS and MARPOL international regulations.

The vessel can attain a maximum speed in excess of 14 knots. Main Propulsion installation includes 2 x Rolls-Royce US255P Azimuth thrusters which are driven by 2200kW electric motors. The two CPP bow thrusters, each rated at 1000kW are also electric driven. The diesel electric plant comprises of 2x1700kW (CAT3512) and 2x2000kW (CAT3516) Generators resulting in total installed electric power of 7.3MW. Main generators are installed in a unique mode where alternators are installed on dampers whereas engine is rigidly mounted resulting minimal vibrations. Further, Vessels cooling system has been optimized to minimize piping and maximize functionality while maintaining redundancy requirements. It is important to note that Rolls Royce is providing a complete integrated system which includes.

- Integrated automation system (ACON) for control and monitoring of ship equipment and machinery. Tailor-made graphical pictures on windows based

man-machine interface, displays necessary information and makes the system easy to operate.

- Propulsion Remote Control System (Helicon X3) which allows accurate and reliable control of the propellers pitch (bow thrusters) and motor speed (RPM). The propulsion control is available at bridge fore and aft stations as well as in the machinery control room.
- The Joystick system (Poscon).
- Icon Dynamic Positioning System.

Since complete propulsion and control package is being delivered by a single vendor, interfacing issues are expected to be minimal.

The engine room is in the forward with a proven dry exhaust system with noise and vibration reducers. With the exhaust and bridge appropriately located, there is no obstruction to the view all around. Locating the engine forward has many advantages; its operation and maintenance is handy; piping and cable routing is significantly simple.

2.1.Vessel's Design Features

2.1.1.Cargo Handling And Capacity

The vessel can carry 18000 bbls of 2.4 SG liquid mud, 11000 Cu ft of Bulk Mud, 1800 BBLS of Methanol, 650000 gals of drill water, 68000 gals of potable water, 270000 gals of fuel and in excess of 3400 tons of deck cargo. The target dead weight of the vessel is 5,200 tons (short tons).

2.1.2.External fire fighting system

This vessel meets all the requirements for external fire fighting (FIFI class 1) with two 1200 cu. m per hour fire monitors on top of the pilot house. For self sustainability, a deluge water spray system is also installed on the vessel.

2.1.3.Hull Form

The unique hull design and integrated rudder and thruster system the MaxiMiser 300 OSVs provide better economy and efficiency. Overall hull performance has been optimized by minimizing wave resistance at the fore body. In doing so, an advanced bulbous bow has been included. Further refinement of hull lines resulted in net gain in

wave resistance reduction by 30%. In practical terms, this means lesser resistance and thus more speed at lower engine powers. It should be noted that shape of bulb is optimized from 'hydrodynamics' as well as 'build-able' aspects.

2.1.4.Maneuvering & DP

Our OSVs are equipped with advanced dynamic positioning systems, ABS DP2, which allow our vessels to maintain position within a minimal variance.

2.1(e) Comfort & Ergonomics:

Even when the ship is fully loaded with deck cargo, there is an all clear passage way from forward to aft of the ship. This has been achieved without any loss in the deck cargo space. Use of cargo rails for venting the tanks is a TAI proprietary and copyrighted innovation in OSV operation; it allows us to gain a lot of clear space with a very less additional construction cost.

2.1.5.Enviro Notation

Growing concern about the environmental degradation has led to an increased demand for measures to protect environment. In response to these concerns, our vessel is designed and constructed with environmentally focused approach by incorporating latest international environmental regulation and associated requirements of ABS ENVIRO class & green passport.

All standards for higher level environmental protection have been adopted for compliance with regulations pertaining to the design characteristics, management, support systems, sea discharges and air discharges. These vessels also have double-bottomed and double-sided hulls that minimize the environmental impact of hull penetrations on marine environments.

2.1.6.Systems And Structure's Unique Design Attributes

TAI's design of this OSV include state of the art propulsion package and control system from Rolls Royce. Since the vessel is diesel electric, automation, redundancy, simplicity, safety and flexibility in operation is achieved by all integrated electric systems and use of mechanical and pneumatic controls is almost non-existent. Vessel design is State-of-the-art lifesaving monitoring, emergency power, fire-alarm and fire suppression systems and systems monitoring equipment. Diesel electric propulsion system together with advanced automation and control and load management systems offers better redundancy,

flexibility and higher fuel efficiency when compared to conventional mechanical vessels. The leads to about 20% greater fuel efficiency than vessels powered by conventional engines and propulsion.

The simplicity of design can perhaps be better understood by one of many examples, for example, the cargo rail stanchions not only serves their prime duty of securing cargo on main deck, but also provide ducting for the ventilation.

One more innovation is the All Corrugated Bulkheads (ACB) concept for easier building and maintenance. All the bulkheads and floors in this vessel are corrugated for less production cost, rapid construction, maintenance free and efficient cleaning of tanks. The corrugations are different form conventional corrugations and have a higher strength to weight ratio. No compromise to longitudinal strenght which exceeds abs criteria by 8 percent.

5.Conclusion

- The unique hull design and integrated rudder and thruster system the MaxiMiser 300 OSVs provide better economy and efficiency.
- An advanced bulbous bow designed for this vessel and further refinement of hull lines resulted in net gain in wave resistance reduction by 30%.
- All standards for higher level environmental protection have been adopted for compliance with regulations pertaining to the design characteristics, management, support systems, sea discharges and air discharges.
- Diesel electric propulsion system together with advanced automation and control and load management systems offers better redundancy, flexibility and higher fuel efficiency when compared to conventional mechanical vessels. The leads to about 20% greater fuel efficiency than vessels powered by conventional engines and propulsion.

6.Acknowledgement

We acknowledge our sincere thanks to all the employees of this organisation who have made this design a successful project. We also express our sincere thanks to Thoma-Sea shipbuilders and engineers who have immediately accepted the design and built the vessel.

- **Nomenclature**

ACON = Integrated Automation System.

ABS= American Bureau of Shipping

DP= Dynamic Propulsion

ENVIRO= ABS Environmental Notation.

GP= Green Passport.

USCG= United States Coast Guard

OSV= Offshore Supply Vessel

CPP= Controlled Pitch Propeller

BBLS= Barrels

SG= Specific Gravity

GALS = Gallons

KW= Kilowatt

LT= Long Tons (1.016 MT)

7.Reference

1. ABS Guide for the Class Notation GREEN PASSPORT (GP)
2. ABS Guide for The Environmental Protection Notation for Vessels.
3. IMO Publication on 'Guidelines for the Transport and Handling of Limited Amounts of Hazardous and Noxious Liquid Substances in Bulk on Offshore Support Vessels'.
4. CFD analysis report submitted by MARIN.