

## APPENDIX I

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**Table 1 Emission Standards from Flare, Gas Turbine, Boiler, Acid Gas Incinerator and Internal Combustion Engine**

No	Source	Fuel	Parameter	Tangguh LNG Current Standard <sup>1</sup> (mg/Nm <sup>3</sup> )	Indonesian Standard <sup>2</sup> (mg/Nm <sup>3</sup> )	IFC Standard <sup>3</sup> (mg/Nm <sup>3</sup> )	TEP Standard <sup>4</sup> (mg/Nm <sup>3</sup> )
1	Flare	-	Opacity	40%	40%	-	40%
2	Boiler <sup>5</sup>	Gas	Nitrogen Oxide (NOx) as NO <sub>2</sub>	320	400	320	320
			Opacity	20%	20%	-	20%
			Sulphur Dioxides (SO <sub>2</sub> )	150	150	-	150
			Total Particulate	50	50	-	50
			Hydrogen Sulphide (H <sub>2</sub> S) <sup>9</sup>	-	-	5	5
3	Gas Turbine <sup>6</sup>	Gas	Nitrogen Oxide (NOx) as NO <sub>2</sub> (15MWth to <50MWth)	320	320	25 ppm (51 mg/Nm <sup>3</sup> )	25 ppm (51 mg/Nm <sup>3</sup> )
			Total Particulate	50	50	-	50
			Sulphur Dioxide (SO <sub>2</sub> )	150	150	-	150
			Hydrogen Sulphide (H <sub>2</sub> S) <sup>9</sup>	-	-	5	5
4	Acid Gas Incinerator <sup>7</sup>	-	Nitrogen Oxide (NOx) as NO <sub>2</sub>	320 <sup>10</sup>	-	-	-
			Sulphur Dioxide(SO <sub>2</sub> )	873 <sup>10</sup>	2600	-	2600
			Hydrogen Sulphide(H <sub>2</sub> S) <sup>9</sup>	-	-	5	5
5	Internal Combustion Engine with Capacity ≤ 570 KWth <sup>8</sup>	Diesel	Nitrogen Oxide (NOx) as NO <sub>2</sub>	1000	1000	-	1000
			Carbon Monoxide (CO)	600	600	-	600
			Hydrogen Sulphide(H <sub>2</sub> S) <sup>9</sup>	-	-	5	5
6	Internal Combustion Engine with Capacity 570 KWth < x ≤ 3 MWth <sup>8</sup>	Diesel	Total Particulate	150	150	-	150
			Sulphur Dioxide(SO <sub>2</sub> )	800	800	-	800
			Nitrogen Oxide (NOx) as NO <sub>2</sub>	1000	1000	-	1000
			Carbon Monoxide (CO)	600	600	-	600
			Hydrogen Sulphide (H <sub>2</sub> S) <sup>9</sup>	-	-	5	5

Note :

1. Reference: Tangguh LNG Environmental Monitoring Procedure No. 900-PRC-EN-2320
2. Reference: MoE Regulation No. 13 Year 2009 regarding Emission Standards for Oil and Gas Industry
3. Reference: General EHS Guidelines, IFC, 2007
4. Tangguh Expansion Project Standards
5. Combustion using O<sub>2</sub> gas correction by 3%
6. Combustion using O<sub>2</sub> gas correction by 15%
7. Combustion using O<sub>2</sub> gas correction by 0%
8. Combustion using O<sub>2</sub> gas correction by 13%
9. Reference: EHS Guideline - Onshore Oil and Gas Development, IFC, 2007
10. This standard is taken from Tangguh Integrated AMDAL which was approved in 2002 based on World Bank Pollution Prevention and Abatement Handbook, 1998 which is more general. This standard is not referred anymore upon the issuance of Minister of Environment Regulation No. 13 Year 2009 regarding Acid Gas Incinerator
11. Gas volume at standard condition (25°C and 1 atm)

**Table 2 Non-Hazardous Waste Incinerator Standard**

No	Parameter	TEP Standard <sup>1</sup> (mg/Nm <sup>3</sup> )
1	Nitrogen Oxide as NO <sub>2</sub>	1000
2	Sulphur Dioxide (SO <sub>2</sub> )	800
3	Total Reduced Sulphur (H <sub>2</sub> S)	35

Note : 1. Tangguh Expansion Project Standard refers to Minister of Environment Decree no. 13 Year 1995 regarding Emission Standard for Stationary Source

**Table 3 Hazardous Waste Incinerator Emission Standard**

No	Parameter	Tangguh LNG Current Standard <sup>1</sup> (mg/Nm <sup>3</sup> )	Indonesian Standard <sup>2</sup> (mg/m <sup>3</sup> )	TEP Standard <sup>3</sup> (mg/Nm <sup>3</sup> )
1	Particulate	50	50	50
2	Sulphur Dioxide(SO <sub>2</sub> )	250	250	250
3	Nitrogen Dioxide (NO <sub>2</sub> )	300	300	300
4	Hydrogen Fluoride (HF)	10	10	10
5	Hydrogen Chloride (HCl)	70	70	70
6	Carbon Monoxide (CO)	100	100	100
7	Total Hydrocarbon (as CH <sub>4</sub> )	35	35	35
8	Arsenic (As)	1	1	1
9	Cadmium (Cd)	0,2	0,2	0,2
10	Chromium (Cr)	1	1	1
11	Lead (Pb)	5	5	5
12	Mercury (Hg)	0,2	0,2	0,2
13	Thallium (Ti)	0,2	0,2	0,2
14	Opacity	10	10	10

Note :

1. Reference: Tangguh LNG Environmental Monitoring Procedure No. 900-PRC-EN-2320
2. Reference: Head of Environmental Impact Management Agency Decree KEP-03/BAPEDAL/09/1995 regarding Technical Guidelines for Hazardous Waste Management
3. Tangguh Expansion Project Standard

**Table 4 Noise Standard**

No	Area	TEP Standard (dbA) <sup>1</sup>
1	Housing	55 45 (night) <sup>2</sup>

Note :

1. Reference : Minister of Environment Decree No. 48 Year 1996 regarding Noise
2. Reference : General EHS Guidelines, IFC, 2007

**Table 5 Ambient Air Standard**

No	Parameter	Measurement Time	Tangguh LNG Current Standard <sup>1</sup> (µg/m <sup>3</sup> )	Indonesian Standard <sup>2</sup> (µg/m <sup>3</sup> )	IFC Standard <sup>3</sup> (µg/m <sup>3</sup> )	TEP Standard <sup>4</sup> (µg/m <sup>3</sup> )
1	Sulphur Dioxide (SO <sub>2</sub> )	1 hour	900	900	-	900
		24 hours	150	365	20 (Guidelines)	20
2	Carbon Monoxide (CO)	1 hour	30000	30000	-	30000
		24 hours	10000	10000	-	10000
3	Nitrogen Dioxide (NO <sub>2</sub> )	1 hour	320	400	200 (Guidelines)	200
		24 hours	150	150	-	150
4	Ozone (O <sub>3</sub> )	1 hour	-	235	-	235
5	Hydrocarbon (HC)	3 hours	-	160	-	160
6	PM 10 PM 2.5	24 hours	150	150	50 (Guidelines)	50
		24 hours	65	65	25 (Guidelines)	25
7	Ash (TSP)	24 hours	230	230	-	230
8	Lead (Pb)	24 hours	-	2	-	2

Note :

1. Reference: Tangguh LNG Environmental Monitoring Procedure No. 900-PRC-EN-2320
2. Reference: Government Regulation No. 41 Year 1999 regarding Air Pollution Control
3. Reference: WHO Ambient Air Quality Guidelines, EHS Guidance, IFC, 2007
4. Tangguh Expansion Project Standard

**Table 6 Standard for Produced Water, Chemically Contaminated Water, Oily Contaminated Water, and Hydrotest**

No	Wastewater Type	Parameter	Tanggung LNG Current Standard <sup>1</sup>	Indonesian Standard <sup>2</sup>	IFC Standard <sup>3</sup>	TEP Standard <sup>4</sup>
1	Produced Water	Temperature	40°C	40°C	-	40°C
		pH	6 - 9	6 - 9	-	6 - 9
		Oil & Grease	20 mg/L	25 mg/L	42 mg/L 29 mg/L 30 daily average	25 mg/L
		Total Phenol	1 mg/L	2 mg/L	-	1 mg/L
		Sulphide (H <sub>2</sub> S)	0,5 mg/L	0,5 mg/L	-	0,5 mg/L
		Ammonia (NH <sub>3</sub> )	5 mg/L	5 mg/L	-	5 mg/L
		Chemical Oxygen Demand (COD)	200 mg/L	200 mg/L	-	200 mg/L
	Methanol	100 mg/L at 30 m distance from discharge point to sea	-	-	100 mg/L at 100 m distance from discharge point to sea	
2	Chemically Contaminated Water	pH	6 - 9	-	-	6 - 9
		Chemical Oxygen Demand (COD)	200 mg/L	-	-	200 mg/L
		Total Suspended Solid (TSS)	100 mg/L	-	-	100 mg/L
		Total Toxic Metal <sup>5</sup>	5 mg/L	-	-	5 mg/L
3	Oily Contaminated Water	Oil & Grease	15 mg/L	15 mg/L	15 mg/L	15 mg/L
		Total Organic Carbon (TOC)	110 mg/L	110 mg/L	-	110 mg/L
4	Drainase dari Kilang LNG dan area Utilitas	Oil & Grease	15 mg/L	15 mg/L	10 mg/L	10 mg/L
		Total Organic Carbon (TOC)	110 mg/L	110 mg/L	-	110 mg/L
5	Desalination Wastewater (Brine Reject)	pH	6 - 9	-	-	6 - 9
		Salinity	At 30 m distance from discharge location at sea, maximum salinity standard is $\pm 5\%$ from ambient	-	-	At 100 m distance from discharge location at sea, maximum salinity standard is $\pm 5\%$ from ambient
6	Hydrotest Wastewater from	pH	6 - 9	-	-	6 - 9
		Total Suspended Solid (TSS)	50 mg/L	-	-	50 mg/L

No	Wastewater Type	Parameter	Tangguh LNG Current Standard <sup>1</sup>	Indonesian Standard <sup>2</sup>	IFC Standard <sup>3</sup>	TEP Standard <sup>4</sup>
	onshore facility without additional chemical and discharged onshore surface water	Oil & Grease	25 mg/L	-	-	25 mg/L
		Iron (Fe)	5 mg/L	-	-	5 mg/L
7	Chemical cleaning wastewater from onshore facility with additional chemical and discharged offshore	pH	6 - 9	-	-	6 - 9
		Total Suspended Solid (TSS)	50 mg/L	-	-	50 mg/L
		Heavy Metal (total) <sup>5</sup>	5 mg/L	-	-	5 mg/L
		Oil & Grease	25 mg/L	-	-	25 mg/L
		Iron (Fe)	5 mg/L	-	-	5 mg/L

Note :

1. Reference: Tangguh LNG current standard for wastewater discharge refers to wastewater discharge permit from Minister of Environment Decree No. 125 Year 2013. Tangguh current standard for hydrotest wastewater refers to hydrotest wastewater discharge permit from Minister of Environment Decree No. 490 Year 2007
2. Reference: Minister of Environment Regulation No. 19 Year 2010 regarding Wastewater Standards for Industry and/or Oil and Gas Activity
3. Reference: Effluent from EHS Guideline Offshore Oil and Gas Development, IFC, 2007; Effluent from EHS Guideline Onshore Oil and Gas Development, IFC, 2007;
4. Tangguh Expansion Project Standard
5. Total Toxic Metal including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc (Minister of Environment Regulation No. 19 Year 2010)

**Table 7 Domestic Sewage Standard**

No	Parameter	Tangguh LNG Current Standard <sup>1</sup>	Indonesian Standard <sup>2</sup>	IFC Standard <sup>3</sup>	TEP Standard <sup>4</sup>
1	pH	6 - 9	6 - 9	-	6 - 9
2	Biochemical Oxygen Demand (BOD)	100 mg/L	100 mg/L	-	100 mg/L
3	Total Suspended Solid (TSS)	100 mg/L	100 mg/L	-	100 mg/L
4	Oil & Grease	10 mg/L	10 mg/L	-	10 mg/L

Note :

1. Reference: Standard from Ministry of Environment Decree No. 125 Year 2013
2. Reference: Minister of Environment Decree No. 112 Year 2003 regarding Domestic Wastewater Standard
3. Reference: General EHS Guidelines, IFC, 2007. This standard is only applicable when wastewater discharge is conducted onshore or at surface water
4. Tangguh Expansion Project Standard

**Table 8 Surface Water Quality Standard**

No	Parameter	Unit	Tangguh LNG Current Standard <sup>1</sup>	Indonesian Standard <sup>2</sup>	TEP Standard <sup>3</sup>
1	Temperature	°C	Deviation 3	Deviation 3	Deviation 3
2	Total Dissolved Solid (TDS)	mg/L	1000	1000	1000
3	Total Suspended Solid (TSS)	mg/L	400	50	50
4	pH		6 - 9	6 - 9	6 - 9
5	Dissolved Oxygen (DO)	mg/L	3	4	4
6	Arsenic (As)	mg/L	1	1	1
7	Cadmium (Cd)	mg/L	0,01	0,01	0,01
8	Chromium (VI)	mg/L	0,05	0,05	0,05
9	Copper (Cu)	mg/L	0,02	0,02	0,02
10	Lead (Pb)	mg/L	0,03	0,03	0,03
11	Mercury (Hg)	mg/L	0,002	0,002	0,002
12	Zinc (Zn)	mg/L	0,05	0,05	0,05
13	Nitrite as N	mg/L	0,06	0,06	0,06
14	Nitrate as N	mg/L	20	10	10
15	Oil & Grease	mg/L	1000	1000	1000
16	Faecal Coliform	Total per 100 ml	2000	1000	1000
17	Total Coliform	Total per 100 ml	10000	5000	5000

Note :

1. Reference: Tangguh LNG Environmental Monitoring Procedure No. 900-PRC-EN-2320
2. Reference: Government Regulation No. 82 Year 2001 regarding Water Quality Management and Water Pollution Control. Water Quality Criteria Class II is used for water which utilized for water recreation infrastructure, freshwater fish farming, farms, water for irrigation, and other utilization that requires the same water quality with former mentioned utilization.
3. Tangguh Expansion Project Standard



**Table 9 Ground Water Standard**

No	Parameter	Unit	Tangguh LNG Current Standard <sup>1</sup>	Indonesian Standard <sup>2</sup>	TEP Standard <sup>3</sup>
1	Mercury (Hg)	mg/L	0,001	0,001	0,001
2	Arsenic (As)	mg/L	0,05	0,05	0,05
3	Cadmium (Cd)	mg/L	0,01	0,01	0,01
4	Chloride (Cl)	mg/L	600	600	600
5	Nitrate as N	mg/L	10	10	10
6	Nitrite as N	mg/L	0,06	0,06	0,06
7	Total Phosphate	mg/L	0,2	0,2	0,2
8	Biochemical Oxygen Demand (BOD)	mg/L	2	2	2
9	Chemical Oxygen Demand (COD)	mg/L	10	10	10
10	pH		6 - 9	6 - 9	6 - 9
11	Total Dissolved Solid (TDS)	mg/L	1000	1000	1000
12	Zinc (Zn)	mg/L	0,05	0,05	0,05
13	Sulphate (SO <sub>4</sub> )	mg/L	400	400	400
14	Sulphide as H <sub>2</sub> S	mg/L	0,002	0,002	0,002
15	Copper (Cu)	mg/L	0,02	0,02	0,02
16	Iron (Fe)	mg/L	0,3	0,3	0,3
17	Manganese (Mn)	mg/L	0,1	0,1	0,1
18	Lead (Pb)	mg/L	0,03	0,03	0,03
19	Faecal Coli	mg/L	100	100	100

Note :

1. Reference: Tangguh LNG Environmental Monitoring Procedure No. 900-PRC-EN-2320
2. Reference: PP No. 82 Government Regulation No. 82 Year 2001 regarding Water Quality Management and Water Pollution Control, Water Quality Criteria Class I - Water which utilized for potable water resource and or other utilization which requires the same water quality as former mentioned utilization.
3. Tangguh Expansion Project Standard

**Table 10 Wastewater Quality Standard from Drilling Platform**

No	Wastewater Type and Parameter	Indonesian Standard <sup>1</sup>	IFC Standard <sup>2</sup>	TEP Standard <sup>3</sup>
Deck Drainage Wastewater				
1	Oil Layer	Null (Visual)	-	Null (Visual)
2	Oil & Grease	-	15 mg/L	15 mg/L
Domestic Sewage (STP)				
1	Chlorine Residue	2 mg/L	-	2 mg/L
2	Floating Object and Foam	Null (Visual)	Null (Visual)	Null (Visual)
Produced Water ( Brine Water from Well Test)				
1	Oil & Grease	50 mg/L	42 mg/L 29 mg/L 30 daily average	42 mg/L 29 mg/L 30 daily average
Cooling Water from Boiler				
1	Temperature	-	Temperature increased not more than 3 <sup>o</sup> C at location 100 m from discharge point	Temperature increased not more than 3 <sup>o</sup> C at location 100 m from discharge point
Wastewater from desalination unit (brine water) Standard for wastewater from desalination unit is not mentioned in Indonesian regulations. Following IFC standard, wastewater from desalination unit is discharged along with other treated wastewater if possible.				

Note :

1. Reference : Minister of Environment Regulation No. 19 Year 2010 regarding Wastewater Standard for Industry and/or Oil and Gas Activity
2. Reference: Effluent from EHS Guideline Offshore Oil and Gas Development, IFC, 2007;
3. Tangguh Expansion Project Standard
4. IFC Standard mainly applicable for discharge location > 12 nm, but since there is no standard for location < 12 nm hence the standard refers to requirement > 12 nm unless defined differently in the permit.

**Table 11 Seawater Ambient Quality Standard**

No	Parameter	Unit	Indonesian Standard <sup>1</sup>	
			Jetty	Marine Biota
1	Clarity	M	> 3	Coral: > 3 Mangrove: - Seagrass: > 3
2	Odour	-	Natural	Natural
3	Turbidity	NTU	-	<5
4	Total Suspended Solid (TSS)	mg/L	80	Coral: 20 Mangrove: 80 Seagrass: 20
5	Garbage	-	Null	Null
6	Temperature	°C	Natural	Natural Coral : 28 - 30 Mangrove: 28 - 32 Seagrass: 28 - 30
7	Oil Layer	-	Null	Null
8	pH		6,5 - 8,5	7 - 8,5
9	Salinity	%	Natural	Natural Coral: 33 - 34 Mangrove: s/d 34 Seagrass: 33 - 34
10	Dissolved Oxygen (DO)	mg/L	-	> 5
11	Biochemical Oxygen Demand (BOD)	mg/L	-	20
12	Total Ammonia	mg/L	0,3	0,3
13	Phosphate	mg/L	-	0,015
14	Nitrate as N	mg/L	-	0,008
15	Sulphide	mg/L	0,03	0,01
16	Poly-Aromatic Hydrocarbon (PAH)	mg/L	-	0,003
17	Total Hydrocarbon	mg/L	1	-
18	Total Phenol	mg/L	0,002	0,002
19	Surfactant	mg/L MBAS	1	1
20	Oil & Grease	mg/L	5	1
21	TBT	mg/L	0,01	0,01
22	Mercury (Hg)	mg/L	0,003	0,001
23	Chromium (VI)	mg/L	-	0,005
24	Arsenic (As)	mg/L	-	0,012
25	Cadmium (Cd)	mg/L	0,01	0,001
26	Copper (Cu)	mg/L	0,05	0,008
27	Lead (Pb)	mg/L	0,05	0,008
28	Seng (Zn)	mg/L	0,1	0,05
29	Nickel (Ni)	mg/L	-	0,05
30	Total Coliform	MPN/100 ml	1000	1000
31	Plankton	Cell/100 ml	-	No blooming

Note : Reference: Minister of Environment Regulation No. 51 Year 2004 regarding Seawater Quality

**Table 12 Sediment Quality Standard**

No	Parameter	ANZECC/ARMCANZ INTERIM SEDIMENT QUALITY Guideline	
		Under ISQG	Upper ISQG
1	Copper (Cu)	65	270
2	Chromium (Cr)	80	370
3	Cadmium (Cd)	1,5	10
4	Mercury (Hg)	0,15	1
5	Lead (Pb)	50	220
6	Arsenic (As)	20	70
7	Zinc (Zn)	200	410
8	Antimony (Sb)	2	25
9	Nickel (Ni)	21	52
10	Silver (Ag)	1	3,7
11	Benthos <sup>1</sup>	-	-

Note:

1. Benthos will be compared with environmental baseline