Background

The goal of this project is to learn more about cruise ship combustion sources. To date, ADEC has not obtained sufficient information from the operators about onboard combustion sources to complete an inventory. Please report if there are any access issues in obtaining information in this questionnaire in the Daily report and immediately notify your manager (Crowley).Address any questions to your manager who will forward to ADEC. Feel free to share information about this project with the crew.

The authority for this project comes from AS 46.03.476 (b):
The ocean ranger shall monitor, observe, and record data and information related to the engineering, sanitation, and health related operations of the vessel, including but not limited to registration, reporting, record-keeping, and discharge functions required by state and federal law.

Findings will be entered in the spaces provided below each item; feel free to use additional notes separately when needed. Sketches, diagrams, photos of handwritten notes, or copies of schematics are welcome where appropriate. Please be as detailed and clear as possible.

Scope:
This verification Project includes three main areas:
• Combustion sources inventory;
• Combustion equipment and operations for power and propulsion; and
• Auxiliary combustion equipment (incinerators, etc.)

General Information

Ocean Ranger Name:	jonathan.driggers
Report Date:	Aug 2, 2018
Ship:	Norwegian Bliss
Ship Code:	NBL

Section 1: Emissions Inventory Instructions

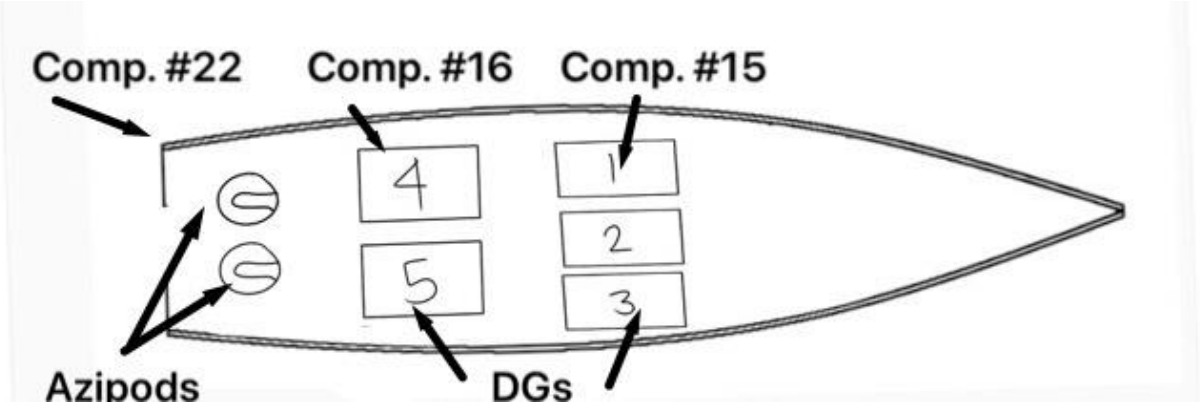
Section 1: Emissions Inventory

1 - Item Type	DG1
1 - Make/Model	MAN B&W Diesel and Turbo SE 12V48/60CR
1 - Year	2016
1 - Serial Number/Unique Identifier	1135841
1 - Maximum Rating	14,400kW; 514 RPM
2 - Item Type	DG2
2 - Make/Model	MAN B&W Diesel and Turbo SE 12V48/60CR
2 - Year	2016
2 - Serial Number/Unique Identifier	1135840
2 - Maximum Rating	14,400kW; 514 RPM
3 - Item Type	DG3
3 - Make/Model	MAN B&W Diesel and Turbo SE 12V48/60CR
3 - Year	2016
3 - Serial Number/Unique Identifier	1135839
3 - Maximum Rating	14,400kW; 514 RPM
4 - Item Type	DG4
4 - Make/Model	MAN B&W Diesel and Turbo SE 14V48/60CR
4 - Year	2016

4 - Serial Number/Unique Identifier	1135838
4 - Maximum Rating	16,800kW; 514 RPM
5 - Item Type	DG5
5 - Make/Model	MAN B&W Diesel and Turbo SE 14V48/60CR
5 - Year	2016
5 - Serial Number/Unique Identifier	1135837
5 - Maximum Rating	16,800kW; 514 RPM
6 - Item Type	Boiler 1
6 - Make/Model	Alfa Laval Aalborg OM TCI-12500
6 - Year	2016
6 - Serial Number/Unique Identifier	9730
6 - Maximum Rating	12,000 kg/hr
7 - Item Type	Boiler 2
7 - Make/Model	Alfa Laval Aalborg OM TCI-12500
7 - Year	2016
7 - Serial Number/Unique Identifier	9731
7 - Maximum Rating	12,000 kg/hr
8 - Item Type	Incinerator 1
8 - Make/Model	Deerberg Systems DS2400
8 - Year	2016
8 - Serial Number/Unique Identifier	1975-DS 2400A
8 - Maximum Rating	625 kg/h Dry Waste; Thermal Capacity 2,400kW
9 - Item Type	Incinerator 2
9 - Make/Model	Deerberg Systems DS2400
9 - Year	2016
9 - Serial Number/Unique Identifier	1975-DS 2400B
9 - Maximum Rating	625 kg/h Dry Waste; Thermal Capacity 2,400kW
10 - Item Type	EDG
10 - Make/Model	AEM- Anhaltische Elektromotorenwerk Dessau GmbH SE500L4
10 - Year	2016
10 - Serial Number/Unique Identifier	3016 00118
10 - Maximum Rating	S[kVA]=2,812; f[Hz]=60; I[A]=2,353;

Section 2: Power and Propulsion

1. Propulsion system: describe in detail how it works and how it is done. (Reduction gear, master slave, Azipod, Fixed Pitch, CPP etc.)	Vessel has total of 5 MAN B&W DGs, 3 are 14,400kW and 2 are 16,800kW; Power developed by DGs supports vessel's 2 ABB Azipods; Each Azipod has a Propulsion Module that contains a three phase electric propulsion motor that directly drives a fixed pitch propeller. Each Azipod has total power of 22MW each (22,000kW each, or total of 44,000kW for both).
2. Include for each component the output / make / model (see next point);	Vessel has total of 5 MAN B&W Diesel and

	Turbo SE DGs onboard, all five with EGCS. MCR rating for each engine is as follows: *DG1- 14,400kW @ 514 RPM *DG2- 14,400kW @ 514 RPM *DG3- 14,400kW @ 514 RPM *DG4- 16,800kW @ 514 RPM *DG5- 16,800kW @ 514 RPM Vessel has 2 ABB Azipods, each with total power of 22MW (22,000kW each, or 44,000kW total). Vessel has 3 Brunvoll FU115LTC3000 Bow Thrusters, each with 3,500kW of power (10,500kW total for all 3).
3. If possible provide for engines blower configuration (by pass valve / waste gate etc.) including load set points.	In reviewing documentation and manuals for DGs and Turbochargers with EO in Technical Office, no information could be found regarding set points for bypass valve or waste gate. The only set points/alarm values that were found were for overspeed, LO temperature, etc;
4. Engines in particular Diesel engines have an MCR rating (kW @RPM). Provide all these ratings (name plate) make and model.	Vessel has total of 5 MAN B&W Diesel and Turbo SE DGs onboard, all five with EGCS. MCR rating for each engine is as follows: *DG1- 14,400kW @ 514 RPM *DG2- 14,400kW @ 514 RPM *DG3- 14,400kW @ 514 RPM *DG4- 16,800kW @ 514 RPM *DG5- 16,800kW @ 514 RPM
5. What is the maximum rating the vessel uses in their power management set up? (85 % 90% of MCR?).	Vessel uses a maximum of 90% of MCR.
6. Include the operation modes. For example Gas turbine is used for "sprint power" include such operation in the descriptions.	Operational modes onboard are determined based on sea conditions, necessary speed, load demand, etc.
7. If possible small hand sketch of system;	
8. Bow / Aft Thrusters? Description and use.	Vessel has a total of 3 identical Brunvoll Bow Thrusters onboard (Bow Forward, Bow Center, and Bow Aft). Their information is as follows: Brunvoll Project #31018 A; Shipyard Meyer Werft GmbH; Unit Number/Position: 10779/BOW FORWARD 10780/BOW CENTER 10781/BOW AFT *THRUSTER UNIT Thruster Type: FU115LTC3000 Gear Ratio: 13/43 Input Speed: 716 RPM Propeller Speed: 216 RPM Propeller Diameter: 3,000mm # of blades: 4 Type of blades: backward skew

	*DRIVE SYSTEM Power: 3,500kW Voltage: 11,000V Frequency: 60Hz Motor Speed: 716 RPM *SERVO SYSTEM HPU TYPE: PV7 40-71 Power Servo Motor: 6.3kW Voltage Servo Motor: 690V Frequency Servo Motor: 60Hz
9. Are fuels saving methods in place? (Reduced speed, fuel savers etc.)	Vessel utilizes combination of NAPA Stability Computer together with vessel's Trim Setting to maximize fuel efficiency.
10. What fuels are used? Fuel consumption at average speed per day?	Vessel currently using HFO in all 5 of its DGs, each with EGCS in closed loop configuration with bleeder valve open, except prior to Endicott Arm, and for entire time in Endicott Arm, when bleeder valve is fully closed. At average speed, which is around 19 knots, vessel uses about 156 MT in a 24 hour period.
11. Power generation on board. Which units are used? Which type of equipment? (Gas turbines, diesel etc.)	Vessel uses all 5 of its MAN B&W DGs(all with EGCS), 3x14,400kW and 2x16,800kW, for Propulsion and Power onboard.
12. Describe which units are used normally under which conditions (sea mode, Port mode, maneuvering mode etc.)	Underway/At Sea: 3-4 DGs online (dependent on sea conditions, speed requirement, load demand), 1 DG on standby; Maneuvering: 3 DGs online, 1 DG on standby; In Port: 1 DG online, 1 DG on standby;
13. What is the average Hotel power while underway?	4,750kW
14. What is the average Hotel power while docked?	5,000kW
15. Are source shared used for Hotel power / propulsion power?	Yes; Vessel utilizes it's 5 MAN B&W DGs for both propulsion power and hotel power.
16. What is relatively the largest group of Hotel power consumers? (Light, airco?), please identify the kW.	Ventilation and Lighting: about 1,200kW Air Conditioning (Chillers): about 1,000kW

Section 3: Auxiliary Sources

17. Incinerators please provide inventory make model and location. What fuel is used for co-firing the incinerator? (if any);	Vessel is equipped with 2 Deerberg Systems DS2400 Incinerators. Incinerators are located on Decks 1-4, Starboard side, Frames 125-140, WTC (Watertight Compartment) 16. MGO is used in Incinerators.
18. Are the incinerators equipped with emissions controls? (After-burners, filters etc.)	Yes; Each Incinerator has 2 chambers as well as secondary burners.
19. Are dryers used on board other than laundry dryers? For example sludge dryers etc.	The only other "dryers" onboard are the 2 Dryers used for drying Bio Waste (food waste) which is then sent to vessel's Incinerators for burning.
20. What are the average operating hours in Alaska / or per day (24 hours in Alaska?) for the incinerators?	Average of 24 hours total run time while in AK waters. During this 2018 season, and on current itinerary, vessel is in AK waters a total of about 3 days and 2 hours (about 74 hours).
21. What are the average operating hours on a voyage to / from Alaska for the incinerators?	Average of 74 hours total run time for a 7 day voyage to AK.

Section 4: General Observations

22. Is vessel crew cooperative on this project?	Crew was cooperative, to the extent that they were "allowed" to be; No photos of any operational screens in the ECR were allowed to be taken, per Chief Engineer's orders. Information from manufacturer's manuals was allowed to be observed and obtained, but only while in presence of EO, in his office, as that is where vessel's manuals, drawings, etc. are located. Permission was asked for each and every photo taken, most granted, some denied per Chief Engineer's orders and Company policy.
23. Are there other remarks/ comments the OR wants to share?	No

Photos and Comments

Photo 1

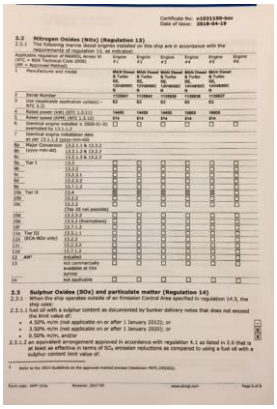


Photo 1 Caption

Photo of page from vessel's IAPP (International Air Pollution Prevention) documentation showing specifications for vessel's 5 MAN B&W DGs onboard.

Photo 2

Photo 2 Caption

Nameplate from vessel's EDG (Emergency Diesel Generator); EDG is made by AEM-Anhaltische Elektromotorenwerk Dessau GmbH.

Photo 3

Photo 3 Caption

Nameplate from one of two identical Deerberg Systems Incinerators onboard.

Photo 4

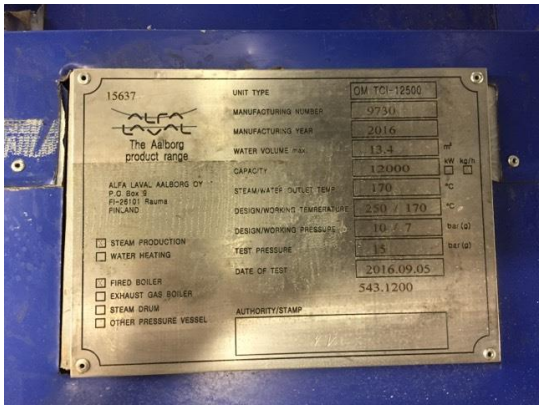


Photo 4 Caption

Nameplate of one of two identical Alfa Laval Aalborg boilers onboard.

Photo 5

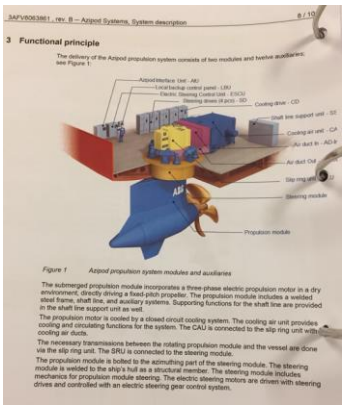


Photo 5 Caption

Description of vessel's two ABB Azipods onboard, used for propulsion and powered by vessel's MAN B&W DGs (total of five onboard).

Complete

Is this report complete? Yes

If this report is complete, tap on Send now. Do not make a selection in the next field. The report will be submitted for final review.