Scientific Services on a Global Basis
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Ship Energy Efficiency Management Plan - 2019

In accordance with revised MARPOL Annex VI IMO Res. MEPC.213(62)

For Vessels Owned or Operated by
TDI Brooks International, Inc.

R/V Proteus

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Particulars

Vessel Particulars		SEEMP particulars	
Ship Name	R/V Proteus	Date of Development	15 March 2019
Call Sign	YJTP5	Implementation Period	From: 15 March 2019
IMO Number	7634290		To: 14 March 2020
Flag State	Vanuatu	Planned date of next evaluation	01 February 2020
Owner Manager/Operator	TDI-Brooks International	Developed by	Les Bender
Trade/Purpose	Oceanographic Research		
Gross Tonnage	830		

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1.0 Introduction

The International Maritime Organization (IMO), as the main regulatory body for international shipping, has required, as of 1 January 2013 that all ships over 400 GT must implement a Ship Energy Efficiency Management Plan (SEEMP). TDI-Brooks recognizes the need to manage the environmental performance of its ships and improve operational efficiencies. The enhancement of efficiencies can reduce fuel consumption, save money, and decrease environmental impacts of its individual ships. In global terms it is recognized that operational efficiencies delivered by a large number of ship operators will make an invaluable contribution to reducing global carbon emissions.

This SEEMP provides TDI-Brooks' approach for monitoring the energy efficiency of its fleet in general and the *R/V Proteus* in particular. In order to produce the best possible plan, it is recognized that TDI operates its fleet on the spot charter market for a specific purpose and this places unusual constraints on energy usage and therefore its efficient management. The primary purpose of TDI's fleet is not to haul goods from port A to port B, but to provide an offshore, mobile work platform for providing field acquisition services. These services generally include geotechnical and geochemical coring operations, environmental baseline surveys, and hydrographic surveys. Our ships are relatively small, broad beamed, and typically sail at speeds of no more than 6 – 9 knots. When on charter the vessel spends most of its time either on station performing coring or EBS operations or transiting to the next site, which may be as close as 500 m away or as far as 15,000 m. The time spent at each coring site can vary from as short as 40 minutes to as long as three hours, or more. While on site the vessel must hold station to a very high tolerance, which requires the use of the main engines. The coring winches are typically powered by stand-alone power packs, which are run nearly continuously when working on site. When the vessels are off charter, they are waiting in port for the next charter, where shore power is usually taken advantage of, or they are voyaging to the site of the next charter. This mode of operations calls for a different approach to monitoring energy efficiency; an approach that is markedly different from what be would be required for a bulk carrier for example.

For the purposes of implementing this plan, we have separated our vessel operations into three broad categories: a) field operations, which includes the short transits between stations within a work site, b) port operations when the vessel is mobilizing for a charter or waiting for the next charter, and c) voyage operations when the vessel is transiting to the site of the next charter. Shipyard operations are not specifically included simply because the machinery is offline and not consuming any energy. Each of these evolutions requires a different package of energy efficiency measures that can be implemented and measured. It is noted that not all of these measures can be applied across the board because of different operating conditions and some of them are mutually exclusive. TDI's vessel usage in 2018 was such that port and anchorage operations, in which fuel was consumed, accounted for 16% of the time and 53% of the year was spent on shore power, in which fuel was not consumed. Field operations accounted for 18% and voyage operations accounted for 13%. Over the period from 2015 through 2018 port and anchorage accounted for 21% of the time, shore power

was 49%, field operation was 19% and transits were 11%. Accordingly this SEEMP is structured to emphasize energy efficiency during field operations, when the greatest amount of energy is required. Port operations, even though it accounts for 70% of the overall time, consumes relatively little energy compared to field and voyage operations. While tied up at the dock the major need for power is to sustain the vessel's hotel loads. If shore power is available then it is used, but in the vast majority of small ports we use this is simply not feasible. Otherwise a single electrical generator is left up and running. The least amount of time is voyage operations. Transits are made at the best possible speed simply because until the vessel arrives on site, the charter cannot begin.

TDI-Brooks currently requires daily reports of fuel and lubrication usage from each vessel in its fleet, and has done so for many years. This data provides a rich source of information from which the present and past status of energy usage can be ascertained and thereby serve as the basis from which the effectiveness of the energy management practices provided for in this SEEMP can be monitored.

The contribution of the Company to the SEEMP in 2019 is to 1) assess the fuel usage, compare it to the established baseline, and identify and investigate significant differences with a view toward improving energy efficiency; 2) provide route planning, and; 3) provide daily meteorological and oceanic forecasts. Broadly speaking the role of officers and crew of the *R/V Proteus* is to be more mindful of how their day-to-day operations affects energy usage, to monitor it more closely than it has been done in the past, and to recommend straightforward measures that can be undertaken at minimal cost to improve efficiency.

2.0 **Regulations**

The Ship Energy Efficiency Management Plan (SEEMP) was introduced to the wider shipping community via the IMO's MEPC.1/Circ.683 'Guidance for the development of a Ship Energy Efficiency Management Plan (SEEMP)' first published in August 2009.

In July 2011 MEPC 62 was released with the adoption of new requirements on CO_2 including making the Ship Energy Efficiency Management Plan (SEEMP) mandatory for both new and existing ships irrespective of flag from 1 January 2013 at the first renewal or intermediate survey after this date.

The intent of the SEEMP is to provide an approach for monitoring ship and fleet efficiency performance over time, and encourage the ship owner, at each stage of the plan, to consider new technologies and practices when seeking to optimize ship performance. SEEMP will not be subject to approval by flag states or Recognized Organizations such is the case with class, but will be part of a new chapter 4 of MARPOL Annex 6 on Regulations and will be required under the International Energy Efficiency Certificate (IEEC).

Pursuant to Regulation 22, each new or existing ship over 400 GT shall keep on board a ship specific Ship Energy Efficiency Management Plan.

Pursuant to Regulation 5, for existing ships the verification of the requirement to have a SEEMP on board shall take place at the first intermediate or renewal survey, whichever is the first.

3.0 Energy Efficiency Measures

In 2018 the *R/V Proteus* used a total of 192,628 US gallons of marine grade oil (MGO); 18,472 gallons while in port, 73,704 gallons while in transit, and 99,652 gallons while working on site. The yearly averaged fuel consumption was 567 gallons per operational day (gpod). This compares to 572 gpod in 2017, 800 gpod in 2016, 441 gpod in 2015, and 527 gpod in 2014.

The route taken by the vessel over the course of 2018 is shown in **Figure 1**. The open ocean routes were optimized to take maximum advantage of the prevailing currents. The tracking data several months in the autumn of 2018 were not recorded.

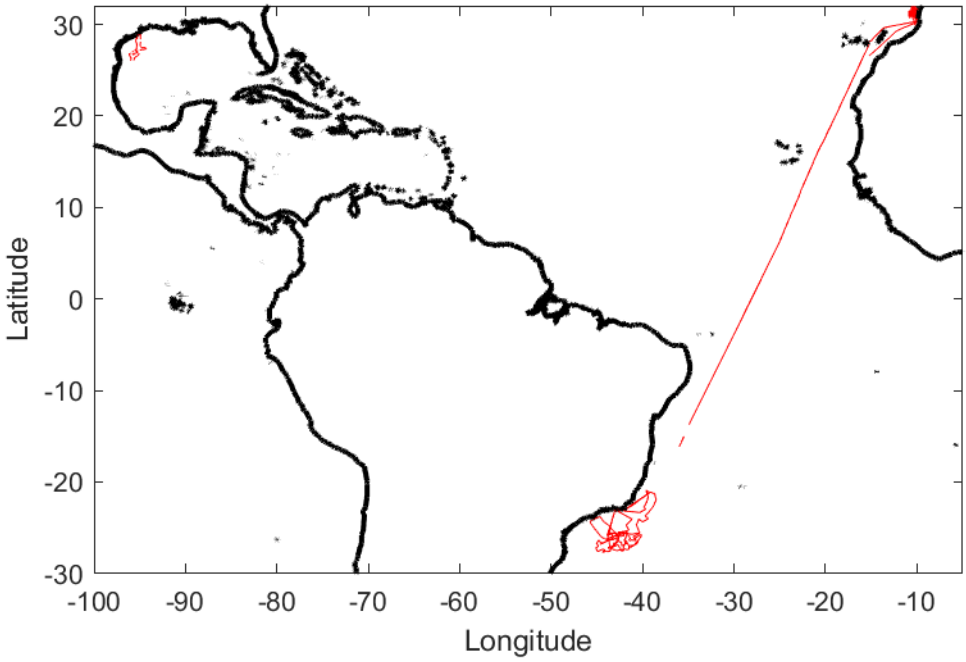

Figure 1 - Route taken by the *R/V Proteus* in 2018.

For the purposes of implementing this plan, the vessel operations have been separated into three broad categories: a) field operations, which include the short transits between stations within a work site, b) port operations while the vessel is waiting for the next charter, and c) voyage operations when the vessel is transiting to the site of the next charter. Each of these evolutions requires different energy efficiency measures.

Table 3-1 summarizes the vessel's usage for 2014 through 2018.

Table 3-1 Year-by-Year Results

Proteus	Shore Power	Port	Anchorage	Work Site	Transit
	[days]	[gpd]	[gpd]	[gpd]	[gpd]
2018	25	155	400	692	1445
2017	79	198	0	562	1341
2016	47	160	600	809	1457
2015	130	181	216	778	1113
2014	-	246	-	810	1145

Figure 2 shows the daily vessel operations in 2018 for the *R/V Proteus.*

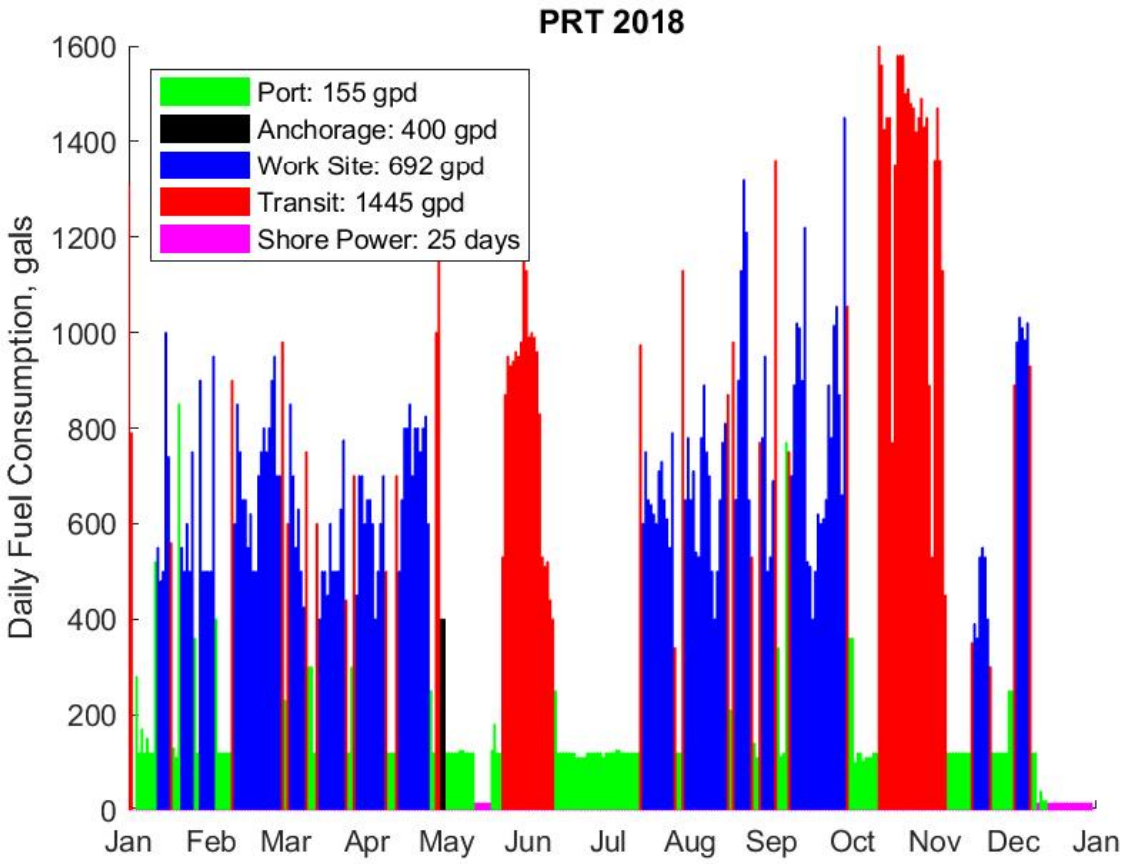

Figure 2 - Daily energy usage in 2018 by category for the *R/V Proteus.*

3.1 Field Operations

It is anticipated that the greatest use of energy will be consumed during field operations. TDI's vessel usage in 2018 was such that field operations accounted for 18% of the time. Historically this has varied from a low of 12% to a high of 27% percent in any given year. In order to monitor and potentially improve energy efficiency during field operations, the following measures are suggested.

Measures for Fuel Efficient Operations	**Implementation Actions**	**Monitoring and Recording Actions**
1. Power Pack Optimization	Proper maintenance of the power pack**. Record fuel and lube oil usage for the power pack**. On long station-to-station transits consider shutting down the power pack.	Responsible Party: *Proteus*
2. Station-to-Station Route Planning	Minimize the total distance traveled to complete all of the stations within a work site.	Responsible Party: Head Office
3. Bridge Crew Training in Ship Handling	The ability to initially achieve station and then maintain it for extended periods is critical to energy efficiency. Proper training is essential before the charter begins.	Responsible Party: Head Office & *Proteus*
4. MetOcean Forecasts	Forecasts of the waves and ocean currents provide advance information about conditions to be expected. This can be used intelligently to plan day-to-day operations.	Responsible Party: Head Office

3.2 Voyage Operations

TDI's vessel usage in 2018 was such that open ocean voyage operations accounted for 13% of the time. Historically this has varied from a low of 8% to a high of 13% percent in any given year. Transits are usually made at the best possible speed simply because until the vessel arrives on site, the charter cannot begin. In order to monitor and potentially improve energy efficiency during voyage operations the following measures are suggested.

Measures for Fuel Efficient Operations	**Implementation Actions**	**Monitoring and Recording Actions**
1. Main Engine Optimization	Proper maintenance of the main engines. **Record daily fuel and lube oil usage.** This is required for all operations.	Responsible Party: *Proteus*
2. Speed Optimization	Adjusting the vessel's speed to arrive in port when a berth is available.	Responsible Party: *Proteus*
3. Route Planning	Taking advantage of prevailing currents, and avoiding opposing currents.	Responsible Party: Head Office
4. Hull Cleaning	Hull inspection and cleaning prior to a voyage, particularly after a long period in a warm water port, will be investigated.	Responsible Party: Head Office

3.3 Port Operations

A TDI vessel spends most of its time in port, at anchorage or on shore power. TDI's vessel usage in 2018 was such that port operations accounted for 69% of the time. Historically this has varied from a low of 60% to a high of 80% percent in any given year. While tied up at the dock or at anchorage the sole need for power is to sustain the vessel's hotel loads. If shore power is available then this is the most advantageous manner in which to improve energy efficiency. Unfortunately it is not always the most cost effective, nor is 60 Hz power widely available at the international ports TDI uses. In that case a single electrical generator is left up and running.

Measures for Fuel Efficient Operations	**Implementation Actions**	**Monitoring and Recording Actions**
1. Shore Power	Switch over to shore power when it is available and cost effective to do so.	Responsible Party: *Proteus*
2. Generator Optimization	Proper maintenance of the generators. **Record daily fuel and lube oil usage.**	Responsible Party: *Proteus*
3. Generator Replacement	Investigate replacing generators with more fuel-efficient models.	Responsible Party: *Head Office - Engineering*

3.4 Head Office

TDI-Brooks currently requires daily reports of fuel and lubrication usage from each vessel in its fleet. This data provides a rich source of information from which the present and past status of energy usage can be ascertained and thereby serve as the basis from which the effectiveness of the energy management practices provided for in this SEEMP can be monitored.

Over the next year TDI commits to the following:

1. The head office will continue to routinely collect the daily fuel and lube usage reports from each vessel in its fleet. This will ultimately be successful only if the ship's crew understands the imperative for reliable and accurate data and continue to provide this data.

2. The head office will analyze the ship's performance data against field, voyage and port operations and assess on a biannual basis the fuel usage, compare it to the established baseline, and identify and investigate significant differences with a view toward improving energy efficiency.

3. The head office will continue to provide MetOcean forecasts and optimal voyage route planning that can be incorporated into each vessel's voyage plans.