Location of Stack Emission of I-PARK2

Description	**ID**	**X**	**Y**
Flue of incineration process	F1	810001	831229

Stack Emission Parameters of I-PARK2

Parameter [1]	**Unit**	**Value**
Total exhaust flow rate (dry) [2]	m^3/h	1650000
Total exhaust flow rate (actual condition)	m^3/h	2562275
Equivalent stack diameter for the six flues	m	6.86 [15]
Base elevation	m	11.5
Stack height	m	70
Exit temperature	K	413
Exit velocity	m/s	19.265 [16]
Oxygen content	%	8.6
Moisture content	%	21.8

Air Pollutants	**Emission concentration at each flue** [2] **(mg/Nm^3)**	**Total emission rate (six flues)** [3] **(g/s)**	**Emission concentration at each flue (actual condition) (mg/m^3)**
	1-hour average		1-hour average
Particulates [4]	10	4.58	6.4
Gaseous and vaporous organic substances (TOC) [5]	10	4.58	6.4
Carbon Monoxide (CO)	50	22.92	32.2
Nitrogen Oxides (NO_x) as Nitrogen Dioxide (NO_2) [6]	60	27.50	38.6
Sulphur Dioxide (SO_2)	30	13.75	19.3
Hydrogen Chloride (HCl)	8	3.67	5.2
Hydrogen Fluoride (HF)	2	0.92	1.3
Ammonia (NH_3) [17]	15	6.875	9.7

Air Pollutants	**Emission concentration at each flue** [2] **(mg/Nm^3)**	**Total emission rate (six flues)** [3] **(g/s)**	**Emission concentration at each flue (actual condition) (mg/m^3)**
	As specified		As specified
Mercury (Hg) [7]	0.02	0.00917	0.01
Total Cadmium & Thallium (Cd & Tl) [7][8]	0.02	0.00917	0.01
Cadmium (Cd)	-	0.00917	0.01
Thallium (Tl)	-	0.00917	0.01
Total Heavy Metal [7][9]	0.3	0.138	0.19
Antimony (Sb)	-	0.138	0.19
Arsenic (As) [10]	-	0.0115	0.02
Chromium (Cr) [11]	-	0.042	0.06
Cobalt (Co)	-	0.138	0.19
Copper (Cu)	-	0.138	0.19
Lead (Pb)	-	0.138	0.19
Manganese (Mn)	-	0.138	0.19
Nickel (Ni) [12]	-	0.0243	0.03
Vanadium (V)	-	0.138	0.19
Dioxins & Furans (in ng I-TEQ/m^3) [13]	0.04	1.83E-08	0.03

Remarks:

[1] The emission parameters are provided by Engineer and subject to the detailed design to be carried out by the future DBO contractor. During the detailed design, the DBO contractor will take into account the environmental requirements set out in this EIA report and the target emission levels and criteria for evaluating air quality impact set out in Annex 4 of the EIAO-TM.

[2] Expressed at 0 degrees Celsius temperature, 101.325 kPa pressure, dry and 11% oxygen content

[3] The emssion rates are calculated in accordance with Annex VI of EU Directive 2007/76/EC and ideal gas law

Emission concentration(mg/m^3) (Ca, wet, Oa) = Cs * (Ts/Ta) * (1-%H2O) * (20.9-Oa) / (20.9-Os)

Oa (%) = Oxygen concentration of flue gas, dry gas

Os (%) = Standard oxygen concentration, dry gas

Ca, wet, Oa (mg/m^3) = Actual flue gas concentration, wet gas, Oa

Cs (mg/m^3) = Flue gas concentration at standard conditions

%H2O = % of moisture in flue gas

Ta (K) = Temperature of flue gas at emission point

Ts (K) = Standard temperature

Emission rate at exhaust (g/s) = Flow rate (m^3/hr) x Emission concentration(mg/m^3) (Ca, wet, Oa) / 3600 /1000

[4] The particulate emssion limit is applied to RSP and FSP in the assessment

[5] TOC will be measured continuously as a key indicator for the quality of combustion in the incineration process

[6] Lower target hourly NOx emission level of 60mg/Nm3 is adopted as mentioned in **Sections 3.3.1** of the EIA report to minimise the air quality impact.

[7] The emission concentration limits are the average value over the sampling period of a minimum of 30mins and maximum of 8 hours according to the prevailing guidance note on the BPM for incinerators (municipal waste incineration) in Hong Kong. The emission rate (g/s) is calculated based on the emission concentration limits for the purpose of the air quality modelling.

[8] The emission rates of "Total Cd & Tl" is assigned to Cd and Tl individually as a conservative approach for assessment purpose. The actual emission shall be within the emission limit specified in the prevailing guidance note on the BPM for incinerators (municipal waste incineration) in Hong Kong).

[9] Total Heavy Metals includes Sb, As, Cr, Co, Cu, Pb, Mn, Ni and V. The total emission rate of Total Heavy Metal was assigned to each of Sb, Co, Cu, Pb, Mn and V as a conservative assumption for assessment purpose. The actual emission shall be within the emission limit specified in the prevailing guidance note on the BPM for incinerators (municipal waste incineration) in Hong Kong).

[10] According to "Guidance on assessing group 3 metal stack emissions from incinerators" (UK Environment Agency), the maximum measured concentration for As is 0.025mg/Nm3. The maximum measured concentrations for As was applied in the emission rate calculation as a realistic and conservative approach. (https://assets.publishing.service.gov.uk/media/5a80dd59ed915d74e6230e2d/LIT_7349.pdf)

[11] According to "Guidance on assessing group 3 metal stack emissions from incinerators" (UK Environment Agency), the maximum measured concentration for Cr is 0.092mg/Nm3. The maximum measured concentrations of Cr was applied in the emission rate calculation as a realistic and conservative approach. (https://assets.publishing.service.gov.uk/media/5a80dd59ed915d74e6230e2d/LIT_7349.pdf)

[12] According to "Guidance on assessing group 3 metal stack emissions from incinerators" (UK Environment Agency), the two highest concentration of Ni are outliers, so the third highest concentration 0.053mg/Nm3 was used. The third highest concentration of Ni were applied in the emission rate calculation as a realistic and conservative approach. (https://assets.publishing.service.gov.uk/media/5a80dd59ed915d74e6230e2d/LIT_7349.pdf)

[13] The emission concentration limits are the average value over the sampling period of a minimum of 6 hours and maximum of 8 hours according to the prevailing guidance note on the BPM for incinerators (municipal waste incineration) in Hong Kong. The emission rate (g/s) is calculated based on the emission concentration limits for the purpose of the air quality modelling.

[14] The key / representative air pollutants emitted from the stack as identified in the EIA report shall be monitored in accordance with the prevailing guidance note on the BPM for incinerators (municipal waste incineration) in Hong Kong to demonstrate compliance with the target air emission levels. The concentration of As, Cr, Ni would be measured individually to verify that their assumed concentration limits are valid upon commissioning and during the operation stage

[15] The diameter of each flue is about 2.8 m. When modeling the stack emission with six flues in close proximity, the plumes emitted from the six flues would inevitably become a combined plume shortly after discharge. Therefore, for the purpose of the air quality modelling, the emissions from the six flues were modelled as a single point of stack emission with an equivalent stack diameter of 6.86 m.

[16] For the purpose of the air quality modelling to simulate the emissions from the six flues as as a single point of stack emission, the exit velocity is divided by the square root of the number of flues (i.e. 6). 7.865 m/s of exit velocity was applied in the modelling.

[17] 15 mg/Nm3 was adopted for NH3 hourly emission limit. This emission limit shall be measured at the exhaust to ensure that the emission for assessment is valid.

Dust emission from Incinerator Bottom Ash Facility

The proposed IBA treatment would be conducted within an enclosed building with dust suppression measures.
Major processes are listed as below:
(1) **Screening process:** screen hole size of 120mm to screen out large materials greater than 120mm.
(2) **Magnetic separation process:** Magnetic separation to recover ferrous metal
(3) **Wet separation process:** Two-stage jigger is used to separate materials into different sizes
(4) **Eddy current separation:** Eddy current separator to recover non-ferrous metal
(5) **Crushing process:** A hammer crusher reduces size of particles to <8-10mm
(6) **Plate and Frame Filter Press:** Final dewatering process.

Since there were no specific emission factor account for IBA treatment process, reference from USPEA AP-42 of similar acitivities were reviewed and presented below.

Table A - USEPA AP-42 11.3 Brick And Structural Clay Product Manufacturing

Description	Value	Units	Remarks
RSP emission from Primary crusher with fabric filter	0.00059	lb/ton	lb of pollutant per ton of raw material processed, USEPA AP-42 Table 11.3-1 (SCC 3-05-003-40)
RSP emission from Grinding and screening operation (processing with fabric filter)	0.0032	lb/ton	lb of pollutant per ton of raw material processed, USEPA AP-42 Table 11.3-1 (SCC 3-05-003-02)
RSP emission from Extrusion line with fabric filter	0.0036	lb/ton	lb of pollutant per ton of raw material processed, USEPA AP-42 Table 11.3-1 (SCC 3-05-003-42) 99% of removal efficiency of the fabric filter
RSP emission from Primary crusher with fabric filter	0.000295	kg/Mg	kg of pollutant per tonne of raw material processed
RSP emission from Grinding and screening operation (processing with fabric filter)	0.0016	kg/Mg	kg of pollutant per tonne of raw material processed
RSP emission from Extrusion line with fabric filter	0.0018	kg/Mg	kg of pollutant per tonne of raw material processed
Total dust emission	0.003695	kg/Mg	

Table B - USEPA AP-42 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing

Description	Value	Units	Remarks
RSP emission from Tertiary Crushing (controlled)	0.00027	kg/Mg	kg/Mg of material processedUSEPA AP-42 11.19.2 Table 11.19.2-1 (SCC 3-05-020-03)
RSP emission from Fines Crushing (controlled)	0.0006	kg/Mg	kg/Mg of material processedUSEPA AP-42 11.19.2 Table 11.19.2-1 (SCC 3-05-020-05)
RSP emission from Screening (controlled)	0.00037	kg/Mg	kg/Mg of material processedUSEPA AP-42 11.19.2 Table 11.19.2-1 (SCC 3-05-020-02, 03)
RSP emission from Fines Screening (controlled)	0.0011	kg/Mg	kg/Mg of material processedUSEPA AP-42 11.19.2 Table 11.19.2-1 (SCC 3-05-020-21
RSP emission from Conveyor Transfer Point (controlled)	2.30E-05	kg/Mg	kg/Mg of material processedUSEPA AP-42 11.19.2 Table 11.19.2-1 (SCC 3-05-020-06)
Total dust emission	0.002363	kg/Mg	

By comparing Table A and Table B above, 0.003695 kg/Mg from Table A was adopted in the assessment as worst case scenario.

Table C - Calculation of Emission rate

Description	Value	Units	Remarks
Amount of IBA processed per day	1465	Mg/day	Provided by Engineer
RSP/FSP emission per day	5413	g/day	FSP emission rate is assumed as RSP emission rate as a conservative approach
RSP/FSP Emission per second	1.253E-01	g/s	Assuming 7 working days per week 12 (7am to 7pm) working hours per day
IBA Hall width	75	m	Provided by Engineer, fabric filter with removal efficient 99% is included in the design.
IBA Hall length	200	m	
IBA Hall area	15000	m2	
IBA Hall height	15	m	
IBA Hall volume	225000	m3	
Assumed ACH	12	no per hour	
Flow volume	2700000	m3/hr	
Total Area of exhaust	60	m2	
Exit velocity of exhaust	12.5	m/s	
Internal Diameter	1.1284	m	
Total number of exhaust	3		3 horizontal exhausts of 20m x 1m each
Dust emission rate per exhaust	4.177E-02	g/s	

Table D - Details of Emission parameters for IBA facility

Exhaust	Source ID	X	Y	Base Elevation (mPD)	Height (mAG)	Internal Diameter (m)	Exit Velocity (m/s)	RSP/FSP emission rate (g/s)
IBA Exhaust 1	IBA_1	810152.70	831445.00	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_2	810153.00	831444.10	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_3	810153.30	831443.20	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_4	810153.70	831442.20	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_5	810154.00	831441.30	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_6	810154.40	831440.30	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_7	810154.70	831439.40	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_8	810155.00	831438.50	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_9	810155.40	831437.50	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_10	810155.70	831436.60	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_11	810156.00	831435.60	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_12	810156.40	831434.70	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_13	810156.70	831433.70	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_14	810157.00	831432.80	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_15	810157.40	831431.90	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_16	810157.70	831430.90	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_17	810158.10	831430.00	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_18	810158.40	831429.00	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_19	810158.70	831428.10	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_20	810159.10	831427.10	11.50	10.00	1.1284	12.5	2.088E-03
IBA Exhaust 2	IBA_21	810172.20	831390.80	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_22	810172.60	831389.80	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_23	810172.90	831388.90	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_24	810173.20	831387.90	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_25	810173.60	831387.00	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_26	810173.90	831386.10	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_27	810174.30	831385.10	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_28	810174.60	831384.20	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_29	810174.90	831383.20	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_30	810175.30	831382.30	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_31	810175.60	831381.30	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_32	810175.90	831380.40	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_33	810176.30	831379.50	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_34	810176.60	831378.50	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_35	810176.90	831377.60	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_36	810177.30	831376.60	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_37	810177.60	831375.70	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_38	810178.00	831374.80	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_39	810178.30	831373.80	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_40	810178.60	831372.90	11.50	10.00	1.1284	12.5	2.088E-03
IBA Exhaust 3	IBA_41	810198.70	831321.10	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_42	810199.00	831320.20	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_43	810199.40	831319.30	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_44	810199.70	831318.30	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_45	810200.00	831317.40	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_46	810200.40	831316.40	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_47	810200.70	831315.50	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_48	810201.10	831314.50	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_49	810201.40	831313.60	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_50	810201.70	831312.70	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_51	810202.10	831311.70	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_52	810202.40	831310.80	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_53	810202.70	831309.80	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_54	810203.10	831308.90	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_55	810203.40	831307.90	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_56	810203.70	831307.00	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_57	810204.10	831306.10	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_58	810204.40	831305.10	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_59	810204.80	831304.20	11.50	10.00	1.1284	12.5	2.088E-03
	IBA_60	810205.10	831303.20	11.50	10.00	1.1284	12.5	2.088E-03

Odour emission from Tipping Hall

Table C - Calculation of Emission rate

Description	Value	Units	Remarks
Tipping Hall width	243	m	Provided by Engineer
Tipping Hall length	48	m	
Tipping Hall area	11664	m2	
Tipping Hall height	9	m	
Tipping Hall volume	104976	m3	
Assumed ACH	12	no per hour	
Flow volume	1259712	m3/hr	
Total Area of exhaust	40	m2	
Exit velocity of exhaust	8.748	m/s	
Internal Diameter	1.1284	m	
Odour emission rate, SOER	1.577	OU/m2s	Reference from WENTX measured emission for Active Tipping Area with waste filling without daily cover [1]
Odour emission rate	18394	OU/s	
Odour removal efficiency	95%		2 stages design (carbon filter + wet scrubber)
Mitigatied Odour emission rate	920	OU/s	
Total number of exhaust	4		4 horizontal exhausts of 10m x 1m each
Mitigatied Odour emission rate per exhaust	230	OU/s	

Note:
[1] The odour emission from IPARK2 Tipping Hall and WENTX Active Tipping Area with waste filling without daily cover are of similar nature and hence the odour emission rate of WENTx were applied for the IPARK2 Tipping Hall.

Table D - Details of Emission parameters for Tipping Hall

Exhaust	Source ID	X	Y	Base Elevation (mPD)	Height (mAG)	Internal Diameter (m)	Exit Velocity (m/s)	Odour emission rate (OU/s)
Exhaust 1	OU_1	809831.00	831410.80	11.50	17.00	1.1284	8.748	22.99266
	OU_2	809831.90	831411.10	11.50	17.00	1.1284	8.748	22.99266
	OU_3	809832.90	831411.50	11.50	17.00	1.1284	8.748	22.99266
	OU_4	809833.80	831411.80	11.50	17.00	1.1284	8.748	22.99266
	OU_5	809834.70	831412.20	11.50	17.00	1.1284	8.748	22.99266
	OU_6	809835.70	831412.50	11.50	17.00	1.1284	8.748	22.99266
	OU_7	809836.60	831412.90	11.50	17.00	1.1284	8.748	22.99266
	OU_8	809837.50	831413.20	11.50	17.00	1.1284	8.748	22.99266
	OU_9	809838.50	831413.60	11.50	17.00	1.1284	8.748	22.99266
	OU_10	809839.40	831413.90	11.50	17.00	1.1284	8.748	22.99266
Exhaust 2	OU_11	809888.00	831432.00	11.50	17.00	1.1284	8.748	22.99266
	OU_12	809888.90	831432.40	11.50	17.00	1.1284	8.748	22.99266
	OU_13	809889.80	831432.70	11.50	17.00	1.1284	8.748	22.99266
	OU_14	809890.80	831433.10	11.50	17.00	1.1284	8.748	22.99266
	OU_15	809891.70	831433.40	11.50	17.00	1.1284	8.748	22.99266
	OU_16	809892.60	831433.80	11.50	17.00	1.1284	8.748	22.99266
	OU_17	809893.60	831434.10	11.50	17.00	1.1284	8.748	22.99266
	OU_18	809894.50	831434.50	11.50	17.00	1.1284	8.748	22.99266
	OU_19	809895.40	831434.80	11.50	17.00	1.1284	8.748	22.99266
	OU_20	809896.40	831435.20	11.50	17.00	1.1284	8.748	22.99266
Exhaust 3	OU_21	809944.90	831453.30	11.50	17.00	1.1284	8.748	22.99266
	OU_22	809945.90	831453.60	11.50	17.00	1.1284	8.748	22.99266
	OU_23	809946.80	831454.00	11.50	17.00	1.1284	8.748	22.99266
	OU_24	809947.70	831454.30	11.50	17.00	1.1284	8.748	22.99266
	OU_25	809948.70	831454.70	11.50	17.00	1.1284	8.748	22.99266
	OU_26	809949.60	831455.00	11.50	17.00	1.1284	8.748	22.99266
	OU_27	809950.50	831455.40	11.50	17.00	1.1284	8.748	22.99266
	OU_28	809951.50	831455.70	11.50	17.00	1.1284	8.748	22.99266
	OU_29	809952.40	831456.10	11.50	17.00	1.1284	8.748	22.99266
	OU_30	809953.30	831456.40	11.50	17.00	1.1284	8.748	22.99266
Exhaust 4	OU_31	810001.90	831474.50	11.50	17.00	1.1284	8.748	22.99266
	OU_32	810002.80	831474.90	11.50	17.00	1.1284	8.748	22.99266
	OU_33	810003.70	831475.20	11.50	17.00	1.1284	8.748	22.99266
	OU_34	810004.70	831475.60	11.50	17.00	1.1284	8.748	22.99266
	OU_35	810005.60	831475.90	11.50	17.00	1.1284	8.748	22.99266
	OU_36	810006.50	831476.30	11.50	17.00	1.1284	8.748	22.99266
	OU_37	810007.50	831476.60	11.50	17.00	1.1284	8.748	22.99266
	OU_38	810008.40	831477.00	11.50	17.00	1.1284	8.748	22.99266
	OU_39	810009.40	831477.30	11.50	17.00	1.1284	8.748	22.99266
	OU_40	810010.30	831477.70	11.50	17.00	1.1284	8.748	22.99266

Appendix 3D Emission Parameters of IPARK2

Location of IPARK2 emission sources: