OSSA POWERLITE

For many years manufacturers have offered yacht owners compromise propulsion and house energy systems adapted from automotive and land based power technologies. This results in systems of minimum cost but inefficient performance and lesser value. Automotive and shore power systems are familiar and comfortable to most designers. Marine applications are demanding and reliability is of paramount importance. Since new technology has often meant additional complexity, the motivation for staying with the familiar is understandable. However, the application of new technology can also greatly enhance reliability. Consider the example of the increase in engine service intervals with the introduction of new electronic injection systems.

OSSA Powerlite systems are the result of rethinking long established engineering principles in light of new technologies to provide an entirely new level of performance and reliability in yacht power systems. With lighter systems and more flexibility in placing components, speed is increased and fuel consumption is decreased. OSSA Powerlite equipped boats are also much quieter under power.

This has been achieved in part by considering two aspects of yacht systems that are usually designed independently, as an integrated system. The power source and the loads are designed to work together as an integrated unit. This approach delivers some big benefits that are not available when the power sources and loads are engineered separately.

Technical Issues With Current Power Technology

Most yachts of conventional design use motors powered by one or more of the following power types to run their house loads – 12 or 24 volt DC, 120 or 230 volt 60 or 50 Hz AC, or hydraulic motors.

Low voltage DC motors require heavy wires or buss bars due to the high amp draw as power increases. The size and weight of the motors and associated wiring impose high design space and financial costs. Locating a large DC motor far from the power source is often impractical due to the size and weight of the power conductors that would be required. Motor cooling can become a factor, and limit the duty cycle to less than what is really required for the job. An example of this would be using a bow thruster to hold the bow steady against a breeze coming from the beam. The size, weight, and costs required to support battery banks of sufficient size to supply such motors is considerable.

AC motors are often chosen for larger power loads, since the higher voltages they operate at require smaller conductors, and they are compatible with shore power. The brushless design also removes a service item common to many DC motors. On the down side, AC motors are very demanding regarding the quality of power required to run them. Power input of a frequency or voltage outside a narrow range can cause the motors to be unable to start, drop off line or fail. This makes adapting AC boat systems to differing shore power specs around the world quite complex.

An especially problematic issue is that AC motors draw an inrush current several times the running load to enable starting. AC generator sets must therefore be sized much larger than the expected maximum loads . This causes a large weight and cost penalty. The need to oversize gensets causes a further reliability problem. These gensets must turn at a fixed RPM in order to maintain the proper power frequency of 50 or 60 Hz. This results in engines that are under loaded because they need to have enough reserve to handle startup loads that only last for fractions of a second. The light loading causes the engines to run below design temperatures, which greatly shortens engine life through a condition called wet-stacking. Fixed speed low load operation also lowers fuel efficiency.

Hydraulic motors and plumbing are less sensitive to environmental damage, but are still prone to oil leaks, the associated plumbing is heavy, and they can be noisy.

OSSA Powerlite Design

The core of an OSSA Powerlite installation is a DC power bus, typically at 120 or 240 volts DC. These voltages were chosen so that OSSA Powerlite accessories can operate on standard shore power through a simple power rectifier.

Besides rectified shore power, the OSSA Powerlite DC bus can be powered by OSSA Powerlite DC diesel gensets, turbines, and fuel cells. This makes the OSSA Powerlite DC bus fully compatible with developing future power sources.

The DC power provides increased safety compared to 120 or 230 AC shore power systems. The OSSA Powerlite buss is completely galvanically isolated from any 12 or 24 volt DC or AC circuits on board.

OSSA Powerlite diesel gensets use the oldest and simplest power generation technique, moving a coil of copper through the field of a permanent magnet. The use of rare earth magnets helps achieve electrical efficiencies of greater than 96 per cent. This high efficiency reduces the load on the cooling system and increases overall fuel efficiency. The wires are encapsulated in epoxy, which increases reliability in the marine environment. The end result is an extremely **rugged, light weight**, **quiet**, and **fuel efficient** genset.

The reason this approach has not been widely used until now is that the AC current produced by such a genset changes both in frequency and voltage, as the power load and RPM of the engine varies. This makes a permanent magnet genset unsuitable for powering AC motors which require power input stable within a very limited range. It is possible to condition the genset output through the use of power electronics but this adds complexity and cost and is problematic due to the inductive nature of AC motor loads.

OSSA Powerlite generators control the speed of the diesel engine to maintain a desired voltage as the load varies. This desired voltage can be fixed, or it may optionally vary to

provide motor speed control to a brush type motor. The AC output is immediately rectified to DC, so that the frequency of the power is not a factor. Major OSSA Powerlite loads are designed to be non-inductive. This can cut the size of the engine required by half because the genset is sized for maximum load, instead of inductive startup loads. The async operation of the engine means that it is always turning at the optimum speed for a given load. This eliminates wet-stacking and **greatly increases engine life**. It also **reduces noise** and increases **fuel economy**, since the engine is no longer required to turn at a fixed high rpm under light load conditions.

If multiple gensets are desired for system redundancy and continuous operation during service, they can be staged to come on or off line as the load conditions change with no concerns about syncing the power frequency.

Propulsion Motors

Separating the diesel engine from the prop shaft to drive it with an electric motor gives the yacht designer several kinds of desirable flexibility. The weight distribution and utilization of space can be optimized so that the machinery is not occupying the most desirable accommodation space. The genset can be completely enclosed in a sound shield, further reducing the noise from engine.

OSSA Powerlite propulsion motors are liquid cooled, direct-drive, variable-speed, synchronous DC motors. They provide the thrust for a diesel electric propulsion system. They are designed to operate at rpms suitable for props, which avoids the weight, cost, and efficiency loss of a step down transmission. The motor controller logic board is common across the range of propulsion motor sizes, with each size having its own matching power module.

Transmitting the power produced by the engine through a shaft and a transmission to a prop might seem to be the most direct, and therefore the most efficient way to apply engine power for propulsion. Due to the torque characteristics of diesel engines, this is not true. A diesel engine is not producing its maximum torque or thrust until it is turning quite quickly. Paradoxically, though, as the rpm increase from the maximum torque point to maximum power, the torque actually falls. Torque is force times distance and directly relates to the amount of thrust that can be delivered by the prop. So this torque-power curve is an unhappy combination for boat performance.

Slower turning diesels would seem to have an advantage because they produce more torque at low rpm. Unfortunately, engine weight and cost is sharply higher. For yachts, the weight penalty of slow turning diesels almost always increases the amount of power required more than the benefit to be gained by the higher torque these engines offer.

Fast turning engines are much lighter for the amount of power they produce, but they need a heavy, costly, and power robbing transmission to deliver the torque required to provide thrust at the prop and are still inefficient providing torque at low speed.

The **ideal solution** is an OSSA Powerlite electric motor that can deliver its maximum torque from the moment power is applied. Since an OSSA Powerlite genset will automatically operate at its most efficient speed for any load and the OSSA Powerlite propulsion motor will deliver maximum thrust even at low RPM, the size and weight of the propulsion package can be dramatically reduced. This results in a **smaller power requirement** for a given performance level. The advantages to this approach have been realized for many years on locomotives, passenger liners, container ships, and military craft. It is only now that the Glacier Bay OSSA Powerlite system has introduced this technology on a practical scale for yacht use.

What about house loads?

Modern yachts have other large power needs besides propulsion. Amongst these needs are air conditioning and refrigeration, cooking and water making, electronics, winches, windlasses and lighting. The same power generation and motor technology used in the OSSA Powerlite propulsion system applies to house loads as well.

Refrigeration, air conditioning, and reverse cycle heating can all be supplied by OSSA Powerlite compatible systems driven by Glacier Bay developed Masterflux compressors manufactured by Tecumseh Products. Masterflux compressor based products start out with a 30% energy efficiency advantage compared to those employing other hermetic compressors due to the use of high side motor cooling. Glacier Bay refrigeration systems are typically more than twice as efficient in power use as the most efficient conventional designs. These systems can be powered by low voltage DC or directly from the 120 or 240 volt OSSA Powerlite DC power bus.

These products are smaller and lighter than conventional systems and draw no inductive startup surge when activated. Many are variable speed so that the power draw varies directly with the cooling or heating need, resulting in more stable temperatures. The cycle and voltage differences are handled automatically when operating from standard shore power.

Other motor powered devices will benefit from operating with OSSA Powerlite DC motors. These can include bow and stern thrusters, water, bilge, and fire pumps, dive compressors, and watermakers, as well as winches and windlasses. These devices can be made physically smaller and lighter than their AC motor powered equivalents because of the higher power density and greater electrical efficiency available in the rare earth magnet motor design.

An OSSA Powerlite system may contain a high voltage DC to 12 or 24 volt converter/battery charger to charge start batteries and a low voltage house bank that supplies radios, instruments, lighting and refrigeration.

An OSSA Powerlite high voltage DC to AC inverter can supply standard AC power for a range of appliances, such as hair driers, blenders, toasters, lights, TV and stereo, plus standard AC outlets. This power could be available at either 120 volt 60 Hz or 230 volt

50 Hz.

Finally, resistance heaters such as water heaters, electric ovens and stove tops will work just the same on DC or AC power sources, and can therefore be operated from shore power or the DC bus with no power conversion needed.

Summary of Benefits

The benefits of light weight to yacht performance are such that a new material or technique that offers improved performance for even a single component is welcome news. An OSSA Powerlite DC buss and related systems will touch ***every*** aspect of your boat design with benefits that multiply when applied to each system. These include:

- **lighter weight**
- **less volume**
- **less noise**
- **longer service life and**
- **increased safety** .
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To a designer this offers:

- **greater economy**
- **better performance**
- **more accommodation space and**
- **more excitement and value to the end user**.

For further details on how OSSA Powerlite products can add performance to your boat project, please contact Wayne Goldman at Glacier Bay Inc. in Oakland, California 1 510 437 9100 ext. 102, or wg@glacierbay.com