Diesel Litres Total - Fiscal 2023

Fiscal 2023

Vessel Name	Sum of B5 MARINE	Sum of MARINE DIESEL ULS	Sum of DIESEL LOW SULPHUR DYED	Sum of B10 MARINE	Sum of B15 MARINE	Sum of B20	Sum of R100
1001 - ALBERNI, QUEEN of	7,174,829.00	-	-	-	-	-	60,786.00
1002 - COQUITLAM, QUEEN of	3,190,380.00	-	-	-	-	-	1,298,067.00
1003 - COWICHAN, QUEEN of	8,626,534.00	-	-	-	-	-	-
1004 - SURREY, QUEEN of	2,163,219.00	-	-	-	-	-	4,559,064.00
1005 - OAK BAY, QUEEN of	-	-	-	144,699.00	3,443,737.00	4,476,761.00	-
1011 - SPIRIT OF BC	1,137,788.00	-	-	-	-	-	-
1012 - SPIRIT OF VANCOUVER ISL	2,306,078.00	-	-	-	-	-	-
1013 - COASTAL RENAISSANCE	10,879,155.00	-	-	-	-	-	-
1014 - COASTAL INSPIRATION	9,171,649.00	-	-	-	-	-	-
1015 - COASTAL CELEBRATION	7,781,115.00	-	-	-	-	-	-
1024 - NEW WESTMINSTER, Q of	3,451,781.00	-	-	-	-	-	-
1030 - SKEENA QUEEN	1,830,110.00	-	-	-	-	-	-
1031 - MALASPINA SKY	2,770,303.00	-	-	-	-	-	-
1040 - NORTHERN EXPEDITION	5,755,975.00	1,159,149.00	-	-	-	-	-
1043 - NORTHERN ADVENTURE	1,575,994.00	2,402,717.00	-	-	-	-	-
1048 - CAPILANO, QUEEN OF	2,712,012.00	-	-	-	-	-	-
1049 - CUMBERLAND, QUEEN OF	2,905,025.00	-	-	-	-	-	-
1050 - QUINSAM	642,046.00	-	-	-	-	-	-
1051 - BOWEN QUEEN	1,412.00	-	-	-	-	-	-
1054 - MAYNE QUEEN	1,371,754.00	-	-	-	-	-	-
1055 - POWELL RIVER QUEEN	951,573.20	-	-	-	-	-	-
1057 - TACHEK	398,369.00	-	-	-	-	-	-
1058 - QUADRA QUEEN II	255,320.00	-	-	-	-	-	-
1059 - QUINITSA	178,278.30	-	-	-	-	-	-
1063 - KAHLOKE	186,466.00	-	-	-	-	-	-
1066 - KWUNA	-	-	366,745.00	-	-	-	-
1067 - KLITSA	233,727.00	-	-	-	-	-	-
1070 - KUPER	457,033.00	-	-	-	-	-	-
1071 - BSC	180,182.00	-	-	-	-	-	-
1072 - ORCA	409,606.00	-	-	-	-	-	-
1073 - EAGLE	279,290.00	-	-	-	-	-	-
1074 - RAVEN	135,648.00	-	-	-	-	-	-
1075 - NORTHERN SEA WOLF	851,838.00	-	-	-	-	-	-
1076 - DISCOVERY	540,142.20	-	-	-	-	-	-
1077 - AURORA	922,269.00	-	-	-	-	-	-

Diesel Litres Total - Fiscal 2023

1078 - NAGALIS	548,726.50	-	-	-	-	-	-	
1079 - K'ULUT'A	704,522.00	-	-	-	-	-	-	
1080 - KWIGWIS	1,009,557.00	-	-	-	-	-	-	
1081 - GWAWIS	632,318.00	-	-	-	-	-	-	
1082 - HERON	238,721.00	-	-	-	-	-	-	
Grand Total	84,560,745.20	3,561,866.00	366,745.00	144,699.00	3,443,737.00	4,476,761.00	5,917,917.00	102,472,470.20

LNG Litres Total - Fiscal 2023

	Total for 2023
1072-Orca	2,445,081.62
1073-Eagle	2,638,034.17
1074-Raven	857,578.91
1082-Heron	1,842,799.26
1011-SOBC	10,290,152.67
1012-SOVI	10,293,432.78
Total Litres	28,367,079.42

BCFerries Technical Memo

FMS Ref: 0710

External File Reference:

Date	March 10, 2017
To	Fleet Engineering, Fleet Operations, Finance
From	Greg Peterson, Director Engineering Services
Subject	**LNG Fuel Received and Consumption Reporting**
	[update to EAM V3.07.60.010 Fuel and Oil Products Orders and Reporting]

BC Ferries has a long established practice of tracking and reporting the deliveries and consumption of fuel in units of volume, specifically Litres of diesel. For practical purposes, the projected use of LNG as a fleet fuel has required the rendering of LNG quantities into comparable units of volume known as "diesel litre equivalent" or "DLE."

As *Salish Class* vessels come into operation the fuel tracking and reporting methodologies are being implemented both shipboard and through Accounts Payable. The proposed methodology presented herein, when approved, will be incorporated into the Engineering Admin Manual article V3.07.60.010 Fuel and Oil Products Orders and Reporting.

Custody Transfer Units

The methodology for determining the quantity of LNG fuel transferred from the supplier's tanker truck to the vessel is the net weight of the tanker truck as measured with transits of a truck scale upon leaving and returning to the supplier's LNG facility.

- Custody transfer units shall be **kilograms (kg)**
- The fuel supplier shall provide a record from the truck scale showing units of weight

Kilograms will be the units entered into the shipboard record keeping system for the quantity of LNG fuel received on board.

Weight Based Conversion to "Diesel Litre Equivalent"

DLE units are units of volume and therefore the conversion parameters must account for energy and density. The density of LNG is dependent the % of constituent properties and the temperature of the cryogenic liquid. For the purpose of setting a conversion standard the following nominal factors will be applied:

- delivery temperature of -160° C
- LNG density of 450 kg/m3 @ -160° C[1]
- LNG energy density (HHV) of 0.055058 GJ/kg {Fortis Rate Schedule 46}
- Low Sulphur Diesel density of 850 kg/m3 @ 15° C
- Low Sulphur Diesel energy density (HHV) of 45.460 MJ/kg {US Dept of Energy}[2]

[1] LNG density based on constituent % from Fortis BC "Hydrocarbon Analysis Report" February 2017 input into Unitrove LNG Density Calculator http://unitrove.com/engineering/tools/gas/liquefied-natural-gas-density.
[2] US Department of Energy: http://hydrogen.pnl.gov/tools/lower-and-higher-heating-values-fuels.

LNG Conversion Factor Parameters		*units*
GJ per kg of LNG	0.055058	GJ/kg
LNG Density @ -160'C	450	kg/m3
Diesel Fuel Density @ 15'C	850	kg/m3
MJ per kg of LNG	55.058	MJ/kg
MJ per kg of Diesel Fuel (HHV)	45.460	MJ/kg
MJ per m3 of Diesel Fuel (HHV)	38641	MJ/m3
MJ per m3 of LNG @ 160'C	24776	MJ/m3
Energy Ratio of LNG to Diesel or "DLE" ratio	**1.560**	litres LNG/litre Diesel

Energy Ratio of LNG to Diesel or "DLE" ratio shall be **1.560**[3]

Methodology for Reporting LNG Fuel Received on Board

- In Step 1 the Bunkering Checklist will record the vessel's LNG storage tank start and end weight to determine a net weight change.
- In Step 2 the fuel supplier Delivery Note provides a net weight from the truck scales and is cross checked with Step 1 values for any significant deviation.
- In Step 3 the Maximo Fuel application is updated with the weight of fuel received and converts the value to DLE for the monthly fuel report that goes to Accounts Payable.

EXAMPLE

	LNG Received on Board	*Quantity*	*Units*	*var.*
Step 1	**Tanker Truck transfer of LNG to Vessel LNG tank (Bunkering Checklist)**			
	Starting Weight from vessel's IAS systems:	5960	kg	
	Ending Weight from vessel's IAS systems:	9538	kg	
	Received:	**3578**	kg	**A**
Step 2	**LNG Supplier sends Delivery Note to Vessel next day**			
	Weight kg is read from Delivery Note:	**3538**	kg	**B**
	Chief Engineer verifies the Delivery Note			
	Deviation is **[A]** / **[B]** - 1:	1.1%	%	
Step 3	**LNG Delivery entered into Maximo**			
	Weight **[B]** kg from Delivery Note:	**3538.0**	kg	**B**
	Maximo algorithm **[B]** kg / 0.450 kg/L / 1.56 DLE:	5040	DLE	**C**
option	Maximo entry note ~ GJ from Delivery Note:	194.8	GJ	**D**

Maximo Algorithm (Fuel Tables)

DLE = Weight (kg) / 0.450 / 1.56

[3] It is noted that this conversion factor of 1.56 is different from the 1.66 factor used in the original LNG Feasibility Study. This is due to different temperature and density values applied in liquid volume conversions. The energy factor remains consistent, as it should, with a nominal value of 25.9 GJ/DLE.