Monitoring report form

(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT		
Title of the project activity	Efficiency Improvement by Boiler Rehabilitation in fossil fuel-fired (Natural Gas) Steam Boiler System	
UNFCCC reference number of the project activity	10006	
Version number of the monitoring report	1	
Completion date of the monitoring report	04/10/2015	
Monitoring period number and duration of this monitoring period	1 and from 01/10/2014 to 30/09/2015	
Project participant(s)	Al Jubail Fertilizer Company (Al Bayroni) Saudi Basic Industries Corporation (SABIC)	
Host Party	Kingdom of Saudi Arabia	
Sectoral scope(s)	1 : Energy industries (renewable - / non-renewable sources)	
Selected methodology(ies)	AM0056 - Efficiency improvement by boiler replacement or rehabilitation and optional fuel switch in fossil fuel-fired steam boiler systems Version 1.0	
Selected standardized baseline(s)	Not Applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	41,831 tCO_2e	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	NA	15,651

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

AL Jubail Fertilizer Company (Al Bayroni), is a petrochemical complex in the business of manufacturing ammonia, urea, 2 Ethyl Hexanol and DOP. Al Bayroni is an affiliate of Saudi Basic Industries Corporation (SABIC) and a joint venture with Taiwan Fertilizer Company (TFC). Saudi Basic Industries Corporation (SABIC) is another project participant.

Al Bayroni currently operates three packaged boilers supplied by Mitsubishi Heavy Industries (MHI). Steam from the boilers is utilized exclusively within Al Bayroni at the process plants. The purpose of this project is to enhance energy efficiency and reduce fuel consumption of these boilers whilst maintaining present steam quality and production rates.

The potential for energy savings and in turn reduction of GHG emissions have been evaluated through an independent study in 2007-2008 by M/S Mitsubishi, Japan and subsequently confirmed through a study by KBR during the same period. As a result, the following modifications and installations have been done to realize energy and GHG savings from the packaged boilers:

- New Economizer
- New modified super-heater
- Associated modifications in convection ducts

The new economizer unit improves energy efficiency by heat recovery from the exhaust gases. Economizers are essentially (heat exchange) mechanical devices which utilize exhaust gases to preheat boiler feed water thereby reducing overall heat demand and consequentially fuel consumption for steam production.

Super heater units proposed in the project will also improve energy efficiency by utilizing heat from flue gas to convert wet steam to dry steam. The super heater is placed in the path of flue gases from the combustion chamber allowing steam to be heated above its saturation temperature removing moisture at constant pressure.

The emission reductions achieved for the current monitoring period: 15,651 tCO2e

A.2. Location of project activity

The project is located inside Al Bayroni, in Jubail Industrial City, Eastern Province, Kingdom of Saudi Arabia (49° 33′ 27.98″ E and 27° 3′ 54.64″ N)

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Kingdom of Saudi Arabia (host)	Private: Al Jubail Fertilizer Company (Al Bayroni) a subsidiary of Saudi Basic Industries Corporation	No
Kingdom of Saudi Arabia	Private: Saudi Basic Industries Corporation (SABIC)	No

A.4. Reference of applied methodology and standardized baseline

The Baseline and Monitoring method has been established for the proposed project following the approved methodology AM0056 (version 1.0) “Efficiency improvement by boiler replacement or rehabilitation and optional fuel switch in fossil fuel-fired steam boiler systems”. No standardized baseline has been used for the project activity.

Weblink: http://cdm.unfccc.int/methodologies/DB/YB7UE3UB2II2INU9Y1CBJYRANZRXER

Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (Version 2, EB 41, Annex 11)

A.5. Crediting period of project activity

01/10/2014 – 30/09/2024 (Fixed, 10 years)

A.6. Contact information of responsible persons/entities

Responsible person for completion of this Monitoring Report is the same as contact for Project Participant – please refer to Appendix 1.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

This project involves the following modifications and installations to realize energy and GHG savings from the packaged boilers:

- New Economizer
- New modified super-heater
- Associated modifications in convection ducts

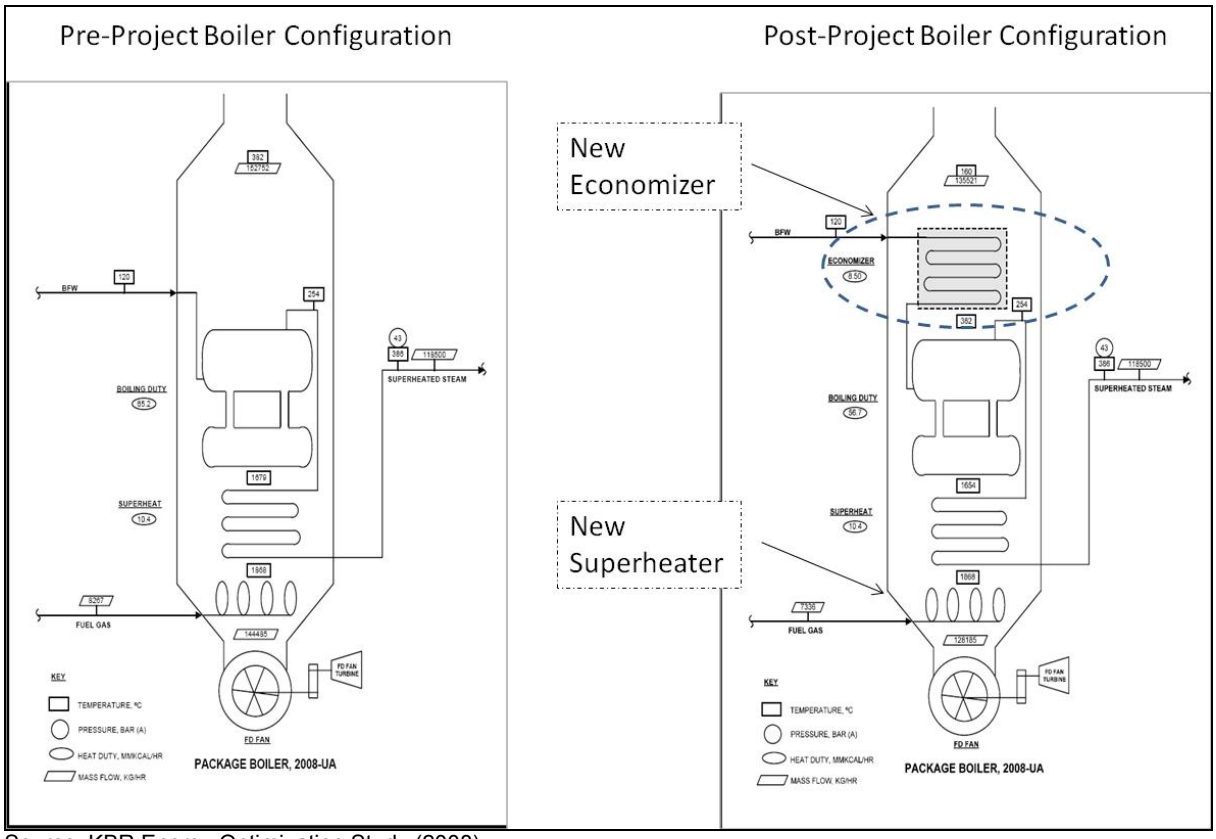
The new economizer unit improves energy efficiency by heat recovery from the exhaust gases. Economizers are essentially (heat exchange) mechanical devices which utilize exhaust gases to preheat boiler feed water thereby reducing overall heat demand and consequentially fuel consumption for steam production. Super heater units in the project also improve energy efficiency by utilizing heat from flue gas to convert wet steam to dry steam. The super heater is placed in the path of flue gases from the combustion chamber allowing steam to be heated above its saturation temperature removing moisture at constant pressure.

Project Timeline, Current Status and Monitoring

10/05/2013: Modification of the first two boilers has been completed.
20/02/2014: Modification of third boiler has been completed.

No major shutdowns were observed in the current monitoring period.

Pre Modification and Post Modification Case:



Source: KBR Energy Optimization Study (2008)

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

There are no temporary deviations from the registered monitoring plan, applied methodology or applied standardized baseline.

B.2.2. Corrections

There are no corrections.

B.2.3. Changes to start date of crediting period

There is no change to the start date of the crediting period

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

No inclusion to the monitoring plan which was not part of the registered PDD.

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

There are no changes from registered monitoring plan, applied methodology or applied standardized baseline.

B.2.6. Changes to project design of registered project activity

There are no changes to the project design from the registered project activity.

B.2.7. Types of changes specific to afforestation or reforestation project activity

Not Applicable.

SECTION C. Description of monitoring system

Al Bayroni's monitoring programme is integral to the company's third party certified (i.e. by British Standards Institute-BSI) ISO 9001:2008 compliant Quality Management System (QMS). All monitoring programmes including associated calibration is within the scope of the QMS and subjected to several audits and reviews including Internal Audits, SABIC Corporate Audits and Third Party (BSI) audits.

Further, Al Bayroni subscribes to SABIC corporate's Safety, Environment, Health & Security Management Systems (SHEMS) applicable to all Rotating equipment, Pressure Relief Devices, Instrument Devises, Tanks & Pressure vessels, Piping, Car seals and Blinds, Hoses, Critical Instruments & Devices by pass, and Cathodic protection program. As a result, any modifications/ changes, replacements and emergency response is governed by the SHEMS programme. Al Bayroni is also certified to the American Chemistry Council Technical Specification Responsible Care® RC 14001.

All the modified facilities have passed through safety review during the design stage (namely HAZOP review) to identify all potential hazards and appropriate mitigation were incorporated during design phase of the project." In addition, there are Standard Operating Procedures (SOPs) available with operating personnel to start, operate and shutdown the boiler safely that includes the emergency scenarios of failure also. These SOPs are facilitated by the online instrumentation, Distributed Control System and Emergency Shutdown System

Through the management systems, monitoring and measurements program, testing and calibration is achieved. Testing and calibration are scheduled through the SAP system and notified by the workflow system to the Instrument division through the SAP maintenance planner.

The equipment / tag for the boilers is marked in block diagrams Figure C.1 -C3 below). The flow and temperature is continually monitoring through DCS log sheet (Table C.1). The monitoring testing and its frequency with the management system procedure reference is also provided in Table C.2

Figure C.1: Packaged Boiler Block Diagram (Boiler 2052-U)

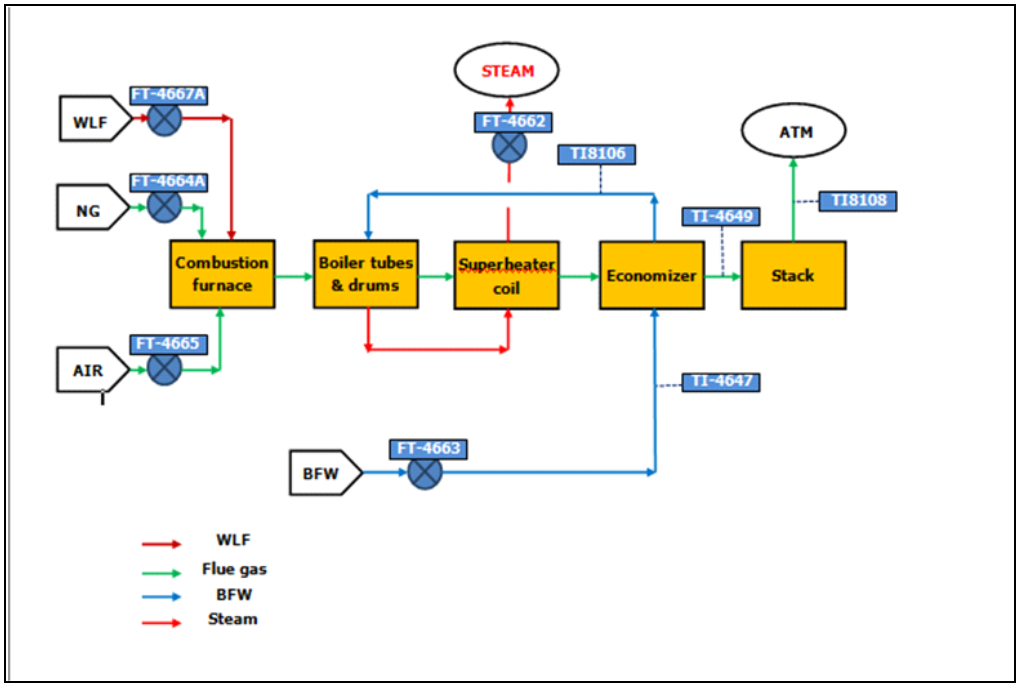


Figure C.2: Packaged Boiler Block Diagram (Boiler 2008-UA)

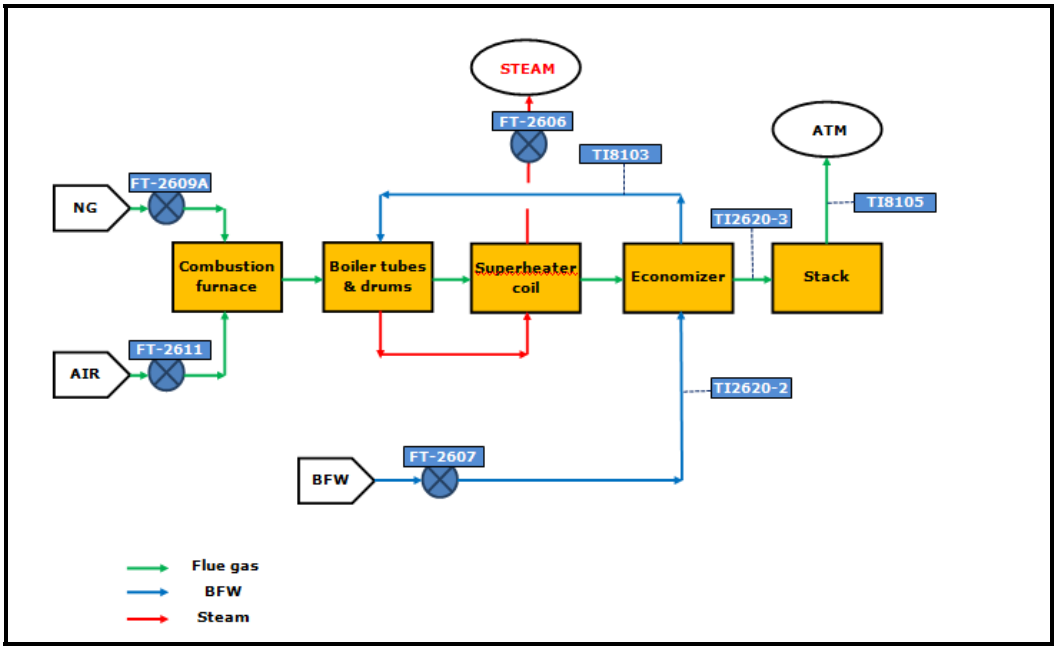


Figure C.3: Packaged Boiler Block Diagram (2008-U)

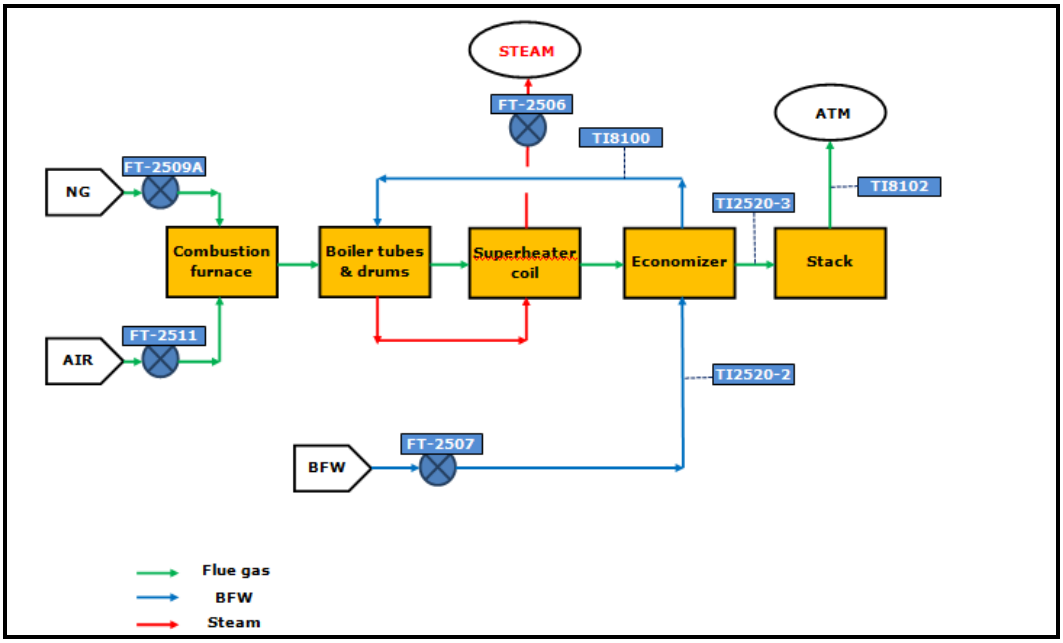


Table C.1 Sample DCS Log Sheet

Log Items	STEAM SUPPLY			STEAM DRUM		BFW			CBD		FUEL GAS (NG)			
	Temp.	SH Stm Press.	Flow	Level (N)	Level (S)	Flow	Temp.	Econ. Out T.	Cond.	PH	Header Press.	Flow	Burner Press.	Flow Meter
	TI-2520-1	PI-2513	FIC-2506	LIC-2508	LI-2516	FIC-2507	TI-2520-2	TI-8100	CI-2517	AI-2518	PIC-2219	FIC-2509	PIC-2510	FI-2509A
	°C	BAR	T/H	MM	MM	M^3/H	°C	°C	µS/cm	pH	BAR	NM^3/H	BAR	NM^3
C. R.	360-410	37-43	<129	-25 ~+100	-25 ~+100	<135	105-125	160-190	<500	9.0-11	2.5-3.5	<12000	0.1-0.9	-
00/MV														
02:00														
04:00														
06:00														
08/MV														
10:00														
12:00														
14:00														
16/MV														
18:00														
20:00														
22:00														

Log Items	(a)	COMBUSTION AIR							FLUE GAS					LOAD
	Fuel/Air Ratio	Flow	F.D.Fan Speed	2008-UJM	F.D.Fan Suc. T.	F.D.Fan Out Pres.	Windbox Pressure	Furnace Pressure	Furnace Draft Pr.	Econ. out Press	Outlet Temp.	Econ. out Temp	Excess O_2	MV Open
	HC-2511-1	FIC-2511	-	Selector mode	TI-2520-4	PI-2515-1	PI-2515-2	PI-2515-3	PI-2515-4	PI-8102	TI-2520-3	TI-8102	AI-2519	XMV 2505
	%	KNM^3/H	RPM	A .O .M	°C	mmH_2O	mmH_2O	mmH_2O	mmH_2O	mBar	°C	°C	%	%
C. R.	70-99	100-	1600-1850	CP	4-55	230-	220-	80-150	-10 ~+10	-10 ~+10	320-	144-	1.0-	<80

		170		LP		330	330				400	205	3.5	
00/MV														
02:00														
04:00														
06:00														
08/MV														
10:00														
12:00														
14:00														
16/MV														
18:00														
20:00														
22:00														

REMARKS:

SIGNATURE BY:	**1ST SHIFT**	**2ND SHIFT**	**3RD SHIFT**
DCS BRD. OPERATOR:			
SHIFT SUPERVISOR:			

Table C.2

Boiler 2052 U				**Boiler 2008 U**				**Boiler 2008 U A**			
	Tag #	Calibration / Testing Frequency	Procedure#		Tag #	Calibration / Testing Frequency	Procedure#		Tag #	Calibration / Testing Frequency	Procedure#
1	Waste Liquid Fuel			**1**	Natural Gas			**1**	Natural Gas		
	FT 4667 A	Yearly	IMP-017		FT 2509 A	Yearly	IMP-017		FT 2609 A	Yearly	IMP-017
2	Natural Gas			**2**	Air			**2**	Air		
	FT 4664 A	Yearly	IMP-017		FT 2511	Yearly	IMP-017		FT 2611	Yearly	IMP-017
3	Air			**3**	Boiler Feed Water			**3**	Boiler Feed Water		
	FT 4665	Yearly	IMP-017		FT 2507	Yearly	IMP-017		FT 2607	Yearly	IMP-017
4	Boiler Feed Water			**4**	Steam			**4**	Steam		
	FT 4663	Yearly	IMP-017		FT 2506	Yearly	IMP-017		FT 2606	Yearly	IMP-017
5	Steam			**5**	Steam Temperature			**5**	Steam Temperature		
	FT 4662	Yearly	IMP-017		TI 8100	Yearly	IMP-024		TI 8103	Yearly	IMP-024
6	Steam Temperature			**6**	Flue Gas Temp			**6**	Flue Gas Temp		

	TI 8106	Yearly	IMP-024		TI 2520-3	Yearly	IMP-024		TI 2620-3	Yearly	IMP-024
7	Flue Gas Temp			**7**	Boiler Feed water temp			**7**	Boiler Feed water temp		
	TI 4649	Yearly	IMP-024		TI 2520-2	Yearly	IMP-024		TI 2620-2	Yearly	IMP-024
8	Boiler Feed water temp			**8**	Flue Gas Tem (Stack)			**8**	Flue Gas Tem (Stack)		
	TI 4647	Yearly	IMP-024		TI 8102	Yearly	IMP-024		TI 8105	Yearly	IMP-024
9	Flue Gas Tem (Stack)										
	TI 8108	Yearly	IMP-024								

Note: Instrument, Maint. Procedure -SHEM 03.02

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/parameter:	CAP
Unit	Tons/Hour (steam)
Description	Maximum long term load (capacity) of the boiler or steam system (tonnes of steam output per hour at full load)
Source of data	Hourly Measurement Data
Value(s) applied)	100-120Tons/Hour for each of the three boilers
Choice of data or measurement methods and procedures	Boiler load classes have been selected based on review of third independent assessments of boiler performance, name plate capacity and historical data. All measurements shall comply with ASME PTC 4-1998
Purpose of data	Baseline emissions
Additional comments	All Measurements are in compliance to ASME PTC 4-1998

Data/parameter:	Boiler load class, i and j
Unit	Range Tons/Hour
Description	Boiler load classes in the case of multi-boiler installations. For each boiler ‘j’ load classes ‘i’ are introduced.
Source of data	Hourly Measurement Data
Value(s) applied	See Appendix 2
Choice of data or measurement methods and procedures	The proposed methodology requires the project developer to choose at least two boiler load classes per boiler freely.
Purpose of data	Baseline emissions
Additional comments	For the boiler load class

Data/parameter:	System Load Class “K”
Unit	(Tons/Hour) Tons/Annum
Description	System Load Classes
Source of data	Hourly Measurement Data
Value(s) applied)	See Appendix 3
Choice of data or measurement methods and procedures	Facility operates 24 hours continuously over the calendar year. Hence hourly measurements and annual totals are available
Purpose of data	Baseline emissions
Additional comments	System Load class

Data/parameter:	FCBLi
Unit	M3/h
Description	Fuel Consumption in each load class (Data available hourly/annually)
Source of data	Hourly Measurement Data
Value(s) applied)	See Appendix 4
Choice of data or measurement methods and procedures	Information from steam system operator based on measurements following strictly international or national acknowledged norms and guidelines.
Purpose of data	Leakage
Additional comments	For fuel consumption in each load class

Data/parameter:	PBLi
Unit	Tons/Hour (Tons/Annum)
Description	Average Hourly Steam Production in each load class
Source of data	Hourly Measurement Data
Value(s) applied)	See Appendix 4
Choice of data or measurement methods and procedures	Information from steam system operator based on measurements following strictly international or national acknowledged norms and guidelines
Purpose of data	Baseline emissions
Additional comments	For the average steam production in each load class

Data/parameter:	NCVFF, BL
Unit	GJ/m3
Description	Net Calorific Value of Fossil Fuel Used (Natural Gas)
Source of data	Hourly Measurement Data
Value(s) applied)	See Appendix 4
Choice of data or measurement methods and procedures	Information from steam system operator based on measurements following strictly international or national acknowledged norms and guidelines.
Purpose of data	Project Emissions
Additional comments	Net calorific value of NG

Data/parameter:	EFC,FF,BL
Unit	tC/GJ
Description	Carbon Emission Factor for fuel used in the boiler system
Source of data	IPCC
Value(s) applied)	0.056tCO2e/GJ
Choice of data or measurement methods and procedures	Regional/local emission factors are not available, hence IPCC factors have been used.
Purpose of data	Baseline emissions
Additional comments	For the carbon emission factor for fuel used in the boiler system

Data/parameter:	OXIDFF,BL
Unit	Fraction
Description	Oxidation factor for the fossil fuel used in the baseline boiler
Source of data	IPCC/ Industry Practice
Value(s) applied)	1
Choice of data or measurement methods and procedures	Regional/local emission factors are not available
Purpose of data	Baseline emissions
Additional comments	Oxidation factor for fossil fuel

Data/parameter:	PRESSBL,MIN
Unit	Barg
Description	Lowest measured pressure of the generated steam during determination of the specific energy consumption
Source of data	Measurement. Use test result for calculations
Value(s) applied)	3.1
Choice of data or measurement methods and procedures	Measurement strictly following international acknowledged norms and guidelines such as ASME PTC 4-1998.
Purpose of data	Baseline emissions
Additional comments	Lowest measured pressure of generated steam

Data/parameter:	PRESSBL,MAX
Unit	barg
Description	Highest measured pressure of the generated steam during determination of the specific energy consumption.
Source of data	Measurement. Use test result for calculations
Value(s) applied)	38.3
Choice of data or measurement methods and procedures	Measurement strictly following international acknowledged norms and guidelines such as ASME PTC 4-1998 .
Purpose of data	Baseline emissions
Additional comments	Highest measured pressure of generated steam

Data/parameter:	TEMPBLMIN
Unit	K
Description	Lowest measured temperature of the generated steam during determination of the specific energy consumption
Source of data	Measurement. Use test result for calculations.
Value(s) applied)	571.7
Choice of data or measurement methods and procedures	Measurement strictly following international acknowledged norms and guidelines such as ASME PTC 4-1998
Purpose of data	Baseline emissions
Additional comments	Lowest measured temperature of generated steam

Data/parameter:	TEMPBLMAX
Unit	K
Description	Highest measured temperature of the generated steam during determination of the specific energy consumption
Source of data	Measurement. Use test result for calculations
Value(s) applied)	671.9
Choice of data or measurement methods and procedures	Measurement strictly following international acknowledged norms and guidelines such as ASME PTC 4-1998.
Purpose of data	Baseline emissions
Additional comments	Highest measured temperature of generated steam

D.2. Data and parameters monitored

Data/parameter:	PPJ,i,y (Individual Boilers)
Unit	(Tons/Hour) Tons/Annum
Description	Generated steam in the monitoring period (01/10/2014 to 30/09/2015) subdivided into load classes in the case of single boiler installations
Measured/calculated/default	There is no single boiler installation therefore not applicable.
Source of data	There is no single boiler installation therefore not applicable.
Value(s) of monitored parameter	There is no single boiler installation therefore not applicable.
Monitoring equipment	There is no single boiler installation therefore not applicable.
Measuring/reading/recording frequency:	There is no single boiler installation therefore not applicable.
Calculation method (if applicable):	Not applicable
QA/QC procedures:	Not applicable
Purpose of data:	Not applicable
Additional comments:	Not applicable

Data/parameter:	PPJ,k,y (System)
Unit	Tons/Annum
Description	Generated steam in the monitoring period (01/10/2014 to 30/09/2015) subdivided into load classes in the case of multi boiler installations
Measured/calculated/default	Measured

Source of data	Hourly Monitoring Data measured and archived at the facility
Value(s) of monitored parameter	2323132.4
Monitoring equipment	Flow Transmitter. Calibration frequency is yearly. Calibration date: 10/01/2015. Model: year of 2012. Make: USR. Tag # FT 4667 A. Accuracy: 0.5%. Procedure IP 017.
Measuring/reading/recording frequency:	Online PIMS Server Data Stamping (Sec/Min/Hours).
Calculation method (if applicable):	NA
QA/QC procedures:	Please see Note 1 below.
Purpose of data:	Baseline emissions
Additional comments:	Generated steam in the monitoring period

Data/parameter:	$PRESS_{BL,MAX}$
Unit	barg
Description	Pressure of the generated steam
Measured/calculated/default	Measured Measurements follow international acknowledged norms and guidelines such as ASME PTC 4-1998.
Source of data	Use test result.
Value(s) of monitored parameter	38.3
Monitoring equipment	Pressure Transmitter. Calibration frequency is yearly. Calibration date: 12/04/2015. Model: year of 2014. Make: Samsung. Tag # FT 3885 A. Accuracy: 1.0%-0.5%. Procedure IP 019.
Measuring/reading/recording frequency:	Online PIMS Server Data Stamping (Sec/Min/Hours).
Calculation method (if applicable):	NA
QA/QC procedures:	Please see Note 1 below.
Purpose of data:	Baseline emissions
Additional comments:	For pressure of generated steam

Data/parameter:	$TEMP_{PJ}$
Unit	K
Description	Temperature of the generated steam
Measured/calculated/default	Measured. Measurements follow international acknowledged norms and guidelines such as ASME PTC 4-1998.
Source of data	Use test result.
Value(s) of monitored parameter	671.9

Monitoring equipment	Steam thermometer. Calibration frequency is yearly. Calibration date: 01/11/2014. Model: year of 2013. Make: URS. Tag # FT 2155 A. Accuracy: 1%. Procedure IP 019.
Measuring/reading/recording frequency:	Hourly.
Calculation method (if applicable):	NA
QA/QC procedures:	Please see Note 1 below.
Purpose of data:	Baseline emissions
Additional comments:	For temperature of generated steam

Note 1:

Al Bayroni's monitoring programme is integral to the company's third party certified (i.e. by British Standards Institute-BSI) ISO 9001:2008 compliant Quality Management System (QMS). All monitoring programmes including associated calibration is within the scope of the QMS and subjected to several audits and reviews including Internal Audits, SABIC Corporate Audits and Third Party (BSI) audits. Further, Al Bayroni subscribes to SABIC corporate's Safety, Environment, Health & Security Management Systems (SHEMS) applicable to all Rotating equipment, Pressure Relief Devices, Instrument Devises, Tanks & Pressure vessels, Piping, Car seals and Blinds, Hoses, Critical Instruments & Devices by pass, and Cathodic protection program. As a result, any modifications/ changes, replacements and emergency response is governed by the SHEMS programme. Al Bayroni is also certified to the American Chemistry Council Technical Specification Responsible Care® RC 14001.

D.3. Implementation of sampling plan

No sampling is required as 100% of data is monitored during the project scenario.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Detailed calculation methodology for baseline emissions is fully described in Section B.6.3. of the PDD. Baseline emission for the system is calculated using the formula:

$$BE_y = 44/12 \cdot EF_{C,FF,BL} \cdot OXID_{FF,BL} \cdot SEC_{syst}$$

Where

$BE_{,y}$	Baseline emissions resulting from steam generation within the capacity of the baseline equipment in the monitoring period (tCO_2/yr)
SEC_{syst}	Specific energy consumption (GJ/t) of the multi boiler steam generation system
$EF_{C,FF,BL}$	Carbon emission factor of baseline fossil fuel (tC/GJ)
$OXID_{FF,BL}$	Oxidation factor of baseline fossil fuel
44/12	Ratio of the molecular weight of CO_2 to the molecular weight of carbon

Given the steam generation capacity for all three boilers has been determined to be 100-120Tons/hour and considering that boiler operations are predominantly within this load range, the following has been considered in estimating annual baseline emissions.

Table E.1: Annual Baseline Emissions Calculation

Steam Generation & Energy Consumptions	
Annual Steam Production (2011) (T/Annum) (from all load classes)	2851360
Boiler Load Classes considered for baseline emissions	100-120 (Individual Boilers)
Annual Steam Generation within selected load class - 2008U (Tons/Annum)	800850.9
Annual Steam Generation within selected load class - 2052U (Tons/Annum)	795270.8

Annual Steam Generation within selected load class - 2008-UA (Tons/Annum)	812988.5
Total Steam Generation within selected load class (3 boilers) (Tons /Annum)	2409110.2
Average Fuel Consumption (Nm3/Ton)	81.17366021
Annual Fuel Consumption within representative load classes (Nm3/ annum)	74.66
Average Energy Consumption (GJ/Ton)	195556292.8
Annual Energy Consumption (GJ/Annum) (SECsyst)	3.240419058
Carbon Emission Factor (Fossil Fuel) (tc/GJ) ($EF_{C.FF.BL}$)	7806526.605
Oxidation Factor ($OXID_{FF.BL}$)	0.056
Baseline Emission (Tons of CO2e)	437165.48
Baseline Emissions (rounded down value) tCO2e	437,165

E.2. Calculation of project emissions or actual net GHG removals by sinks

To estimate the project emissions, the 'Tool to calculate project or leakage CO2 emissions from fossil fuel combustion' (version 2) was used. The tool requires CO2 emissions to be calculated using equation as stated below:

$PE_{FC,JY} = \sum FC_{I,J} \times COEF_{I,Y}$

Where,

$PE_{FC,JY}$ = Are the CO2 emissions from fossil fuel combustion in process j during the year 'y' (tCO2/year)

$\sum FC_{I,J}$ = Is the quantity of fuel type 'i' combusted in process 'j' during the year y (Mass or Volume Unit/year)

$COEF_{I,Y}$ = Is the CO2 emission coefficient of fuel type 'i' in year 'y' (tCO2/mass or volume unit)

i = are the fuel types

Two options have been provided in the tool to calculate the CO2 emission coefficient (COEFi,y). Option 2 (equation below) (i.e. based on net calorific value and CO2 emission factor) has been used in estimating the emission coefficient.

$COEFi,y = NCVi,y \times EF\ CO2i,y$

Where,
NCVi,y = Is the weighted average net calorific value of the fuel type i, in year y (GJ/Mass or Volume Unit)

EF CO2 i,y = Is the weighted average CO2 emission factor of fuel type i in year y (tCO2/GJ)

Project emissions have been estimated as presented in Table below.

Table E.2: Project Emissions Calculation

Representative System Load Classes considered	100-120 (Individual Boilers)
Baseline Fuel Consumption within representative load classes (Nm3/annum)	195556292.78
Project Fuel Savings (%)	9.70%
Revised Fuel Consumption within representative load classes (Nm3/annum)	179864167.53
Average Calorific Value of Fuel (GJ/m3)	0.04161195
Annual Energy Consumption (GJ/Annum) (Post Rehabilitation)	7773285.80
Project Emissions (Tons/Annum)	419,131

E.3. Calculation of leakage

Emissions due to leakage have been calculated using equation 9 of the AM0056 (v 1.0):

$$LE_{CH4,y} = \left(FC_{PJ,y} \cdot NCV_{PJ,y} \cdot EF_{PJ,upstream,CH4} - FC_{BL,y} \cdot EF_{BL,upstream,CH4}\right) \cdot GWP_{CH4}$$

Quantity of fossil fuel combusted in the project plant during the monitoring period (t or m³), monitored as described in the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (FCpjy)	179864167.53
Average net calorific value of the fossil fuel combusted during the monitoring period (GJ/t or GJ/m³) monitored as described in the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (NCVpjy)	0.04161195
Emission factor for upstream fugitive methane emissions of fossil fuel used in the project activity from production, transportation, distribution, and, in the case of LNG, liquefaction, transportation, re-gasification and compression into a transmission or distribution system, (t CH4 per GJ fuel supplied to final consumers) tCH4/GJ, $EF_{PJ, UPSTREAM CH4}$)	0.000296
Fossil fuel that would have been combusted in the absence of the project activity during the monitoring period (GJ) ($FC_{BL,Y}$)	7806526.60
Global warming potential of methane valid for the relevant commitment period.	25
Leakage (Tons of CO2e)	2,383

Note: There will no change in the source of fuel supply or mode of delivery as a result of the project. Therefore emission factor for upstream fugitive methane emissions remains same prior to and post project.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	437,165	419,131	2,383	NA	15,651	15,651

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	41,831	15,651

E.6. Remarks on difference from estimated value in registered PDD

The actual emission reductions are lower than the estimated quantity in the registered PDD.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	**X** Project participant **X** Person/entity responsible for completing the CDM-MR-FORM
Organization name	Saudi Basic Industries Corporation (SABIC)
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Project participant and/or responsible person/ entity	X Project participant Person/entity responsible for completing the CDM-MR-FORM
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Appendix 2. The selected boiler load classes

Boiler Load Class (Tons/hr)	2008-U Load Classes	2008-UA Load Classes	2052-U Load Classes
0-20	1	1	1
21-40	2	2	2
41-60	3	3	3
61-80	4	4	4
81-100	5	5	5
101-120	6	6	6
>120	7	7	7

Appendix 3. System generation load class

System Load	2008U	2052U	2008UA
21-40	OFF	ON	OFF
41-60	OFF	ON	OFF
61-80	OFF	ON	OFF
81-100	OFF	OFF	ON
	OFF	ON	ON
101-120	OFF	ON	ON
121-140	OFF	ON	ON
141-160	OFF	ON	ON
161-180	OFF	ON	ON
	ON	ON	OFF
	ON	ON	ON
181-200	ON	ON	OFF
	ON	ON	ON
201-220	ON	ON	OFF
	ON	ON	ON
221-240	ON	ON	OFF
	ON	ON	ON
241-260	ON	ON	OFF
	ON	ON	ON
261-280	ON	ON	ON
281-300	ON	ON	ON
301-320	ON	ON	ON
321-340	ON	ON	ON
340-360	ON	ON	ON
>360	ON	ON	ON

Appendix 4. SFC Estimation Per Load Class

Boilers	Load Class	Range (MT/H)	FCBL,i	PBL,i	SFCi,j	Calorific Value	SEC	SEC Sys
			Fuel (Nm3/Hour)	Steam (T/Hour)	Nm3/Tsteam	GJ/Nm3	GJ/T Steam	GJ/hr
2008-U	1	0-20	499.6	3.9	128.10	0.039	5.00	19.51
	2	21-40	2431.3	40	60.78	0.039	2.38	95.39
	3	41-60	3928.4	53.8	73.02	0.039	2.86	153.77
	4	61-80	5690.9	72.6	78.39	0.039	3.08	223.91
	5	81-100	7631.5	96	79.49	0.039	3.11	298.89
	6	101-120	7944.3	104.1	76.31	0.042	3.18	330.62
	7	>120	8664.4	126.9	68.28	0.041	2.80	354.83
2008-UA	1	0-20	Not Operational	Not Operational	Not Operational	Not Operational	Not Operational	Not Operational
	2	21-40	3644.88	31.10	117.19	0.039	4.58	142.56
	3	41-60	4402.8	53.4	82.45	0.039	3.21	171.66
	4	61-80	6013.2	72.2	83.29	0.039	3.27	236.07
	5	81-100	7922.3	95.1	83.30	0.039	3.28	311.62
	6	101-120	8501.2	106.4	79.90	0.042	3.33	353.97
	7	>120	10002.3	122.9	81.39	0.041	3.30	406.06
2052-U	1	0-20	2071.4	17.1	121.13	0.041	4.99	85.25
	2	21-40	2780.9	29.6	93.95	0.040	3.80	112.39
	3	41-60	3675.6	55.7	65.99	0.039	2.57	143.42
	4	61-80	5198.3	70.9	73.32	0.039	2.88	204.44
	5	81-100	6812.9	93	73.26	0.039	2.86	266.05
	6	101-120	7311.7	107.8	67.83	0.042	2.82	304.03
	7	>120	Not Operational	Not Operational	Not Operational	Not Operational	Not Operational	Not Operational

Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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