Switching of fuel from Low Sulphur Waxy Residue fuel oil

to natural gas at Gangnam branch Korea District Heating Corporation Project

MONITORING REPORT

Version 01

2009. 5.14

CDM registration number: 0835

Monitoring period: 1/4/2008 – 31/3/2009

SECTION A. General description of project activity

A.1 Title of the project activity

Switching of fuel from Low Sulphur Waxy Residue fuel oil to natural gas at Gangnam branch Korea District Heating Corporation Project

Version number of the document : 01

Data of the document: 14/5/2009

A.2 Introduction of the project activity

This monitoring report is based on CDM project"Switching of fuel from Low Sulphur Waxy Residue fuel oil to natural gas at Gangnam branch Korea District Heating Corporation Project" to estimate actual GHG emission reduction using monitored data. (The project activity has been registered on 2007, April 2nd in UNFCCC, with the CDM registration number of 0835)

Crediting period : 01/04/2008 – 31/3/2018

Monitoring period : 01/04/2008 – 31/3/2009

CERs : 45,323

A.3 Description of the project activity

The project activity is switching Low Sulphur Waxy Residue fuel oil (LSWR) to natural gas at Suseo heat source facility, Gangnam branch, Korea District Heating Corporation (KDHC)
The project is developed, financed and implemented by KDHC.

In the project activity, the existing four LSWR-only heat boilers were replaced by three NG(natural gas)-only heat boilers in the end of 2007. The project activity primarily aims at reducing greenhouse gas emission by switching the boilers' fuel from LSWR to natural gas.

The purpose of the project activity

The purpose of the project activity is reducing greenhouse gas and producing heat by replacing fuel from LSWR to natural gas.

Contribution of the project activity to sustainable development

The project activity contributes to sustainable development for following reasons:

- Natural gas is less carbon intensive when compared to other fossil fuels, like LSWR. So using natural gas contributes to the mitigation of greenhouse gases emissions
- The transportation of natural gas to the site by using pipelines is safer and more environmentally friendly than LSWR because it avoids the use of road trucks carrying LSWR.
- As a good practice for environmental improvement, the project activity could be replicated across other district heating companies or heat suppliers in Korea.

A.4 Category(ies) of project activity

Sectoral scope 1,4 – Energy industries (renewable- / non-renewable sources)

SECTION B. Monitoring methodology and plan

B.1 Name of monitoring methodology applied to the project activity

Version: 03

Name of monitoring methodology: ACM0009 “Consolidated monitoring methodology for fuel switching from coal or petroleum fuel to natural gas”

B.2 Data be monitored

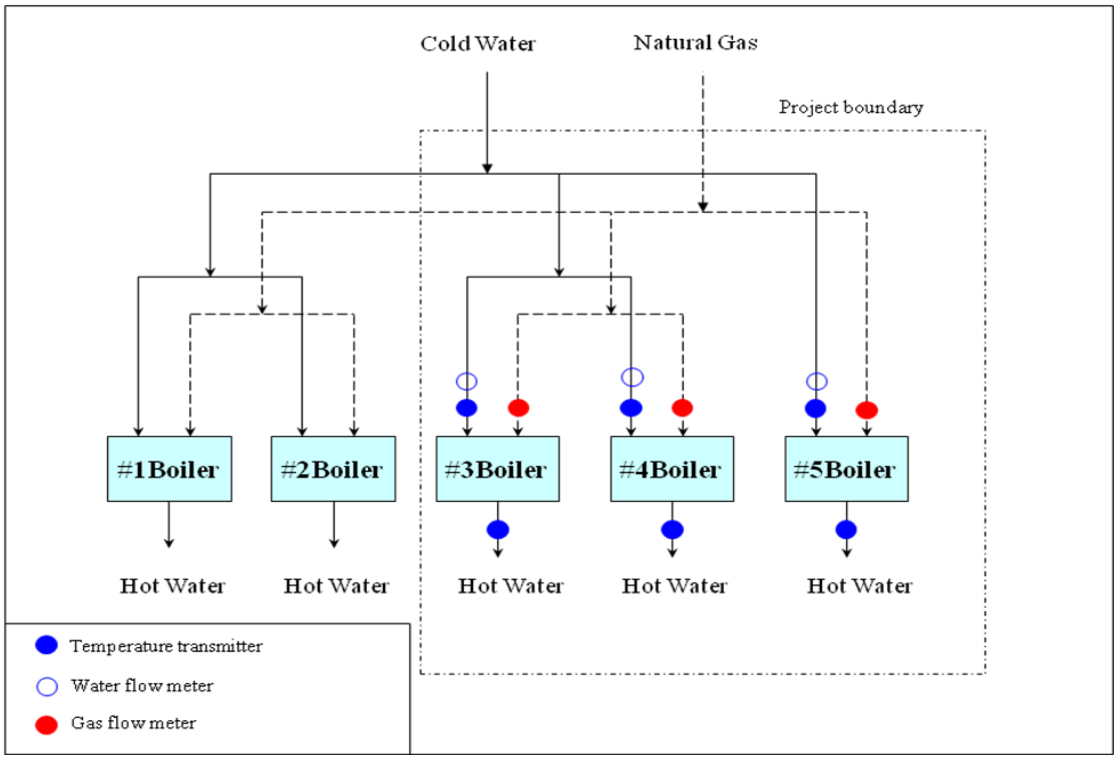
ID number	Data Variable	Unit	Resource	Measured(M) Calculated(C)	Proportion of data monitored	How will data be archived (electronic/paper)	Comments
$FF_{project,i,y}$	Natural gas consumed in process element *i* in year y	m^3	Measured	M	100%	Electronic/paper	
$\varepsilon_{project,i.y}$	Fuel efficiency of natural gas used at the process *i*	%	Calculated from monitored variables	C/M	100%	Electronic	
$HG_{project,i,y}$	Heat produced in the year y	Gcal	Measured	M	100%	Electronic/paper	
$NCV_{NG,y}$	Net calorific value of Natural Gas in year y	$Kcal/m^3$	Korea Ministry of Commerce, Industry, Energy	N/A	N/A	N/A	
$NCV_{LSWR,y}$	Net calorific value of LSWR in year y	Kcal/L	Korea Ministry of Commerce, Industry, Energy	N/A	N/A	N/A	
$EF_{NG,CO2,y}$	CO2 emission factor of Natural gas combusted in year y	tCO_2/TJ	IPCC	N/A	N/A	N/A	
$EF_{LSWR,,CO2,y}$	CO2 emission factor of LSWR combusted in year y	tCO_2/TJ	IPCC	N/A	N/A	N/A	

B.3 Monitoring plan

<Data collection >

KDHC Gangnam branch Suseo source Center Control Room should collect information on all the activity. KDHC Gangnam branch Suseo source Center Control Room estimates, records and manages heat production, fuel consumption, fuel efficiency, load factor all the day per each hour(24 hours) through distributed control system.

1. The consumption of natural gas is monitored by KDHC Gangnam branch Suseo source Center Control Room. The Volume measured is multiplied automatically through DCS(Data collection system) by an adjustment factor considering the temperature and pressure to convert it to standard state.
2. The heat production is calculated automatically by the DCS on the basis of DH water's flow rate metered in front of a boiler and differential temperature between DH water supplied to users and DH water returned to KDHC that are metered in front of and at the back of boiler respectively.
3. Korea District Heating Corporation will collect computed data every year and publish annual operation result report.
4. The following flowchart shows the actual situation of meters and boilers in this field:

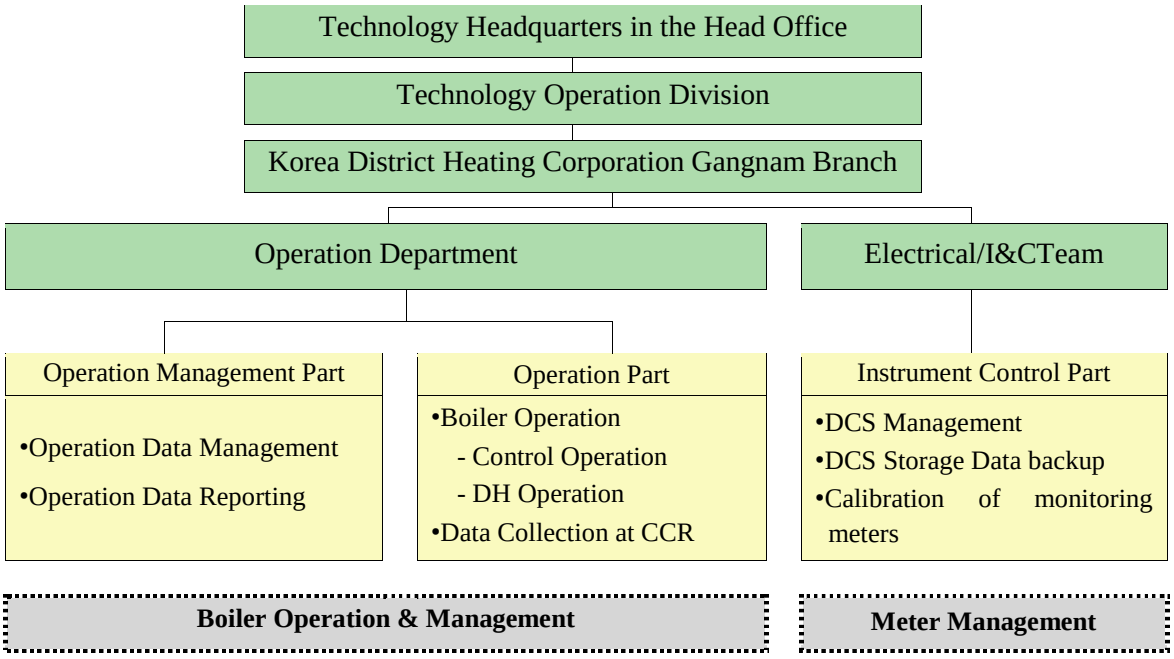


<CDM monitoring structure>

The CDM monitoring structure consists of the Operation Department and the Electrical/I&C Team of Gangnam branch and Technology Operation Division of Headquarters of KDHC.

The CDM monitoring team of gangnam branch takes charge of boiler operation, boiler management, data collection and back-up. The CDM monitoring team of Headquarters takes charge of the calculation of emission reductions and monitoring report.

CDM Monitoring Structure



<Training>

CDM monitoring team will be trained for boiler operation and management by the technology operation Division

<Responsibilities for and institutional arrangements for data collection and archiving>

Gangnam branch is in charge of data collection and KDHC's Head office is in charge of its storage.

• Data storage method

All monitoring data is collected electronically by DCS and the operators' record operation data on log sheet at local site. The data collected at the server of DCS and the log sheet will be stored.

• Data modification method

If recorded data are different from monitored data, the manager of operational management part will call a meeting to discuss the problem with the manager of instrument control part, the manager of operation part and the supplier of the monitoring equipment like ABB Korea. The minutes of the meeting will be stored

Name of person is charge and their work is as following:

Person in charge	Team	Work
Soon Yong-suk	KDHC Gangnam branch Operation management team	Data collection and storage
Choi Hae-seek	KDHC Gangnam branch Electrical/I&C Team	Data collection and storage

<Quality Assurance and Quality Control>

Korea District Heating Corporation Gangnam branch obtained ISO14001 certification in December, 1996 and is operating continuous and systematic Environment management system. Korea District Heating Corporation Gangnam branch Suseo source obtained monitoring and QA/QC process for all parameters related to proposed project activity monitoring through ISO14001 certification. Monitoring plan of the proposed project activity will be managed in integration and continuation with Environment management system through ISO14001.

SECTION C. Estimation of GHG emissions by sources

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The green house gas(GHG) emission reduction(ER) is estimated by the following equation

$$ER_y = BE_y - PE_y - LE_y$$

C.1 Estimating the emission by sources of GHG's in the baseline scenario

$$BE_y = \sum_{i=1}^{3} FF_{project,i,y} \times \frac{NCV_{NG,y} \times \varepsilon_{project,i,y}}{NCV_{FF,y} \times \varepsilon_{baseline,i,y}} \times NCV_{FFi} \times EF_{FF,co2,i}$$

where

$\varepsilon_{baseline,i,y}$ is fixed in PDD section B.6.2

$\varepsilon_{project,i,y}$ can be calculated using the real value of heat produced and gas consumed according to the data of 2008.

It can be found out that the energy efficiency used for emission reduction calculation in PDD was calculated by HHV, for that the energy efficiency must be calculated by LHV which mentioned in methodology ACM0009. In order to carry out the real emission reduction by this project, the energy efficiency was re-calculated using LHV(NCV) in this monitoring report. (Baseline energy efficiency using HHV on PDD was 82.8% of element 1; 82.9% of element 2 and 82.8% of element 3. And baseline energy efficiency using LHV in monitoring report is 87.7% of element 1, 87.8% of element 2 and 87.7% of element 3. Project energy efficiency using HHV in PDD was 86% and project energy efficiency using LHV in monitoring report is 95%,)

Further information about baseline emission Calculation can be found in PDD Section B. 6.1

C.2 Estimating the emission by sources of GHG's due to the project activity

$$PE_y = \sum_{i=1}^{3} FF_{project,i,y} \times NCV_{NG.y} \times EF_{NG,co_2,i}$$

Further information about Calculation of project emission can be found in PDD Section B.6.1

C.3 Estimating the emission by sources of GHG's by Leakage

$$LE_y = LE_{CH4,y} + LE_{LNG,CO2,y}$$

Where

$$LE_{CH4,y} = (FF_{project,y} \times NCV_{NG,y} \times EF_{NG,upstream,CH4} - FF_{baseline,LSWR,y} \times NCV_{LSWR} \times EF_{LSWR,upstream,CH4}) \times GWP_{CH4}$$

$$LE_{LNG,CO2,y} = FF_{project,y} \times EF_{CO2,upstream,LNG}$$

Further information about Calculation of Leakage can be found in PDD Section B.6.1

C.4 Data used in Calculation

Data used in Calculation

Parameter	Data unit	Value applied	Description	Source	comment
$NCV_{NG,y}$	Kcal/Nm^3	9,550	Average net calorific value of the natural gas combusted during the year *y*	Korea Ministry of Commerce, industry an energy	
$EF_{NG,CO2,y}$	tCO2/TJ	56.1	CO2 emission factor of the natural gas combusted in all element process in the year *y*	IPCC	
$NCV_{FF,y}$	Kcal/*l*	9350	Average net calorific value of the LSWR that would be combusted in the absence of the project activity in the element process *i* during the year *y*	Korea Ministry of Commerce, industry an energy	
$EF_{FF,Co2,y}$	tCO2/TJ	77.3677	CO2 emission factor of the LSWR that would be combusted in the absence of the project activity in the all element process	IPCC	

$\varepsilon_{baseline,1,y}$	%	87.7%	Energy efficiency of the element process 1 if fired with LSWR	KDHC	
$\varepsilon_{baseline,2,y}$	%	87.8%	Energy efficiency of the element process 2 if fired with LSWR	KDHC	
$\varepsilon_{baseline,3,y}$	%	87.7%	Energy efficiency of the element process 3 if fired with LSWR	KDHC	
$EF_{NG,upsteam,CH4}$	tCH4/PJ	296	Emission factor for upstream fugitive methane emissions from production, transportation and distribution of natural gas in tCH4 per MWh fuel supplied to final consumers	ACM0009	
$EF_{LSWR,upsteam,CH4}$	tCH4/PJ	4	Emission factor for upstream fugitive methane emissions from production of the LSWR in CH4 per MWh fuel produced	ACM0009	
GWP_{CH4}	tCO2/tCH4	21	Global warming potential of methane valid for the relevant commitment period	IPCC	
$EF_{CO2,upsteam,LNG}$	tCO2/TJ	6	Emission factor for upstream CO2 emission due to fuel combustion/ electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system	ACM0009	

C.5 Emission reduction in monitoring period

Date	Boiler No.	BE (tCO_2e)	PE (tCO2e)	LE (tCO2e)	ER (tCO2e)
2008.4	3	4,276	2,899	627	750
	4	4,882	3,275	709	898
	5	1,546	1,059	230	257
	Total	10,704	7,233	1,566	1,905
2008.5	3	1,675	1,133	246	296
	4	381	258	57	66
	5	0	0	0	0
	Total	2,056	1,391	303	362
2008.6	3	0	0	0	0
	4	0	0	0	0
	5	0	0	0	0
	Total	0	0	0	0
2008.7	3	0	0	0	0
	4	0	0	0	0
	5	0	0	0	0
	Total	0	0	0	0
2008.8	3	0	0	0	0
	4	0	0	0	0
	5	0	0	0	0
	Total	0	0	0	0
2008.9	3	486	329	72	85
	4	0	0	0	0
	5	0	0	0	0
	Total	486	329	72	85
2008.10	3	0	0	0	0
	4	0	0	0	0
	5	5,756	3,877	839	1,040
	Total	5,756	3,877	839	1,040
2008.11	3	15,705	10,656	2,304	2,745

	4	15,144	10,310	2,229	2,605
	5	14,742	9,960	2,154	2,628
	Total	45,591	30,926	6,687	**7,978**
2008.12	**3**	24,100	16,369	3,538	4,193
	4	22,072	15,074	3,259	3,739
	5	16,888	11,301	2,443	3,144
	Total	63,060	42,744	9,240	**11,076**
2009.1	**3**	23,990	16,312	3,526	4,152
	4	22,829	15,608	3,374	3,847
	5	19,701	13,101	2,832	3,768
	Total	66,520	45,021	9,732	**11,767**
2009.2	**3**	16,223	11,102	2,401	2,720
	4	17,159	11,744	2,540	2,875
	5	6,381	4,317	934	1,130
	Total	39,763	27,163	5,875	**6,725**
2009.3	**3**	10,117	6,946	1,502	1,669
	4	6,910	4,750	1,027	1,133
	5	9,060	6,187	1,338	1,535
	Total	26,087	17,883	3,867	**4,337**
Total		260,040	176,558	38,159	**45,323**

APPENDIX 1

Source of gas consumption and heat production

Month	Boiler	$FF_{project,i,y}$ (m^3)	$HG_{heat,i,y}$ *(Gcal)*	$\varepsilon_{project,i,y}$
April	**3**	1,292,084	11,587	93.8%
	4	1,459,936	13,236	94.9%
	5	471,703	4,187	92.9%
	Subtotal	3,223,723	29,010	-
May	**3**	505,047	4,537	94.0%
	4	114,632	1,035	94.5%
	5	0	0	0.0%
	Subtotal	619,679	5,572	-
June	**3**	0	0	0.0%
	4	0	0	0.0%
	5	0	0	0.0%
	Subtotal	0	0	-
July	**3**	0	0	0.0%
	4	0	0	0.0%
	5	0	0	0.0%
	Subtotal	0	0	-
August	**3**	0	0	0.0%
	4	0	0	0.0%
	5	0	0	0.0%
	Subtotal	0	0	-
September	**3**	146,348	1,319	94.3%
	4	0	0	0.0%
	5	0	0	0.0%
	Subtotal	146,348	1,319	-
October	**3**	0	0	0.0%
	4	0	0	0.0%
	5	1,728,055	15,582	94.4%
	Subtotal	1,728,055	15,582	-
November	**3**	4,750,380	42,512	93.7%
	4	4,596,048	41,056	93.5%

	5	4,440,109	39,928	94.1%
	Subtotal	13,786,537	123,495	-
December	**3**	7,297,277	65,237	93.6%
	4	6,720,027	59,866	93.2%
	5	5,038,088	45,729	95.0%
	Subtotal	19,055,392	170,832	-
January	**3**	7,271,782	64,950	93.5%
	4	6,958,030	61,928	93.1%
	5	5,840,561	53,332	95.6%
	Subtotal	20,070,372	180,210	-
February	**3**	4,949,165	43,917	92.9%
	4	5,235,492	46,516	93.0%
	5	1,924,139	17,282	94.0%
	Subtotal	12,108,796	107,716	-
March	**3**	3,096,511	27,396	92.6%
	4	2,117,454	18,741	92.6%
	5	2,758,001	24,537	93.1%
	Subtotal	7,971,965	70,674	-
Total (average efficiency)	**3**	29,308,594	261,455	93.5%
	4	27,201,618	242,378	93.5%
	5	22,200,656	200,577	94.1%
	Subtotal	78,710,868	704,410	-