JOINT IMPLEMENTATION PROJECT

Energy efficiency increase in steelmaking and sinter plants JSC “Zaporizhstal”, Ukraine

(project name)

The Project Developer

General Director CJSC “National Carbon Sequestration Foundation”	______________	Fedorov Y.N.

Seal

The Project Owner

Deputy Chairman of Board Technical Director JSC “Zaporizhstal”	______________	Putnoki A.U.

Seal

Zaporizhzhya
April 2011

JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Energy efficiency increase in steelmaking and sinter plants JSC “Zaporizhstal”, Ukraine

Sectoral scope: (3) Energy demand, (9) Metal production

Version: 02

Date: 15/03/2011

A.2. Description of the project:

The JSC “Zaporizhstal” is one of the largest metallurgical works in Ukraine. The JSC “Zaporizhstal” is a manufacturer of high-quality metal products – pig iron, steel, flat products of carbon, low-alloyed, alloyed and stainless steel, joist webs, tinplate, construction materials and consumer goods. The main metallurgical plants at the JSC “Zaporizhstal” are sinter plant, blast-furnace plant, steelmaking (open-hearth) plant, foundry plant, slabbing mill, hot-rolling mill and cold-rolling mill

JSC “Zaporizhstal” is implementing project for energy efficiency increase in steelmaking and sinter plants by introduction of new gas burners with spay and niche technology (SNT). Project implementation provides to the decrease of natural gas consumption for steel and sinter production and as a result to GHG emissions reductions.

Situation existing prior to the starting date of the project:

Natural gas is used in steelmaking plant for metal heating by steel smelting and in sinter plant for firing of sinter charge by sinter production. Efficiency of fuel burning depends on technological parameters and fuel burners.

Before project implementation the following burners were used: in steelmaking plant – gas burners with oxygen conversion designed by IChM, in sinter plant – twin-lead multiple-jet gas burners designed by PKO-0180.096.0 JSC “Zaporizhstal”. The main indicators of steel and sinter production before project implementation are presented in the Annex 2.

Project scenario

Project includes installation of gas burners with spray and niche technology designed by CJSC “ZPK “Specgazprom” on aggregates in steelmaking and sinter plant in amount of 58 pcs. The gas burners with spray and niche technology have same construction qualities that provide to more effective use of fuel and less air pollutant emissions in comparison with other types of burners. The project scenario has same significant investment and technological barriers that prevent the project implementation in the absence of additional financing from joint implementation mechanism of Kyoto protocol.

History of the project

The decision to implement the project on the installation of gas burners with spray and niche technology in sinter and steelmaking plants at the JSC “Zaporizhstal” was taken in 2005. The replacement of gas burners is implemented stepwise in 2005-2009. The work documentation is elaborated for each aggregate for new gas burners installation in period of installation works. The final replacement of traditional burners in the burner with spray and niche technology is made in 2009. The decision about the project implementation and financing was done with accounting of possible additional investments to the project by using joint implementation mechanism of Kyoto protocol.

Baseline scenario

In the absence of the project the traditional gas burners are to be used in steelmaking and sinter plants at the JSC “Zaporizhstal” (the same as in the situation existing prior to the starting date of the project): in steelmaking plant – gas burners with oxygen conversion designed by IChM, in sinter plant – twin-lead multiple-jet gas burners designed by PKO-0180.096.0 JSC “Zaporizhstal”. The traditional burners are produced in the mechanical plant JSC “Zaporizhstal”, meet the technological requirements of steel and sinter production, have confirmed its reliability long-term use.

Reduction of greenhouse gases emissions

GHG emission reductions are achieved by project implementation because of natural gas consumption decrease by production in steelmaking and sinter plant at JSC “Zaporizhstal” as result of gas burners with spray and niche technology installation. The estimated GHG emission reductions due to the energy efficiency increase in steelmaking and sinter plants JSC “Zaporizhstal” is about 461,300 tCO_2 equivalent in 2008-2012 or in average 92,260 tCO_2 equivalent per year.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host Party)	• JSC “Zaporizhstal”	No
Party B	Not determined[1]	-

A.4. Technical description of the project:

A.4.1. Location of the project:

The project is located on the territory of the JSC “Zaporizhstal”, city of Zaporizhzhya, Zaporizhzhya region, Ukraine.

A.4.1.1. Host Party(ies):

Ukraine

A.4.1.2. Region/State/Province etc.:

Zaporizhzhya region

---

[1] Party B is not determined on the moment of PDD elaboration and will be determined later after the project approval by the Host Party (Ukraine).

A.4.1.3. City/Town/Community etc.:

Zaporizhzhya

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project (maximum one page):

The project is being implemented within the integrated iron-and-steel works of the JSC “Zaporizhstal” located in the city of Zaporizhzhya, Zaporizhzhya region, Ukraine. The site co-ordinates are: 47°52’ N, 35°09’ E.

Ukraine is situated in the south-eastern part of Central Europe. It occupies an area of 603,000 sq. km. Ukraine stretches for 1,316 km from the west to the south and for 893 km from the north to the south. In the south Ukraine is washed by the Black Sea and the Sea of Azov. In the north Ukraine borders Belarus, in the east and north-west Russia, in the south-west Hungary, Romania and Moldova and Poland and in the west Slovakia. Ukraine comprises 24 administrative districts.

Zaporizhzhya region: it is situated in the south-east of Ukraine. The area of the Zaporizhzhya region is 27,200 sq. km (4.5% of the area of Ukraine). Population – 2,023,800 people (4% of the population of Ukraine). The Zaporizhzhya region borders Dnipropetrvsk, Kherson and Donetsk regions and in the south-east its coast is washed by the waters of the Sea of Azov.

The Zaporizhzhya region is one of the most developed industrial regions of Ukraine. Over 90% of total industrial production is in heavy industry, the electric power industry and machine-construction. Over 160 large manufacturing corporations operate in the region.

The city of Zaporizhzhya is the administrative capital of the Zaporizhzhya region situated on the Dnieper river. The population of the city of Zaporizhzhya is about 855,500 people (2007).

Figure A.4.1-1. Ukraine, Zaporizhzhya

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

The project "Energy efficiency increase in steelmaking and sinter plants JSC "Zaporizhstal", Ukraine" is implemented for the purpose of natural gas consumption decrease and GHG emission reductions by steel and sinter production. The energy efficiency is achieved in steelmaking and sinter plants as result of the installation of new gas burners with spray and niche technology instead of traditional gas burners.

Description of gas burners with spray and niche technology (SNT):

1. Gas burners design. The gas burner with SNT technology consist of the following parts: case of square section, pylon with gas-ports in bottom and upper part for flame stabilization, two gas chambers, air conduit.

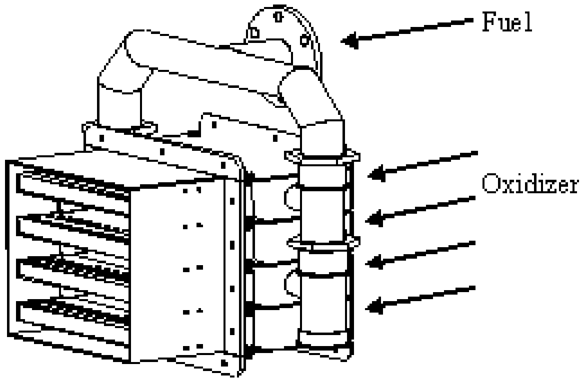


Figure A.4.2-1. Principle scheme of gas burners with SNT

2. Technology of fuel combustion. Gas through the gas supply pipe enters the gas chambers, from which comes the inner cavity of the pylons-stabilizers. Gas is fed by gas-directional channels to the gas port, from which the gas sprays, all along the front burner, served in the zone between the pylons, perpendicular to the flow of air from the blowing fan to be sent through a air conduit. Spray of gas mixed with air, forming a gas-air mixture is moving along the plane of the nozzle bar pylon, forming a butt pylon short-torch flame along the entire front burner inside the furnace unit.

3. Technological features and benefits. The design of gas burner with SNT and implemented technology for gas combustion ensure homogenization of gas-air mixture, low aerodynamic drag, increase the intensity of combustion at a moderate speed and low excess air ratio, increase the efficiency of fuel combustion. In the burner flame creates an ordered structure, which provides to stability of combustion pressure oscillations in the gas network, increasing the heat in the firebox of the unit, complete combustion of gas and a uniform temperature in the combustion space of heat-technical aggregate.

Design and technological advantages of gas burners with SNT provide a reduction in fuel consumption compared with other types of burners that can reduce emissions of GHG resulting from combustion of natural gas in the sinter and steelmaking plants of JSC "Zaporizhstal". The main indicators of steel and sinter production using the gas burners with SNT are presented in the section A.4.3.

The project includes the installation of gas burners with spray and niche technology on aggregates in steelmaking and sinter plants. The table demonstrated the main stage of project implementation is provided below.

Table A.4.2-1. The gas burners installed on aggregates in steelmaking and sinter plants of JSC “Zaporizhstal”

№	Aggregate	Type of burner	Number	Data of installation
1.	Two-bath steel melting aggregate #1	SNG-33M	4	September 2005
2.	Open-hearth furnaces # 2	SNG-33VS SNG-55SV	3 2	January 2006 January 2009
3.	Open-hearth furnaces # 5	SNG-33VS SNG-55SV	3 2	December 2005 March 2009
4.	Open-hearth furnaces # 6	SNG-33VS SNG-55SV	3 2	February 2006 July 2009
5.	Open-hearth furnaces # 7	SNG-33VS SNG-55SV	3 2	February 2006 February 2009
6.	Open-hearth furnaces # 8	SNG-33VS SNG-55SV	3 2	December 2005 March 2009
7.	Open-hearth furnaces # 10	SNG-33VS SNG-55SV	3 2	January 2006 February 2009
8.	Open-hearth furnaces # 11	SNG-33VS	3	December 2005
9.	Open-hearth furnaces # 12	SNG-33VS SNG-55SV	3 2	January 2006 May 2009
10.	Sinter machines # 2[2]	SNG-22AG	4	June 2006
11.	Sinter machines # 3	SNG-22AG	4	April 2007
12.	Sinter machines # 4	SNG-22AG	4	August 2006
13.	Sinter machines # 5	SNG-22AG	4	October 2006
14.	Sinter machines # 6	SNG-22AG	4	November 2007

The operation time of gas burners with spray and niche technology on aggregates of metallurgical works is about one year in steelmaking plant and about five years in sinter plant.

The project’s technology and equipment corresponds to the good practice of gas burners using in the metallurgical works as they ensure the high efficiency of fuel combustion in metallurgical aggregates.

The technical maintenance of the gas burners with SNT is provided by properly trained and qualified staff of JSC “Zaporizhstal” in accordance with actual regulations.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

---

[2] The gas burners with spray and niche technology (SNG-22AG) were not installed on the sinter machine #1 because the sinter machine #1 is to replace with new sinter machine.

GHG emission reductions are achieved in steelmaking and sinter plant at JSC "Zaporizhstal" as result of gas burners with spray and niche technology installation. The using of gas burners with SNT provides to more efficiency fuel burning in comparison with the situation in the absence of the project. Therefore are achieved the decrease of natural gas consumption and accordingly GHG emission reductions arising by natural gas combustion.

The estimated GHG emission reductions due to the project implementation is about 461,300 tCO_2 equivalent in 2008-2012 or in average 92,260 tCO_2 equivalent per year.

The main indicators of GHG emission reduction by steel and sinter production are presented in the table A.4.3-1. The detailed description of GHG emissions in project and baseline scenario is provided in the section B and E.

Table A.4.3-1. GHG emissions by steel and sinter production in the project and baseline scenario (average value for 2008-2012)[3]

№	Parameter	Measurement units	Baseline scenario	Project scenario	Change
1.1.	Steel production	t / year	3,594,776	3,594,776	0
1.2.	Specific CO_2 emissions in steelmaking plant	tCO_2 equivalent / t	0.127	0.104	- 0.023
1.3.	CO_2 emissions in steelmaking plant	tCO_2 equivalent / year	457,323	374,222	- 83,101
2.1.	Sinter production	t / year	5,035,718	5,035,718	0
2.2.	Specific CO_2 emissions in sinter plant	tCO_2 equivalent / t	0.009	0.008	- 0.001
2.3.	CO_2 emissions in sinter plant	tCO_2 equivalent / year	47,090	37,931	- 9,159
3.	Total CO_2 emissions	tCO_2 equivalent / year	504,413	412,153	- 92,260

The current legislation of Ukraine does not restrict activities causing GHG emissions in the field of control of anthropogenic GHG emissions. Thus the project of energy efficiency increase in steelmaking and sinter plants at the JSC "Zaporizhstal" may be developing according to any possible scenario. In case there is no possibility to attract the additional investments to implement the project with the help of the mechanisms of the Kyoto protocol, the project would develop in compliance with the baseline scenario (the choice and justification of the baseline scenario are provided in the section B.1. and B.2.). The baseline scenario does not contradict the national and the branch policy in the field of the GHG emissions regulations and could be implemented in the absence of the proposed project but that would not allow reducing the GHG emissions.

---

[3] The provided data is based on Technical reports of steelmaking and sinter plants JSC "Zaporizhstal" for 2008-2009, forecast of steel and sinter production for 2010-2012 (prepared by Planning and economic department of JSC "Zaporizhstal") and GHG emissions estimation provided in the section E.

A.4.3.1. Estimated amount of emission reductions over the crediting period:

Table A.4.3-2. Estimated amount of emission reductions during the first commitment period[4]

	Years
Length of the crediting period	5 years (60 months)
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent.
2008	90,778
2009	99,797
2010	85,145
2011	89,449
2012	96,131
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	461,300
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	92,260

Table A.4.3-3. Estimated amount of emission reductions before the first commitment period

	Years
Length of the crediting period	2 years (24 months)
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent.
2006	98,483
2007	127,256

---

[4] Estimation of GHG emission reductions (stated in tables A.4.3-2, A.4.3-3, A.4.3-4) is provided for 2006-2009 based on actual data of steelmaking and sinter plants JSC “Zaporizhstal” (data source: monthly technical reports) and forecast of steel and sinter production for 2010-2016 (prepared by Planning and economic department of JSC “Zaporizhstal”) using the formulae provided in the section D.

Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	225,739
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	112,870

Table A.4.3-4. Estimated amount of emission reductions after the first commitment period[5]

	Years
Length of the crediting period	4 years (48 months)
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent.
2013	97,732
2014	97,732
2015	97,732
2016	97,732
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	390,928
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	97,732

A.5. Project approval by the Parties involved:

The Letter of Approval will be received after project determination. This is in consistent with Host Party legislation: Procedure of Drafting, Review, Approval and Implementation of Projects Aimed at Reduction of Anthropogenic Emissions of Greenhouse Gases, approved by the Decree of the Cabinet of Ministers of Ukraine No. 206 dated February 22, 2006 (as restated by the Decree of the Cabinet of Ministers of Ukraine No. 718 dated August 20, 2008).

---

[5] The period of GHG emission reductions calculation is limited by lifetime of open-hearth plant operation. The open-hearth furnaces will be decommissioned in 2017 after construction of new oxygen converter plant.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

Description and justification of the baseline chosen is provided in accordance with Guidance on criteria for baseline setting and monitoring (Version 02).[6]

The **JI specific approach**[7] is used for description and justification of the baseline chosen that includes the following steps:

1. Indication and description of the approach chosen regarding baseline setting
2. Application of the approach chosen

Step 1. Indication and description of the approach chosen regarding baseline setting

The JI specific approach for baseline setting is elaborated in accordance with Appendix B of the JI guidelines[8] and paragraph 23 through 29 of the Guidance on criteria for baseline setting and monitoring (Version 02). The baseline is identified by listing and describing plausible future scenarios on the basis of conservative assumptions and selecting the most plausible one taking into account the key factors that affect a baseline.

The **following steps** are implemented for baseline setting:

1. Identification and description of plausible future scenarios

At this stage the plausible future scenarios are defined and checked if they are in line with the current legislation and if they are available to the project participants.

2. Analysis of the key factors that affect the implementation of the plausible future scenarios

The key factors are directly or indirectly factors to the plausible future scenarios that affect their implementation. The following factors considered as the key factors that affect the plausible future scenarios implementation: technological barriers, financial barrier (the description and application of the mentioned key factors are provided by Step 2 of the approach chosen). The other factors stated in paragraph 25 of the Guidance on criteria for baseline setting and monitoring (Version 02) can not be considered as the key factors that affect the baseline.

3. Selecting the most plausible scenario

This stage results in defining of the baseline. The baseline is the most attractive plausible future scenario.

Step 2. Application of the approach chosen

1. Identification and description of plausible future scenarios

The list of the plausible future scenarios shall be developed according to the following terms:

- all plausible future scenarios shall be available to the project participants;
- all plausible future scenarios shall be provide outputs in comparable quantities and with comparable quality and properties.

---

[6] Source: http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

[7] In accordance with paragraph 9(a) “Guidance on criteria for baseline setting and monitoring”, (Version 02). The approved CDM methodologies are not used for choice, justification and setting of the baseline.

[8] Source: http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=2

The list of plausible future scenarios:

Plausible future scenario 1. Project implementation without registration as a JI project. Installation of gas burners with spray and niche technology on aggregates in steelmaking and sinter plants.

Plausible future scenario 2. Continuation of the current situation. Use of traditional gas burners on aggregates in steelmaking and sinter plants: in sinter plant – twin-lead multiple-jet gas burners, in steelmaking plant – gas burners with oxygen conversion.

Plausible future scenario 3. Installation of new gas burners in steelmaking and sinter plants different from traditional gas burners and from gas burners with spray and niche technology.

Description of plausible future scenarios:

Plausible future scenario 1

Plausible future scenario 1 includes installation of gas burners with spray and niche technology designed by CJSC "ZPK "Specgazprom" on aggregates in steelmaking and sinter plants in amount of 58 pcs. Gas burners are used for natural gas combustion for metal heating by steel smelting in steel-smelting furnaces and for firing of sinter charge by sinter production in sinter plant. The operation time of gas burners with spray and niche technology is about one year. The specificity of these burners is the need of compressed air provision for natural gas distribution and burners cooling. The plausible future scenario 1 is the scenario of project implementation without registration as a JI project.

Plausible future scenario 2

Continuation of the current situation includes the use of traditional burners: in sinter plant – twin-lead multiple-jet gas burners, in steelmaking plant – gas burners with oxygen conversion. The traditional burners are produced in the mechanical plant JSC "Zaporizhstal". Gas burners is used for natural gas combustion for metal heating by steel smelting in steel-smelting furnaces and for firing of sinter charge by sinter production in sinter plant. The operation time of traditional gas burners is about five years.

Plausible future scenario 3

Plausible future scenario 3 includes installation of new gas burners in steelmaking and sinter plants different from gas burners in plausible future scenario 1 and plausible future scenario 2. Gas burners is used for natural gas combustion for metal heating by steel smelting in steel-smelting furnaces and for firing of sinter charge by sinter production in sinter plant.

The plausible future scenario 3 is not available to the project participants as the basic type of the gas burners used on aggregates in steelmaking and sinter plants are the gas burners included in the plausible future scenario 2. The possibility of alternative burners use in steelmaking plant was considered before project implementation[9] but the alternative burners were not in consistent with operation conditions of steel-smelting furnaces. The long term use of traditional burners (plausible future scenario 2) without each replacement with alternative gas burners confirms that the appropriate alternative burners were not available to the project participants until first testing of burners with spray and niche technology in JSC "Zaporizhstal".

The plausible future scenarios 1 and 2 are available to the project participants and comply with the operation conditions of steel and sinter production in JSC "Zaporizhstal".

Compliance of the chosen scenarios with the current legislation and regulations

The gas burners in the plausible future scenarios 1 and 2 are in compliance with the current legislation and regulations in area of burners operation on aggregates in steelmaking and sinter plants.

---

[9] Protocol of alternative burners' consideration at JSC "Zaporizhstal" is available.

2. Analysis of the key factors that affect the implementation of the plausible future scenarios

The key factors are directly or indirectly factors to the plausible future scenarios that affect their implementation.

The list of the key factors that affect the implementation of the plausible future scenarios:[10]

1) Technological barriers.
2) Financial barrier (cost efficiency).

Definition of key factors

Technological barriers.

Technological barrier is the application of technology and equipment for natural combustion on heating aggregates in metallurgical works that can provide to malfunction of basic technological processes of steel and sinter production.

Financial barrier (cost efficiency).

The presence of a financial barrier for a specific scenario means that economic parameters of the scenario are not acceptable for the project participants.

The presence of the above barriers for implementation of plausible future scenarios means that they may not be implemented if there is a more profitable scenario or there is no possibility of overcoming them.

Analysis of the key factors that affect the implementation of the plausible future scenarios

Technological barriers.

Plausible future scenario 1 includes installation of gas burners with spray and niche technology designed by CJSC "ZPK "Specgazprom" on aggregates in steelmaking and sinter plants JSC "Zaporizhstal". These gas burners were not used in other metallurgical works before the project implementation,[11] in this connection there are some technological barriers to their use.

The operation time of gas burners with spray and niche technology on aggregates of metallurgical works is about one year in contrast to the traditional gas burners with operation time about five years. The short operation time provides to the additional operational costs for purchase and installation of gas burners with spray and niche technology.

The gas burners with spray and niche technology are produced by CJSC "ZPK "Specgazprom" only. Therefore by need of gas burners replacement at JSC "Zaporizhstal" is it required the involvement of the burners' producer. In case of urgent need of replacement of the out of service burners may be a delay with the delivery of burners from producer on independent from JSC "Zaporizhstal" grounds, that can provide to the malfunction of basic technological processes of steel and sinter production.

The additional technological barrier for use of burners with spray and niche technology is the need of compressed air provision for natural gas distribution and burners cooling in contrast to the traditional gas burners with water cooling. Taken into account that the gas burners are used in the aggregates with a working temperature of 1500 °C (steel-smelting furnaces) the compressed air for cooling is a key factor in the maintenance of burners. The problem with compressed air provision leads to the gas burners failure in a short time and the impossibility of its recovery. Furthermore a violation of compressed air,

---

[10] The factors that are not provided in the list of the key factors (including factors provided in the paragraph 25 of Guidance on criteria for baseline setting and monitoring (Version 02)) have not an influence on plausible future scenarios implementation.

[11] The gas burners with spray and niche technology were installed for the first time at JSC "Zaporizhstal". Source: Letter from CJSC "ZPK "Specgazprom" dated on 08/11/2010.

including pressure fall, leads to the outage of natural gas distribution in the aggregates and possible fuel leakage in the building plant, which is unacceptable on rules of safety.

The compressed air is produced in the compressor plant of JSC "Zaporizhstal". Experience of the compressor plant operation shows that the violation of supplying consumers with compressed air may occur by the following reasons: de-energization, disruption of water supplies, oil pressure fall, violation of the mechanical and electrical characteristics of the equipment.[12] The time required to restore a compressed air provision due to these reasons, exceeds the limit of the possible operation of burners without cooling.

Therefore the plausible future scenario 1 implementation is affected by significant technological barriers because of the technology and equipment application that were not used in other metallurgical works before the project implementation. The identified barriers can provide to malfunction of basic technological processes of steel and sinter production as the steel smelting and charge sintering cannot be provided without natural gas burning or by gas burners malfunction. The overcoming of technological barriers to plausible future scenario 1 is associated with the financial costs. The analysis of cost efficiency in the plausible future scenario 1 is provided below in description of the financial barrier.

Plausible future scenario 2 includes the use of traditional gas burners. These burners are used in the sinter and steelmaking plant for a long time, produced in the mechanical plant JSC "Zaporizhstal", have a long lifetime (4-5 years) and meet the requirements of basic technological processes. Therefore the technological barriers do not affect the implementation of the plausible future scenario 2.

Financial barrier (cost efficiency).

In order to assess the impact of the financial barrier on the defined plausible future scenarios it is provided the economic efficiency analysis of the investment costs.

The most relevant financial index for the analysis of the plausible future scenarios is the average unit cost of steel production by use of defined gas burners. The results of cost efficiency analysis are shown in the table B.1-1.[13]

Table B.1-1. Results of cost efficiency analysis

№	Parameter	Plausible future scenario 1	Plausible future scenario 2
1.	Investment, th. hryvnia	29,707.3	104.9
2.	Operational costs[14], th. hryvnia / year	170,366.8	158,126.1
3.	Steel production, th. t / year	4,385.3	4,385.3
4.	Unit cost of steel production by use of defined gas burners, hryvnia / t	40.1	36.1

---

[12] These reasons of compressed air provision violation and their presence is confirmed by aggregate logs of the compressor plant JSC "Zaporizhstal".

[13] The economic efficiency analysis including sensitivity analysis is attached in excel file.

[14] Operational costs include the costs of energy resources (natural gas, compressed air, technical water) and equipment maintenance. The values of specific natural gas consumption taken for cost efficiency analysis are 0.062 th. m^3/t for plausible future scenario 1 and 0.076 th. m^3/t for plausible future scenario 2. The detailed economic efficiency analysis is attached in excel file.

The results of cost efficiency analysis provided in the table B.1-1. show that the plausible future scenario 2 is more attractive regarding the financial index than the plausible future scenario 1: the average unit cost of steel production in the plausible future scenario 2 (36.1 hryvnia / t) is less than in the plausible future scenario 1 (40.1 hryvnia / t). This issue is confirmed by performed sensitivity analysis.

3. Choice of the most plausible future scenario – baseline

The results of the performed analysis of the key factors affected the plausible future scenarios make it possible to draw the conclusion that the most plausible future scenario is the plausible future scenario 2: Continuation of the current situation. Use of traditional gas burners on aggregates in steelmaking and sinter plants: in sinter plant – twin-lead multiple-jet gas burners, in steelmaking plant – gas burners with oxygen conversion. The plausible future scenario 2 is the **baseline**.

The following parameters are used **to establish the baseline** (estimation of greenhouse gases emissions according to the baseline):

- steel production in steel-smelting furnaces in steelmaking plant;
- sinter production in sinter plant;
- chemical composition of natural gas;
- specific natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario;
- specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario.

Data / parameter	$\mathbf{P_{STEEL,F\text{-}i,y}}$
Data unit	t
Description	Steel production in i- steel-smelting furnace
Time of determination/monitoring	Monthly according to the monitoring plan
Source of data (to be) used	Measured
Value of data (for ex ante calculations/determinations)	Presented in the Annex 2 “Baseline information”
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Steel production in i- steel-smelting furnace ($P_{STEEL,F\text{-}i,y}$) for 2006-2009 is determined based on monthly technical reports of steelmaking plant JSC “Zaporizhstal”. Steel production in i- steel-smelting furnace ($P_{STEEL,F\text{-}i,y}$) for 2010-2016 is determined based on forecast of steel production in steelmaking plant prepared by Planning and economic department of JSC “Zaporizhstal” taking into account part of steel production in each furnace in 2005-2009. The calculation is attached in excel file.
QA/QC procedures (to be) applied	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant

	standards and approved methodologies. Department of automatization and metrology of the JSC "Zaporizhstal" is responsible for calibration/verification procedures.
Any comment	**-**

Data / parameter	**$P_{SINTER,y}$**
Data unit	t
Description	Sinter production in sinter plant
Time of determination/monitoring	Monthly according to the monitoring plan
Source of data (to be) used	Measured
Value of data (for ex ante calculations/determinations)	Presented in the Annex 2 "Baseline information"
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Sinter production in sinter plant ($P_{SINTER,y}$) for 2006-2009 is determined based on monthly technical reports of sinter plant JSC "Zaporizhstal". Sinter production in sinter plant ($P_{SINTER,y}$) for 2010-2016 is determined based on forecast of sinter production in steelmaking plant prepared by Planning and economic department of JSC "Zaporizhstal"
QA/QC procedures (to be) applied	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC "Zaporizhstal" is responsible for calibration/verification procedures.
Any comment	**-**

Data / parameter	**$W_{j,NG,y}$**
Data unit	Fraction
Description	Molar fraction of j-component of natural gas
Time of determination/monitoring	Monthly according to the monitoring plan
Source of data (to be) used	Measured
Value of data (for ex ante calculations/determinations)	Presented in the Annex 2 "Baseline information"

Justification of the choice of data or description of measurement methods and procedures (to be) applied	Molar fraction of j-component of natural gas ($W_{j,NG,y}$) for 2006-2009 is determined based on certificates of physical and chemical parameters of natural gas provided by gas supplier. Molar fraction of j-component of natural gas ($W_{j,NG,y}$) for 2010-2016 is determined as average value for 2006-2009. The calculation is attached in excel file.
QA/QC procedures (to be) applied	The natural gas supplier provides certificates with physical-chemistry parameters of natural gas. Additional procedures of quality control are not foreseen.
Any comment	-

Data / parameter	**$SFC_{NG,F-i,BL}$**
Data unit	kg of standard fuel / t
Description	Specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario
Time of determination/monitoring	Determined ex ante
Source of data (to be) used	Calculated
Value of data (for ex ante calculations/determinations)	Furnace number – $SFC_{NG,F-i,BL}$ 1 – 21.32 2 – 99.71 5 – 100.79 6 – 99.87 7 – 92.48 8 – 97.24 10 – 100.56 11 – 88.32 12 – 99.81
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario ($SFC_{NG,F-i,BL}$) is calculated by the formulae: $SFC_{NG,F-i,BL} = [\Sigma(FC_{NG,F-i,BL,m}) / \Sigma(P_{STEEL,F-i,BL,m})] * 10^3$ $SFC_{NG,F-i,BL}$ - specific natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario, kg of standard fuel / t; $FC_{NG,F-i,BL,m}$ - natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario, t of standard fuel; $P_{STEEL,F-i,BL,m}$ - steel production in i- steel-smelting furnace in the baseline scenario, t;

	m - month. The calculation is provided for period 24 months before gas burners replacement. Initial data for calculation is provided by Central laboratory JSC "Zaporizhstal" based on technical reports of steelmaking plant for September 2003 – February 2006. The monthly calculation of specific natural gas consumption for the long period (2 years) reflects the possible change of the furnace charge in open-hearth plant and steel grade. For the conservative assumption of baseline emissions is used the lower boundary of 95-% confidential interval of specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario (the calculation is attached in excel file).
QA/QC procedures (to be) applied	Measuring devices for natural gas consumption and steel production are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies.
Any comment	Specific natural gas consumption for steel production in steel-smelting furnace #1 is more less than in other steel-smelting furnaces as the furnace #1 is a two-bath steel melting aggregate that is more effectiveness that other open-hearth furnaces (2, 5, 6, 7, 8, 10, 11, 12). This is confirmed by relevant studies, e.g. Voskobojnikov V.G., Kudrin V.A., Yakushev A.M. General metallurgy. – Moscow: IKC "Akademkniga", 2005 – 768 p.

Data / parameter	**$SFC_{NG,SINTER,BL}$**
Data unit	kg of standard fuel / t
Description	Specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario
Time of determination/monitoring	Determined ex ante
Source of data (to be) used	Calculated
Value of data (for ex ante calculations/determinations)	5.66
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario ($SFC_{NG,SINTER,BL}$) is calculated the formulae: $SFC_{NG,SINTER,BL} = [\Sigma(FC_{NG,SINTERPLANT,BL,m}) /$

	$\Sigma(P_{SINTER,BL,m}) * k_{NG}] * 10^3$ $SFC_{NG,SINTER,BL}$ - specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, kg of standard fuel / t; $FC_{NG,SINTERPLANT,BL,m}$ - natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, th. m^3; $P_{SINTER,BL,m}$ - sinter production in sinter plant in the baseline scenario, t; k_{NG} - conversion factor of natural gas into standard fuel, t of standard fuel/thousand m^3 m - month. The calculation is provided for period 24 months before gas burners replacement. Initial data for calculation are provided by Central laboratory JSC “Zaporizhstal” based on technical reports of sinter plant for August 2004 – July 2006. The calculation is attached in excel file.
QA/QC procedures (to be) applied	Measuring devices for natural gas consumption and sinter production are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies.
Any comment	The value of conversion factor of natural gas into standard fuel is taken 1.15 t of standard fuel/thousand m^3 according to the Instruction for order of enterprise’s fuel and energy balance compilation, Moscow, 1985 – p. 63-65. This assumption is conservative as the average value of conversion factor (k_{NG}) calculated based on actual data (natural gas certificates for period 2004-2006) is not less than 1.15 t of standard fuel/thousand m^3.

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

JI specific approach is used for demonstration of additionality of the project in accordance with the paragraph 2(a) of the Annex I to the “Guidance on criteria for baseline setting and monitoring”, (Version 02). The approved CDM methodologies and tools are not used for demonstration of additionality.

The demonstration that the project provides reductions in emissions by sources that are additional to any that would otherwise occur, is provided using the following step-wise approach:

1. Indication and description of the approach applied
2. Application of the approach chosen
3. Provision of additionality proofs

Step 1. Indication and description of the approach applied

A JI-specific approach is chosen for justification of additionality. Guidance on criteria for baseline setting and monitoring prescribes in this case to provide traceable and transparent information showing that the baseline was identified on the basis of conservative assumptions, that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources.

Step 2. Application of the approach chosen

The analysis outlined in the section B.1. clearly demonstrates that the baseline scenario is: Plausible future scenario 2. Continuation of the current situation. Use of traditional gas burners on aggregates in steelmaking and sinter plants: in sinter plant – twin-lead multiple-jet gas burners, in steelmaking plant – gas burners with oxygen conversion. The project is not a part of the baseline scenario, which can be shown by analyzing the key factors that affect the implementation of the plausible future scenario 1. The results of the key factors analysis (provided in the section B.1.) demonstrated that the project scenario is not part of the identified baseline scenario are provided in the table B.2-1.

Table B.2-1. Impact of the barriers on the plausible future scenarios implementation

№	Scenario	Technological barriers	Financial barrier
1.	Plausible future scenario 1 (project without JI registration)	Technological barrier exist because of the technology and equipment application that were not used in other metallurgical works before the project implementation. The analysis of the technological barriers is provided in the section B.1 of the PDD.	Financial barrier exists. The average unit cost of steel production in the plausible future scenario 1 (40.1 hryvnia/t) is more than for the baseline scenario. The results of the cost efficiency analysis are provided in the table B.1-1 in the section B.1 of the PDD.
2.	Plausible future scenario 2 (baseline scenario)	Technological barrier do not exist because of traditional technology and equipment application. The analysis of the technological barriers is provided in the section B.1 of the PDD.	Financial barrier doesn’t exist. The average unit cost of steel production in the plausible future scenario 2 (36.1 hryvnia/t) is less than for the project without JI registration. The results of the cost efficiency analysis are provided in the table B.1-1 in the section B.1 of the PDD.

The analysis of the key factors affected future scenarios implementation shows that the project activity is not a part of the baseline. Therefore the reduction of emissions obtained in the course of project implementation is additional to the baseline.

Explanation of how registration of the Project as a JI (Joint Implementation) project will reduce the effect of the barriers that prevent the Project being implemented in the absence of the use of the JI mechanism.

The registration of the project as a JI project and the attracting the additional financing at the expense of the ERUs trading will help to get over the identified barriers and to increase the attractiveness of the project activity.

The investment from the ERUs sale can alleviate the financial barrier and technological barriers as these barriers are connected with additional financing in comparison to the baseline. This shows that the registration of the project as a JI project will assist overcoming the above determined barriers.

Step 3. Provision of additionality proofs

The proofs to support above information are contained in the following documents:

- Protocols of decision of project implementation and other relevant documentation from project participants;
- Cost efficiency analysis of the project;
- Relevant studies;
- Laws of Ukraine for energy and industry development and JI projects implementation.

Explanations on how GHG emission reductions are achieved

GHG emission reductions are achieved in the steelmaking and sinter plants at JSC “Zaporizhstal” as result of gas burners with spray and niche technology installation. The using of gas burners with spray and niche technology provides to more efficiency fuel combustion in comparison with the situation in the absence of the project. Therefore are achieved the decrease of natural gas consumption and accordingly GHG emission reductions arising by natural gas combustion.

The estimated GHG emission reductions due to the energy efficiency increase in steelmaking and sinter plants JSC “Zaporizhstal” is about 461,300 tCO_2 equivalent in 2008-2012 or in average 92,260 tCO_2 equivalent per year.

The detailed description of the GHG emissions in the baseline and the project scenario is provided in the section E of the PDD.

B.3. Description of how the definition of the project boundary is applied to the project:

The project boundary covers all facilities (technological processes) where greenhouse gas emissions (emission reductions) occur as a result of the project implementation:

- Steelmaking plant (steel-smelting furnaces);
- Sinter plant (sinter machines).

The units included into the project boundaries and the description of their impact on the GHG emissions is given in the table B.3-1. The sources of the GHG emissions and the greenhouse gases included into the calculation of emissions in the baseline and the project scenarios are given in the table B.3-2. The principal scheme of the project boundary is shown in the fig. B.3-1.

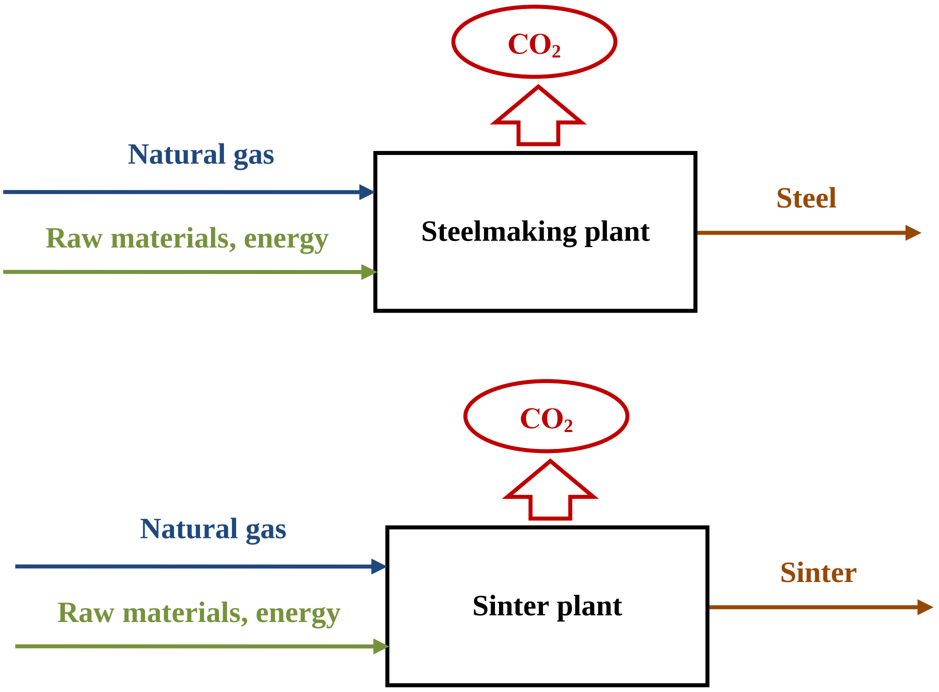
Table B.3-1. The objects in the project boundaries and description of their effect on GHG emissions

№	Unit	Description
1.	Steelmaking plant	Steel melting in steel-smelting furnaces at JSC “Zaporizhstal” is provided with natural gas for metal charge heating. GHG emissions are arising by natural gas combustion in steel-smelting furnaces.
2.	Sinter plant	Sinter production in sinter machines at JSC “Zaporizhstal” is provided by firing of sinter charge with natural gas. GHG emissions are arising by natural gas combustion in sinter machines.

Table B.3-2. Emission sources and greenhouse gases included / excluded in project boundaries

№	Emission sources	Gas	Included / excluded	Description
1.	Steelmaking plant	CO_2	included	Emissions from natural gas combustion by steel production in steelmaking plant.
		CH_4	excluded[15]	Excluded for simplification.
		N_2O	excluded[16]	Excluded for simplification.
2.	Sinter plant	CO_2	included	Emissions from natural gas combustion by sinter production in sinter plant.
		CH_4	excluded	Excluded for simplification.
		N_2O	excluded	Excluded for simplification.

Fig. 3-1. Principal scheme of the project boundary.



The GHG emission sources are determined according requirements of the Guidance on criteria for baseline setting and monitoring Version 02 (Table B.3-3.).

---

[15] CH_4 emissions from all emission sources in the project and baseline scenario are not taken into account as they are negligible. Comments are provided in the table B.3-3.

[16] N_2O emissions from all emission sources in the project and baseline scenario are not taken into account as they are negligible. Comments are provided in the table B.3-3.

Table B.3-3. Requirements for project boundaries determination

№	Criterion to define the project boundaries	Comments
1.	Under the control of the project participant.	The sources of emissions (steelmaking plant, sinter plant) are under the control of the JSC "Zaporizhstal" as they are the property of the Company and are directly operated by the Company.
2.	Reasonably attributable to the project.	The sources of the GHG emissions stated in table B.3-1. are directly connected to the project activity. Due to this all the defined sources are reasonably attributable to the project.
3.	Significant, i.e., as a rule of thumb, would by each source account on average per year over the crediting period for more than 1 per cent of the annual average anthropogenic emissions by sources of GHGs, or exceed an amount of 2,000 tonnes of CO_2 equivalent, whichever is lower.	Emissions by the considered sources are significant, they total to more than 1% and exceed an amount of 2,000 t of CO_2 equivalent (see section E.) CH_4 and N_2O emissions are not considered in the project boundaries as their total emissions are not significant in the project and baseline scenarios (less than 1 per cent of the annual average anthropogenic emissions and not exceed an amount of 2,000 t of CO_2 equivalent). The quantitative assumption of CH_4 and N_2O emissions is attached.

Leakage assessment

In accordance with "Guidance on criteria for baseline setting and monitoring", (Version 02) the leakage is determined as "the net change of anthropogenic emissions by sources and/or removals by sinks of GHGs which occurs outside the project boundary, and that can be measured and is directly attributable to the JI project."

The main emissions potentially giving rise to leakage in the context of the project are:

- emissions arising from natural gas use (e.g. extraction, processing, transport) for steelmaking and sinter plants at the JSC "Zaporizhstal";
- emissions arising from energy resources production used in sinter and steelmaking plant at the JSC "Zaporizhstal" as electricity, compressed air, technical water and oxygen.

In case the potential leakage is determined the project participants must undertake an assessment of the potential leakage of the proposed JI project and explain which sources of leakage are to be calculated, and which can be neglected.[17]

The project implementation provides to the natural gas consumption decrease in steelmaking and sinter plants at JSC "Zaporizhstal" (section A.4.3). Therefore the emissions from natural gas use (e.g. extraction, processing, transport) will be also decreased. The leakage from natural gas use can be excluded from consideration. This is a conservative approach for emission reductions calculation as that provides to less emission reductions.

The change of the energy resources consumption in sinter and steelmaking plant and potential leakage are assessed.[18] After the project implementation only the compressed air consumption is increased in metallurgical works. Other energy resources consumption (oxygen, electricity, technical water) is not

---

[17] In accordance with the paragraph 18 of the Guidance on criteria for baseline setting and monitoring (Version 02).

[18] The assessment is provided in excel file.

changed. The assessed average annual leakage connected to the compressed air production is not exceeding 30.0 tCO_2/year (that is less than 1 per cent of the annual average anthropogenic emissions). Therefore the leakage is insignificant and can be neglected.

The project has not an influence on other JI project implemented at JSC "Zaporizhstal" (UA1000189 Reconstruction of the oxygen compressor plant at the JSC "Zaporizhstal", Ukraine; UA1000222 Effective utilization of the blast-furnace gas and waste heat at the JSC "Zaporizhstal", Ukraine). The oxygen production in oxygen compressor plant JSC "Zaporizhstal" is not changed because of project implementation as there is not change of oxygen consumption in Open-hearth plant. The project affects not the electricity and heat generation in combine heat and power plant JSC "Zaporizhstal" as the electricity and heat generation depends only on waste energy resources (blast-furnace gas and waste heat).

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of baseline setting: 15/03/2011

The baseline has been developed by:

CJSC "National Carbon Sequestration Foundation"

Contact person: Mr. Roman Kazakov, principal specialist

Tel.: +7 499 788 78 35 ext. 113

Fax: +7 499 788 78 35 ext. 107

E-mail: kazakovra@ncsf.ru

CJSC "National Carbon Sequestration Foundation" is not a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

11/08/2005

The starting date of the project is determined as date on which the designing works for installation gas burners with SNT is beginning.[19]

C.2. Expected operational lifetime of the project:

11 years (132 months)

The expected operational lifetime of the project is determined as lifetime of main equipment.[20]

C.3. Length of the crediting period:

Length of the crediting period is: 01/01/2006[21] – 31/12/2016 (11 years, 132 months), including:

- Period before the first commitment period: 01/01/2006 – 31/12/2007 (2 years, 24 months);
- First commitment period: 01/01/2008 – 31/12/2012 (5 years, 60 months);
- Period after the first commitment period: 01/01/2013 – 31/12/2016 (4 years, 48 months).

---

[19] Protocol of technical meeting on 11/08/2005

[20] The expected operational lifetime of the project is limited by lifetime of open-hearth plant operation. The open-hearth furnaces will be decommissioned in 2017 after construction of new oxygen converter plant.

[21] The starting date of the crediting period is determined since 01/01/2006 after installation of new gas burners on steelmaking furnaces ## 1, 5, 8, 11. The starting date of the crediting period is beginning after the date the first emission reductions in accordance with paragraph 19 Guidance on criteria for baseline setting and monitoring (Version 02).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The monitoring plan is elaborated using the following step-wise approach[22]:

Step 1. Indication and description of the approach chosen regarding monitoring

Step 2. Application of the approach chosen

The description of the above approach is provided below.

Step 1. Indication and description of the approach chosen regarding monitoring

A JI specific approach is chosen for monitoring plan setting in accordance with paragraph 9 (a) of Guidance on criteria for baseline setting and monitoring (Version 02). The approved CDM baseline and monitoring methodologies and each elements are not used for monitoring.

The chosen JI specific approach is based on paragraph 30 of Guidance on criteria for baseline setting and monitoring (Version 02). The approach chosen includes the following procedures:

- The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions by sources of GHGs occurring within the project boundary during the crediting period;
- The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary during the crediting period;
- The identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions by sources of GHGs outside the project boundary that are significant and reasonably attributable to the project during the crediting period;
- The collection and archiving of information on environmental impacts, in accordance with procedures as required by the host Party;
- Quality assurance and control procedures for the monitoring process;
- Procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed JI project, and for leakage effects.

The application of the above described approach is provided below and in the following section D.1.1.-D.4.

---

[22] In accordance with Guidelines for users of the joint implementation project design documentation form Version 04. Source: http://ji.unfccc.int/Ref/Documents/Guidelines.pdf

Step 2. Application of the approach chosen

Monitoring of GHG emission reductions is based on the emissions monitoring by the following scenarios:

Project scenario: Installation of gas burners with spray and niche technology on the basic aggregates in steelmaking and sinter plants.

Baseline scenario: Continuation of the current situation. Use of traditional gas burners on aggregates in steelmaking and sinter plants: in sinter plant – twin-lead multiple-jet gas burners, in steelmaking plant – gas burners with oxygen conversion.

The approach used for GHG emissions monitoring in the project and baseline scenarios includes the calculation of CO_2 emissions from natural gas combustion for steel smelting in steel-smelting furnaces and for firing of sinter charge by sinter production based on data of combusted natural gas amount and emission factor from fuel combustion. GHG emission reductions are calculated as the difference between baseline and project emissions.

The monitoring of project and baseline emissions covers not the emissions from other fuel combustion (e.g. coke breeze by sinter production) and carbon raw materials oxidation (e.g. limestone by sinter production and pig iron by steel production) as the project has not influence on other fuel consumption and oxidation processes of carbon raw materials. This is in accordance with established project boundaries (section B.3 of the PDD).

There are no other fuel types at JSC “Zaporizhstal” (except of natural gas) used for steel smelting in steel-smelting furnaces and for firing of sinter charge by sinter production.[23]

Parameters necessary for GHG calculation in accordance with the above-mentioned approaches are as follows:

1. Parameters which are continuously monitored during the crediting period:

- natural gas consumption for steel production in steel-smelting furnaces;
- natural gas consumption for firing of sinter charge in sinter plant;[24]

---

[23] Confirmed by technical reports JSC “Zaporizhstal” for previous period (2004-2010).

[24] The natural gas consumption in sinter plant includes the fuel consumption in all sinter machines (#1-6) in spite of the sinter machine #1 is not completed with gas burners with spray and niche technology (because of the sinter machine #1 is to replace with new sinter machine). This approach for monitoring is necessary as only one natural gas flow meter for sinter plant is used. This approach is conservative as including in the monitoring sinter machine #1 without gas burners with spray and niche technology provides to less emission reductions. After sinter machine #1 installation the monitoring plan will be revised for purpose of effect of sinter machine #1exclusion while the sinter machine #1 will be not equipped with gas burners with spray and niche technology. That is possible as the natural gas consumption on sinter machine #1 will be measured by additional flow meter.

- steel production in steel-smelting furnaces;
- sinter production in sinter plant;
- chemical composition of natural gas;
- net calorific value of natural gas.

These parameters including the information on their recording and archiving are given in tables D.1.1.1 and D.1.1.3. The principle scheme of the monitoring points' location is given at the figure D.1-1. and D.1-2.

2. Parameters which are determined once and are taken as constants for the whole monitoring period. They are available at the stage of determination:

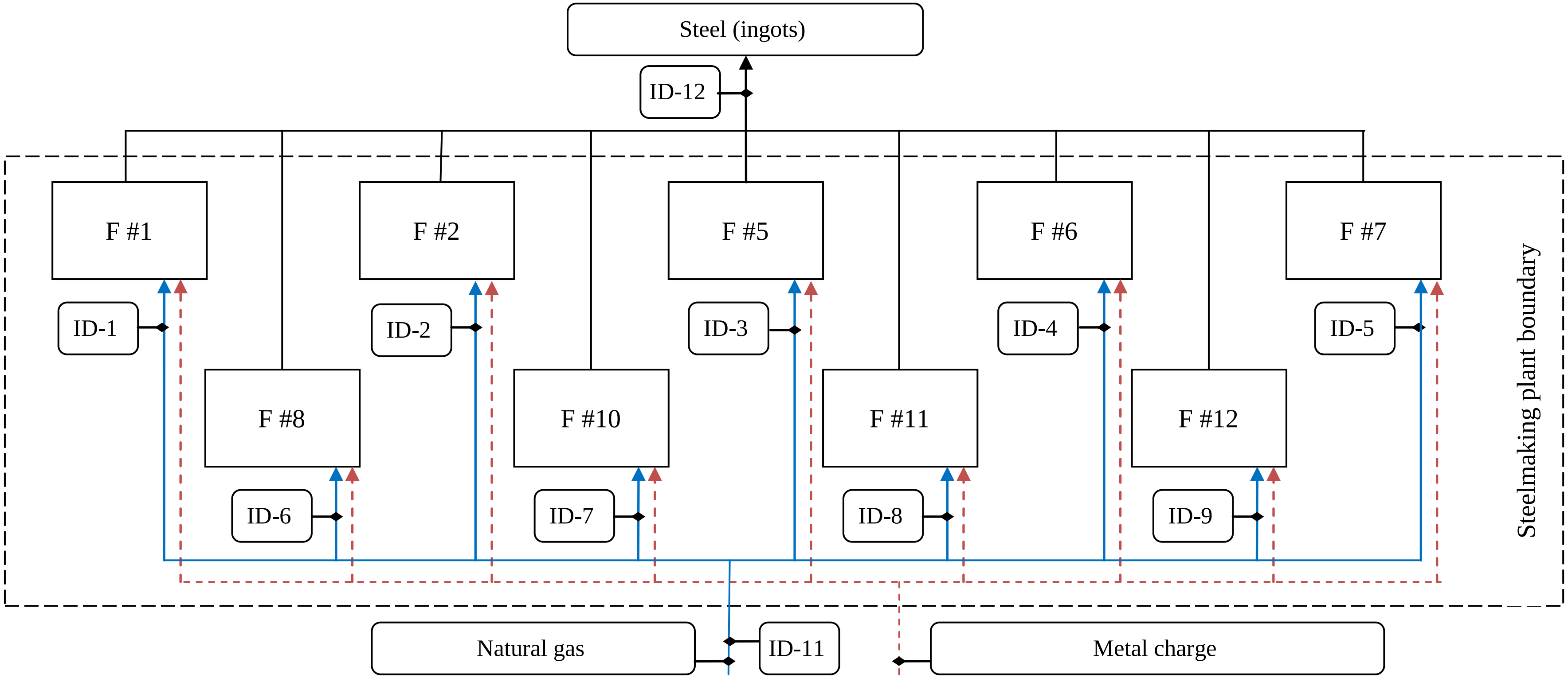
- specific natural gas consumption for steel production in steel-smelting furnaces in the baseline scenario;
- specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario;
- CO_2 density under the standard conditions;
- number of the carbon moles per mole of the gaseous fuel component;
- conversion factor of natural gas into standard fuel.

The above parameters detailed information is provided in the Annex 3 “Monitoring plan”.

3. Parameters which are determined once and are taken as constants during monitoring but are not available at the stage of determination:

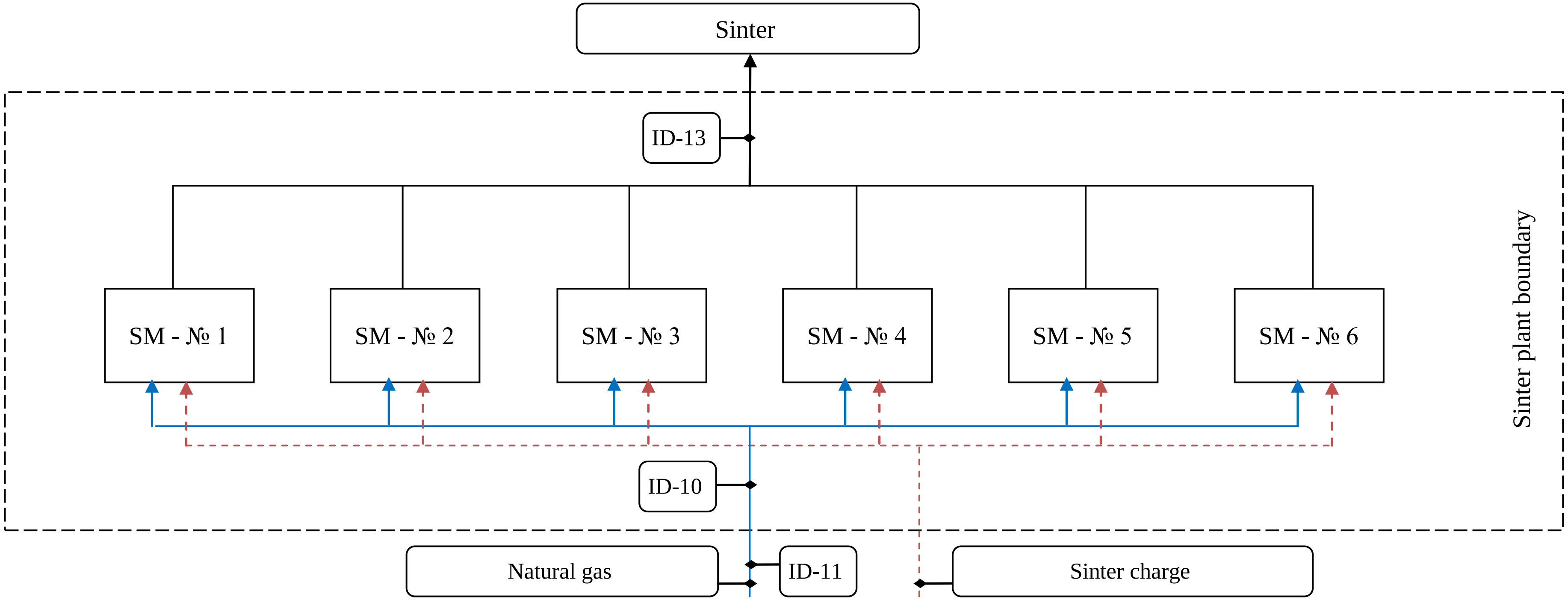
Absent.

Figure D.1-1. Principal scheme of monitoring point location in steelmaking plant



F – Steel-smelting furnace (F #1 - Two-bath steel melting aggregate; F #2, 5, 6, 7, 8, 10, 11, 12 – Open hearth furnaces).

Figure D.1-2. Principal scheme of monitoring point location in sinter plant



SM – Sinter machine

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
ID-1 $FC_{NG,F-1,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #1 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.
ID-2 $FC_{NG,F-2,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #2 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.

ID-3 $FC_{NG,F-5,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #5 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.
ID-4 $FC_{NG,F-6,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #6 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.

ID-5 $FC_{NG,F-7,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #7 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.
ID-6 $FC_{NG,F-8,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #8 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.

ID-7 $FC_{NG,F-10,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #10 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.
ID-8 $FC_{NG,F-11,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #11 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.

ID-9 $FC_{NG,F-12,PJ,m}$	natural gas consumption for steel production in steel-smelting furnace #12 in the project scenario	Technical report of open-hearth plant	t of standard fuel	c	monthly	100 %	Electronic and paper	Calculation provided by Central laboratory based on measuring data recorded by Chief power engineer department according to the formulas stated in the Annex 3 of the PDD.
ID-10 $FC_{NG,SINTERPLANT,PJ,m}$	natural gas consumption for firing of sinter charge in sinter plant in the project scenario	Technical report of sinter plant	thousand m^3	m	monthly	100 %	Electronic and paper	Primary recording is provided by Chief power engineer department based on meters data.
ID-11.1 $W_{j,NG,m}$	molar fraction of j-component of natural gas	Certificate of physical and chemical parameters of natural gas	fraction	m	monthly	100 %	Electronic and paper	The data of physical and chemical parameters of natural gas is delivered by the gas supplier.
ID-11.2 $NCV_{NG,m}$	net calorific value of natural gas	Certificate of physical and chemical parameters of natural gas	kcal/m^3	m	monthly	100 %	Electronic and paper	The data of physical and chemical parameters of natural gas is delivered by the gas supplier.

$FC'_{NG,STEELPLANT,PJ,m}$	total natural gas consumption in steel plant in the project scenario	Calculation of energy resources consumption by consumers.	thousand m^3	m	monthly	100 %	Electronic and paper	Primary recording is provided by Chief power engineer department based on meters data.
$FC'_{NG,F-i,PJ,m}$	natural gas consumption in i-steel-smelting furnace in the project scenario	Calculation of energy resources consumption by consumers.	thousand m^3	m	monthly	100 %	Electronic and paper	Primary recording is provided by Chief power engineer department based on meters data.
$n_{C,j}$	number of the carbon moles per mole of natural gas j-component	Reference data	-	e	monthly	100 %	Electronic	Detailed information is provided in the Annex 3.
ρ_{CO2}	CO_2 density under the standard conditions (293 K, 101.3 kPa)	Reference data	kg/m^3	e	monthly	100 %	Electronic	Detailed information is provided in the Annex 3.
k_{NG}	conversion factor of natural gas into standard fuel	Reference data	t of standard fuel/thousand m^3	e	monthly	100 %	Electronic	Detailed information is provided in the Annex 3. The conservativeness of the reference data use will be justified during the monitoring or parameter will be monitored.

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Project emissions:

(1) $PE_y = PE_{STEELPLANT,y} + PE_{SINTERPLANT,y}$

PE_y - CO_2 project emissions, tCO_2

$PE_{STEELPLANT,y}$ - CO_2 emissions from fuel combustion in steelmaking plant in the project scenario, tCO_2

$PE_{SINTERPLANT,y}$ - CO_2 emissions from fuel combustion in sinter plant in the project scenario, tCO_2

y - year

Steelmaking plant:

(1.1) $PE_{STEELPLANT,y} = \Sigma\ (FC_{NG,F-i,PJ,m} * EF_{CO2,NG,m})$

$PE_{STEELPLANT,y}$ - CO_2 emissions from fuel combustion in steelmaking plant in the project scenario, tCO_2

$FC_{NG,F-i,PJ,m}$ - natural gas consumption for steel production in i- steel-smelting furnace in the project scenario, t of standard fuel

$EF_{CO2,NG,m}$ - CO_2 emission factor from natural gas combustion, tCO_2/ t of standard fuel

i - steel-smelting furnace # 1, 2, 5, 6, 7, 8, 10, 11, 12

m - month

y - year

Natural gas consumption for steel production in i-steel-smelting furnace in the project scenario ($FC_{NG,F-i,PJ,m}$) is calculated by Central Laboratory JSC "Zaporizhstal" based on measuring data of natural gas consumption ($FC'_{NG,STEELPLANT,PJ,m}$, $FC'_{NG,F-i,PJ,m}$) and steel production ($P_{STEEL,F-i,PJ,m}$) using the formulae (1.1.1)

(1.1.1) $FC_{NG,F-i,PJ,m} = \{[(FC'_{NG,STEELPLANT,PJ,m} – \Sigma\ FC'_{NG,F-i,PJ,m}) / (\Sigma\ P_{STEEL,F-i,PJ,m}) * P_{STEEL,F-i,PJ,m}] + FC'_{NG,F-i,PJ,m}\}*k_{NG}$

$FC_{NG,F-i,PJ,m}$ - natural gas consumption for steel production in i-steel-smelting furnace in the project scenario, t of standard fuel

$FC'_{NG,STEELPLANT,PJ,m}$ - total natural gas consumption in steel plant in the project scenario, thousand m^3

$FC'_{NG,F\text{-}i,PJ,m}$ - natural gas consumption in i-steel-smelting furnace in the project scenario, thousand m^3

$P_{STEEL,F\text{-}i,PJ,m}$ - steel production in i-steel-smelting furnace in the project scenario, t

k_{NG} - conversion factor of natural gas into standard fuel, t of standard fuel/thousand m^3

The additional information about natural gas consumption for steel production in i-steel-smelting furnace in the project scenario ($FC_{NG,F\text{-}i,PJ,m}$) calculation and conversion factor of natural gas into standard fuel (k_{NG}) determination is provided in the Annex 3 of the PDD.

Sinter plant:

(1.2) $PE_{SINTERPLANT,y} = \Sigma\ (FC_{NG,SINTERPLANT,PJ,m} * k_{NG} * EF_{CO2,NG,m})$

$PE_{SINTERPLANT,y}$ - CO_2 emissions from fuel combustion in sinter plant in the project scenario, tCO_2

$FC_{NG,SINTERPLANT,PJ,m}$ - natural gas consumption for firing of sinter charge in sinter plant in the project scenario, thousand m^3

k_{NG} - conversion factor of natural gas into standard fuel, t of standard fuel/thousand m^3

$EF_{CO2,NG,m}$ - CO_2 emission factor from natural gas combustion, tCO_2/ t of standard fuel

m - month

y - year

CO_2 emission factor from natural gas combustion[25]

(1.3) $EF_{CO2,NG,m} = \Sigma\ (W_{j,NG,m} * n_{C,j} * \rho_{CO2}) / NCV_{NG,m} * 7000$

$EF_{CO2,NG,m}$ - CO_2 emission factor from natural gas combustion, tCO_2/t of standard fuel

$W_{j,NG,m}$ - molar fraction of j-component of natural gas, fraction

$n_{C,j}$ - number of the carbon moles per mole of natural gas j-component

---

[25] The calculation of CO_2 emission factor from natural gas combustion (formulae 1.3) is based on stoichiometric CO_2 formation from carbon molecules contented in gaseous component of natural gas.

ρ_{CO2} - CO_2 density under the standard conditions (293 K, 101.3 kPa), kg/m^3

$NCV_{NG,m}$ - net calorific value of natural gas, kcal / m^3

7000 - calorific value of standard fuel, kcal / kg

j - CH_4, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}, C_6H_{14}, CO_2, N_2, O_2

m - month

The calculation of CO_2 emission factor from natural gas combustion ($EF_{CO2,NG,m}$) will be provided based on actual monitored data of chemical composition ($W_{j,NG,m}$) and net calorific value ($NCV_{NG,m}$) of natural gas used at JSC "Zaporizhstal". Therefore the more transparency of GHG calculation will be achieved in comparison to use of the reference data of emission factors from fuel combustion (e.g. IPCC).

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
ID-11.1 $W_{j,NG,m}$	molar fraction of j-component of natural gas	Certificate of physical and chemical parameters of natural gas	fraction	m	monthly	100 %	Electronic and paper	The data of physical and chemical parameters of natural gas is delivered by the gas supplier.

ID-11.2 $NCV_{NG,m}$	net calorific value of natural gas	Certificate of physical and chemical parameters of natural gas	kcal/m^3	m	monthly	100 %	Electronic and paper	The data of physical and chemical parameters of natural gas is delivered by the gas supplier.
ID-12 $P_{STEEL,F\text{-}i,PJ,m}$	steel production in i- steel-smelting furnace in the project scenario	Weigher	t	m	monthly	100 %	Electronic and paper	Recorded by slabbing mill shop.
ID-13 $P_{SINTER,PJ,m}$	sinter production in sinter plant in the project scenario	Weigher	t	m	monthly	100 %	Electronic and paper	Recorded by sinter plant.
$SFC_{NG,F\text{-}i,BL}$	specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario	Calculated based on historical data. Fixed parameter	kg of standard fuel / t	c	monthly	100 %	Electronic	Detailed information is provided in the Annex 3.
$SFC_{NG,SINTER,BL}$	specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario	Calculated based on historical data. Fixed parameter	kg of standard fuel / t	c	monthly	100 %	Electronic	Detailed information is provided in the Annex 3.
$n_{C,j}$	number of the carbon moles per mole of natural gas j-component	Reference data	-	e	monthly	100 %	Electronic	Detailed information is provided in the Annex 3.

ρ_{CO2}	CO_2 density under the standard conditions (293 K, 101.3 kPa)	Reference data	kg/m^3	e	monthly	100 %	Electronic	Detailed information is provided in the Annex 3.
k_{NG}	conversion factor of natural gas into standard fuel	Reference data	t of standard fuel/thousand m^3	e	monthly	100 %	Electronic	Detailed information is provided in the Annex 3. The conservativeness of the reference data use will be justified during the monitoring or parameter will be monitored.

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Baseline emissions:

(2) $BE_y = BE_{STEELPLANT,y} + BE_{SINTERPLANT,y}$

BE_y - CO_2 baseline emissions, tCO_2

$BE_{STEELPLANT,y}$ - CO_2 emissions from fuel combustion in steelmaking plant in the baseline scenario, tCO_2

$BE_{SINTERPLANT,y}$ - CO_2 emissions from fuel combustion in sinter plant in the baseline scenario, tCO_2

y - year

Steelmaking plant:

(2.1) $BE_{STEELPLANT,y} = \Sigma\ (FC_{NG,F\text{-}i,BL,m} * EF_{CO2,NG,m})$

$BE_{STEELPLANT,y}$ - CO_2 emissions from fuel combustion in steelmaking plant in the baseline scenario, tCO_2

$FC_{NG,F\text{-}i,BL,m}$ - natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario, t of standard fuel

$EF_{CO2,NG,m}$ - CO_2 emission factor from natural gas combustion, tCO_2/ t of standard fuel

i - steel-smelting furnace # 1, 2, 5, 6, 7, 8, 10, 11, 12

m - month

y - year

(2.1.1) $FC_{NG,F\text{-}i,BL,m} = P_{STEEL,F\text{-}i,PJ,m} * SFC_{NG,F\text{-}i,BL}*10^{-3}$

$FC_{NG,F\text{-}i,BL,m}$ - natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario, t of standard fuel

$P_{STEEL,F\text{-}i,PJ,m}$ - steel production in i- steel-smelting furnace in the project scenario, t

$SFC_{NG,F\text{-}i,BL}$ - specific natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario, kg of standard fuel/t

i - steel-smelting furnace # 1, 2, 5, 6, 7, 8, 10, 11, 12

m - month

Specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario ($SFC_{NG,F\text{-}i,BL}$) is calculated by the formulae (2.1.2) and fixed for the whole monitoring period. The additional information about $SFC_{NG,F\text{-}i,BL}$ calculation is provided in the Annex 3 of the PDD.

(2.1.2) $SFC_{NG,F\text{-}i,BL} = [\Sigma(FC_{NG,F\text{-}i,BL,m}) / \Sigma(P_{STEEL,F\text{-}i,BL,m})] * 10^3$

$SFC_{NG,F\text{-}i,BL}$ - specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario, kg of standard fuel / t

$FC_{NG,F\text{-}i,BL,m}$ - natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario, t of standard fuel

$P_{STEEL,F\text{-}i,BL,m}$ - steel production in i- steel-smelting furnace in the baseline scenario, t

m - month

Sinter plant:

(2.2) $BE_{SINTERPLANT,y} = \Sigma\ (FC_{NG,SINTERPLANT,BL,m} * EF_{CO2,NG,m})$

$BE_{SINTERPLANT,y}$ - CO_2 emissions from fuel combustion in sinter plant in the baseline scenario, tCO_2

$FC_{NG,SINTERPLANT,BL,m}$ - natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, t of standard fuel

$EF_{CO2,NG,m}$ - CO_2 emission factor from natural gas combustion, tCO_2/ t of standard fuel

m - month

y - year

(2.2.1) $FC_{NG,SINTERPLANT,BL,m} = P_{SINTER,PJ,m} * SFC_{NG,SINTER,BL}*10^{-3}$

$FC_{NG,SINTERPLANT,BL,m}$ - natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, t of standard fuel

$P_{SINTER,PJ,m}$ - sinter production in sinter plant in the project scenario, t

$SFC_{NG,SINTER,BL}$ - specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, kg of standard fuel/t

m - month

Specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario ($SFC_{NG,SINTER,BL}$) is calculated by the formulae (2.2.2) and fixed for the whole monitoring period. The additional information about $SFC_{NG,F-i,BL}$ calculation is provided in the Annex 3 of the PDD.

(2.2.2) $SFC_{NG,SINTER,BL} = [\Sigma(FC_{NG,SINTERPLANT,BL,m}) / \Sigma(P_{SINTER,BL,m}) * k_{NG})] * 10^3$

$SFC_{NG,SINTER,BL}$ - specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, kg of standard fuel/t

$FC_{NG,SINTERPLANT,BL,m}$ - natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, th. m^3

$P_{SINTER,BL,m}$ - sinter production in sinter plant in the baseline scenario, t

k_{NG} - conversion factor of natural gas into standard fuel, t of standard fuel/thousand m^3

m - month

CO_2 emission factor from natural gas combustion[26]

(2.3) $EF_{CO2,NG,m} = \Sigma (W_{j,NG,m} * n_{C,j} * \rho_{CO2}) / NCV_{NG,m} * 7000$

$EF_{CO2,NG,m}$	- CO_2 emission factor from natural gas combustion, tCO_2/t of standard fuel
$W_{j,NG,m}$	- molar fraction of j-component of natural gas, fraction
$n_{C,j}$	- number of the carbon moles per mole of natural gas j-component
ρ_{CO2}	- CO_2 density under the standard conditions (293 K, 101.3 kPa), kg/m^3
$NCV_{NG,m}$	- net calorific value of natural gas, kcal / m^3
7000	- calorific value of standard fuel, kcal / kg
j	- CH_4, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}, C_6H_{14}, CO_2, N_2, O_2
m	- month

The calculation of CO_2 emission factor from natural gas combustion ($EF_{CO2,NG,m}$) will be provided based on actual monitored data of chemical composition ($W_{j,NG,m}$) and net calorific value ($NCV_{NG,m}$) of natural gas used at JSC "Zaporizhstal". Therefore the more transparency of GHG calculation will be achieved in comparison to use of the reference data of emission factors from fuel combustion (e.g. IPCC).

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

Not applicable

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

---

[26] The calculation of CO_2 emission factor from natural gas combustion (formulae 2.3) is based on stoichiometric CO_2 formation from carbon molecules contented in gaseous component of natural gas.

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Not applicable

D.1.3. Treatment of leakage in the monitoring plan:

The leakage is negligible. See the section B.3. of the PDD.

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

Not applicable

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

(3) $ER_y = BE_y - PE_y$

ER_y - CO_2 emission reductions, tCO_2

BE_y - CO_2 baseline emissions, tCO_2

PE_y - CO_2 project emissions, tCO_2

y - year

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

The environmental impacts' monitoring of the project activity is determined by the host party legislation:

- the Ukrainian Low “Environmental protection” from 25.06.91 # 1264-XII;
- the Ukrainian Low “Atmosphere protection” from 16.10.1992 # 2707-XII;

and internal procedures of JSC “Zaporizhstal”:

- Standard JSC “Zaporizhstal” STP 6.4-02-08 “Environmental management”;
- Standard JSC “Zaporizhstal” STP 8.2-13-10 “GHG emissions reduction monitoring”.

The project environmental impacts will be recorded by the Laboratory of the environment protection of the JSC “Zaporizhstal” in compliance with the existing procedures. The environmental impacts' monitoring includes the quantitative definition of the manufacturing activity impacts on the environment for the current period: pollutant emissions into the atmosphere, waste water release, formation and allocation of the manufacturing wastes. The project of energy efficiency increase in steelmaking and sinter plants JSC “Zaporizhstal” provides to the pollutant emissions in the corresponding plants of metallurgical works. There are not sources of waste water and manufacturing wastes.[27]

---

[27] See the section F of the PDD.

The main sources of emissions in project boundary and pollutants included in the environmental impacts' monitoring are provided in the table D.1.5-1.

Table D.1.5-1. Characteristic of pollutant emission sources in the project boundary.

№	Source number	Source name	Main pollutant
1	115	Sinter plant. Sinter machine # 1 type K-2-50 with sintering area 62.5 m^2	Dust, NO_x, CO, SO_2
2		Sinter plant. Sinter machine # 2 type K-2-50 with sintering area 62.5 m^2	Dust, NO_x, CO, SO_2
3		Sinter plant. Sinter machine # 3 type K-2-50 with sintering area 62.5 m^2	Dust, NO_x, CO, SO_2
4		Sinter plant. Sinter machine # 4 type K-2-50 with sintering area 62.5 m^2	Dust, NO_x, CO, SO_2
5	116	Sinter plant. Sinter machine # 5 type K-2-50 with sintering area 62.5 m^2	Dust, NO_x, CO, SO_2
6		Sinter plant. Sinter machine # 6 type K-2-50 with sintering area 62.5 m^2	Dust, NO_x, CO, SO_2
7	305	Open-hearth plant. Two-bath steel melting aggregate #1 with load 250 t x 2	Dust, NO_x, CO, SO_2
8	306	Open-hearth plant. Open-hearth furnace #2 with load 500 t	Dust, NO_x, CO, SO_2
9	307	Open-hearth plant. Open-hearth furnace #5 with load 500 t	Dust, NO_x, CO, SO_2
10	308	Open-hearth plant. Open-hearth furnace #6 with load 500 t	Dust, NO_x, CO, SO_2
11	309	Open-hearth plant. Open-hearth furnace #7 with load 500 t	Dust, NO_x, CO, SO_2
12	310	Open-hearth plant. Open-hearth furnace #8 with load 500 t	Dust, NO_x, CO, SO_2
13	311	Open-hearth plant. Open-hearth furnace #10 with load 500 t	Dust, NO_x, CO, SO_2
14	312	Open-hearth plant. Open-hearth furnace #11 with load 500 t	Dust, NO_x, CO, SO_2
15	313	Open-hearth plant. Open-hearth furnace #12 with load 500 t	Dust, NO_x, CO, SO_2

The record of the data on the project environmental impacts will be done on the basis of the approved instrumental measuring and calculation methods. The emissions of dust, CO, NO_x and SO_2 from sinter machines (sources #115-116) and from steel-smelting furnaces (source #305-313) will be measured once a year by Laboratory of the environment protection of the JSC "Zaporizhstal".[28] The annual dust, CO, NO_x and SO_2 emissions are calculated yearly using the values of specific pollutant emissions from emission sources in steelmaking and sinter plants at the JSC "Zaporizhstal" elaborated by UkrGNTC "Energostal" and approved by Ministry of Environmental protection Ukraine. The results of pollutant emissions measuring are used for control of environmental standards.

The information of the project environmental impacts is to be hold at the JSC "Zaporizhstal" and is to be delivered to the state executive jurisdiction in the form of the state statistics.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table D.1.1.1 ID-1, $FC_{NG,F-1,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC "Zaporizhstal" is responsible for calibration/verification procedures.
Table D.1.1.1 ID-2, $FC_{NG,F-2,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC "Zaporizhstal" is responsible for calibration/verification procedures.
Table D.1.1.1 ID-3, $FC_{NG,F-5,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC "Zaporizhstal" is responsible for calibration/verification procedures.
Table D.1.1.1 ID-4, $FC_{NG,F-6,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC "Zaporizhstal" is responsible for calibration/verification procedures.
Table D.1.1.1 ID-5, $FC_{NG,F-7,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC "Zaporizhstal" is responsible for calibration/verification procedures.

---

[28] Laboratory of the environment protection of the JSC "Zaporizhstal" has a necessary accreditation.

Table D.1.1.1 ID-6, $FC_{NG,F\text{-}8,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC “Zaporizhstal” is responsible for calibration/verification procedures.
Table D.1.1.1 ID-7, $FC_{NG,F\text{-}10,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC “Zaporizhstal” is responsible for calibration/verification procedures.
Table D.1.1.1 ID-8, $FC_{NG,F\text{-}11,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC “Zaporizhstal” is responsible for calibration/verification procedures.
Table D.1.1.1 ID-9, $FC_{NG,F\text{-}12,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC “Zaporizhstal” is responsible for calibration/verification procedures.
Table D.1.1.1 ID-10, $FC_{NG,SINTERPLANT,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC “Zaporizhstal” is responsible for calibration/verification procedures.
Table D.1.1.1, D.1.1.3 ID-11.1 $W_{j,NG,m}$	low	The natural gas supplier provides certificates with physical-chemistry parameters of natural gas. Additional procedures of quality control are not foreseen.
Table D.1.1.1, D.1.1.3 ID-11.2 $NCV_{NG,m}$	low	The natural gas supplier provides certificates with physical-chemistry parameters of natural gas. Additional procedures of quality control are not foreseen.
Table D.1.1.3 ID-12, $P_{STEEL,F\text{-}i,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC “Zaporizhstal” is responsible for calibration/verification procedures.
Table D.1.1.3 ID-13, $P_{SINTER,PJ,m}$	low	Measuring devices are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies. Department of automatization and metrology of the JSC “Zaporizhstal” is responsible for calibration/verification procedures.

If the expected monitoring data are not available during the monitoring period because of measuring devices malfunction the monitoring data are to be calculated based on average data for previous period (for natural gas consumption, sinter production and natural gas chemical composition) and determined based on certificates of melting (for steel production).

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

The initial data for calculation of GHG emission reductions (according to tables D.1.1.1 and D.1.1.3) will be prepared monthly by the chief power engineer department, open-hearth plant and sinter plant based on primary data collected by department of product-weighting systems (DPWS), control equipment and automatization (CEA) department and supplier of natural gas. The Laboratory for environmental protection of the JSC "Zaporizhstal" collects all monitoring data and calculates the GHG emission reductions. The detailed scheme of the monitoring data collection, delivery and processing is provided in the Fig. 3-1.

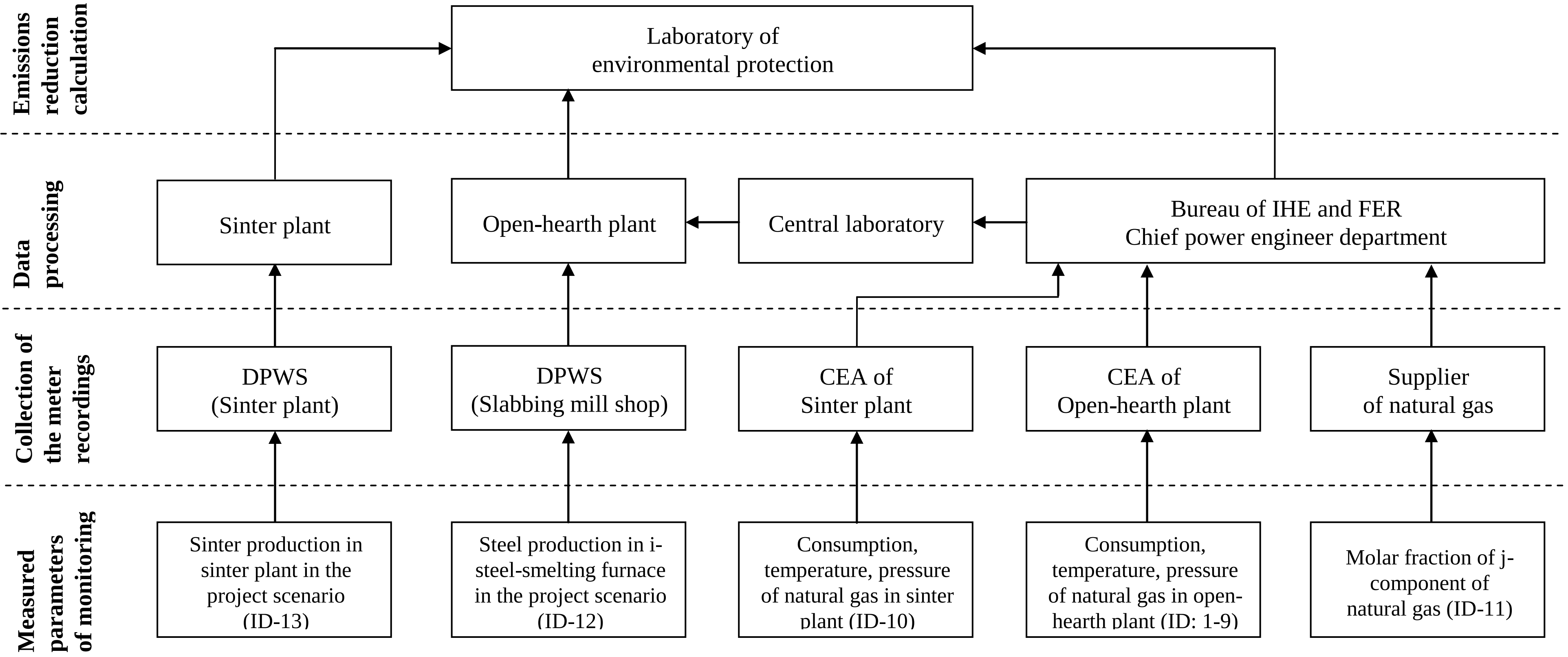
The monitoring data are recorded and archived in the following documents:

- Technical reports of the open-hearth plant (measuring data of steel production in steel-smelting furnaces and calculated by central laboratory data of natural gas consumption in steel-smelting furnaces) – prepared by Open-hearth plant;
- Technical reports of the sinter plant (measuring data of sinter production) – prepared by Sinter plant;
- Reports of gaseous department (measuring data of natural gas consumption in sinter plant) – prepared by Chief power engineer department;
- Certificates with physical-chemistry parameters of natural gas (measuring data of chemical composition of natural gas) – prepared by Supplier of natural gas.

The calculation of the actual reduction of the GHG emissions will be provided monthly by the engineer of the Laboratory for environmental protection in compliance with the formulae given in the sections D.1.1.2 and D.1.1.4. To monitor the reduction of the GHG emissions a calculation model will be used, it is elaborated in Excel. The monitoring report will be prepared yearly by Laboratory for the environmental protection of JSC "Zaporizhstal" and CJSC "National Carbon Sequestration Foundation".

The procedures of the initial data collection for the reduction of the GHG emissions monitoring, the data delivering and processing, GHG reduction calculation and monitoring report preparation will be included to the existing reporting system of the JSC "Zaporizhstal" (Standard JSC "Zaporizhstal" STP 8.2-13-10 "GHG emissions reduction monitoring"). The initial data to calculate the reduction of the GHG emissions and the results of the calculations will be archived in the Laboratory for environmental protection during the crediting period and two years after this.

Fig. 3-1. Scheme of the monitoring data collection, delivery and processing.[29]



---

[29] CEA – control equipment and automatization; Bureau of IHE and FER – bureau of industrial heat energy and fuel and energy recording; DPWS – Department of product-weighting systems

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

The monitoring plan has been developed by:

CJSC “National Carbon Sequestration Foundation”

Contact person: Mr. Roman Kazakov, principal specialist

Tel.: +7 499 788 78 35 ext. 113

Fax: +7 499 788 78 35 ext. 107

E-mail: kazakovra@ncsf.ru

CJSC “National Carbon Sequestration Foundation” is not a project participant.

SECTION E. Estimation of greenhouse gas emission reductions

Estimation of GHG emissions in project and baseline scenario and GHG emission reductions is made based on actual data for 2006-2009 and forecasted data for 2010-2016 using the formulae given in the section D.[30]

E.1. Estimated project emissions:

Table E.1-1. Estimated project emissions before the first commitment period

№	Emission source	Unit	2006	2007
1.	Steelmaking plant	tCO_2 equivalent	473,327	458,255
2.	Sinter plant	tCO_2 equivalent	16,076	45,282
3.	Total project emissions	tCO_2 equivalent	489,403	503,537

Table E.1-2. Estimated project emissions during the first commitment period

№	Emission source	Unit	2008	2009	2010	2011	2012
1.	Steelmaking plant	tCO_2 equivalent	423,739	313,131	355,365	374,428	404,446
2.	Sinter plant	tCO_2 equivalent	40,165	33,762	37,805	38,577	39,348
3.	Total project emissions	tCO_2 equivalent	463,904	346,893	393,170	413,005	443,794

Table E.1-3. Estimated project emissions after the first commitment period

№	Emission source	Unit	2013	2014	2015	2016
1.	Steelmaking plant	tCO_2 equivalent	411,819	411,819	411,819	411,819
2.	Sinter plant	tCO_2 equivalent	39,348	39,348	39,348	39,348
3.	Total project emissions	tCO_2 equivalent	451,167	451,167	451,167	451,167

E.2. Estimated leakage:

The leakage is negligible. See the section B.3. of the PDD.

---

[30] Calculation of GHG emission reductions including initial data is attached in excel file.

E.3. The sum of E.1. and E.2.:

Table E.3-1. Estimated project emissions and leakage before the first commitment period

№	Parameter	Unit	2006	2007
1.	Project scenario	tCO_2 equivalent	489,403	503,537
2.	Leakage	tCO_2 equivalent	-	-
3.	Total emissions	tCO_2 equivalent	489,403	503,537

Table E.3-2. Estimated project emissions and leakage during the first commitment period

№	Parameter	Unit	2008	2009	2010	2011	2012
1.	Project scenario	tCO_2 equivalent	463,904	346,893	393,170	413,005	443,794
2.	Leakage	tCO_2 equivalent	-	-	-	-	-
3.	Total emissions	tCO_2 equivalent	463,904	346,893	393,170	413,005	443,794

Table E.3-3. Estimated project emissions and leakage after the first commitment period

№	Parameter	Unit	2013	2014	2015	2016
1.	Project scenario	tCO_2 equivalent	451,167	451,167	451,167	451,167
2.	Leakage	tCO_2 equivalent	-	-	-	-
3.	Total emissions	tCO_2 equivalent	451,167	451,167	451,167	451,167

E.4. Estimated baseline emissions:

Table E.4-1. Estimated baseline emissions before the first commitment period

№	Emission source	Unit	2006	2007
1.	Steelmaking plant	tCO_2 equivalent	569,808	578,155
2.	Sinter plant	tCO_2 equivalent	18,078	52,638
3.	Total baseline emissions	tCO_2 equivalent	587,886	630,793

Table E.4-2. Estimated baseline emissions during the first commitment period

№	Emission source	Unit	2008	2009	2010	2011	2012
1.	Steelmaking plant	tCO_2 equivalent	503,739	402,302	432,543	455,747	492,284
2.	Sinter plant	tCO_2 equivalent	50,943	44,388	45,772	46,707	47,641
3.	Total baseline emissions	tCO_2 equivalent	554,682	446,690	478,315	502,454	539,925

Table E.4-3. Estimated baseline emissions after the first commitment period

№	Emission source	Unit	2013	2014	2015	2016
1.	Steelmaking plant	tCO_2 equivalent	501,258	501,258	501,258	501,258
2.	Sinter plant	tCO_2 equivalent	47,641	47,641	47,641	47,641
3.	Total baseline emissions	tCO_2 equivalent	548,899	548,899	548,899	548,899

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

Table E.5-1. Estimated emission reductions before the first commitment period

№	Parameter	Unit	2006	2007
1.	Difference between E.4. and E.3. representing the emission reductions of the project	tCO_2 equivalent	98,483	127,256

Table E.5-2. Estimated emission reductions during the first commitment period

№	Parameter	Unit	2008	2009	2010	2011	2012
1.	Difference between E.4. and E.3. representing the emission reductions of the project	tCO_2 equivalent	90,778	99,797	85,145	89,449	96,131

Table E.5-3. Estimated emission reductions after the first commitment period

№	Parameter	Unit	2013	2014	2015	2016
1.	Difference between E.4. and E.3. representing the emission reductions of the project	tCO_2 equivalent	97,732	97,732	97,732	97,732

E.6. Table providing values obtained when applying formulae above:

Table E.6-1. Table containing results of emission reductions estimation before the first commitment period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2006	489,403	-	587,886	98,483
2007	503,537	-	630,793	127,256
Total (tonnes of CO_2 equivalent)	992,940	-	1,218,679	225,739

Table E.6-2. Table containing results of emission reductions estimation during the first commitment period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2008	463,904	-	554,682	90,778
2009	346,893	-	446,690	99,797
2010	393,170	-	478,315	85,145
2011	413,005	-	502,454	89,449
2012	443,794	-	539,925	96,131
Total (tonnes of CO_2 equivalent)	2,060,766	-	2,522,066	461,300

Table E.6-3. Table containing results of emission reductions estimation after the first commitment period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2013	451,167	-	548,899	97,732
2014	451,167	-	548,899	97,732
2015	451,167	-	548,899	97,732
2016	451,167	-	548,899	97,732
Total (tonnes of CO_2 equivalent)	1,804,668	-	2,195,596	390,928

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

In accordance with state regulations[31] the environmental impact assessment is to be provided before construction, expansion and reconstruction of industrial or civil objects. The considered project of the JSC "Zaporizhstal" is not complying with mentioned area of an environmental impact assessment therefore the environmental impact assessment was not undertaken.

The project implementation provides to the decrease of negative environmental impact because of pollutant emission reductions from fuel combustion (table F.1-1). There are not other environmental impacts factors by project implementation as waste water, industrial waste, electro-magnetic and ionizing radiation, etc.

Table F.1-1. Average pollutant emissions before (2004-2005) and after (2006-2007) project implementation in open-hearth plant JSC "Zaporizhstal", t/year[32]

№	Pollutant	2004-2005	2006-2007	Change
1	NO_x	3,080.721	1,247.215	- 1,833.506
2	SO_2	130.517	13.563	- 116.954
3	CO	1,966.083	278.706	- 1,687.377
4	Total	5,177.320	1,539.483	- 3,637.837

The above provided data show that the project does not lead to negative impacts on the environment and transboundary effect.

The following actions are undertaken for environment protection in steel and sinter plants JSC "Zaporizhstal":

- Atmosphere:

  Sinter machine #1 is equipped with a two-stage gas treatment unit consisting of dry inertial dust collector (1 stage) and 2 MP-VTI scrubbers (2 stage), preceded by a dusting of the steel lattice plates irrigated water;

  Sinter machine # 2-4 are equipped with a two-stage gas treatment unit consisting of 5 operating in parallel Venturi tubes (1 stage) and 2 MP-VTI scrubbers (2 stage) with irrigated walls;

  Sinter machine # 5-6 are equipped with a gas treatment unit consisting of 6 cyclones CN-15, 2 horizontal slotted Venturi tubes and scrubbers - spray catcher 8-SKU 1,2;

  Open-hearth furnaces and two-bath steel melting aggregate are equipped with a two-stage gas treatment unit consisting of 10 operating in parallel Venturi tubes and spray catcher system (two cyclones - spray catcher, tank, mud sump).

---

[31] DBN A.2.2-1-2003 "Project making. Containing of environmental impact assessment (EIA) while project and construction of factories, buildings and facilities" approved by order of Gosstroy of Ukraine from 15.12.2003 # 214 and implemented since 01.04.2004.

[32] Air pollutant emissions in sinter plant and dust emissions from steel-smelting furnaces were not changed. Data source: Reports on air protection for 2004-2007. Form № 2-TP Air (annual).

- Water:

  Organization of water-supply with water recycling system.
- Industrial waste:

  Industrial metal waste is returned to production, and other waste is to be disposed in accordance with applicable licenses and permits.

JSC “Zaporizhstal” has necessary permissions in area of environmental impact of the project activity. The actual permission for air pollutant emissions:

- Permission # 2310136600-39 for air pollutant emissions for a period 30.12.2009 – 29.12.2019, given by Ministry for Environmental Protection of Ukraine on 30.12.2009.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

As described in the section F.1. the project implementation provides to the decrease of negative environmental impact and does not fall under current legislation in terms of EIA. In this regard, the environmental expertise of the project was not conducted in accordance with the requirements of Ukrainian legislation in area of environmental expertise objects.[33]

The JSC “Zaporizhstal” has all the necessary permissions for the sources of the pollution emissions (presented in the section F.1).

---

[33] The law of Ukraine “About environmental expertise” № 45/95-ВР dated on 09.02.1995

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

The stakeholder' comments on the project at the JSC "Zaporizhstal" were not held on the basis of the requirements of the Ukrainian legislation about the stakeholder' comments:

1. The order of the Ministry for Environmental Protection of Ukraine "About the participation of the public in taking decisions in the sphere of the environment protection" №168, as of 18.12.2003, Official report of Ukraine, 2004, №6, p.357
2. State building norms A.2.2-1-2003 "Design. Composition and content of the materials of assessment of the impacts on the environment during designing and constructing the enterprises, buildings and structures". Approved by the order of the state construction jurisdiction of Ukraine as of 15.12.2003, № 214 put into operation from 01.04.2004.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	JSC "Zaporizhstal"
Street/P.O.Box:	Pivdenne shosse
Building:	72
City:	Zaporizhia
State/Region:	Zaporizhia oblast (region)
Postal code:	69008
Country:	Ukraine
Phone:	+38 (061)218-33-01, +38 (061) 218-34-14
Fax:	+38 (061) 213-18-58
E-mail:	zstal@zaporizhstal.com
URL:	http://www.zaporizhstal.com/
Represented by:	Lykov Aleksandr Abramovych
Title:	Deputy Director Technical
Salutation:	Mr.
Last name:	Lykov
Middle name:	Abramovych
First name:	Aleksandr
Department:	Head power engineer department
Phone (direct):	+38 (061) 218-33-00
Fax (direct):	-
Mobile:	-
Personal e-mail:	Lykov@zaporizhstal.com

Annex 2

BASELINE INFORMATION

The additional baseline information is as follows:

- Table containing the key elements of the baseline (including variables, parameters and data sources);
- Parameters of the steelmaking and sinter plants JSC "Zaporizhstal" operation in 2004-2009 and forecast until 2016.

Table containing the key elements of the baseline[34]

№	Parameter	Description	Source
1.	$P_{STEEL,F\text{-}i,y}$	steel production in i-steel-smelting furnace	For 2006-2009: monthly technical reports of steelmaking plant JSC "Zaporizhstal". For 2010-2016: calculated based on forecast of steel production prepared by Planning and economic department of JSC "Zaporizhstal" taking into account part of steel production in each furnace in 2005-2009.
2.	$P_{SINTER,y}$	sinter production in sinter plant	For 2006-2009: monthly technical reports of sinter plant JSC "Zaporizhstal". For 2010-2016: forecast of sinter production prepared by Planning and economic department of JSC "Zaporizhstal".
3.	$W_{j,NG,y}$	molar fraction of j-component of natural gas	For 2006-2009: certificates of physical and chemical parameters of natural gas provided by gas supplier. For 2010-2016: calculated as average value for 2006-2009.
4.	$SFC_{NG,F\text{-}i,BL}$	specific natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario	Calculated as average value of specific natural gas consumption for steel production in i- steel-smelting furnace for period 24 months before gas burners replacement. Initial data for calculation is provided by Central laboratory JSC "Zaporizhstal" based on technical reports of steelmaking plant for September 2003 – February 2006.
5.	$SFC_{NG,SINTER,BL}$	specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario	Calculated as average value of specific natural gas consumption for firing of sinter charge in sinter plant for period 24 months before gas burners replacement. Initial data for calculation is provided by Central laboratory JSC "Zaporizhstal" based on technical reports of sinter plant for August 2004 – July 2006.

---

[34] Detailed information about choice and justification of key elements is provided in the section B.1 of the PDD.

Steel production in steel-smelting furnaces in steelmaking plant JSC "Zaporizhstal" ($P_{STEEL,F-i,y}$) in 2003-2009, t/year

Furnace number	2003	2004	2005	2006	2007	2008	2009
1	1,065,741	1,109,738	1,107,921	1,053,882	1,110,078	1,066,342	998,527
2	402,435	403,218	313,032	410,291	415,999	386,818	393,988
5	422,397	435,493	426,406	433,757	439,335	372,357	377,948
6	434,335	413,399	434,105	433,167	445,280	383,027	268,898
7	413,736	408,179	409,488	426,957	442,602	395,769	362,355
8	415,514	435,209	432,935	432,548	442,216	372,759	394,590
10	395,298	417,049	410,019	411,160	419,456	387,222	102,306
11	369,897	400,834	402,553	386,464	286,941	216,507	57,046
12	421,535	421,328	433,944	401,366	444,827	353,696	314,727
Total	4,340,888	4,444,447	4,370,403	4,389,592	4,446,734	3,934,497	3,270,385

Forecast of steel production in steel-smelting furnaces in steelmaking plant JSC "Zaporizhstal" ($P_{STEEL,F-i,y}$) in 2010-2016, t/year

Furnace number	2010	2011	2012	2013	2014	2015	2016
1	890,399	938,165	1,013,376	1,031,849	1,031,849	1,031,849	1,031,849
2	322,217	339,503	366,720	373,405	373,405	373,405	373,405
5	341,111	359,411	388,224	395,301	395,301	395,301	395,301
6	322,217	339,503	366,720	373,405	373,405	373,405	373,405
7	338,750	356,922	385,536	392,564	392,564	392,564	392,564
8	345,835	364,388	393,600	400,775	400,775	400,775	400,775
10	277,680	292,577	316,032	321,793	321,793	321,793	321,793
11	213,912	225,387	243,456	247,894	247,894	247,894	247,894
12	321,880	339,147	366,336	373,014	373,014	373,014	373,014
Total	3,374,000	3,555,000	3,840,000	3,910,000	3,910,000	3,910,000	3,910,000

Sinter production in sinter plant JSC "Zaporizhstal" ($P_{SINTER,y}$) in 2004-2009, t/year

Parameter	2004	2005	2006[35]	2007	2008	2009
Sinter production	5,271,529	5,658,876	5,654,074 (1,947,537)	5,626,020	5,419,251	4,759,337

---

[35] The provided values of sinter production in 2006 are 5,654,074 t – total sinter production in 2006 (January-December) and 1,947,537 t – sinter production in 2006 for the period after the replacement of gas burners (September-December).

Forecast of sinter production in sinter plant JSC "Zaporizhstal" ($P_{SINTER,y}$) in 2010-2016, t/year

Parameter	2010	2011	2012	2013	2014	2015	2016
Sinter production	4,900,000	5,000,000	5,100,000	5,100,000	5,100,000	5,100,000	5,100,000

Chemical composition of natural gas used in JSC "Zaporizhstal" ($W_{j,NG,y}$) in 2006-2009, %

Component	2006	2007	2008	2009	Average value
CH_4	94.664	93.621	93.377	94.051	93.928
C_2H_6	2.561	3.162	3.296	2.773	2.948
C_3H_8	0.555	0.660	0.726	0.756	0.674
C_4H_{10}	0.159	0.189	0.225	0.219	0.198
C_5H_{12}	0.046	0.055	0.066	0.048	0.054
C_6H_{14}	0.041	0.048	0.057	0.019	0.041
CO_2	0.453	0.581	0.580	0.383	0.499
N_2	1.519	1.682	1.673	1.747	1.655
O_2	0.005	0.002	0.001	0.004	0.003

Annex 3

MONITORING PLAN

Parameters which are determined once and are taken as constants for the whole monitoring period and are available at the stage of determination.

Data / parameter	**$SFC_{NG,F-i,BL}$**
Data unit	kg of standard fuel / t
Description	Specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario
Time of determination/monitoring	Determined ex ante
Source of data (to be) used	Calculated
Value of data (for ex ante calculations/determinations)	Furnace number: $SFC_{NG,F-i,BL}$ 1: 21.32 2: 99.71 5: 100.79 6: 99.87 7: 92.48 8: 97.24 10: 100.56 11: 88.32 12: 99.81
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario ($SFC_{NG,F-i,BL}$) is calculated by the formulae: $SFC_{NG,F-i,BL} = [\Sigma(FC_{NG,F-i,BL,m}) / \Sigma(P_{STEEL,F-i,BL,m})] * 10^3$ $SFC_{NG,F-i,BL}$ - specific natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario, kg of standard fuel / t; $FC_{NG,F-i,BL,m}$ - natural gas consumption for steel production in i- steel-smelting furnace in the baseline scenario, t of standard fuel; $P_{STEEL,F-i,BL,m}$ - steel production in i- steel-smelting furnace in the baseline scenario, t; m - month. The calculation is provided for period 24 months before gas burners replacement. Initial data for calculation is provided by Central laboratory JSC “Zaporizhstal” based on technical reports of steelmaking plant for September 2003 – February 2006. The monthly calculation of specific natural gas consumption for the long period (2 years) reflects the possible change of the furnace charge in open-hearth plant and steel grade. For the

	conservative assumption of baseline emissions is used the lower boundary of 95-% confidential interval of specific natural gas consumption for steel production in i-steel-smelting furnace in the baseline scenario (the calculation is attached in excel file).
QA/QC procedures (to be) applied	Measuring devices for natural gas consumption and steel production are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies.
Any comment	Specific natural gas consumption for steel production in steel-smelting furnace #1 is more less than in other steel-smelting furnaces as the furnace #1 is a two-bath steel melting aggregate that is more effectiveness that other open-hearth furnaces (2, 5, 6, 7, 8, 10, 11, 12). This is confirmed by relevant studies, e.g. Voskobojnikov V.G., Kudrin V.A., Yakushev A.M. General metallurgy. – Moscow: IKC “Akademkniga”, 2005 – 768 p.

Data / parameter	**$SFC_{NG,SINTER,BL}$**
Data unit	kg of standard fuel / t
Description	Specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario
Time of determination/monitoring	Determined ex ante
Source of data (to be) used	Calculated
Value of data (for ex ante calculations/determinations)	5.66
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario ($SFC_{NG,SINTER,BL}$) is calculated the formulae: $SFC_{NG,SINTER,BL} = [\Sigma(FC_{NG,SINTERPLANT,BL,m}) / \Sigma(P_{SINTER,BL,m}) * k_{NG}] * 10^3$ $SFC_{NG,SINTER,BL}$ - specific natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, kg of standard fuel / t; $FC_{NG,SINTERPLANT,BL,m}$ - natural gas consumption for firing of sinter charge in sinter plant in the baseline scenario, th. m^3; $P_{SINTER,BL,m}$ - sinter production in sinter plant in the baseline scenario, t; k_{NG} - conversion factor of natural gas into

	standard fuel, t of standard fuel/thousand m^3 m - month. The calculation is provided for period 24 months before gas burners replacement. Initial data for calculation are provided by Central laboratory JSC "Zaporizhstal" based on technical reports of sinter plant for August 2004 – July 2006. The calculation is attached in excel file.
QA/QC procedures (to be) applied	Measuring devices for natural gas consumption and sinter production are calibrated/verified in compliance with the state regulation, in- plant standards and approved methodologies.
Any comment	The value of conversion factor of natural gas into standard fuel is taken 1.15 t of standard fuel/thousand m^3 according to the Instruction for order of enterprise's fuel and energy balance compilation, Moscow, 1985 – p. 63-65. This assumption is conservative as the average value of conversion factor (k_{NG}) calculated based on actual data (natural gas certificates for period 2004-2006) is not less than 1.15 t of standard fuel/thousand m^3.

Data / parameter	**$n_{C,j}$**
Data unit	-
Description	Number of the carbon moles per mole of natural gas j-component
Time of determination/monitoring	Determined ex ante
Source of data (to be) used	IPCC Guidelines for National Greenhouse Gas Inventories, 2006 – Volume 2: Energy, Chapter 4: Fugitive Emissions, p. 4.45
Value of data (for ex ante calculations/determinations)	$n_{C,CH4}$ = 1; $n_{C,C2H6}$ = 2; $n_{C,C3H8}$ = 3; $n_{C,C4H10}$ = 4; $n_{C,C5H12}$ = 5; $n_{C,C6H14}$ = 6; $n_{C,CO2}$ = 1; $n_{C,N2}$ = 0; $n_{C,O2}$ = 0.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
QA/QC procedures (to be) applied	-
Any comment	-

Data / parameter	ρ_{CO2}
Data unit	kg/m^3
Description	CO$_2$ density under the standard conditions (293 K, 101.3 kPa)
Time of determination/monitoring	Determined ex ante
Source of data (to be) used	Methodology of the calculation of the pollution emissions into the atmosphere during the associated petroleum gas flaring, Research institute “Atmosphere”, 1998.
Value of data (for ex ante calculations/determinations)	1.831
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
QA/QC procedures (to be) applied	-
Any comment	-

Data / parameter	k_{NG}
Data unit	t of standard fuel/thousand m^3
Description	Conversion factor of natural gas into standard fuel
Time of determination/monitoring	Determined ex ante
Source of data (to be) used	Instruction for order of enterprise’s fuel and energy balance compilation, Moscow, 1985 – p. 63-65.
Value of data (for ex ante calculations/determinations)	1.150
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Actual net calorific value of natural gas used at JSC “Zaporizhstal” is in rate 8,030 – 8,240 kcal/m^3 (according to the natural gas certificates for 2006 - 2010). The conversion factor of natural gas into standard fuel calculated as actual net calorific value divided into 7,000 kcal/kg of standard fuel is in rate of 1.147-1.171 t of standard fuel/thousand m^3. That corresponds good to the determined value.
QA/QC procedures (to be) applied	-

Any comment	The conservativeness of the reference data (1.150 t of standard fuel/thousand m^3) use will be justified during the monitoring, otherwise parameter (k_{NG}) will be monitored.

The formulae used for calculation of natural gas consumption for steel production in i-steel-smelting furnace (ID: 1-9):

$$FC_{NG,F\text{-}i,PJ,m} = \{[(FC'_{NG,STEELPLANT,PJ,m} - \Sigma\ FC'_{NG,F\text{-}i,PJ,m}) / (\Sigma\ P_{STEEL,F\text{-}i,PJ,m}) * P_{STEEL,F\text{-}i,PJ,m}] + FC'_{NG,F\text{-}i,PJ,m}\}*k_{NG}$$

$FC_{NG,F\text{-}i,PJ,m}$ - natural gas consumption for steel production in i-steel-smelting furnace in the project scenario, t of standard fuel

$FC'_{NG,STEELPLANT,PJ,m}$ - total natural gas consumption in steel plant in the project scenario, thousand m^3

$FC'_{NG,F\text{-}i,PJ,m}$ - natural gas consumption in i-steel-smelting furnace in the project scenario, thousand m^3

$P_{STEEL,F\text{-}i,PJ,m}$ - steel production in i-steel-smelting furnace in the project scenario, t

k_{NG} - conversion factor of natural gas into standard fuel, t of standard fuel/thousand m^3

The calculation is provided monthly by Central laboratory JSC “Zaporizhstal” based on measuring data of natural gas consumption ($FC'_{NG,STEELPLANT,PJ,m}$, $FC'_{NG,F\text{-}i,PJ,m}$) and steel production ($P_{STEEL,F\text{-}i,PJ,m}$). The total natural gas consumption in steel plant in the project scenario ($FC'_{NG,STEELPLANT,PJ,m}$) includes the natural gas consumption in steel smelting furnaces and auxiliary equipment (mixers, cutting, ladles, etc.). The primary data of natural gas consumption are recorded by Chief power engineer department. The calculated data are recorded in the technical reports of Open-hearth plant. The measuring devices are included in the monitoring plan (section D.2).