

5 Air Quality Impact Assessment During Operation at Tsing Yi

5.1 Introduction

- 5.1.1 With consideration of the nature of construction activities involved for the decommissioning of the Dock at Yam O Wan and the commissioning of the Dock at Tsing Yi, i.e. the dredging and relocating anchor blocks at the seabed, it is unlikely that there will be any adverse air quality impact on the environment.
- 5.1.2 However, as there is no land based electricity supply, the operation of the Dock relies on stationary diesel generators located on the Dock, which are the major pollutant emission sources at the proposed new site during operation. The potential air quality impact arising from the future Dock operation at Tsing Yi is assessed in this section.

5.2 Environmental Legislation, Policies, Plans, Standards and Criteria

Air Pollution Control Ordinance Cap. 311

- 5.2.1 Air quality is regulated under the provisions of the Air Pollution Control Ordinance, Cap. 311 (APCO) which controls air pollutant emissions from industrial activities and other sources, including vehicle emissions and asbestos. Under current legislation, the Air Quality Objectives (AQOs), presented in Table 5-1, provide the statutory AQOs for the Air Control Zones (ACZs) that have been declared for the whole of Hong Kong.
- 5.2.2 Sulphur dioxide (SO₂) and nitrogen dioxide (NO₂) are the major pollutants from the operation of diesel generators. Therefore, the maximum acceptable sulphur dioxide and nitrogen dioxide concentrations for 1 hour and 24 hours, as defined in the Air Quality Objectives (AQOs), are used as the assessment criteria.

Pollutant	Concentration $\mu\text{g}/\text{m}^3$ (i) Averaging Time				
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	3 Months (iv)	1 Year (iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulates (v)			260		80
Respirable Suspended Particulates (v)			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30000	10000			
Photochemical Oxidants (as ozone) (vi)	240				
Lead				1.5	

Notes:

- (i) Measured at 298°K (25° C) and 101.325 kPa (one atmosphere)
- (ii) Not to be exceeded more than three times per year.
- (iii) Not to be exceeded more than once per year.
- (iv) Arithmetic means.
- (v) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.
- (vi) Photochemical oxidants are determined by measurements of ozone only.

Table 5-1 Hong Kong Air Quality Objectives

Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)

5.2.3 The criteria for assessing air quality impacts are specified in Annex 4 of the EIAO-TM, of which the following criterion is relevant to this study:

- meet the Air Quality Objectives and other standards established under the Air Pollution Control Ordinance.

5.3 Description of Environment

Surrounding Land Uses

- 5.3.1 The Dock will be anchored in the sea approximately 200m to the southwest coast of Tsing Yi. The land uses in the vicinity are mainly industrial such as oil depots, shipyards, paint factories and bus depots. Dock No.1 of Yiu Lian Dockyard Limited is located to the northeast of the Dock.

Background Air Quality

- 5.3.2 Although EPD conducts routine air quality monitoring throughout Hong Kong, there is no air quality monitoring station (AQMS) at Tsing Yi. The closest AQMS is at Kwai Chung and was selected to represent the background air quality in the vicinity of the proposed Dock due to its similarity in the land uses and the topographic conditions. The available monitoring results of the past five years are summarised in Table 5-2.

Year	Annual Average Concentration of SO ₂ (µg/m ³)	Annual Average Concentration of NO ₂ (µg/m ³)
2001	22	69
2002	21	67
2003	29	70
2004	32	70
2005	32	63

Source: Air Quality in Hong Kong (2001 to 2004) and Annual Air Quality Statistics 2005, EPD

Table 5-2 Annual Averaged Concentration of SO₂ and NO₂ at Kwai Chung Air Quality Monitoring Station

Air Sensitive Receivers

- 5.3.3 Representative air sensitive receivers (ASRs) in the vicinity of the proposed new site are identified and listed in Table 5-3. Table 5-3 also shows the local ground levels, number of storey and the assessment levels of the ASRs. The closest ASR is the office building of Euroasia Dockyard which is located approximately 480m away from the Dock. The maximum height of ASRs is the second floor of Tsing Yi South Fire Station, at 34.9mPD. Figure 5-1 shows the surrounding environment and the ASRs. Figure 5-2 shows the assessment area within 500m radius of the Dock.

ASR	Distance between ASR and the Dock (m)	Ground Level (mPD)	No. of Storey and Assessment Height (mPD)	Uses	
A1 - Tsing Yi South Fire Station	600	23.5	3	G/F – 24.9	Fire Station
				1/F – 29.9	
				2/F – 34.9	
A2 - Euroasia Dockyard Enterprise & Development Limited – office building	480	6.0	3	G/F – 7.4	Office
				1/F – 12.4	
				2/F – 17.4	
A3 - Mobil Oil Depot office building	690	6.3	6	G/F – 7.7	Office
				1/F – 12.7	
				2/F – 17.7	
				3/F – 22.7	
				4/F – 27.7	
				5/F – 32.7	

Note:

1. It is assumed that the headroom is 5m and the prediction point of pollutant level is at 1.4m above the floor level.

Table 5-3 Representative Air Sensitivity Receiver

5.4 Assessment Methodology

Emission Source

- 5.4.1 There are a total of five diesel generator on the Dock. Three of them, identified as G1, G2 and G3, are located in a plant room inside the Dock for general works. G3 will be operated when G1 or G2 is out of service. The remaining two generators, identified as G4 and G5, are located on the cranes at the port side and the starboard side of the Dock.
- 5.4.2 Five exhaust points were identified on the Dock: three exhaust pipes from the plant room inside the Dock, of which one is for standby only, and two from the generators on the cranes. As the cranes do not move frequently, they are considered to be point sources in the assessment. Table 5-4 summarises the operation details of the generators.

	Generator inside the Plant Room ⁽¹⁾	Generator for Cranes ⁽¹⁾
Number of Generators	3	2
Power (kW)	485 for each	G4 – 160 G5 – 229
Elevation of Exhaust (m above sea level)	22	20 – 22
Diameter of Exhaust Outlet (m)	0.3	0.25
Operation Hours	G1: 24 hours G2: 12 - 16 hours G3: stand-by	10 hours
Fuel Type	Light Diesel	Light Diesel
Sulphur Content (%) (w/w)	0.5	0.5
Fuel Consumption Rate (L/hr) ⁽²⁾	137.6	G4 – 43.1 G5 – 53.1
Exhaust Gas Flow Rate ⁽³⁾ , m ³ /min	111.2	G4 – 27.9 G5 – 44.5
Exhaust Emission Velocity (m/s)	26.2	G4 - 9.5 G5 - 15.1
Exhaust Gas Temperature (°C) ⁽³⁾	570.7	G4 – 545 G5 - 500

Notes:

- (1) All information provided by Yiu Lian Dockyard except fuel consumption and exhaust flow rate and exhaust gas temperature.
- (2) Fuel consumption rates of 100% loading of the generators are adopted with reference to specification sheets of similar power output generators of the same brand (Caterpillar) as a worst-case scenario.
- (3) As there was no relevant information on exhaust flow rate and gas temperature in the manufacturer's catalogue, the best available information was obtained from specification sheets of similar power output generators of the same brand.

Table 5-4 Operation Details of the Generators of Floating Dock No. 3

5.4.3 In order to assess the cumulative air quality impact, the generators on Dock No. 1 were also included in the assessment to simulate the worst-case scenario during operation. There are a total of three generators in the plant room of Dock No. 1. One of them is the auxiliary generator, which is used when there is no ship on the Dock. Therefore, the worst-case scenario will be the continuous operation of the other two generators, namely EG1 and

EG2, during normal working days. Table 5-5 shows these operation details of these generators.

	Generators for normal docking days ⁽¹⁾	Auxiliary Generator ⁽¹⁾
Number of Generators	2	1
Power (kW)	650	400
Elevation of Exhaust (m above sea level)	14	14
Diameter of Exhaust Outlet (m)	0.35	0.35
Operation Hours	EG1: 24 hours EG2: 8-10 hours	Stand by
Fuel Type	Light Diesel	Light Diesel
Sulphur Content (%)(w/w)	0.5	0.5
Fuel Consumption Rate (L/hr) ⁽²⁾	174.9	102.5
Exhaust Gas Flow Rate ⁽³⁾ , m ³ /min ⁽³⁾	144.0	102.5
Exhaust Emission Velocity (m/s)	24.9	17.8
Exhaust Gas Temperature (°C) ⁽³⁾	544.1	524.2

Notes:

(1) All information was provided by Yiu Lian Dockyard except for fuel consumption rate, exhaust flow rate and exhaust gas temperature.

(2) Fuel consumption rates of 100% loading of the generators are adopted with reference to specification sheets of similar power output generators of the same brand (Caterpillar) as a worst-case scenario..

(3) As there was no relevant information on exhaust flow rate and gas temperature in the manufacturer's catalogue, the best available information was obtained from specification sheets of similar power output generators of the same brand.

Table 5-5 Operation Details of the Generators of Floating Dock No. 1

Methodology

- 5.4.4 The SO₂ and NO₂ concentrations within a 500m-radius from the Dock have been predicted using the Industrial Source Complex Short Term (ISCST3) which is a computer model developed by the United States Environmental Protection Agency (US EPA). The ISCST3 model takes into account emission rates of SO₂ and NO₂ emission sources, meteorological conditions and receptor information. The emission rates of NO₂ from the generators are based on the estimation from the US EPA "Compilation of Air Pollutant Emission Factors" (AP-42) and the operation data provided by Yiu Lian. The emission rates of SO₂ from the generators are based on fuel consumption rates of the generators in 100% loading and the maximum sulphur content in fuel. The calculation of emission rates are provided in Appendix 5A.
- 5.4.5 A full year meteorological data measured from Tsing Yi Automatic Weather Station and the mixing height data obtained from King's Park Meteorological Station of the Hong Kong Observatory was input for modelling exercise. As there is no ASR at the western side of the Dock, the modelling grid receptor of dimensions 720m (latitude) x 1260m (longitude) was established immediately to the east of the Dock. The concentrations of SO₂ and NO₂ at the nearest ASRs identified in Table 5-3 were predicted. The worst hit level was found at the second level of Tsing Yi Fire Station (i.e. 34.9mPD / 11.4m above ground). The 1-hour and 24-hour concentrations of SO₂ and NO₂ at representative elevations, 1.4m (G/F), 11.4m (2/F) and 26.4m (5/F) above ground, were also evaluated. The averaged SO₂ and NO₂ concentrations at Kwai Chung AQMS as presented in Table 5-2 was included in the modelling results for ambient correction.

5.5 Impact Evaluation

- 5.5.1 The cumulative air quality impact modelled, in the concentration isopleths, are shown in Appendix 5B.
- 5.5.2 The SO₂ and NO₂ concentrations at the identified ASRs at all the selected elevations within the assessment area are in compliance with the AQOs. Tables 5-6 and 5-7 show the predicted SO₂ and NO₂ concentrations at the nearby ASRs within the modelling grid.

ASR	Cumulative SO ₂ Concentrations (µg/m ³)											
	1-hour						24-hour					
	G/F	1/F	2/F	3/F	4/F	5/F	G/F	1/F	2/F	3/F	4/F	5/F
A1	101.1	101.5	122.9	-	-	-	36.8	36.9	36.9	-	-	-
A2	53.4	53.6	53.8	-	-	-	34.3	34.6	35.1	-	-	-
A3	53.2	53.8	55.0	60.9	78.8	101.2	32.5	32.5	32.4	32.4	32.4	33.6

Note:

1. The average background concentration of SO₂ is 27.2µg/m³.

Table 5-6 Predicted Cumulative SO₂ Concentrations at nearby ASRs

ASR	Cumulative NO ₂ Concentrations (µg/m ³)											
	1-hour						24-hour					
	G/F	1/F	2/F	3/F	4/F	5/F	G/F	1/F	2/F	3/F	4/F	5/F
A1	162.5	166.8	214.7	-	-	-	80.1	80.2	80.2	-	-	-
A2	102.4	102.5	104.1	-	-	-	77.2	77.5	78.2	-	-	-
A3	106.0	107.6	109.7	113.2	137.2	167.4	75.2	75.2	75.2	75.1	74.9	76.4

Note:

1. The average background concentration of NO₂ is 67.8 µg/m³.

Table 5-7 Predicted Cumulative NO₂ Concentrations at nearby ASRs

5.6 Mitigation Measures

- 5.6.1 No mitigation measures are required for the emissions from generators as the predicted SO₂ and NO₂ concentrations are well below the AQOs. However regular checking and maintenance of the generators are recommended to maintain their performance.

5.7 Residual Impacts

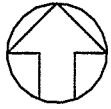
- 5.7.1 As the SO₂ and NO₂ concentrations predicted in Section 5.5 are well below the AQOs, no mitigation measures are required. The residual impacts will be the same as those presented in Section 5.5.

5.8 Environmental Monitoring and Audit Requirements

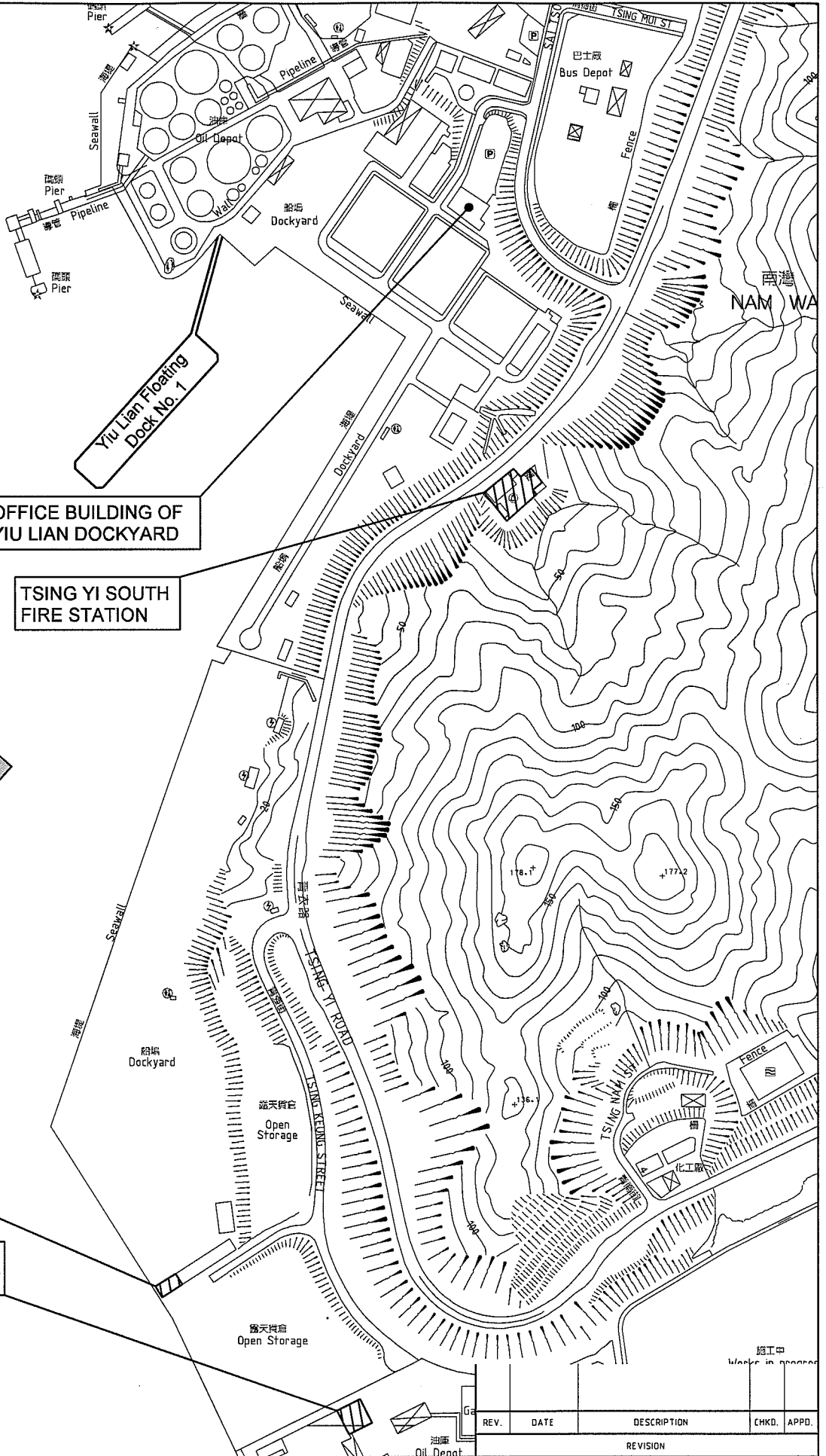
- 5.8.1 As the modelling results showed that the operation of the proposed Dock at Tsing Yi would not cause adverse air quality impact, no air quality monitoring and audit is required.

5.9 Conclusion

- 5.9.1 There will be no adverse air quality impact at the existing site (Yam O Wan) or at the Tsing Yi site during relocation.
- 5.9.2 The air quality impact of gaseous emissions from the diesel generators at Tsing Yi was assessed. Based on the fuel consumption rates and operation details, the prediction results are in compliance with the respective AQOs. Therefore, it is concluded that there would be no adverse air quality impact during the future operation of the Dock at Tsing Yi.



 AIR SENSITIVE RECEIVER



Yiu Lian Floating Dock No. 1

OFFICE BUILDING OF YIU LIAN DOCKYARD


TSING YI SOUTH FIRE STATION

Yiu Lian Floating Dock No. 3

EUROASIA DOCKYARD ENTERPRISE & DEVELOPMENT LIMITED - OFFICE

OFFICE BUILDING MOBILE OIL DEPOT

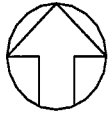
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DRAWING TITLE
Location of Yiu Lian Floating Dock No. 3
 Location of Nearby Air Sensitive Receivers

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DATE	15-09-2006				
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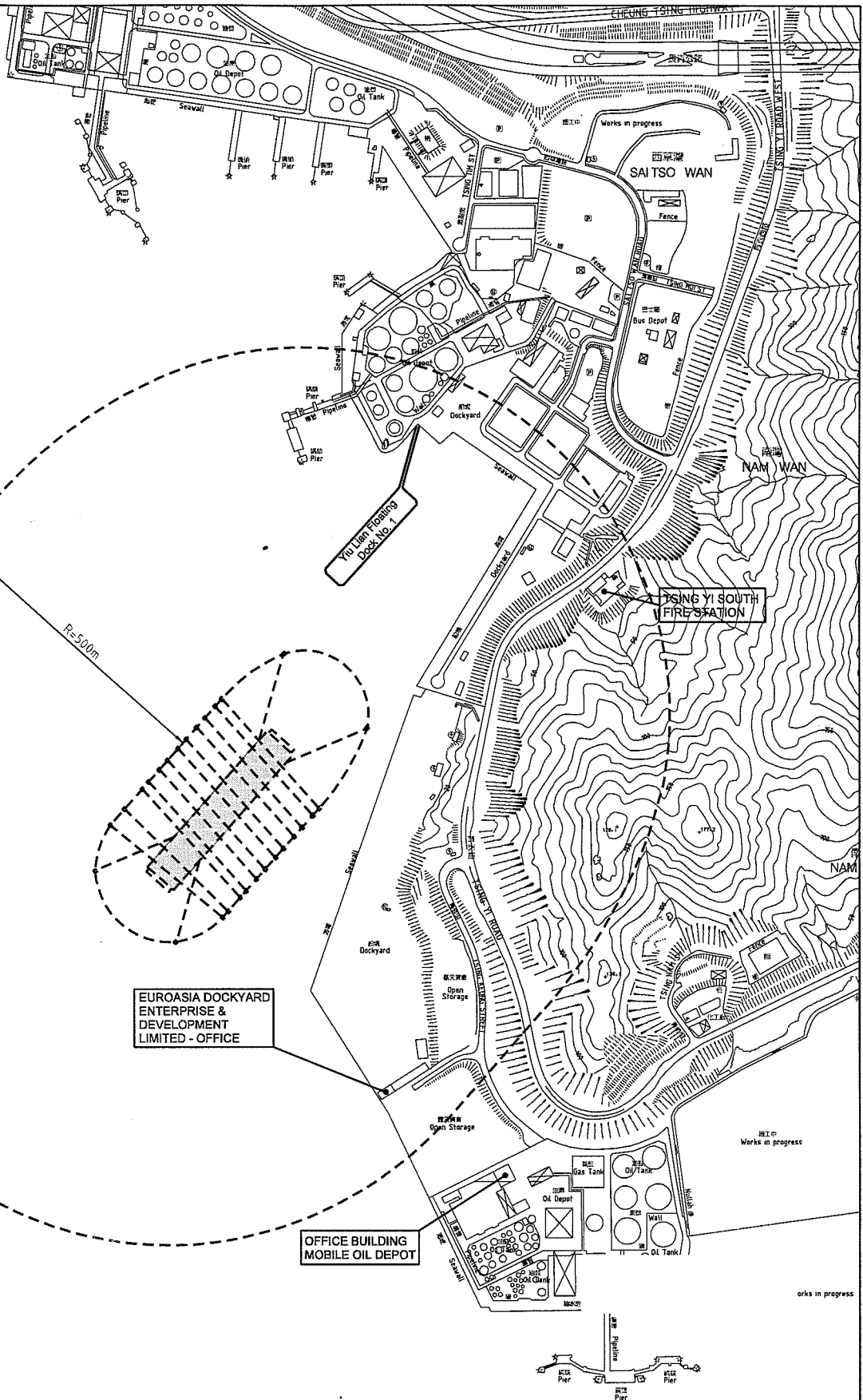
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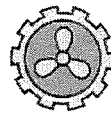
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