AES-VCM MONG DUONG POWER CO., LTD.
MONG DUONG 2 BOT THERMAL POWER PLANT
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ENVIRONMENTAL MONITORING REPORT FOR MONG DUONG 2 BOT THERMAL POWER PLANT

The first six months - 2016

HA NOI, JULY – 2016

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CÔNG TY TRÁCH NHIỆM HỮU HẠN ĐIỆN LỰC AES - VCM MÔNG DƯƠNG
S.G.C.N: 2200220048 - L.D.N.NG - TX.CẨM PHẢ T.QUẢNG NINH

DAVID STONE
Managing Director

BACH KHOA ENVIRONMENTAL AMICABLE TECHNOLOGY, JSC. (BKEST)
(BKEST)

M.S.D.N: 0103772255 - C.T.C.P
CÔNG TY CỔ PHẦN CÔNG NGHỆ THÂN THIỆN MÔI TRƯỜNG BÁCH KHOA
Q.HAI BÀ TRƯNG - T.P HÀ NỘI

GIÁM ĐỐC
Tạ Văn Sơn

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GENERAL INTRODUCTION ON MONG DUONG 2 THERMAL POWER PLANT

Mong Duong 2 Thermal Power Plant is one of two thermal power plant projects. It locates in Mong Duong Electricity Power Centre and has construction site that locates near No. 18A national route. The distance from Mong Duong thermal power plant to Ha Long city is about 50 km and to Cam Pha commune about 18 km in the North East. Mong Duong Electricity Power Centre locates in zone 3, Mong Duong ward, Cam Pha commune, Quang Ninh province. This position lies near Mong Duong estuary and along Luong Gac (Gac Channel). This is an advantage for not only transporting materials by waterway to construction site but also installing cooling water system for two factories. Along South East coast of Electricity Power Centre is range of low mountain. In Luong Gac, there is coal port and chemical store belong Bai Tu Long Coal Company. The plant has total capacity about 1200 MW (including two sets of machinery with average capacity is 600MW) with total investment about 2 billions USD. Construction stage was started since September 15th, 2011 and is already commercial operation with both Units:

- Unit-1 COD on March 4, 2015 with gross capacity 600 MW.
- Unit-2 COD on April 22, 2015 with gross capacity 600 MW.

Total capacity is 1200MW.

Area of plant is 81,822 ha. Plant is built in zone 3, Mong Duong ward, Cam Pha commune, Quang Ninh province. Boundary of plant: by the East: beside Binh Minh port; by the South: beside rivulet; by the West: beside Mong Duong 1 thermal power plant; by the North: beside the road which leads to plant and Mon Duong river. The location where the Project has been build has many advantages in transferring material by waterway, constructing, investigating, exploiting, and operating the Plant. Mong Duong Power Complex including Mong Duong 2 Thermal Power Plant Project and general plan of Centre is shown in **Figure 1.1.**

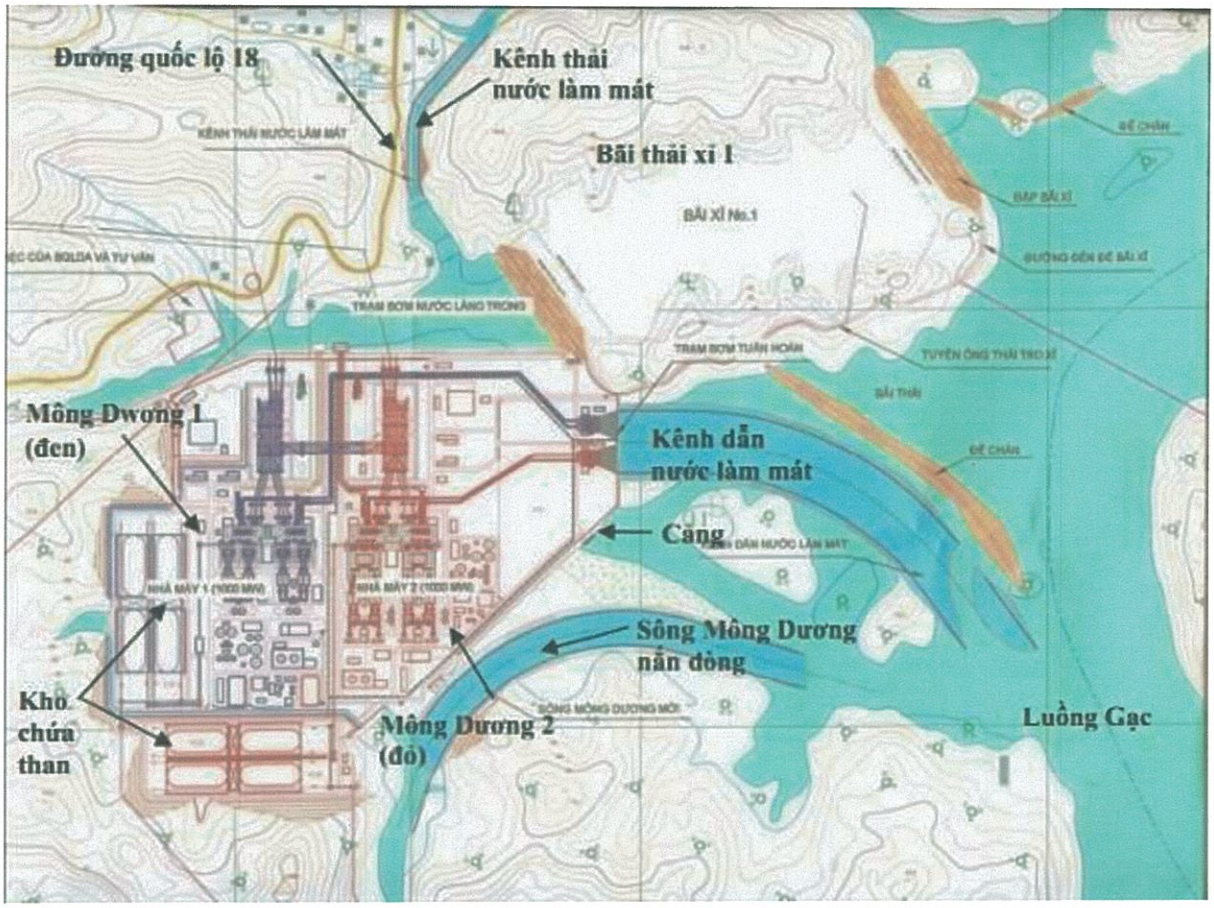

Figure 1.1. Mong Duong 2 Thermal Power Plant location

Mong Duong 2 Thermal Power Plant project had been built after Mong Duong Electricity Power Centre completing all the necessary infrastructures (leveling platform, converting flow of Mong Duong River, completing water collection system, water discharge system to cool, ash pounds…). The works within project include:

+ Infrastructure of Thermal Power Plant: including generator, primary transformer and ancillary works.

+ The operator, warehouse, workshop.

+ Piping, cooling pump system of general channel from Luong Gac River to Electricity Power Centre. Sewage piping system from plant to Luong Gac Canal.

+ Intake and cooling discharges canal system of Power Complex.

+ Piping system leads oil from oil receiving point.

+ Slag and ash transportation system includes pump station and pump system (High Slurry Concentration Disposal System -HSCD) of Power Complex.

+ Coal shed (with capacity about 15 days of Generation at Full Capacity).

+ Water and wastewater treatment facility.

+ Internal road.

+ Firefighting and prevention system.

+ Temporary and permanent worker's accommodation.

+ The internal drainage system.

+ Jetty for receive oil and limestone.

+ Ash pond.

The categories used together with Mong Duong 1 Thermal Power Plant are shown in the following table

Table 1.1. The common facilities are used together with Mong Duong Power Centre

No	Categories	Description
1.	All area of centre	Mong Duong 2 plant account for 50%.
2.	Coal receiving Area	Using conveyer to transport coal in centre.
3.	Cooling water supplying channel	This construction is built by EVN. Connection point is pump station in the East Side of the Project.
4.	Cooling water discharging channel	This construction is built by EVN. It locates in the North Side of the Project.
5.	Fresh water supplying system	This construction is built in the North - West Side of the Plant by EVN.
6.	500 KV connection line	This construction is built by EVN. Mong Duong 2 connection structure inside the Transmission Power Sub-station.
7.	110 KV power supply line for testing in factory	This construction is built by EVN. Mong Duong 2 connected at self-substation to the point inside the project site.
8.	Road	At primary road of Mong Duong 2.
9.	Fuel Oil and Limestone receiving port	Only used by Mong Duong 2. Area is 0.57 ha.
Source: AES-VCM Mong Duong Power Co. Ltd., October, 2014		

All general categories of construction are completed and put in use.

CHAPTER I. PLAN OF ENVIRONMENTAL MONITORING PROGRAM IN MONG DUONG 2 THERMAL POWER PLANT IN 2016

Environmental monitoring program in year 2016 has been started in January; this time is the second year of operation stage of plant. The main purpose is evaluation on environmental quality during operation stage. Environmental monitoring program are performed to make report on periodic environment quality of Mong Duong 2 Thermal Power Plant. This program ensures environmental management object of Mong Duong 2 Thermal Power Plant project to meet National Environmental Protection Laws requirements and AES Company Environmental Standards during operation stage. The detailed objects are shown in detail as follow:

I.1. The purpose of monirtoring program

The purpose of monitoring program is to evaluate the environmental quality, to examine the pollution level of each environmental component and to collect continuous data to serve environmental management works for Mong Duong 2 Thermal Power Plant and Mong Duong Electricity Power Centre according with:

- The impact of environmental agents/pollutants.
- Components, polluted sources, concentration/contents/intensity of pollutants.
- Forecasting changes in the levels and effects of these agents.
- Information to managers, namely management board of Mong Duong Thermal Power Plant to take measures in order to mitigate or prevent the harmful effects of environmental pollution caused by the operation of the plant

Besides, this environmental monitoring program is also followed the requirements of approved EIA report of Mong Duong 2 Thermal Power Plant in Decision No. 803/QĐ-BTNMT on May 22, 2007 and the certificate of completion Environmental Protection constructions No. 42/GXN-TCMT on April 21, 2015.

I.2. Environmental monitoring parameters and frequency in 2016

All the environmental monitoring parameters are selected typically for each environmental component.

For Mong Duong 2 Thermal Power Plant, monitoring parameters selecting for all monitoring time are strictly complied with EIA report and based on the fact operating stage of the factory.

Main monitoring parameters and frequency are seen in table below:

Table 1.2. Environmental parameters and frequency in 2016 - operation stage of the plant

No	Item	Term of work	Location	Frequency requirement			Monitoring parameters	Reference standard	Final frequency	Sample quantity
				ADB EIA	MONRE EIA	Permit				
1	Air and flow gases	Emission	In stack (2 points)	Continues measure	Continues measure	-	SO_2; NO_x; CO; Bụi	QCVN 19:2009 QCVN 22:2009	Continues measure/quarterly	Continues measure
		Ambient air	Ambient air (Total : 5 points)	Quarterly	Quarterly	-	SO_2; TSP; PM10; NO_2; CO	QCVN 05:2013	Quarterly	5
2	Noise	Noise (LAeq) (day and night)	5m from the noise sources - Office, housing - 5m from fence - Resident area	Weekly Monthly Quarterly	Weekly Monthly	Weekly Monthly	Noise	QCVN 26:2010	Weekly Monthly Quarterly	10 x2
3	Water	Surface water	SW 01 - SW 08; DD 1, 4, 5; CH 1,2,3,5;PW-01 to PW-09; MD1, AP 2 – 4 (21 points)	Yearly	Quarterly	-	Temp, pH; TSS; EC; NH_4^+; NO_3^-; DO; BOD_5; Total N&P; heavy metal (As, Cr, Cd, Cu, Pb,Zn, Ni, Hg, Fe, Mn, Se..), total oil & grease and coliforms	QCVN 08-MT:2015 QCVN 10-MT:2015	Quarterly	21
		Ground water	PW-01 to PW-09; GW-01-D to GW - 11; (20 points)	Yearly	-	-	Heavy metal (As,Cr, Cd, Cu, Pb, Zn, Ni, Hg, Fe, Mn,Se), SVOC, VOC, TPH, and .	QCVN 09-MT:2015	Yearly	20

							coliforms			
		Ash pond leachate	Ash pond 1	Twice per year	-	-	Heavy metal (As, Cr, Cd, Cu, Pb, Zn, Ni, Hg, Fe, Mn, Se)	QCVN 09-MT:2015	Twice per year	4
4	Waste water	Current speed	Luong Gac discharge canal	2 times/year Continuous in two weeks in first year of plant operation stage	-	-	Automatic current meters	-	Twice per year	2
		Cooling discharge water	Discharge point to common Mong Duong Power Complex canal	Weekly	-	Continous measure	Flow rate; pH; Temp; Residual Chlorine	QCVN 40:2011	Contiously	
				-		Monthly	Temp; pH; Colour; COD; BOD5; TSS; As,Hg; Pb, Cd, Cr^{3+}, Cr^{6+}, Cu, Zn, Ni, Mn, Fe, Oil & grease, F^-, S2-; Nutrients (N&P), ; residual chlorine, amonium & coliform.		Monthly	3
		Industrial wastewater discharge	Discharge point into the Cooling water canal	Monthly (for the 1st Year) Quarterly (therafter	-	Monthly	Temp; pH; Colour; COD; BOD_5; TSS; As,Hg; Pb, Cd, Cr^{3+}, Cr^{6+}, Cu, Zn, Ni, Mn, Fe, Oil & grease, F^-, S^{2-}; Nutrients (N&P), ; Residual Chlorine, amonium & coliform.		Monthly	1

		Sanitary wastewater	Outlet of the Sanitary Wastewater Treatment	-	Quarterly	Quarterly	pH; BOD5; TSS; TDS; sunfur (H2S); Ammonium (NH4); Nitrat (NO3-); oil and grease; Phophatse (PO43-); coliform	QCVN 14:2008	Quarterly	3
		Receiving surface water source	200m from upstream and downstreem (Luong Gac cannal)	-	-	Quarterly	Nhiệt độ; pH; TSS; DO, COD; NH_4^+; F^-, S^{2-}; CN-: As, Pb, Cd, Cr^{3+}, Cr^{6+}, Cu, Zn,Hg; Mn, Fe, dầu mỡ, phenol, coliform.	QCVN 10-MT:2015	Quarterly	3
5	Ecology	Aquatic Ecosystem Monitoring	Same points of surface water quality monitoring	Quarterly	Quarterly	-	Zooplankton, phytoplankton, bottom animals, fish spawn-young fish. Aquaculture species, productivity of each species	-	Quarterly	21
		Terrestrial Ecosystems Monitoring	High land, mountainous vegetation Mangrove vegetation	Quarterly in the first year Semi-annually in the following years	Quarterly	-	- Change of highland vegetation area - Change of mangrove vegetation area - Abnormal change of flora development.	-	Quarterly	21
6	Climate	Wind direction and speed; temperature; rainfall and cloud cover	Within site boundaries - refer to WMO / USEPA guidelines to select appropriate points	Continuous with hourly measurements	-	-	Automated self recording instruments	-	Continous measure	

I.3. Monitoring locations

All the environmental monitoring locations are selected by the actual condition of the environment status, are under requirement of the EIA, and mentioned in the MONRE certificate No 42/GXN-TNMT dated 21 April 2015 on completion environment facility.

The survey was conducted before sampling to examine the monitoring points by GPS-Silva-21802-901, Sweden. The coordinates are listed as in **Table 1.3** follows:

Table 1.3. The coordinates of monitoring points in Mong Duong 2 Thermal Power Plant

Item	No	Points	X	Y
I. AIR ENVIRONMENT				
Air ambient (05 points)	K1	Plant area near coal warehouse	21°04'13.4" N	107°20'56.2"E
	K2	Nguyen Trai primary school, Mong Duong ward	21°03'57.5" N	107°19'20.1"E
	K3	Mong Duong secondary school, zone No. 1, Mong Duong ward	21°03'56.2"N	107°20'20.8"E
	K4	Household of Mr. Ha Văn Tien, village 2, Cam Hai commune	21°05'47.6"N	107°21'44.7"E
	K5	Trang Huong Village, Dong Xa Commune, Van Don District (brigage area No.242)	21°03'21.2"N	107°23'26.7"E
II. WATER ENVIRONMENT				
Sanitary waste water (03 points)	SH1	Admin area	21°04'39.6"N	107°21'07.8"E
	SH2	Chemical dosing building	21°04'28.7"N	107°21'09.6"E
	SH3	Coal warehouse area	21°04'11.5"N	107°20'56.5"E
Cooling water (03 points)	CW1	Intake point of cooling water	21°04'32.6"N	107°21'18.5"E
	CW2	Discharge point into the cooling water canal	21°04'28.3"N	107°20'57.1"E
	CW3	Discharge point to common Mong Duong Power complex canal	21°04'42.4"N	107°21'03.1"E

Industrial waste water (01 points)	WW1	Discharge point into the Cooling water canal	21°04'31.1"N	107°21'04.4"E
Surface water (21 points)	MD1	Tran bridge area	21°03'48.0"N	107°19'26.7"E
	MD2	Mong Duong bridge area	21°03'51.5"N	107°20'50.6"E
	MD3	Coal conveyor area of the plant 2	21°04'07.8"N	107°21'00.8"E
	MD4	River gate - discharge to Luong Gac canal	21°04'25.3"N	107°21'41.0"E
	SW12	Cooling water canal head	21°04'39.5"N	107°20'40.6"E
	SW13	Behind cooling water outlet of Mong Duong 1 Thermal Power Plant	21°04'43.4"N	107°20'50.9"E
	SW14	Behind cooling water outlet of Mong Duong 2 Thermal Power Plant	21°04'48.3"N	107°21'04.4"E
	SW15	Cooling water channel	21°05'05.0"N	107°21'41.0"E
	SW16	Cooling water channel	21°05'05.0"N	107°21'57.3"E
	SW17	End of cooling water channel, before pouring in to Luong Gac canal	21°05'21.4"N	107°22'22.8"E
	SW1	*SW1*	21°05'43.1"N	107°22'50.4"E
	SW2	*SW2*	21°05'17.4"N	107°23'07.2"E
	SW3	*SW3*	21°03'41.8"N	107°22'35.2"E
	SW4	*SW4*	21°04'08.9"N	107°22'02.9"E
	SW5a	*SW5a*	21°05'12.8"N	107°22'42.7"E
	SW5b	*SW5b*	21°04'45.6"N	107°22'11.5"E
	SW6	*SW6*	21°03'05.7"N	107°22'14.6"E
	SW7	*SW7*	21°03'12.3"N	107°22'49.0"E
	SW8	*SW8*	21°05'42.5"N	107°22'16.0"E
	SW9	*SW9*	21°05'31.0"N	107°22'36.2"E
	SW10	*SW10*	21°04'59.0"N	107°22'36.3"E

	SW11	*SW11*	21°03'49.2"N	107°22'09.2"E
	SW18	*SW18*	21°04'33.7"N	107°21'21.3"E
	SW19	*SW19*	21°04'33.5"N	107°21'42.5"E
Ground water (20 points)	GW08	Drilled wells water in household of Mr Nguyen Cong Thuc – village 2, hamlet 2, Cam Hai commune	21°05'45.1"N	107°21'50.9"E
	PW02	Dug wells water in household of Mr Ngo Gia Dinh – Group 9, zone 8, Mong Duong ward	21°05'06.1"N	107°21'01.7"E
	PW08	Drilled wells water in household of Mr Hoang Van Quang – Group 7, zone 8 , Mong Duong ward	21°04'28.3"N	107°20'00.2"E
	PW03	Dug wells water in collective zone of Khe Cham coal company – Group 1, zone 9, Mong Duong ward	21°04'14.8"N	107°19'23.6"E
	PW04	Dug wells water in household of Mr Hoang Dinh Thang – Group 4, zone 5, Mong Duong ward	21°03'53.1"N	107°19'30.2"E
	PW07	Dug wells water in household of Mr Pham Van Xa – Group 4, zone 1, Mong Duong ward	21°03'47.8"N	107°20'27.7"E
	GW01-D	Dug wells water in household of Mrs. Nguyen Thi Mai – Village 5, zone 11, Mong Duong ward	21°03'53.2"N	107°20'49.4"E
	PW06	Drilled wells water in household of Mr Nguyen Chi Thin – Trang Huong village, Doan Ket commune, Van Don district	21°04'15.0"N	107°23'23.6"E
	GW10-D	GW10-D: Drilled wells water in household of Mr Tu Van Hong – Trang Huong village, Doan Ket commune, Van Don district	21°04'15.1"N	107°23'41.5"E
	GW09	GW09: Drilled wells water in household of Mr Tu Van Tinh - Trang Huong village, Doan Ket commune, Van Don district	21°04'08.7"N	107°23'37.6"E
	PW05	PW05: Drilled wells water in household of Mr Tu Van Hai - Trang Huong village, Doan Ket commune, Van Don district	21°03'47.8"N	107°23'28.5"E
	GW06	Around ash pond 1- downstream	21°04'57.5"N	107°21'41.7"E
	GW11	Around ash pond 1- downstream	21°04'54.6"N	107°21'43.4"E

	GW07	Around ash pond 1- down-stream	21°04'52.7"N	107°21'44.7"E
	GW05	Around ash pond 1- upstream	21°04'49.2"N	107°21'29.8"E
	PW01	Underground water wells near distribution station	21°04'31.8"N	107°20'55.2"E
	GW02	Underground water wells near coal warehouse	21°04'18.1"N	107°21'02.7"E
	GW03	Near fence of plant and near intake point of cooling water	21°04'37.5"N	107°21'13.6"E
Ash pond leachate (03 points)	R1	Leachate from ash pond near GW 07	21°04'51.0"N	107°21'45.5"E
	R2	Leachate from ash pond near GW 06	21°04'58.4"N	107°21'42.7"E
	R3	Water from as pond number 1 of plant	21°04'51.6"N	107°21'42.2"E
III. NOISE				
Noise (20 points) Eliminate two noise positions including number 5 and number 9 from Noise map de-sign by Doo-san	N1	Bus, heave equil parking area	21°04'40.2"N	107°21'07.5"E
	N2	Outside plant near with lay-down area	21°04'38.5"N	107°21'14.7"E
	N3	Main access road	21°04'30.8"N	107°21'18.9"E
	N4	Outside plant near with fuel oil tank	21°04'23.0"N	107°21'11.0"E
	N5	Near the east side of the coal warehouse	21°04'08.3"N	107°20'56.4"E
	N6	Near the south side of the coal warehouse	21°04'06.6"N	107°20'46.9"E
	N7	Near the west side of the coal warehouse	21°04'09.8"N	107°20'38.8"E
	N8	Outside plant near with mill plant #2	21°04'23.8"N	107°20'54.1"E
	N9	Outside plant near with cooling water discharging position	21°04'32.7"N	107°20'58.2"E
	N10	Near with outlet #1	21°04'40.0" N	107°21'02.8"E
	N18	Near residental region, about 1000m from the North West of	21°04'44.8" N	107°20'39.2"E

		plant (near EVN operator house)		
	N19	Near residental region, about 500m from the East of plant (near Mong Duong temple)	21°04'28.2" N	107°21'26.6"E
	N20	Area between boiler and emission treatment area of set of machinery #1 and #2	21°04'23.5" N	107°21'00.3"E
	N21	Base of stack	21°04'18.6" N	107°20'59.5"E
	N22	Side entrance into coal store (about 200m from base of stack)	21°04'13.4" N	107°20'59.5"E
	N23	Fencing wall between Mong Duong 1 thermal power plant and coal conveyor area of Mong Duowng 2 thermal power plant (about 200m from the West of base of stack)	21°04'15.4" N	107°20'54.6"E
	N24	Outside of FGD water treatment house (about 200m from the East of base of stack)	21°04'22.7" N	107°21'07.7"E
	N25	Road between FGD water treatment house and Chemical store (about 400m from the East of base of stack)	21°04'26.3" N	107°21'09.0"E
	N26	Front of door of operator house	21°04'37.9" N	107°21'06.8"E
	N27	Road which leads to plant – outside discharge channel near EVN Building	21°04'40.6" N	107°20'40.5"E
IV. AQUATIC ORGANISM				
21 sampling points of aquatic organism are the same with the surface water samplers				

I.4. Environmental monitoring method and equipment/instruments

Main environmental monitoring methods are:

✓ Surveying, collecting data, sampling, on-field measurement of environmental parameters.

✓ Sampling, preservation and measurement on-field and laboratory in compliance with current Vietnamese standards, circulars and regulations.

✓ Data processing and evaluation, statistical method in comparison to QCVN/TCVN and international standards.

Methods for measurement, sampling and preservation; equipment/instruments are detailed in **Table 1.4 and Table 1.5** according with:

Table 1.4. Method for on-field measurement, sampling and preservation

No	Environmental components	Name/ number of sampling and measurement methods	Equipment/LOD
Ambient air			
1	Temp	QCVN 46:2012/BTNMT	0°C – 180°C
2	Humidity	QCVN 46:2012/BTNMT	0 – 100% RH
3	Wind speed	QCVN 46:2012/BTNMT	0 – 60m/s
4	Wind direction	QCVN 46:2012/BTNMT	0 – 360°
5	TSP (Average 24hrs)	TCVN 5067:1995	Dust sampling equipment with high volume Staplex Model TFIA-2 FCDT
6	PM10 (đo TB 24h)	AS/NZS 3580.9.6:2003	Dust PM10 Samplers, Airmetric-TAS PM10-USA
7	CO	SOP-CO	Equipment for gas sampling multifunction, Kimoto HS-7 Flow Sampling: .,5-2 liter/min
8	SO_2	MASA Method 704A	
9	NO_2	MASA Method 406	
Noise			
1	Noise (LAeq)	TCVN 7878-2:2010	30-130 dB
Surface water		TCVN 6663-1:2011, TCVN 6663-3:2008, TCVN 5994-1995, TCVN 6663-6:2008, ISO 19458	
1	Temp	TCVN 4557:1988	0 - 80°C
2	pH	TCVN 6492:2011	0 - 14
3	Conductivity (EC)	SMEWW 2510:2012	0 - 100 mS/cm
4	Dissolved oxygen (DO)	TCVN 7325 : 2004	0 - 16 mg/l

Wastewater		TCVN 6663-1:2011, TCVN 5999:1995, TCVN 6663-3:2008	
1	Temp	TCVN 4557:1988	0 - 80°C
2	pH	TCVN 6492:2011	0 – 14
Coastal water		TCVN 6663-1:2008, TCVN 6663-3:2008, TCVN 5998:1995	
1	pH	TCVN 6187-2:1996	2-12
2	Temp	SMEWW 2550B:2012	0-80°C
3	Conductivity (EC)	SMEWW 2510B:2012	0-100 mS/cm
4	Dissolved oxygen (DO)	TCVN 7325:2004	0-16 mg/l
Ground water		TCVN 6663-1:2011, TCVN 6663-11:2011, TCVN 6663-3:2008	
1	Temp	SMEWW 2550B:2012	0-80°C
2	pH	TCVN 6492:2011	2-12
Aquatic organism			
	- Qualitative and quantitative sampling of plankton (zooplankton, phytoplankton) by the pyramid scoop nets. - Qualitative and quantitative sampling of benthos by trawl nets, handy racket		

Table 1.5. Analytical methods in the Laboratory

No	Environmental Components	Name/ number of analytical methods	MDL/LOD
AMBIENT AIR			
1	Total suspended particulate (TSP)	TCVN 5067:1995	0.01mg/m^3
2	PM10 Dust	AS/NZS 3580.9.6:2003	0.01mg/m^3
3	CO	SOP-PT-01	1 mg/m^3 2.8 mg/m^3-16.8 mg/m^3
4	SO_2	MASA 704A:1988 (TCVN 5971:1995)	1.3 µg/m^3
5	NO_2	MASA 406 (TCVN 6137:2009)	0.1µg/m^3 2 – 6.7 µg/m^3
WASTE WATER			
1	Colour	TCVN 6185:2008	5 Pt -Co

2	BOD_5 (20^OC)	TCVN 6001–1:2008	2 mg/L
3	COD	SMEWW 5220 C:2012	2 mg/L
4	Total suspended solid (TSS)	TCVN 6625:2000	2 mg/L
5	TDS	SOP-TDS	0 - 1.999mg/L
5	Arsenic (As)	EPA 200.8	1.26 µg/L
6	Mercury (Hg)	EPA 200.8	0.72 µg/L
7	Lead (Pb)	EPA 200.8	0.72 µg/L
8	Cadimi (Cd)	EPA 200.8 TCVN 6193:1996	0.6 µg/L 0.006 mg/L
9	Chrome VI (Cr^{6+})	TCVN 6658 : 2000	2.3 µg/L
10	Chrome III (Cr^{3+})	TCVN 6658 : 2000	2.3 µg/L
11	Copper (Cu)	EPA 200.8 TCVN 6193:1996	9.15 µg/L 0.013 mg/L
12	Zinc(Zn)	EPA 200.8 TCVN 6193:1996	1.59 µg/L 0.014 mg/L
13	Nikel (Ni)	EPA 200.8 TCVN 6193:1996	3.21 µg/L 0.022 mg/L
14	Mangan (Mn)	EPA 200.8	3.87 µg/L
15	Iron (Fe)	EPA 200.8	5.31 µg/L
16	Mineral Oil	EPA 1664	0.3 mg/L
17	Florua (F-)	TCVN 6494-1:2011	>0.1mg/L
18	Sulfide (calculated by H_2S)	SMEWW 4500-S^{2-} D:2012	0.03 mg/L
19	Total Nitrogen	TCVN 6638:2000	3 mg/L
20	Total Phosphorus	TCVN 6202: 2008	0.017 mg/L. 0.05 – 4mg/l
21	Residual Chlorinate	TCVN 6225 – 3:2011	0.17 mg/L
22	Ammonium (Calculated by N)	SMEWW 4500-NH_4^+-F	0.23 mg/L
		TCVN 6179-1:1996	0.3 mg/L
25	Coliforms	TCVN 6187-2:1996	3 MPN/100mL
SURFACE WATER			
1	Colour	TCVN 6185: 2008	5 Pt -Co
2	DO	TCVN 7325:2004	0 - 16 mg/L
3	Total suspended solids (TSS)	TCVN 6625 : 2000	2 mg/L
4	BOD_5 (20^OC)	TCVN 6001–1:2008	2 mg/L
5	Ammonium NH_4^+	SMEWW 4500-NH_4^+-F	0.018 mg/L
		TCVN 6179-1:1996	0.030 mg/L
6	Asenic (As)	EPA 200.8	0.33 µg/L
7	Mercury (Hg)	EPA 200.8	0.3 µg/L
8	Lead (Pb)	EPA 200.8	0.27 µg/L
9	Cadimi (Cd)	EPA 200.8	0.09 µg/L
10	Chrome	EPA 200.8	0.87 µg/L
11	Copper (Cu)	EPA 200.8	1.11 µg/L
12	Zinc (Zn)	EPA 200.8	0.39 µg/L
13	Nikel (Ni)	EPA 200.8	1.14 µg/L
14	Mangan (Mn)	EPA 200.8	3.87 µg/L

15	Iron (Fe)	EPA 200.8	1.86 µg/L
16	Selen (Se)	EPA 200.8	1.05 µg/L
17	Total Oil & grease	SMEWW 5520B	0.3 mg/L
18	Coliform	TCVN 6187-2:1996	3 MPN/100mL
COASTAL WATER			
1	BOD_5	TCVN 6001:2008	2 mg/l
2	TSS	TCVN 6625:2000	2 mg/l
3	Nitrate (NO_3^--N)	SMEWW 4500 NO_3^-	0,01mg/l
4	Total nitrogen	TCVN 6638:2000	3 mg/l
5	Total Phosphorus	TCVN 6202: 2008	0.017 mg/l
6	Ammonium	SMEWW 4500 NH3.F:2012	0.018 mg/l 0.030 mg/l
7	Asenic (As)	EPA method 200.8	0.33 µg/l
8	Mercury (Hg)	EPA Method 200.8	0.3 µg/l
9	Lead (Pb)	EPA Method 200.8	0.27 µg/l
10	Cadimium (Cd)	EPA Method 200.8	0.18 µg/l
11	Chrome (Cr)	TCVN 6658:2000	2.3 µg/l
12	Copper (Cu)	EPA Method 200.8	1.11 µg/l
13	Zinc (Zn)	EPA Method 200.8	0.39 µg/l
14	Nikel (Ni)	EPA Method 200.8	1.14 µg/l
15	Manganese (Mn)	EPA Method 200.8	1.14 µg/l
16	Iron (Fe)	EPA Method 200.8	1.86 µg/l
17	Selen (Se)	EPA Method 200.8	1.05 µg/l
18	Total Oil and Grease	SMEWW 5520B:2012	0.3 µg/l
19	Coliform	TCVN 6187-2:1996	3 MPN/100ml
GROUND WATER			
1	Asenic (As)	EPA 200.8	0.18 µg/l
2	Mercury (Hg)	EPA 200.8	0.24 µg/l
3	Lead (Pb)	EPA 200.8	0.21 µg/l
4	Cadimium (Cd)	EPA 200.8	0.09 µg/l
5	Chrome (Cr)	EPA 200.8	0.8 µg/l
6	Copper (Cu)	EPA 200.8	0.75 µg/l
7	Zinc (Zn)	EPA 200.8	0.57 µg/l
8	Nikel (Ni)	EPA 200.8	1.14 µg/l
9	Manganese (Mn)	EPA 200.8	1.14 µg/l
10	Iron (Fe)	EPA 200.8	1.35 µg/l
11	Selen (Se)	EPA 200.8	1.05 µg/l
12	SVOC	APHA 6200	0.01 mg/l
13	VOC	APHA 6200	0.01 mg/l
14	TPH	APHA 5200 C, F	0.01 mg/l
15	Coliforms	TCVN 6187-2:1996	3 MPN/100ml
AQUATIC ORGANISM			

1	Zooplankton, Phytoplankton Zoobenthos	Quantified by erythrocytes counting methods Zooplankton samples quantified by counting chamber Bogo-ROV Medium invertebrate and nematodes (Nematoda) according to TCVN 7220-1:2002; TCVN 7220-2:2002; Statistical methods, survey information. Unit Cell/liter with phytoplankton and zooplankton, unit individual/m^3 with zooplankton, individual/m^2 with benthos.

Note:

- TCVN: Vietnamese standards
- SOP-PT: Internal procedures guiding the analysis in the laboratory
- MASA: Methods of Air Sampling and Analysis
- AS/NZS: Australian/New Zealands Standards
- EPA: Environment Protection Agency
- SMEWW: Standard Method for The Examination of Water and Waste Water
- SVOC: Semivolatile Organic Compound
- VOC: Volatile organic compound
- TPH: Total petroleum hydrocarbon

CHAPTER II. RESULTS AND ASSESSMENT

The environmental monitoring program of the first six months, 2016 (second operational year) was conducted continously with the monitoring program in 2015 and this was conducted following all the requirements of designed program in the operation stage of the plant. The monitoring program was carried out monthly from January, Feb, March, April, May, June and this included environmental components: ambient air, noise, emssion, ground water, wastewater, surface water, coastal water, cooling water, leachate from ash pond, ecology (terrestrial ecosystem and aquatic ecosystem) were monitored in compliance with frequency, positions, parameters mentioned in Chapter I.

The monitoring results are shown in the following sections.

II.1. Ambient Air

Ambient air quality monitoring program was conducted preodically including Feb, May 2016 (the second year of the operation stage of the plant) at 5 points as detailed in Table 2.1 follow:

Table 2.1. Positions and coordinates of ambient air samplers

No	Positions	X	Y
K1	Project area near coal store	21°04'134" N	107°20'56.2"E
K2	Nguyen Trai primary school, Mong Duong ward	21°03'57.5" N	107°19'20.1"E
K3	Mong Duong secondary school, zone 1 Mong Duong ward	21°03'56.2"N	107°20'20.8"E
K4	Household of Mr. Ha Van Tien, village 2, Cam Hai commune	21°05'47.6"N	107°21'44.7"E
K5	Trang Huong Village, Dong Xa Commune, Van Don District (brigade area No.242)	21°03'21.2"N	107°23'26.7"E

The results of ambient air monitoring was presented in the periodical environmental report in February, May in 2016 - The result of ambient air monitoring is detailed on the Environmental Monitoring Results Report corresponding to the first 6 months for 2016.

The climate condition, Microclimate in Mong Duong II Plant from January to June 2016 of the operation stage is showed on the table 2.2

Table 2.2. Microclimate condition in the preodical monitoring time in February, May - 2016 in the operation stage of the plant

No	Symbol	Position	Temp (°C)	Humidity (%)	Wind speed (m/s)	Wind direction
February						
1	K1	Project area near coal store	15.6	70.9	1.6	NE
2	K2	Nguyen Trai primary school, Mong Duong ward	16.2	68.6	1.5	NE
3	K3	Mong Duong secondary school, zone 1 Mong Duong ward	15.8	71.1	1.6	NE
4	K4	Household of Mr. Ha Van Tien, village 2, Cam Hai commune	15.1	72.9	1.8	NE
5	K5	Trang Huong Village, Dong Xa Commune, Van Don District (brigade area No.242)	16.0	65.9	1.4	NE
May						
1	K1	Project area near coal store	34.3	71.7	1.4	SE
2	K2	Nguyen Trai primary school, Mong Duong ward	33.1	72.6	1.7	SE
3	K3	Mong Duong secondary school, zone 1 Mong Duong ward	33,0	73.9	1.8	SE
4	K4	Household of Mr. Ha Van Tien, village 2, Cam Hai commune	33.5	73.0	1.2	SE
5	K5	Trang Huong Village, Dong Xa Commune, Van Don District	32.9	71.0	1.2	SE

The ambient air quality in positions of plant is shown through monitoring results with basic parameters as follows:

*** TSP**

TSP contents at the different points and different times during the day were shown in **Figure 2.1.**

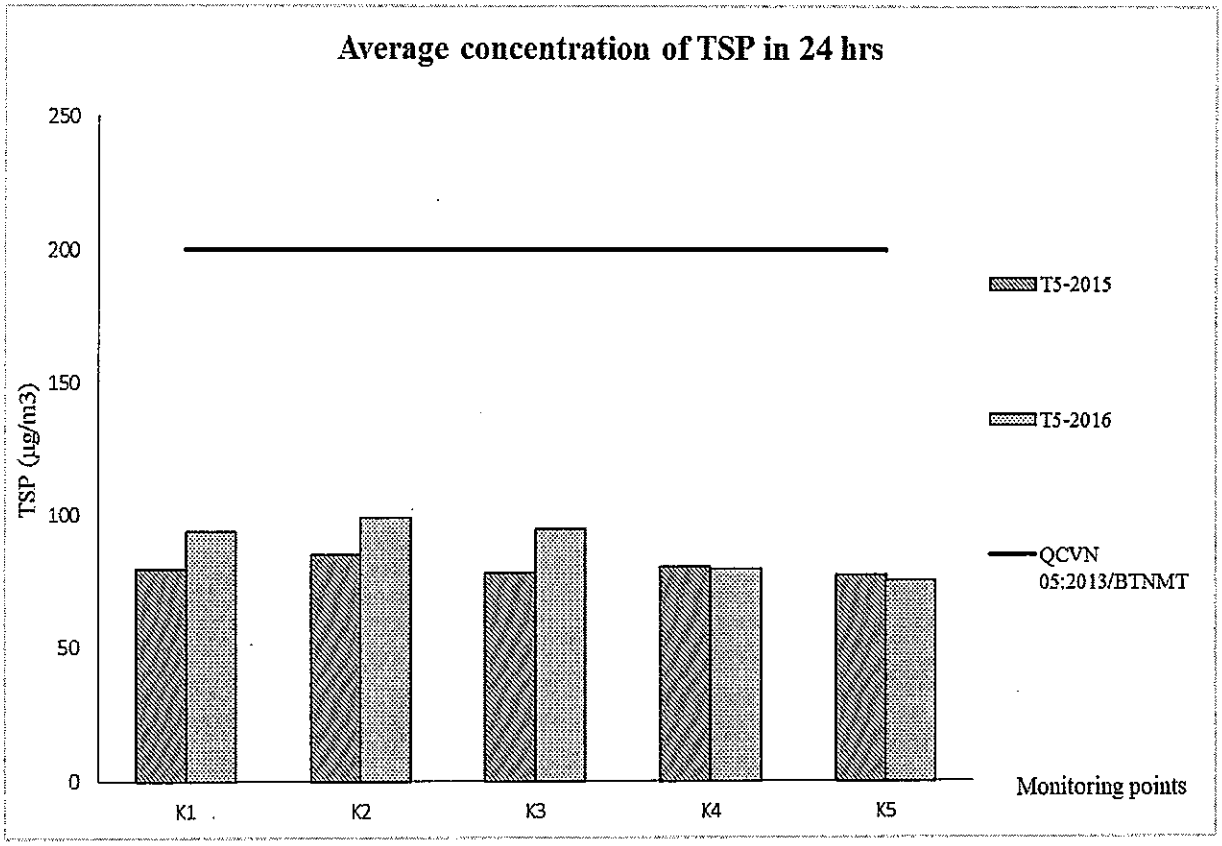

Figure 2.1. The chart of comparion of TSP content at monitoring points in May/2015 - May/2016

The chart of TSP content at the monitoring points shows that there is a difference in TSP's value at 05 points but not much. Moreover, all monitoring points have the TSP's values that are less than the allowed standards. The lowest TSP's value is at K5 because this point is belong to the resident area so it was not affected by the plant's operation.

The K1 point is near the coal store so that it is necessary to have solution to reduce the TSP.

The TSP content of the May 2016 shows increasing slightly compared with this time in 2015. Therefore, it's good signal that the plant is ongoing well and stably.

*** SO_2**

The monitoring results of SO_2 concentration in ambient air are indicated in Figure 2.2 below

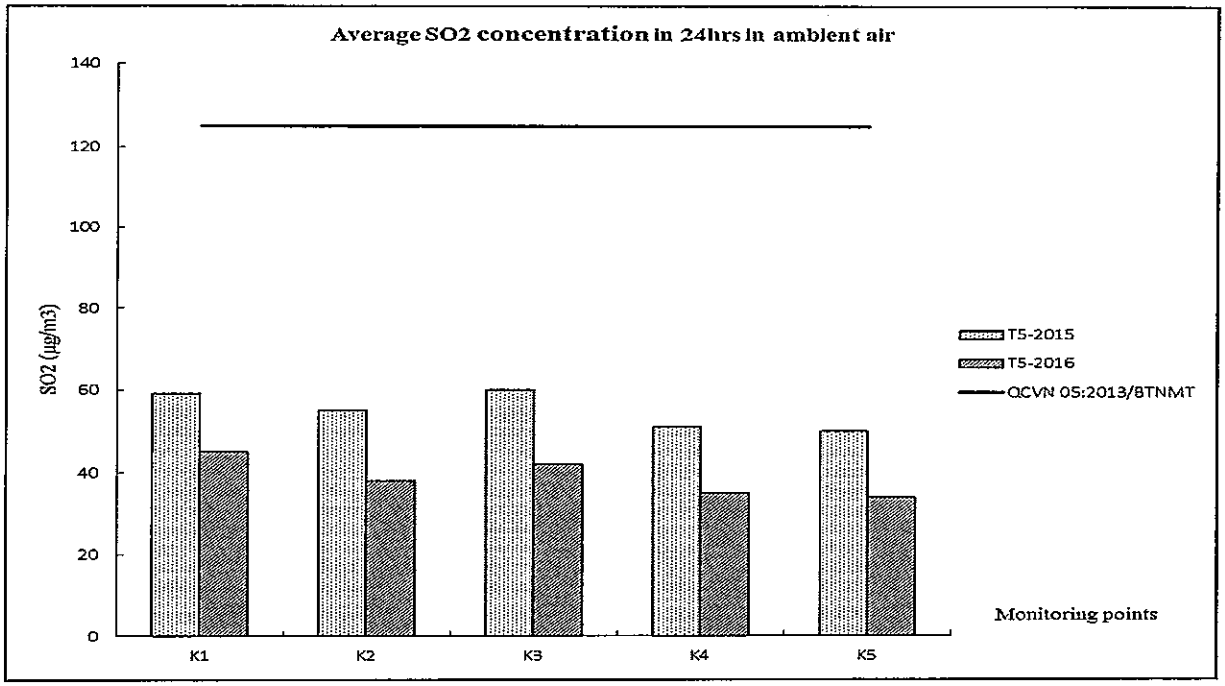

Figure 2.2. The chart of SO_2 concentration at the monitoring points (May-2015 and May-2016)

Chart shows SO_2 concentrations at all monitoring points are smaller than the allowed standard. There is not much difference of SO_2 concentrations at different points. Compared with the same time last year, SO_2 concentrations reduce at all the monitoring points from K1 to K5.

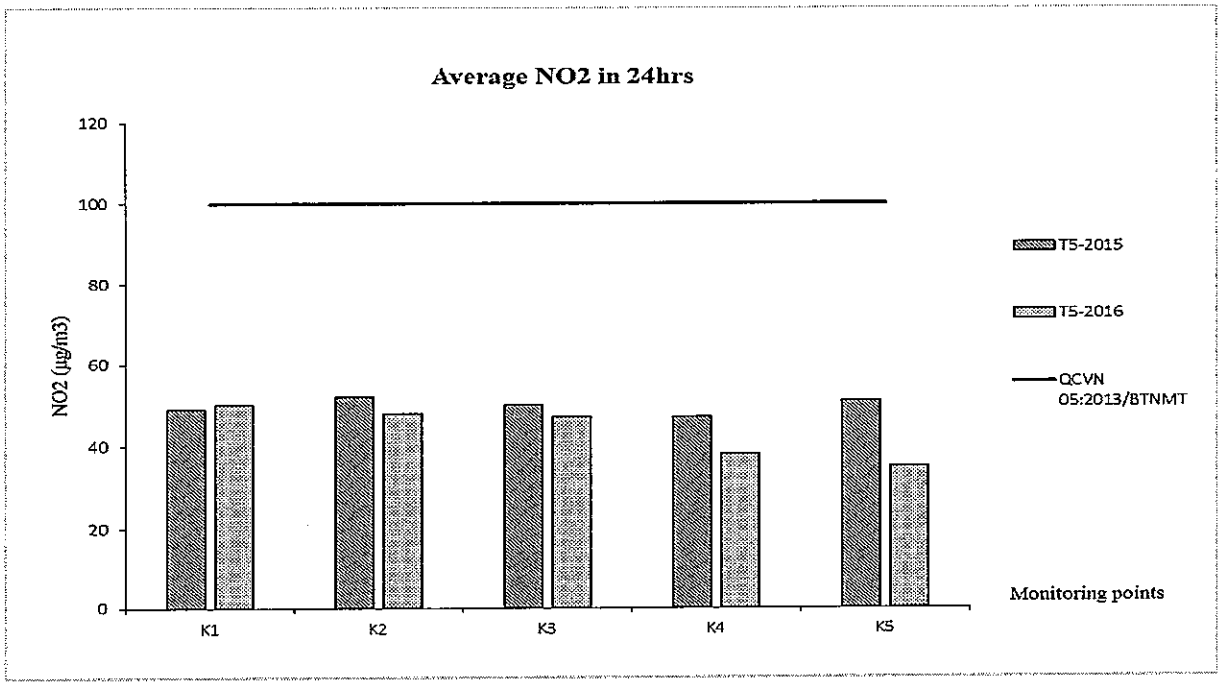

Figure 2.3. NO_2 concentrations at all monitoring points (May-2015 and May-2016)

The chart shows that the NO_2 concentrations at all monitoring points are smaller than allowed standard. There are no fluctuations among the months; even in many points, the NO_2 concentration reduce slightly. Thus, it should be continue to monitor periodically.

In conclusion, ambient air environment in the area of Mong Duong 2 Thermal Power Plant is not polluted by parameters of TSP, CO, SO_2, and NO_2.

II.2. Noise

Noise was measured at the 20 different points in the plant including:

N1: Parking area
N2: Outside plant near with lay-down area
N3: Main road
N4: Outside plant near with fuel oil tank
N5: Near the east side of the coal warehouse
N6: Near the south side of the coal warehouse
N7: Near the west side of the coal warehouse
N8: Outside plant near with mill plant #2
N9: Outside plant near with cooling water discharging position
N10: Near with outlet #1
N18: Near residential area, about 1000 m in the North West of plant (near EVN operation office)
N19: Near residential, about 500m in the East of plant (near temple)
N20: Area between boiler and emission treatment area of set of machinery #1 and #2
N21: Base of stack
N22: Side entrance into coal store (about 200m from base of stack)
N23: Fencing wall between Mong Duong 1 thermal power plant and coal conveyor area of Mong Duowng 2 thermal power plant (about 200m from the West of base of stack)
N24: Outside of FGD water treatment house (about 200m from the East of base of stack)
N25: Road between FGD water treatment house and Chemical store (about 400m from the East of base of stack)
N26: Front of door of operator house
N27: Road which leads to plant – outside discharge channel near EVN building

The noise level results at 18 points in daytime and nightime in the plant and included 2 points outside the plant were presented in the Appendix "Environmental monitoring result for Mong Duong 2 BOT thermal power plant" covering the first sixt month of 2016. The results also shows that almost the noise values at all the monitoring points (N1-N27) are smaller than allowed values in compliance with the QCVN 26:2010/BTNMT standard.

II.3. Air emission

Air emission of the plant was continuously monitored by automated measeremement instrument (CEMS) in order to early warning the incident for timely management. Besides, the environmental monitoring program for air emission is conducted in Feb and May 2016 with the parameters of Dust, CO, SO_2, NO_x in the Unit 1 and 2 Stacks. Monitoring results are compared with emissions standards QCVN 19:2009/BTNMT, QCVN 22:2009/BTNMT column B, C_{max}= 0.56 x C.

It is important to highlight that for access issues to the stack due to an elevator malfuction on May, the periodically measurement was interrupted and re-start on July 2016).

At the time of sampling 2 units were operating normally.

Air emission of monitoring time Feb 2016 was taken at 2 points of stacks after the treatment system of unit 1 & 2. At the time of sampling the unit 1 was operating normally with capacity of 354 MW, the unit 2 capacity of 358 MW. The monitoring results compared with QCVN 22:2009/BTNMT Column B, Cmax = 0.56 xC, is detailed in the Table 2.3 below:

Table 2.3. Monitoring result of air emission

No	Parameters	Unit	Result		QCVN 22:2009/BTNMT	
			S1	S2	*C(Column B)*	*Cmax*
1.	Dust	mg/Nm^3	18.4	13.6	200	112
2.	SO_2	mg/Nm^3	55,4	64.7	500	280
3.	CO	mg/Nm^3	41.5	39.3	1,000	640
4.	NO_x (calculated by NO_2)	mg/Nm^3	326.8	303.2	1,000	560

The result of air emission shows that all the parameters of air emission meet QCVN 22:2009/BTNMT. This means that the air emission and dust treatment system includes NOx treatment system by selective catalytic reduction (SCR), dust treatment by electrostatic precipitators (ESP) and SO_2 treatment by flue-gas desulfurization system (FGD) works with high efficiency.

II.4. Water Environment Quality

II.4.1. Wastewater

The wastewater samples in the monthly monitoring program in 2016 includes 01 industrial wastewater sample and 03 cooling water samples. The quarterly monitoring program (Feb, May) includes 03 sanitary samples and 03 surface water samples at receiving source.

a. Sanitary wastewater

Sanitary wastewater included 3 samples.

SH1: Sanitary wastewater in admin area.

SH2: Sanitary wastewater in Chemical dosing building.

SH3: Sanitary wastewater in coal warehouse area.

In the periodical environmental monitoring program 2016, wastewater samples are monitored quarterly (February, May). However, the wastewater treatment systems still don't work steadily; therefore, sanitary wastewater samples just were taken in February 2016. Since then, in order to avoid the release of unacceptable wastewater into the environment, the Company has been implemented control measures such as inviting consultants for operating the wastewater treatment systems effectivelly. In addition, of that all the domestic wastewater generated has been transported to the authorized thrid party wastewater treatment plant periodically by septic vacuum truck instead of discharging through the canal.

The results of the sanitary wastewater monitoring at the 3 points during the February 2016 monitoring time accoring with the QCVN 14:2008/BTNMT shows exceedance in Ammonium and Coliforms accoring with:

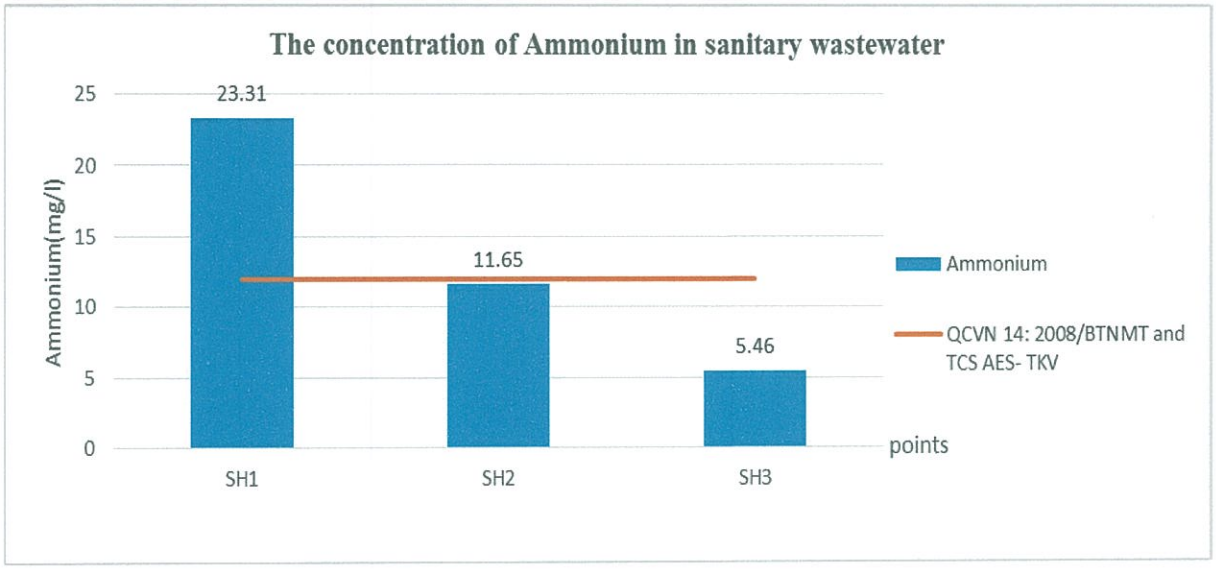

Figure 2.4. The chart of Ammonium in sanitary wastewater in Feb-2016

The results shows that the concentration of Ammonium in point SH1 exceeds the allowed regulations about 1.9 times. While, SH2 and SH3 have the Ammonium concentration that are lower than the standard permissible value. SH3 has the lowest Ammonium concentration and is smaller 2.2 times than allowed standard.

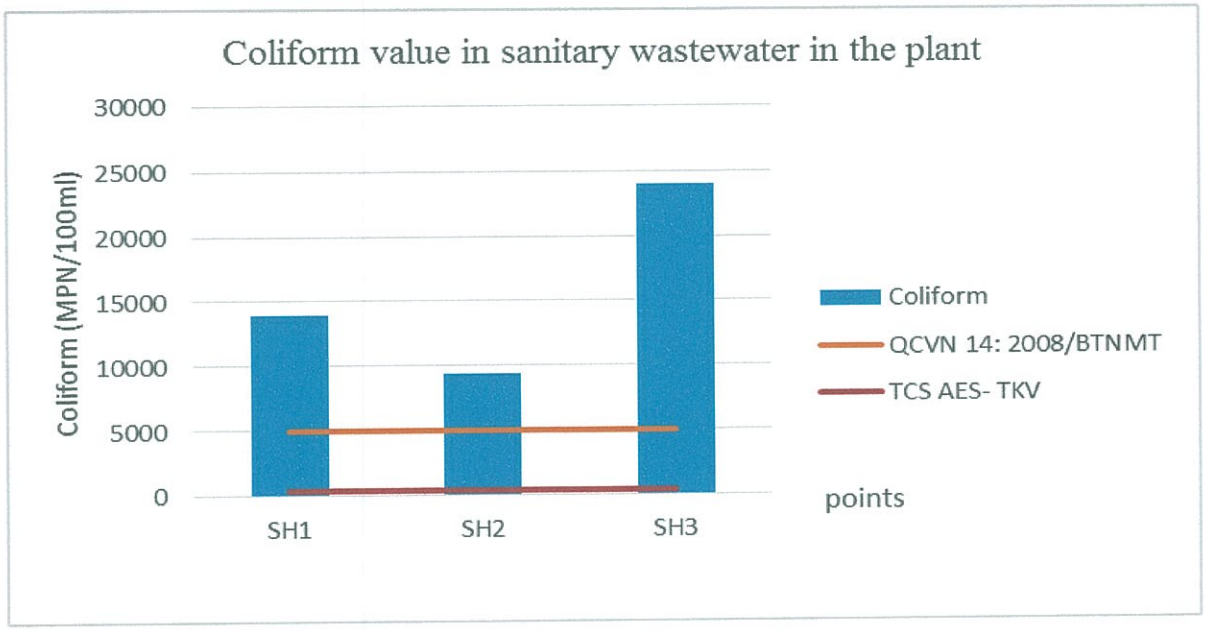

Figure 2.5. The chart of Coliforms content in sanitary wastewater in Feb-2016

Likely Ammonium, Coliform content in sanitary wastewater also exceededs permitted standards (QCVN 14:2008 / BTNMT). Coliform values of the 03 samples are higher than the allowed standards about 2.2 to 12 times.

The rest of the parameters in sanitary wastewater meets the requirements of QCVN 14:2008/BTNMT.

Above parts are the results of monthly monitoring Feb 2016, existing domestic wastewater system is still being calibrated to stable operation. Meantime while it is not achieving the required emissions standards as required in QCVN 14: 2008 / BTMNT, the plant continue to use septic vacuum truck for transport to the authorized third party wastewater treatment instead of discharging through the channel.

b. Industrial wastewater

The sources of the coming into the industrial wastewater treatment system includes irregular wastewater, regular wastewater, and oil contaminated wastewater. The capacity of the treatment system is 110 m^3/h. Wastewater samples at WW1 was taken at the discharging point at the cooling channel during the normal operation

The monitoring results of the months show that all parameters's values of industrial wastewater are smaller than QCVN 40:2011/BTNMT column B. This demonstrates that the industrial wastewater treatment system works extremely well and stable in operation stage of Mong Duong II Thermal Power Plant. Some charts show the fluctuation of main parameters in wastewater (BOD_5, Coliform) of the plant's wastewater over the first 6 months in 2016 and compared them to the same period of 2015.

BOD_5

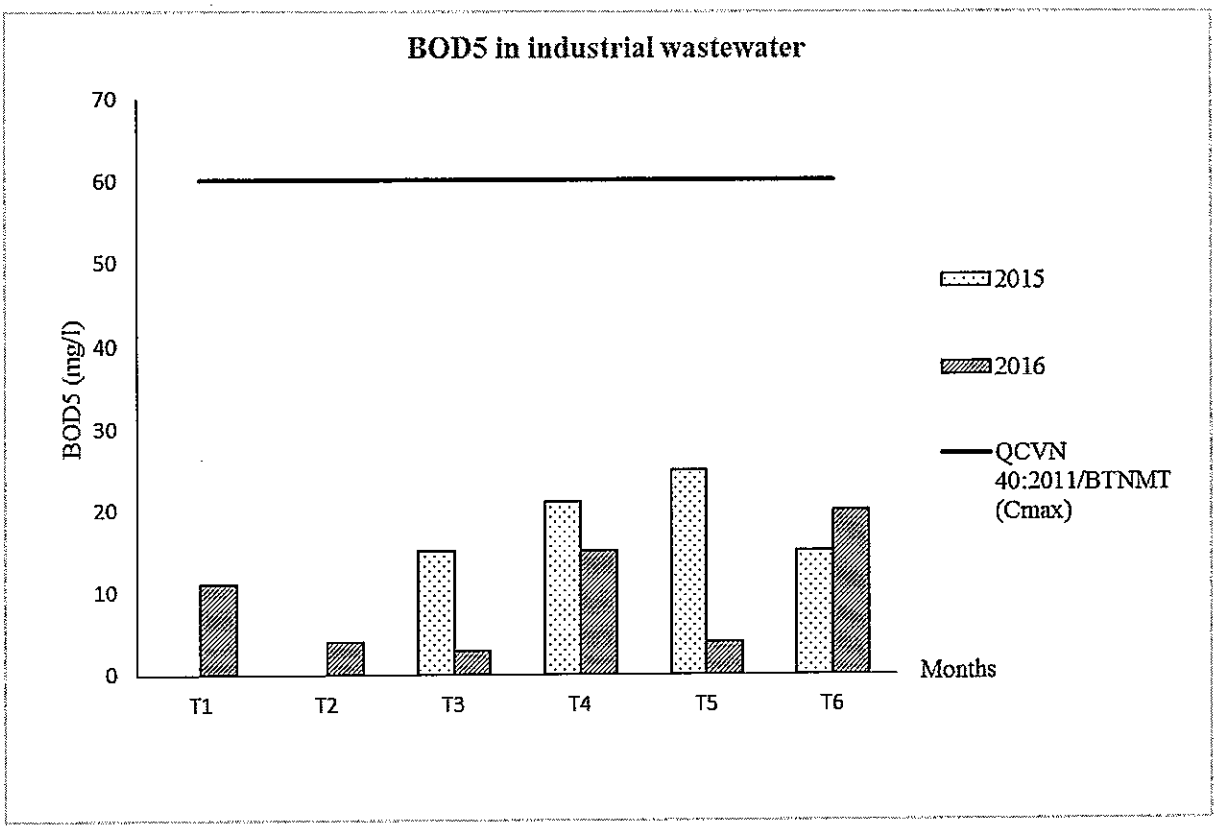

Figure 2.6. The chart of BOD_5 concentration of month Jan-June, 2016 and same time in 2015

Coliform

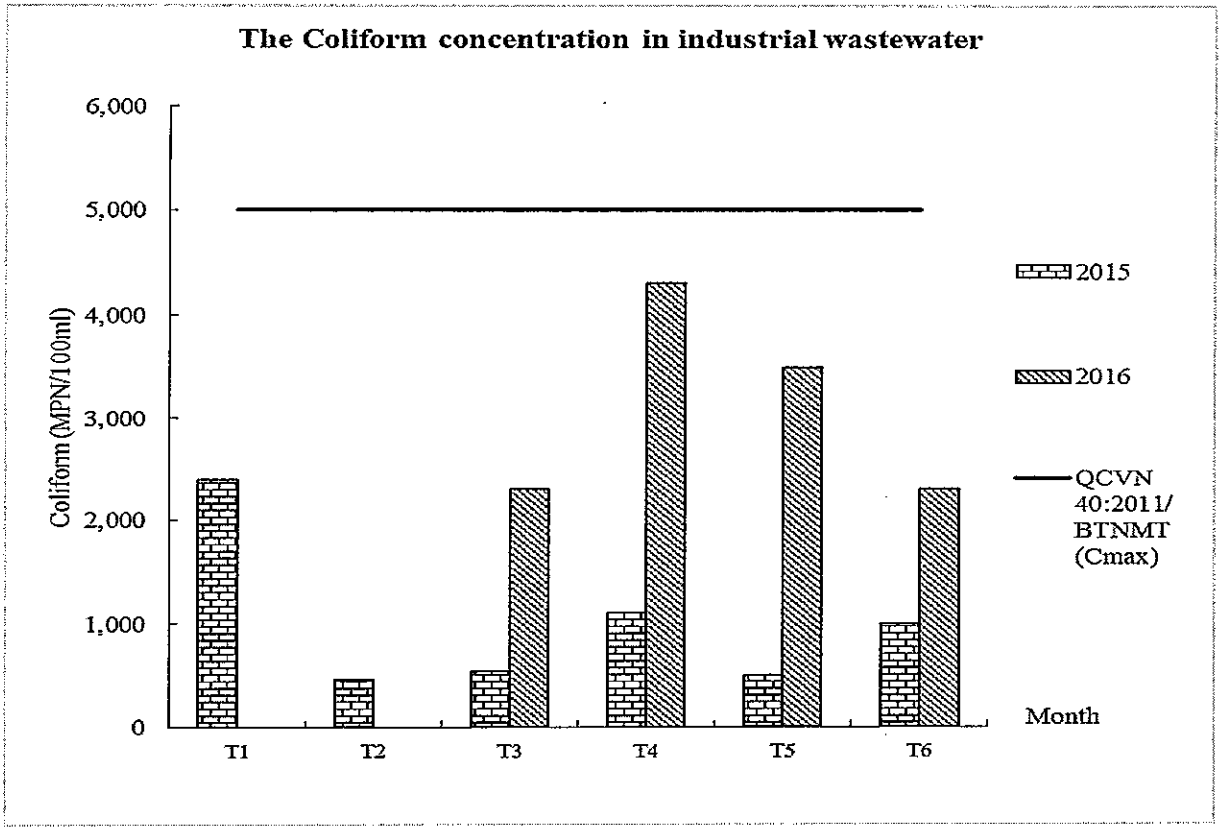

Figure 2.7. The chart of Coliform content in industrial wastewater of the plant in the months Jan-June, 2016 and the same time in 2015

Like two parameters above, other parameters of industrial wastewater meet QCVN 40:2011/BTNMT. It means that the industrial wastewater treatment system operate effectivelly.

II.4.2. Cooling Water

To evaluate the quality of the cooling water supply for the plant as the output of discharging systems; the cooling water samples were taken at 03 positions at intake points of cooling water, discharge point into the cooling water channel and discharge point to common Mong Duong power complex channel. The detailed positions are:

- CW1: Intake point of cooling water.
- CW2: Discharge point into the cooling water channel.
- CW3: Discharge point to common Mong Duong Power complex channel.

At the time of sampling, the plant was operated normally and the flow of cooling water was about 4,000,000 m^3/day-night. According to design requirements as well as the characteristics of the cooling water, two (02) parameters need to bestrictly controlled like temperature and residual chlorine concentration that their values are under

weekly control and monitoring. In addition, the quality of the cooling water is compared with QCVN 40:2011/BTNMT- National technical regulation on industrial wastewater column B and the results is showed in the graph below.

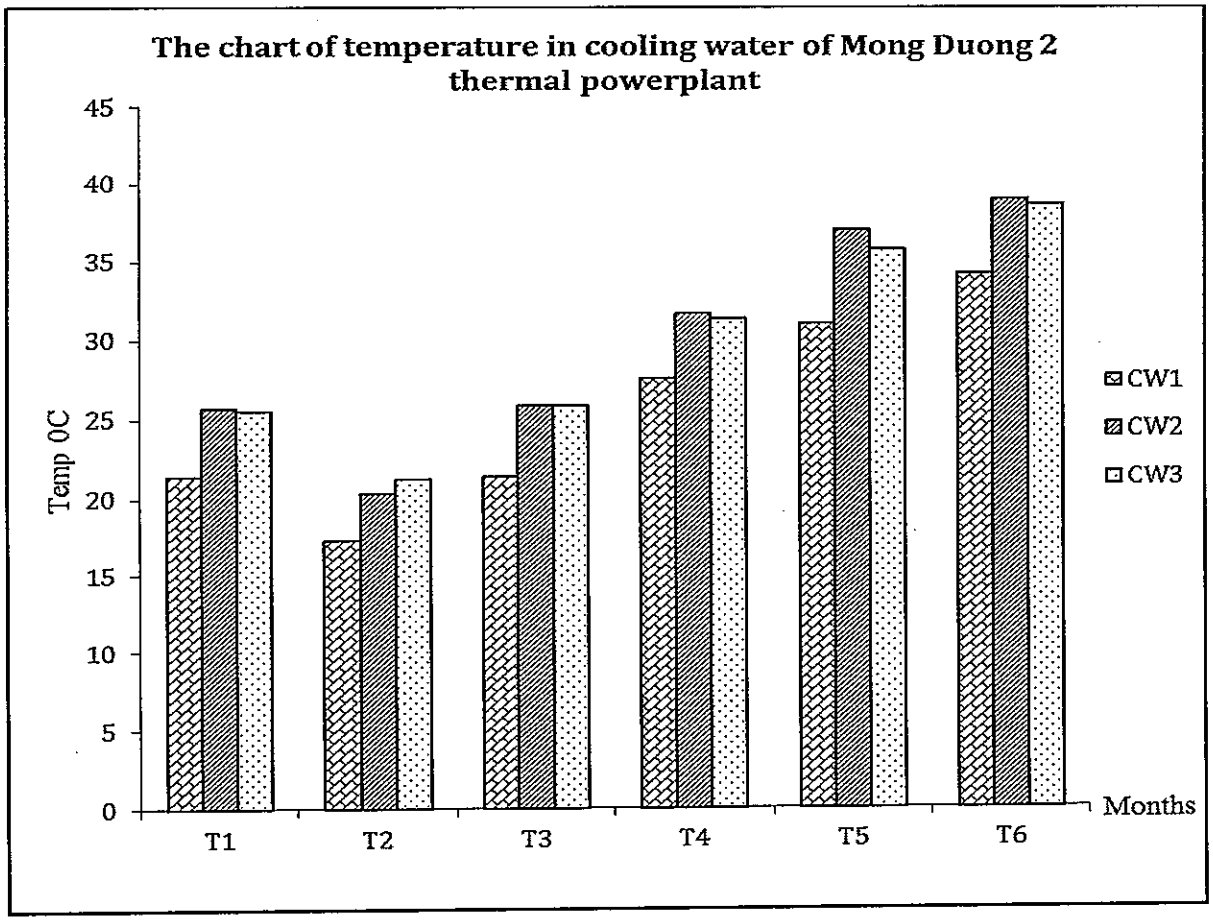

Figure 2.8. The chart of Temperature in cooling water through Jan-June, 2016

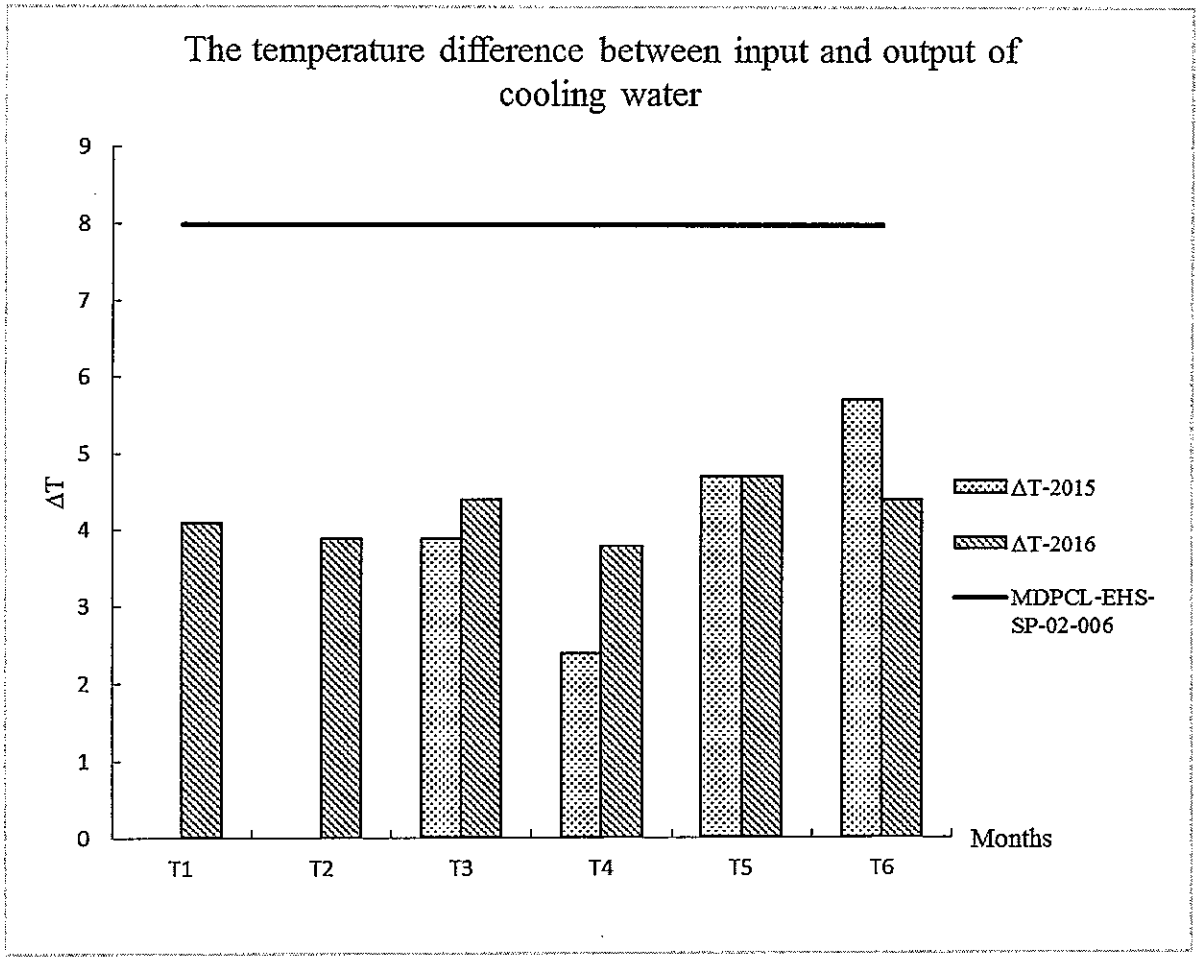

Figure 2.9. The difference of temperature between the input and output of cooling water through months Jan-June, 2016 and the same time in 2015

The graph shows that the temperature values at 3 monitoring positions are smaller than 40°C. The temperature increases from January to July because of the influence of environmental temperature, however we can see that the quality of cooling water has been stricted managed in order to ensure that the temperature value complies with the operational standards of the plant. It means that the temperature always is smaller than 40°C and temperature difference between the input and the output does not exceed 8°C. In addition, residual chlorine concentration in cooling water is also monitored on weekly basis from January to June and the result is quite low, around 0.2 mg /l. Besides, the values of the rest of parameters meet QCVN 40: 2011/BTNMT.

II.4.3. Surface water

Environment Surface Water around the Mong Duong Thermal Power Plant area have been monitored on quarterly bases (February - May 2016) during operation phase and it has been included 03 surface water samples.

- SW1: The upper point of receiving waste water from Luong Gac cannal

- SW17: The point of receiving waste water of Luong Gac cannal
- SW5a: The down point of receiving waste water from Luong Gac cannal

In addition, 21 surface water samples were monitored quarterly in February and May 2016 in order to evaluate periodically the level of influence of regional wastewater discharged into environment.

The monitoring results of surface water samples indicate that the majority of parameters' value are smaller than the allowed standards QCVN 08:2008/BTNMT B1 column about several times, except for the parameters Ammonium (see graph Figure 2.10). It is imporatant to remark that particularly for surface water monitoring results, temperature of the cooling water was always maintained stable , do not exceed the 40°C following QCVN requirement.

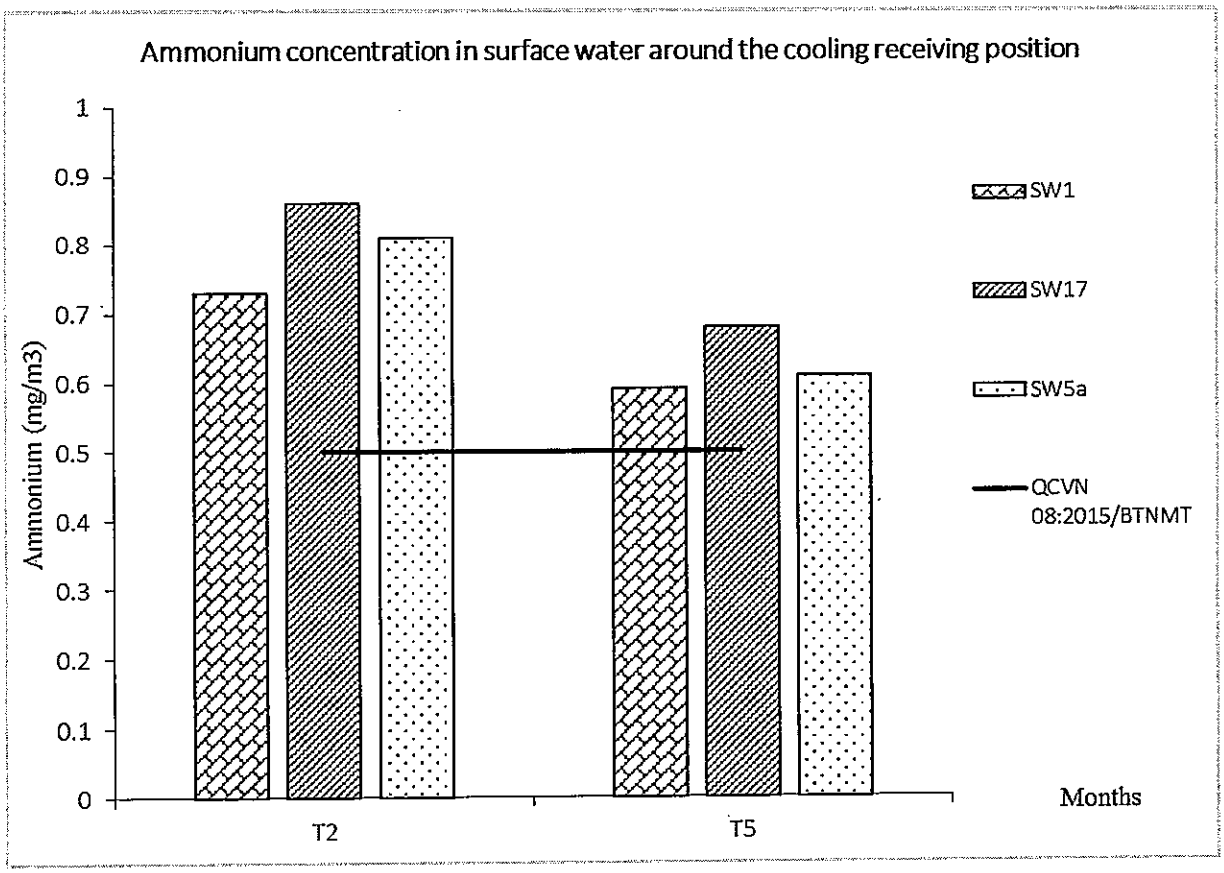

Figure 2.10. The chart of Ammonium concentration in surface water in February and May 2016

The graph shows that the Ammonum concentration in surface water samples are higher from 1 to 1.5 times than the allowed standard (QCVN 10-MT: 2015/BTNMT) .

Wastewater and cooling water discharge into the environment from the plant have reached the requirement QCCP in all parameters, but the quality of surface water at cooling receiving point is polluted by Ammonium. Therefore, we can conclude that the reason of water pollution is not due to plant operation; however, plant should con-

tinue to monitor and supervise other sources poured into the basin to have timely preventive measures.

II.4.4. Coastal water

The quality of coastal water were assessed quarterly (February and May) and it's included 14 samples: SW1, SW2, SW3, SW4, SW5a, SW5b, SW6, SW7, SW8, SW9, SW10, SW11, SW18, SW19.

The monitoring results showed that most of the parameters in coastal water are under the allowed standards with the exception of Ammonium and Iron. The values of Ammonium and Iron are higher than the permitted standards (see chart 2.11 and 2.12).

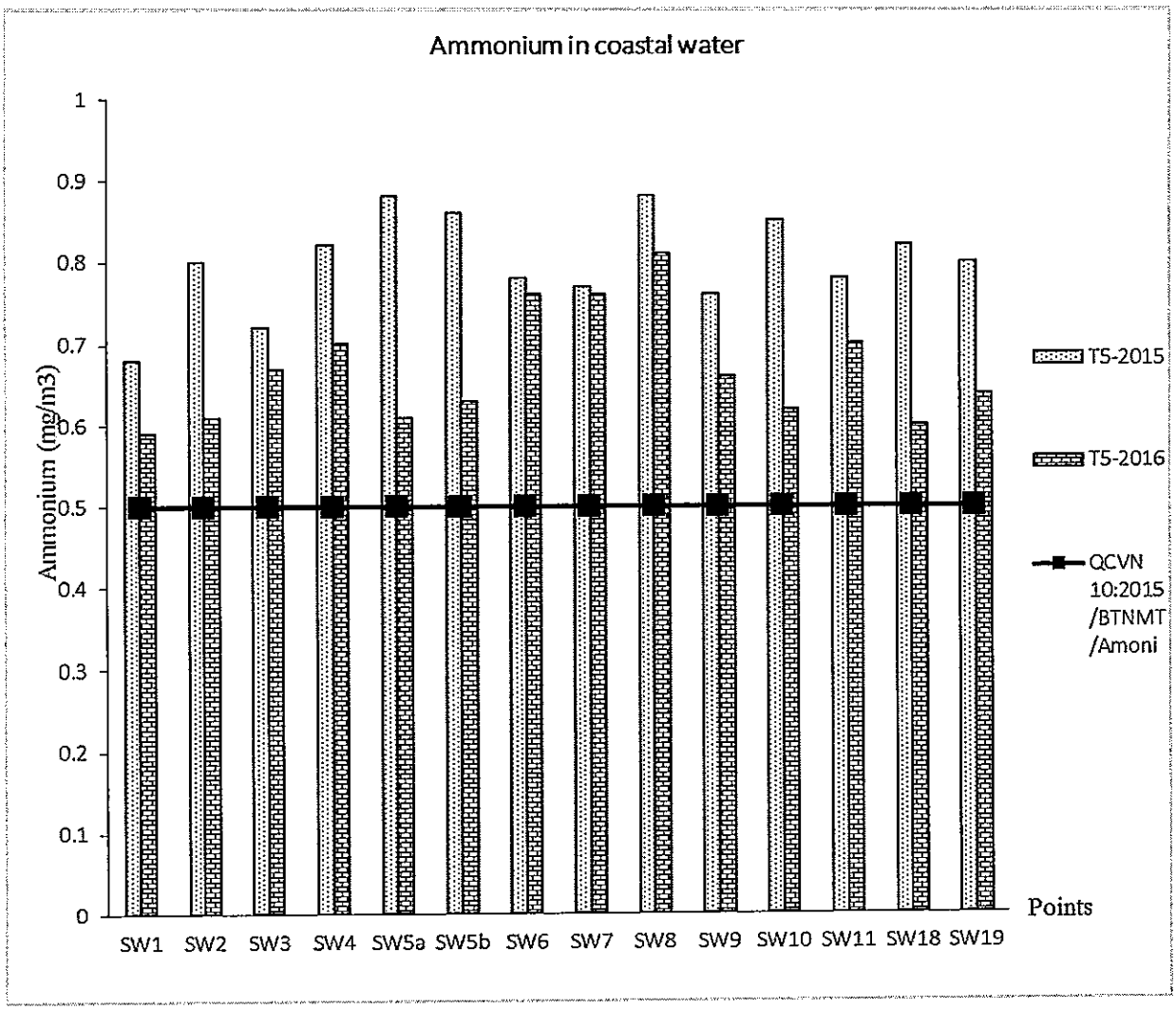

Figure 2.11. The chart of Ammonium concentration in coastal water in May-2016 and the same time in 2015

The graph shows that Ammonium concentration in coastal water samples exceeds permitted standards QCVN 10-MT: 2015 / BTNMT from 1 to 1.5 times. Ammonium concentrations between samples are fairly and the difference are not much.

Compared to the same period last year (2015), we can see the concentration of Ammonium in the same point decreases slightly.

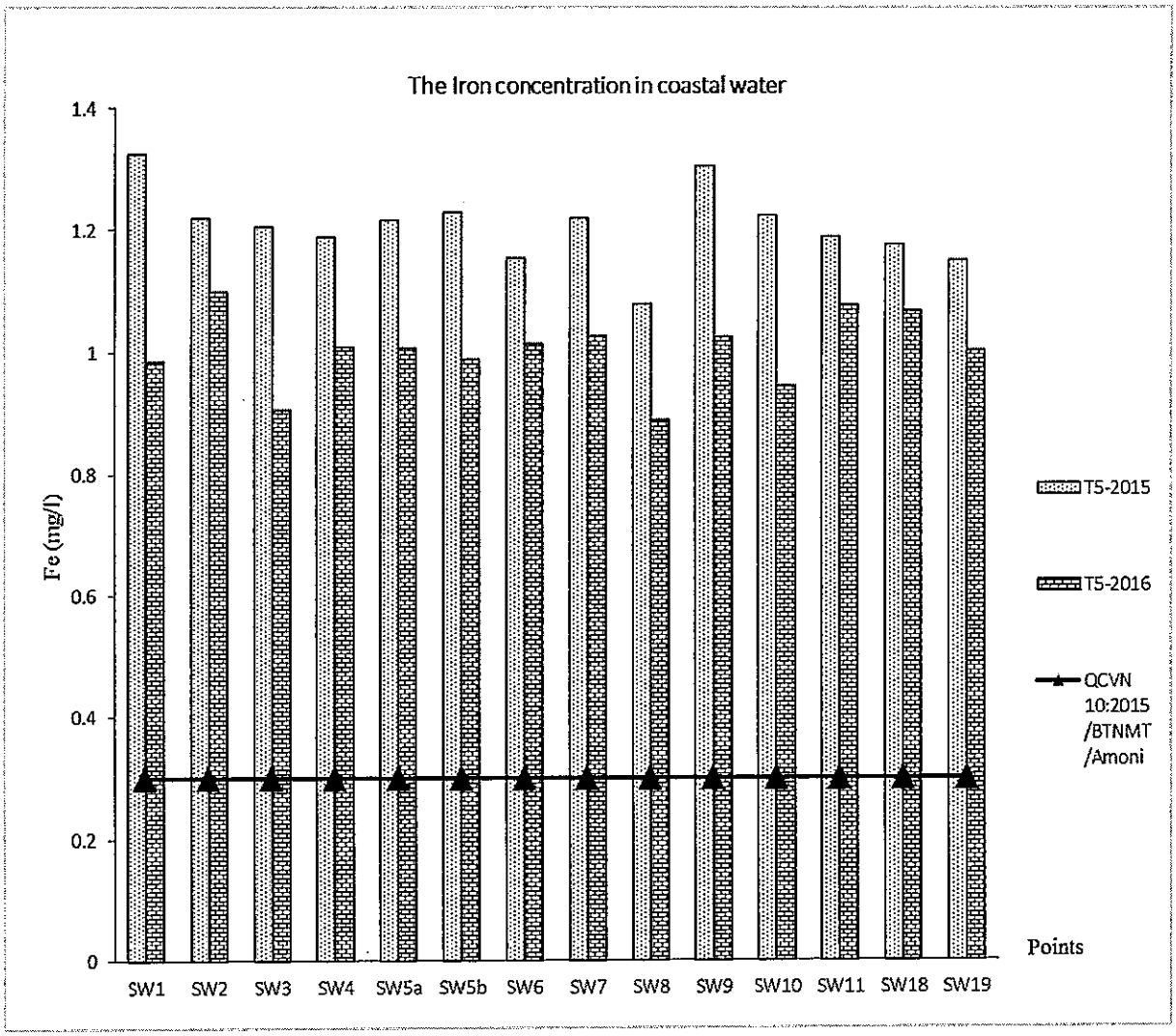

Figure 2.12. The chart of Iron concentration in coastal water in May-2016 and the same time in 2015

The chart shows the values of Iron concentration in coastal water samples are high and exceed the standards from 1.5 to more than 3 times. The difference of Iron concentration in coastal water samples are not much. Compared to the same period in 2015, the Iron concentration decreases slightly but still beyond QCVN 10-MT: 2015/BTNMT.

The characteristics of the cooling water and wastewater of the plant always meet the standards values, so we can conclude that the cause of the pollution of Ammonium, Iron in coastal water is not due to activities of the plant operation activities. However, the proposal to continue monitoring and supervising other waste resources pouring into the basin to have timely preventive measures.

II.4.5. Ground water

Groundwater monitoring is conducted periodically 1 time/year on May-2016. Groundwater samples in the Mong Duong 2 Thermal Power Plant were taken at 04 wells. In these wells, groundwater samples were taken at different depths. Some other ground water samples were taken in the residential areas around the plant. The total number of groundwater monitoring samples were 20.

Monitoring results shows that most of the values of the parameters are under allowed standards with the exception of Manganese, Iron, Coliform and Mercury as you can see in the chart figure **2.13, 2.14, 2.15, 2.16**).

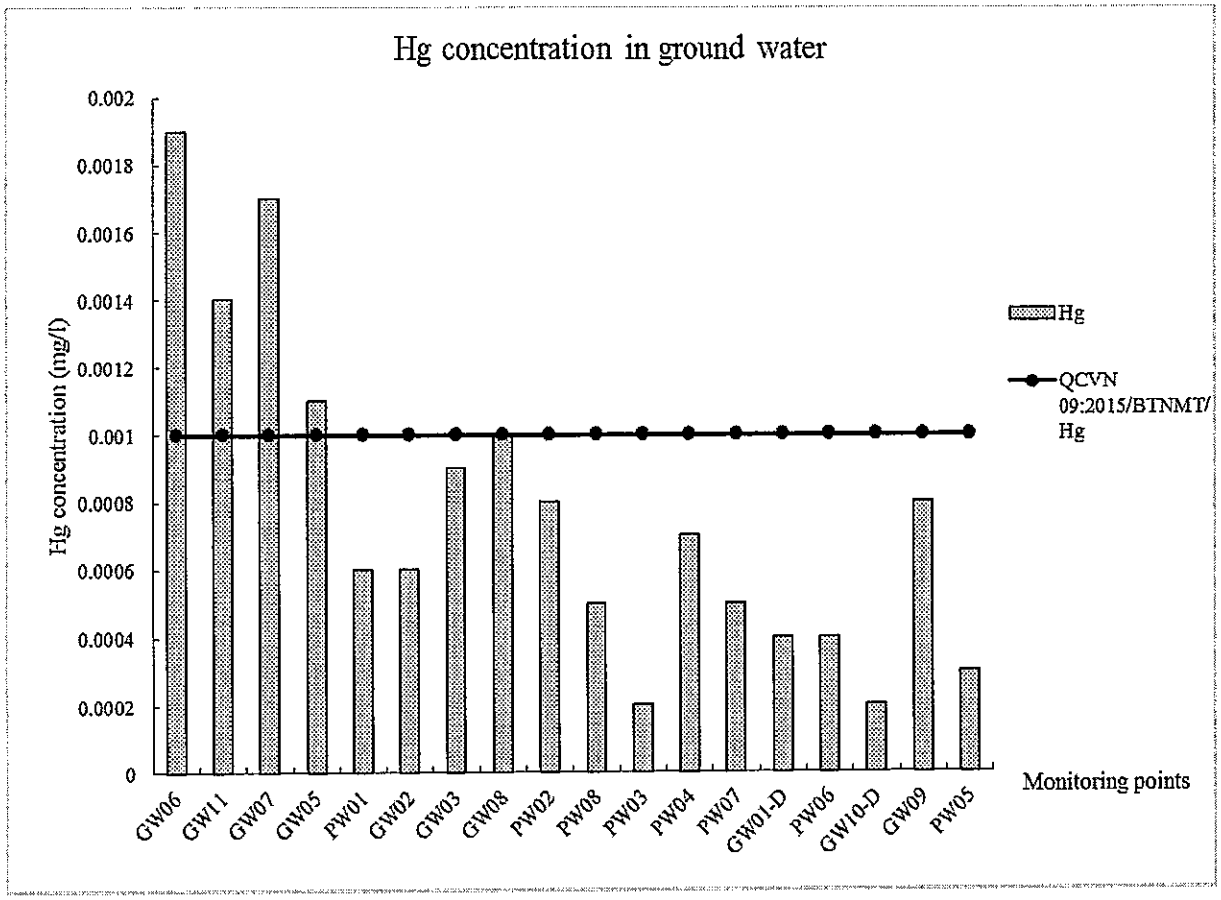

Figure 2.13. Hg concentration in ground water samples in May-2016

The chart shows that there are 4 ground water points which have higher concentration than allowed standard. They are GW05, GW06, GW07 and GW01. GW06 has the highest Hg concentration with 0.0019 mg/l and is higher 1.9 times than allowed standard. GW07, GW11 and GW05 are higher from 1.1 to 1.7 times than allowed standard. PW03 and GW10-D have the lowest Hg concentration. Comparing with the result taken in last year, Hg concentration decreases slightly.

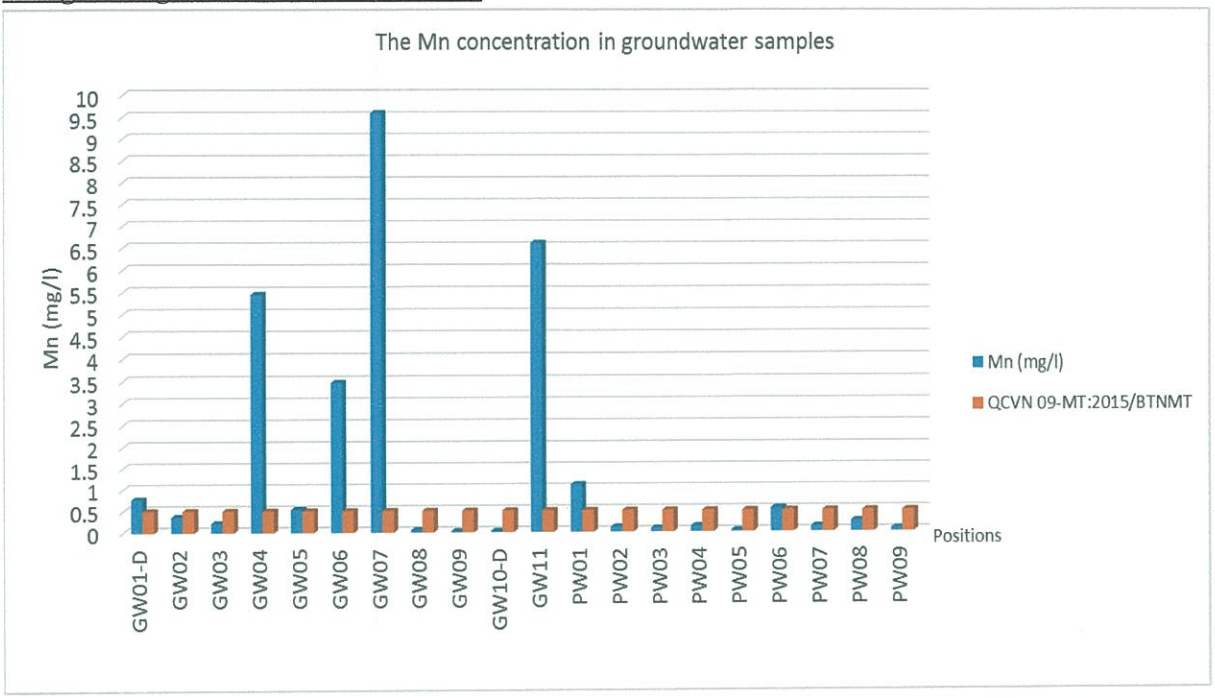

Figure 2.14. Mn concentration in groundwater samples in May-2016

The chart shows that in 20 groundwater samples, there are 08 groundwater samples, which have higher Mn concentrations than allowed standard. They are GW01-D, GW04, GW05, GW06, GW07, GW11, PW01 and PW06. GW07 has the highest Mn concentration and is higher 19.2 than allowed standard. GW11 has the Mn concentration that is higher 13.2 times than allowed standard. While the rest of groundwater samples have lower Mn concentration than allowed standard. Comparing with the result taken in last year, the Mn concentration of groundwater samples in this year increases but insignificantly.

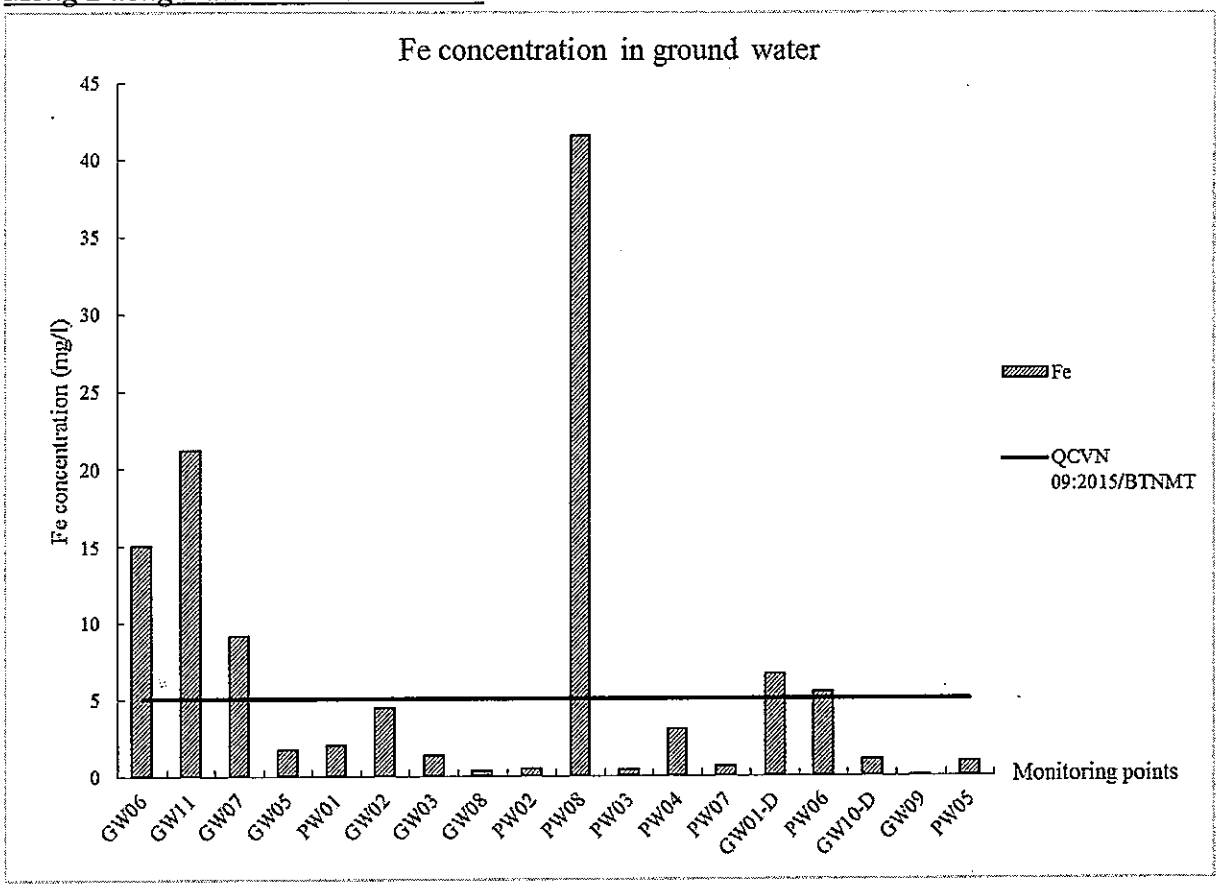

Figure 2.15. Fe concentration of groundwater samples in May- 2016

Similar to the Mn and Hg concentrations, the Fe concentration in some groundwater samples are so high and exceeded allowed standard. PW08 has the highest Fe concentration and is higher 8.3 times than allowed standard. GW01-D, GW04, GW06, GW07, GW11 and PW06 also have the higher Fe concentration than allowed standard.

Thus, groundwater environment in plant and surrounding area have higher metal concentrations such as Mn, Fe and Hg than allowed standard.

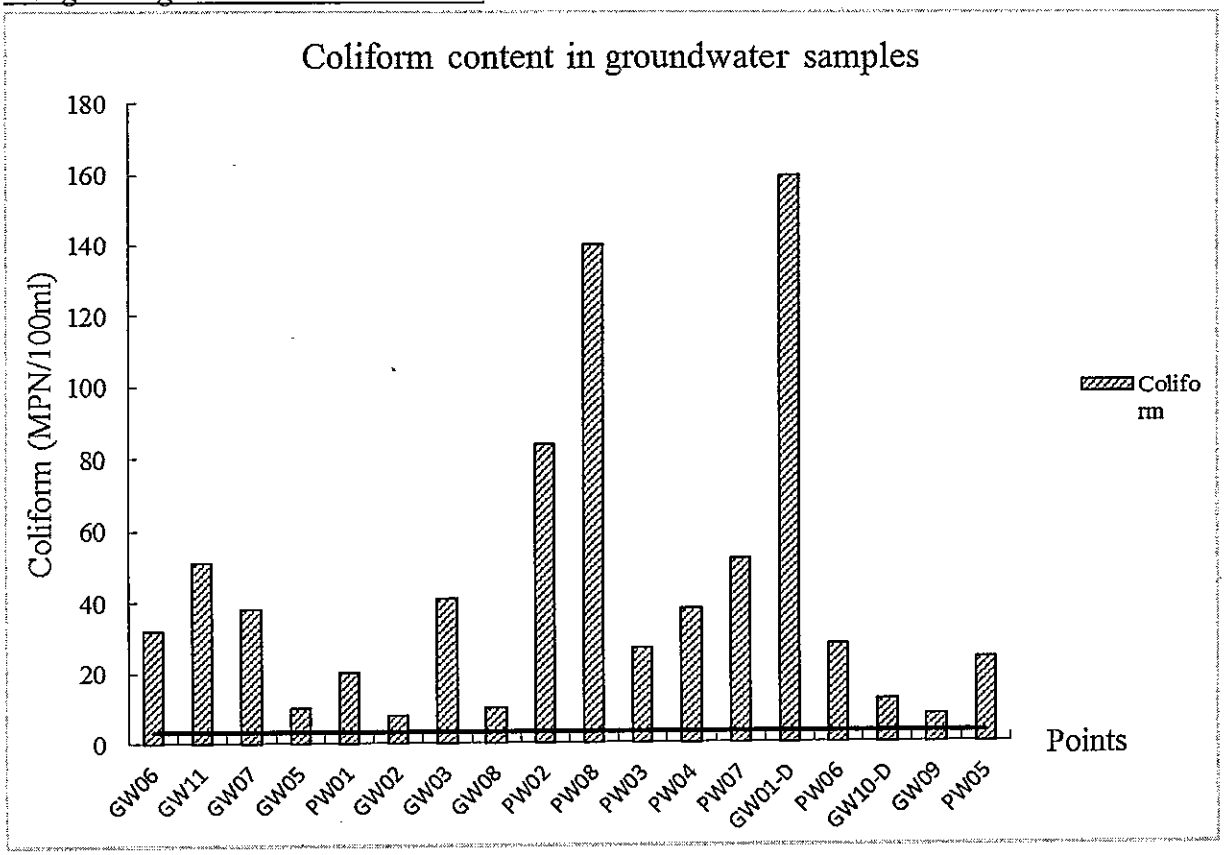

Figure 2.16. Coliforms content in ground water in May, 2016

Besides the metal targets (Mn, Hg, Fe), groundwater environment in monitoring time during May 2016 in Mong Duong Thermal Power Plant has pollution signs of Coliform biological criteria. Monitoring results show that all groundwater samples have Coliform content that exceedes permitted standard value limit so many times. Especially, GW01-D sample has the highest value of Coliform and is higher 53.3 times than the standard, followed by samples PW08, PW02 with the Coliforms values is higher than 47 times and 28 times than the standard limit value. In other groundwater samples, the Coliform values are higher from 3 to 17 times than the permitted standards. Thus, the groundwater samples are contaminated with Coliform biological indicator.

VOC: The identified constituents: IPA; benzyl alcohol; Ethylene glycol; Acetone, aetone nitril; n- Hydro carbon C5-C9.

TPH criteria: Total hydro carbon n-parafin, iso-parafin; Aromatic.

This is the qualitative component of volatile organic substances, partial evaporation and total petroleum hydrocarbons in groundwater areas, quantitative. Most of the results in the area of groundwater samples showed that oscillations were about 0.01 mg / l and these are very small concerns.

II.5. Ecology environment

Ecological monitoring programs were conducted in Feb and May 2016 in the area of Mong Duong Thermal Power Plant and its surroundings, the survey of wild vegetation types, plant cover, vegetation area of residence, the groups of aquatic organisms including plankton and benthos, fish and fisheries. This survey is to evaluate the changes of flora and fauna in this area by impact from the plant operation.

Plants: are surveyed under section passing through the area in a radius of about 1000m continuing to investigate under communal roads, inter-village roads. This area included residential area, hills covered with trees (*Acacia mangium, Acacia auriculiformis, Eucalyptus camphora*), agricultural crops (rice, maize, spinach, sweet potatoes, cassava, manioc...) and vegetables and carpet of the coastal mangroves, estuaries.

- Aquatic: Surveying aquatic groups such as plankton (phytoplankton, Zooplankton), zoobenthos, fish and fisheries.

II.5.1. Plants

Through field surveys, reference documents for botanical research in inner areas, we can recorded 164 species in 47 family of vascular plants belonging to two phylum Pteridophyta and Angiospermae. In which the class Dicotyledoneae belonging to Angiospermae have the biggest species, and families (109 species of 32 families (68% of the families and 66% of the species). Although class Monocotyledoneae has only 57 species of 14 families (23% of families and 29% of species), they are the species with has the larges number of individuals in the plant carpets, shrubs and agriculture crops everywhere. Phylum Pteridophyta has the lowest proportion of species (6 species belonging to 5 families, 4% of species). Mangrove plant has 15 species belonging to phylum Pteridophyta and phylum Angiospermae (***see table in apenddix of preodically environmental report in Feb, May 2016)***.

The flora in the region is quite variety in life forms. The life forms here include hardwood species, bush plants, vines, herbal trees, aquatic plants, the species of parasite, species of semi-parasitic, species of the dependent livings, the species of palm trees, the plant of underground body... There are 7 main living forms which are shown in Table 1, Appendix of periodically environmental monitoring report February, May 2016.

The major livings of vegetation in the region as follows:

- Planted forest ecosystem:

Planted forest includes species such as *Acasia magium, Acacia auriculiformis, Eucalyptus camphora.* Plantation area was distributed in the area of low hills in the surrounding of the Plant site. The structure of planted forest consists two storeys: wood tree layer and shrubs, herbal plants scattered. There is convolved but not much. Compared to natural forests, planted forests are simple in structure and species are very poor.

- Secondary shrubs ecosystem:

Secondary groups of shrub scatter in these area. The secondary shrubs ecosystems appearance due to overexploitation of forest leading to no recovery conditions. Secondary shrub mainly includes trees, tree with early branches, no more than 5 meters in height. There is common species of family Euphorbiacea such as *Breynia fruticosa, Euphorbia hirta, Ricinus communis*; some species of family Fabaceae such as *Casia nodosa, Baulrinia ornata, Mimosa diplotricha, Minosa pudica, Mimosa pigra*; some species of family Asteraceae such as *Eupatorium odoratum, Ageratum conyzoides.* Besides shrubs, there are some herbal plants species belonging to families: Family Poaceae such as *Eleusine indica, Chrysopogon acicultus*; Family Asteraceae has *Eupatorium odoratum, Ageratum conyzoides, Crassocephalum crepidioides, Elephantopus...* Some species of vines such as *Puerraria montana, Mimosa pudica, Argyreia capitata.* Some other species also appear here such as *Rhodomyrtus tomentosa, Melastoma domecandrum...*

- Grassland ecosystem:

Scattered in the area, grassland ecosystem is mainly formed by burning forests, clearing to grow industrial, agriculture plants. After being used, because of many different reasons, effectiveness of crop production is reduced, low economic benefits, soil erosion, nutrition of land is poor leading to being empty. The present species in the area such as *Eupatorium odoratum, Uraria lagopodioides, Desmodium pulchellum...* In this ecosystem, there are also common *Mimosa pudica, Puerraria montana, Crassocephalum crepidioides, Imperata cylindrica* and some scattered shrubs.

- Agricultural and residential ecosystem

An agricultural ecosystem of the study area is quite varied, including rice, maize, beans, vegetables, manioc, sweet potato...

The kinds of plants in the residential area are various, including perennial fruit trees and short days, providing tree shade, trees for building materials, ornamental plants, food plants, spices... Perennial Fruit trees such as *Artocarpus heterophyllus, Mangifera glauca, Cocos nucifera, Psydium guyjava, Citrus grandis...* Short fruit trees such as *Musa paradisraca, Caryca papaya.* Providing shade tree such as *Combretum malabaricum.* Trees used for construction materials such as *Melia azedarach, Bam-*

busa. Plants with flowers of all kinds, *Barrongtonia ancutagula*, *Ficus benjamina*... Plants for food, abundant spices include: *Ipomoea aquatica*, vegetables of all kinds (*Brassica*), *Ocimum basilicum*, *Allium ascolonicum, Allium sativum, Zingiber officinale, Curcuma longa*...

- *Mangrove ecosystem:*

The area of Mong Duong Thermal Power Plant is surrounded by the mountains next to the seaside, there are only few and narrow rivers, so there is no alluvia, narrow quagmire, and undeveloped mangrove covered with all small shrubs in height of 0.5 - 2.5 m. The main communities are:

* Biome *Avicennia marina* with species such as *Cynodon dactylon, Suaeda maritima* on the muddy alluvial sand, shore off, tidal medium and low.

* Biome pioneered inshore *Aegiceras corniculatum* with the subspecies such as *Avicennia marina, Cyperus rotundus*.

* Biome mixed *Rhizophora stylosa, Bruguiera gymnorrhiza Kandelia obovata, Aegiceras corniculatum* on average tidal wetlands.

* Biome dominant *Bruguiera gymnorrhizaspecies* such as *Rhizophora stylosa, Kandelia obovata, Aegiceras corniculatum* on the land in high tide flooded.

Mangrove vegetation is mainly distributed in the north to De Dach estuaries, Cam Hai communes, however, with small area.

II.5.2. Aquatic

a. Phytoplankton

Monitoring results in d May, 2016 also identified 61 species of phytoplankton in the algae phylum: Bacillariophyta, Pyrrophyta and Cyanophyta. Among them, Bacillariophyta algae have the highest number of species (48 species), followed by Pyrrophyta algae (11 species) and finally Cyanophyta algae (2 species). Phytoplankton in the region is the most common species, and no significant difference compared with the results of previous surveys in the region.

Quantity density of phytoplankton range from 127,3 tb/l (this must to present in cells/l instead of tb/l) to 7,386.0 tb/l cells/l in which quantity density of Bacillariophyta algae has highest proportion, deciding quantity density of phytoplankton in areas (90%). The remaining algae has quantity density negligible (Results are presented in Annex of March and May Environmental Monitoring Reports - aquatic results - phytoplankton – sampling quantitative).

b. Zooplankton

The results of monitoring zooplankton in the area of Mong Duong 2 Thermal Power Plant on May 2016 without much volatility when compared to the monitoring results on Feb, 2016 still identified 58 species and groups of species of zooplankton. In particular, Copepoda groups have the highest number of species (45 species), Facial industry Cladocera groups (2 species). The other groups have 11 species.

The quantity density of zooplankton range is from 717.5 Individuals/ m^3 to 1361.6 Individuals/m^3 in which the Copepoda groups has the highest percentage (over 60%), next to the other groups and finally Cladocera groups (Results are presented in appendix - results of aquatic results - zooplankton - quantitative samples).

c. Zoobenthos

The monitoring results of zoobenthos on May 2016 still identified 66 species of zoobenthos in the groups including: Polychaeta groups have 4 species; Crustacea groups have 6 species; Mollusca - Gastropoda groups have 23 species; Mollusca - Bivalvia groups have 33 species.

The density of zoobenthos ranged from 102 Individuals/m^2 to 257 Individuals/m^2 and biomass range from 10.22 g/m^2 to 32.04 g/m^2. In which the Mollusca groups have the highest density and biomass, next to the Crustacea groups and finally Polychaeta groups (Results are presented in March and May Environmental Monitoring Reports - aquatic results - Zoobenthos –quantitative samples).

d. Fish and fisheries

We still recording 103 species of marine fishs in 12 order 43 family including orders: Orectolobiformes, Clupeidae, Myctophiformes, Aguilliformes, Siluriformes, Beloniformes, Gasterosteiformes, Mugiliformes, Perciformes, Scopaeniformes, Pleuronectiformes and Tetraodontiformes (see table in appendix of Monitoring report in Feb and May 2016). In which, Perciforme is the basic component in the structure of fish fauna, including 20 families (46%) and 57 species (55%). The others fishes such as Siluriformes (5 families and 9 species), Beloniformes (3 families with 5 species) Mugilidae (3 families with 6 species), Flounder (2 families with 6 species). The other fishies, each fish skeleton includes 1 to 2 families with 1 to 2 species. The families with the huge species like Gobiidae (12 species), *Engraulidae* (8 species), *Sciaenidae* (5 species), *Clupeidae* (4 species), *Mugilidae* (4 species), *Theraponidae* (4 species), *Carangidae* (4 species), *Ophichthydae* (4 species). The remaining families have only 1 to species.

The fish families with high production and economic value in the region include more than 30 species of these: Mugilidae, Polynemidae, Leiognathidae, Serranidae, Theraponidae, Carangidae, Sciaenidae, Gobiidae, Clupeidae, Engraulidae, Ar-

iidae... Marine fisheries in the region mainly fish near shore with low production. In the surrounding of the area there are a few fish cages cultured by the families: mainly *Epinephelus fasciatus, Malabar grouper*. In this area, there are also a few shrimp ponds with small achievement leading not to be cultivated.

In summary, the ecosystems in the areas of Mong Duong thermal power plant and surroundings include: planted forest ecosystem, secondary shrubs ecosystem, grassland ecosystem, agricultural and residential ecosystem, mangrove ecosystem almost no significant change and abnormalities when comparing the monitoring results between the monitoring time in Feb and May, 2016 and the same time in 2015.

The groups of plankton species, benthic and fish are the most common species, often see with no significant changes.

CHAPTER III. . CONCLUSION AND RECOMMENDATION

III.1. Conclusion

The environmental monitoring program in operation stage of Mong Duong 2 Thermal Power Plant has been conducted in the first six months in 2016 from January to June, the sampling locations were approved according to plan, the environmental monitoring components include: ambient air, noise, air emission, waste water, cooling water, surface water, coastal water, ground water and ecological environment. Based on the results of environmental monitoring, the assessments on environmental quality in the area of the plant in operation stage as follows

Noise:

The noise values at 18 locations in the plant's area and 02 locations in the surrounding residential areas were satisfied with the specified standards: TCVSLD 3733/2002/QD-BYT.

Noise results measuring weekly in both quarters (1,2) at the two points in residential surrounding the plant meet the requirements of this standard.

Ambient air:

Ambient air quality surrounding the plant area is relatively good. The values of the follow parameters such as TSP, PM 2.5; PM10, gases such as CO, SO_2, NO_2 were meet QCVN 05:2013/ BTNMT. Especially, dust levels at the locations near transportation road and the coal store are needed to monitor more often because of the impact from transportation.

Air emission:

The air emission monitoring results at 02 stacks from 02 units shown that values of all monitored parameters were met the requirement of QCVN 22:2009/BTNMT. It demonstrates that the gases treatment systems are still operating stable and effective.

***Wastewater*:**

Wastewater of the plant areas in the monitoring programsincludes industrial wastewater, cooling water and sanitary water. In which, parameters' values of idustrial wastewater are smaller than allowed standard (QCVN 40:2011/BTNMT) except BOD5 and Coliform.

Cooling water:

Based on the monitoring results of cooling water, all parameters' values of cooling water are smaller than the limit values allowed by the standard (QCVN

40:2011/BTNMT), especially temperature and residue chlorine are stably maintained by strictly controlled condition.

Surface water:

During the construction stage, the surface water sampling locations previously were already filled (De Dach River and a branch flowing to Mong Duong estuary). Therefore, in this operation stage, the survey team has selected some new positions for surface water monitoring; see the tables in the report. The surface water sampling locations in Mong Duong estuary and Luong Gac canal are remain the same quantity.

There were some signals of polluted parameter in surface water in the factory neighborhoods areas. According to the monitoring results, in surface water samples in the estuary discharging into Luong Gac canal, Ammonium concentration exceed permitted standards. Compared with the same monitoring time in 2015, the parameters' values decreased slightly.

Due to wastewater and cooling water from the factory all met the standard. Therefore, surface water quality in the plant's area may be directly affected by other discharging sources outside the plant, due to human activities. Therefore, it should recommend that plant consider the residential activities surrounding as well as the other discharge sources outside of the plant.

Coastal water:

Similar to surface water, coastal water is evaluated by 14 coastal water samples on Gac canal. Monitoring results shown that there are some parameters in coastal water samples do not meet allowed standard, notably: Ammonium and Iron. In comparion with the same monitoring time in 2015, these parameters' values decrease slightly but still over than the standard QCCP. To have more acurate assessments it should be continuously monitored or increased frequency with surface water and coastal water to evaluate the fluctuation of these warning parameters.

Ecological environment:

Most aquatic species identified as species adapted to salinity wide, common in coastal estuaries, freshwater species and marine species native to the area, invasive low percentage. The density of phytoplankton, zooplankton and benthic at the survey locations are relatively low rate in all groups. The first step to have data did not fully reflect the characteristics and biodiversity as well as featured on the amount of aquatic communities in the area. Therefore, there should be more closely examined statistics and increase repeatability to base judgments about movements of aquatic communities and ecological environment in the region.

There are no significant changes between 02 monitoring times in Feb and May 2016 on ecological system.

QA/QC application in environmental monitoring program

The periodical environmental monitoring program in Mong Duong 2 Thermal Power Plant were strictly applied the Circular No. 21:2012/TT-BTNMT on Instruction the QA/QC application in environmental monitoring program. All the procedures of Quality Assurance and Quality Control on field, sample preservation and transportation, laboratory analysis (on-field blank and duplicate samples, laboratory duplicate sample) are conducted and %RPD calculation as well as evaluation of comleting data. *(see detail in Environmental Monitoring Report monthly from Jan to June, 2016).*

III.2. Recommendation

Based on the monitoring results of the first 6 months in operation stage in Mong Duong 2 Thermal Power Plant, the monitoring team and implementing units may give some recommendations to the management board of Mong Duong 2 Thermal Plants and the contractor at the plant as follows:

We need to continue implementation of environmental monitoring activities periodically with the noise component, ambient air, wastewater, surface water, ecological environment according to plan, the roadmap setting out in the region during the operation stage of Mong Duong 2 Thermal Power Plant. This is in order to detect early signs of environmental pollution due to the impact of the plant through each stage or other events affecting the region.

We need to continue and expand the assessment of the impact of plant's operations to the surrounding residential area. Especially, we should focus on evaluating expansion and detailed assessment of surface water and groundwater in the area. Study and estimate the impact of 2 plants to people's living. Beside the influence of environment, it is need to assess the social impact on population in Mong Duong 2 Thermal Power Plant Area.

Providing updated information on the situation of the environment for the local authority and building contractors to have plans for dealing with pollution as well as minimize the polluting activity to the regional environment.

APPENDIX

APPENDIX 1. ON FIELD MONITORING PHOTOS

APPENDIX 2. SAMPLING AREA MAP

APPENDIX 1. ON-FIELD MONITORING PHOTOS

Figure 3.1. Air sampling and noise measurement in plant area

Figure 3.2. Ambient air monitoring in residential area near the plant

Figure 3.3. Water and biology sampling

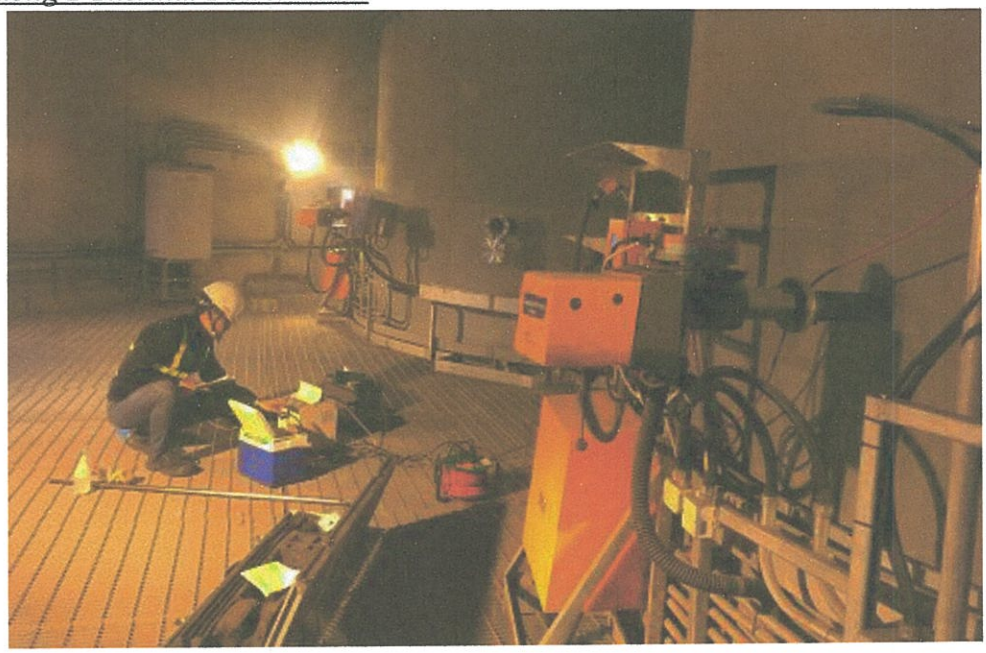

Figure 3.4. Air emission sampling

APPENDIX 2. SAMPLING MAP

Figure 3.5. Map of sampling area

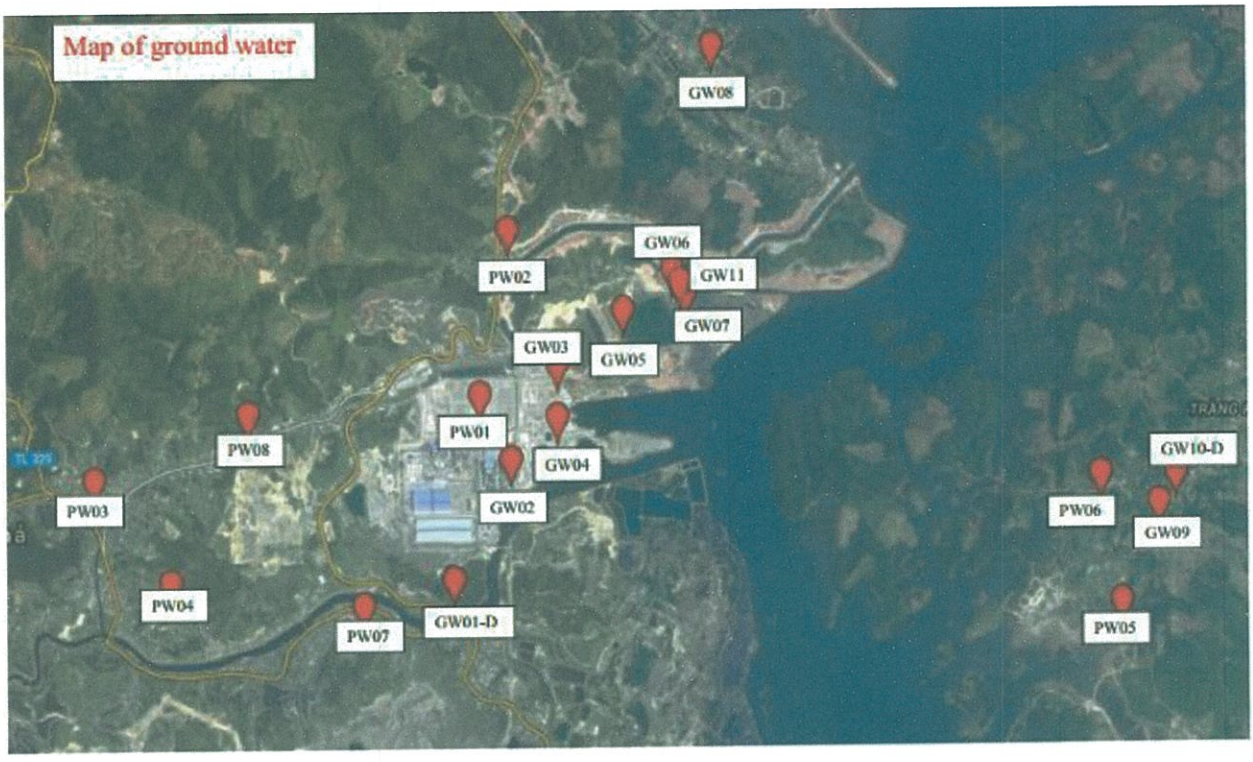

Figure 3.6. Map of ground water sampling area

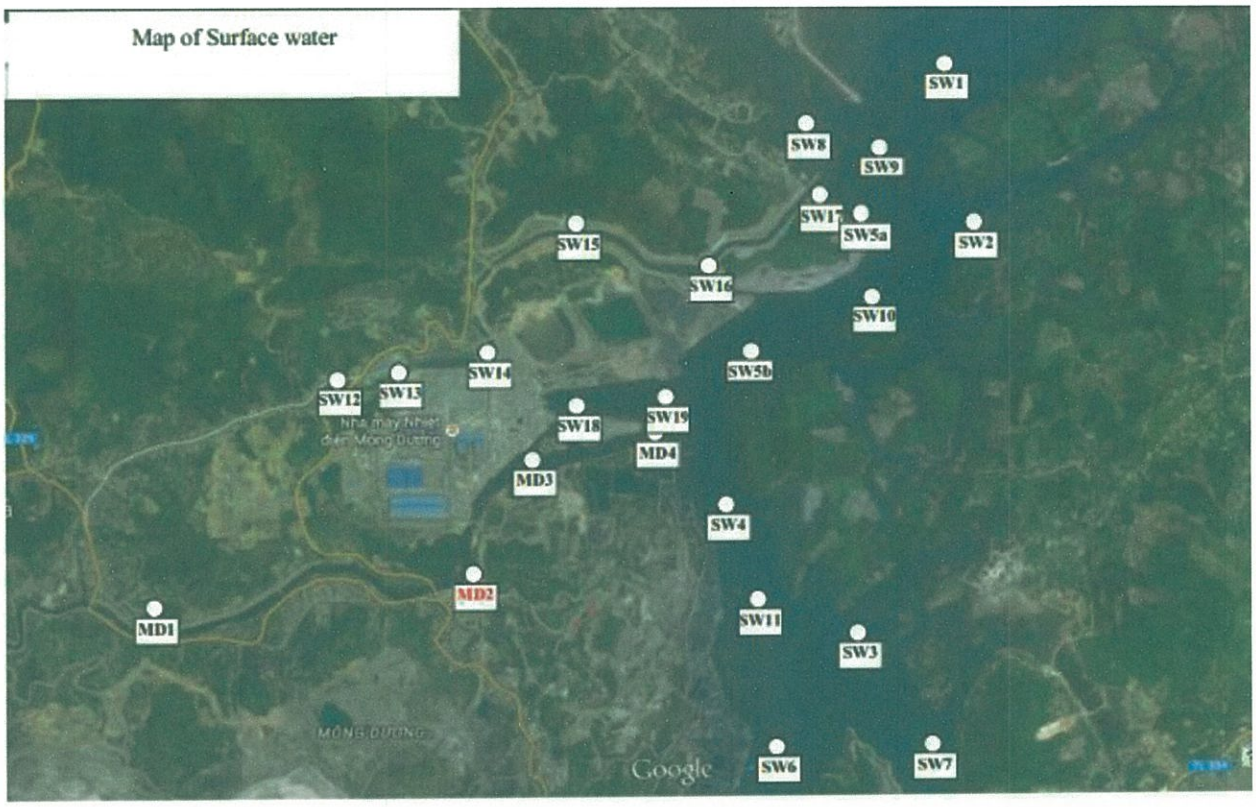

Figure 3.7. Map of surface water sampling