

Appendix 3.3 - Detailed Calculations of Marine Emission for the IWMF at the Artificial Island Near Shek Kwu Chau

		IETS vessels ⁽¹⁾⁽²⁾	IWTS vessels ⁽²⁾	IWMF vessels	West Kowloon vessels	Staff vessels	Vistor vessels
Maneuvering speed (knots)		approximate 6	approximate 6	approximate 6	approximate 8	minimum 10	minimum 10
Idling period		19.5 hrs (21:30 - 17:00)	21 hrs (21:00 - 18:00)	21 hrs (21:00 - 18:00)	07:30 - 19:30	07:00 - 09:00, 14:00 - 16:00, 17:00 - 18:00 & 21:00 - 23:00	09:00 - 18:00
Number of trip per day		One vessel trip	One vessel trip	One vessel trip	One vessel trip	07:00 - 09:00, 14:00 - 16:00, 17:00 - 18:00 & 21:00 - 23:00 (2 trips/hr)	09:00 - 18:00 (2 trips/hr)
Engine Power	Propulsion Engine (kW)	2 x 662kW	2 x 662kW	2 x 662kW	2 x 1118.5kW	1 x 1050 kW ⁽³⁾	1 x 1050 kW ⁽³⁾
	Auxiliary Engine (kW)	2 x 165kW	2 x 165kW	2 x 165kW	125kW x 2	N/A	N/A
Load Factor during Maneuvering (%)	Propulsion Engine	50%	50%	50%	80%	100% ⁽⁴⁾	100% ⁽⁴⁾
	Auxiliary Engine	NA	NA	NA	N/A	N/A	N/A
Load Factor during Idling (%)	Propulsion Engine	75kWh	75kWh	75kWh	N/A	10% ⁽⁴⁾	10% ⁽⁴⁾
	Auxiliary Engine				N/A	N/A	N/A
Exhaust height of vent pipe above sea level (m)	Propulsion Engine	8	8	8	12	2 ⁽³⁾	2 ⁽³⁾
	Auxiliary Engine	8	8	8	12	N/A	N/A
Exhaust temperature of vent pipe (°C)	Propulsion Engine	255 -260	210 - 230	210 - 230	600	264 ⁽³⁾	264 ⁽³⁾
	Auxiliary Engine	NA	NA	NA	350	N/A	N/A
Exhaust diameter of vent pipe (m)	Propulsion Engine	0.3	0.3	0.3	0.273	0.2 ⁽³⁾	0.2 ⁽³⁾
	Auxiliary Engine	0.15	0.15	0.15	0.14	N/A	N/A

Notes:

(1) Average shore power measurement during berthing at IETS from 9 - 17 August 2008 as a reference :

Chai Wan vessel 73 Kwh
Nim Wan vessel 63.5 Kwh

(2) Exhaust temperature for IETS & IWTS was measured at WENT jetty on 19 August 2008 during the loading/unloading of containers when one propulsion engine is in operation :

IETS vessel - loading/unloading at WENT jetty from 08:00 - 14:30,

IWTS vessel - loading/unloading at WENT jetty from 14:30 - 17:30

One auxiliary engine operates for both vessels during the remaining period of berthing.

(3) Information provided by engineer.

(4) Based on the Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data from USEPA, the load factor of passenger vessel in idling mode was 10%, and ferry during travelling was assumed full load.

According to Current Methodologies and Best Practices in Preparing Port Emission Inventories,

$$\text{Emission (g/hr)} = \text{Engine Power (kW)} \times \text{Loading Factor} \times \text{Emission Factor (g/kWh)}$$

	Emission Factor (g/kWh)	Adjusted Emission Factors using fuel with average 0.3% sulphur content (g/kWh)
NO _x	13.2	13.2
SO ₂	0.63	0.126
PM10	0.72	0.144

IETS & IWTS & IWMF vessels

		Total emission/vessel (g/s)	Travel Distance (m)	Travel Time(min)	Emission Rate (g/s)
EF of NO _x /ferry	During Maneuvering	2.4273	2950	15.92	1.073E-02
	During Idling	0.2750			2.750E-01
EF of SO ₂ /ferry	During Maneuvering	0.0232	2950	15.92	1.025E-04
	During Idling	0.0026			2.625E-03
EF of RSP/ferry	During Maneuvering	0.0265	2950	15.92	1.171E-04
	During Idling	0.0030			3.000E-03

West Kowloon vessels

		Total emission/vessel (g/s)	Travel Distance (m)	Travel Time(min)	Emission Rate (g/s)
EF of NO _x /ferry	During Maneuvering	6.5619	2950	11.94	2.176E-02
	During Idling	0.0000			0.000E+00
EF of SO ₂ /ferry	During Maneuvering	0.0626	2950	11.94	2.077E-04
	During Idling	0.0000			0.000E+00
EF of RSP/ferry	During Maneuvering	0.0716	2950	11.94	2.374E-04
	During Idling	0.0000			0.000E+00

Staff/Visitor vessels

		Total emission/vessel (g/s)	Travel Distance (m)	Travel/Idling Time (min)	Emission Rate/vessel (g/s)
EF of NO _x /ferry	During Maneuvering	3.8500	2950	9.55	1.021E-02
	During Idling	0.3850		10.00	6.417E-02
EF of SO ₂ /ferry	During Maneuvering	0.0368	2950	9.55	9.750E-05
	During Idling	0.0037		10.00	6.125E-04
EF of RSP/ferry	During Maneuvering	0.0420	2950	9.55	1.114E-04
	During Idling	0.0042		10.00	7.000E-04

		Emission Rate/vessel (g/s)	Emission Rate for 2 trips (g/s)
EF of NO _x /ferry	During Maneuvering	1.021E-02	2.043E-02
	During Idling	6.417E-02	1.283E-01
EF of SO ₂ /ferry	During Maneuvering	9.750E-05	1.950E-04
	During Idling	6.125E-04	1.225E-03
EF of RSP/ferry	During Maneuvering	1.114E-04	2.229E-04
	During Idling	7.000E-04	1.400E-03

Notes:

- (1) The above vessels information are provided by EPD.
- (2) Refer to the information provided from the subject EPD officer of the Island East, Island West and Outlying Islands RTS, marine gas oil with average 0.3% sulphur is used as marine vessel fuel. Thus, emission factor for marine gas oil is adopted in the assessment.
- (3) OLM will be used for NO₂/NO_x conversion