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

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SECTION A. General description of the project

A.1. Title of the project:

Reconstruction of the OJSC “Nizhniy Tagil Iron and Steel Works” blast furnaces #5 and #6, Russian Federation

Sectoral Scope: (9) Metal production

PDD version: 1.01

Date: 02.09.2009

A.2. Description of the project:

OJSC “Nizhniy Tagil Iron and Steel Works” (OJSC “NTMK”), which is a part of “Evraz Group S.A.”, is the company with the complete metallurgical cycle. The “NTMK” production of metal products in 2008 amounted to over 4.6 mln tons.

Molten iron, which is produced in the blast furnace shop (BFS) from sinter and pellets, is used as the raw material for steel making at the “NTMK” basic oxygen furnace (BOFS) and open-hearth furnace (OHFS) shops. By the moment of the project realization commencement, five blast furnaces (BF) were operated at the “NTMK” BFS, and furnace #6 was suspended.

The project specifies reconstruction of “NTMK” BF #5 and #6 with the introduction of resource saving technologies of molten iron production. Project realization allowed shutting down BF # 2, 3 and 4 and ensuring the production of molten iron, needed for “NTMK” steelmaking operations, by a more efficient technique with lower fuel consumption.

Reconstruction of BF #6 was commenced in 2002 and completed in 2004. After BF #6 was commissioned, furnace #5 was stopped for reconstruction and commissioned again in 2006.

Each one of the reconstructed BF has the working volume of 2200m^3 and project capacity of 1.8 mln tons of molten iron per annum. The BF complex includes the furnace itself, system of iron-ore raw material charging, stove block, casting yard and the system of blast furnace gas extraction and cleaning.

Table A.1 shows main resource saving technical solutions, implemented in the course of project realization at “NTMK” BF #5 and #6.

Table A.1

Key resource saving measures implemented during “NTMK” BF #5 and #6 reconstruction

#	Unit or section of the blast furnace complex	Measures	Results
1	Blast furnace	Change of furnace line (sectional shape). Introduction of furnace expert control system.	Reduction of coke consumption for molten iron production in BF
2	System of iron-ore raw material charging	Installation of Central Bell Less Top with rotary hopper manufactured by “Paul Wurth”	Reduction of coke consumption for molten iron production in BF
3	Stove block	Installation of the Kalugin stoves	Reduction of coke consumption for molten iron production in BF
4	System of blast furnace gas extraction and cleaning	Installation of top-pressure recovery turbine (TPRT) at BF #6	Use of the BF exit gases’ excessive pressure for secondary electricity generation

The following kinds of carbon-bearing materials, fuel and energy carriers are used at "NTMK" for molten iron production:

- Coking coal;
- Natural gas;
- Electric energy;
- Limestone.

Project realization allowed the reduction of CO_2 emissions into the atmosphere primarily due to the decrease of coke consumption, which is produced in the course of "NTMK" coke-chemical operations from the coking coal and used as fuel in the blast furnaces. The coke consumption at the reconstructed BF #5 and #6 was reduced to 450kg/t of molten iron as compared to the baseline 495kg/t on the average for BF ##1-5.

Realization of this project ensured the reduction of negative environmental impact caused by "NTMK" operations in the city of Nizhniy Tagil due to the introduction of the up-to-date system of BF aspiration system. One should note, that the volume of the BFS contaminants' emissions before the project realization was meeting the requirements of the Russian environmental legislation.

A.3. Project participants:

Party involved	Legal entity project participant (if applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party A: The Russian Federation (Host Party)	Legal entity A1: OJSC "Nizhniy Tagil Iron and Steel Works" – project owner and developer	No
Party B: The United Kingdom of Great Britain and Northern Ireland	Camco Carbon Russia Limited	No

OJSC "Nizhniy Tagil Iron and Steel Works" (hereinafter – "NTMK") is the metallurgical complex with the complete cycle of steel production located in the city of Nizhniy Tagil (Sverdlovsk region), the Russian Federation.

In 2008 "NTMK" produced 5.2 mln tons of steel and over 4.6 mln tons of rolled metal products.

"NTMK" primary production chain includes coke-chemical, blast furnace and steel-smelting operations and a series of rolling mills. The general diagram of the production flows of raw materials, fuel and energy carriers is presented in Figure A.1.

The coke-chemical operations (CCO) include two coke shops with six coke furnace batteries for coke production from coking coal. In the coke furnace batteries, the coke gas is extracted from coal, which is later transported to the CCO auxiliary shops for extraction of coke processing by-products. After this, the stripped coke gas is used within the company as fuel.

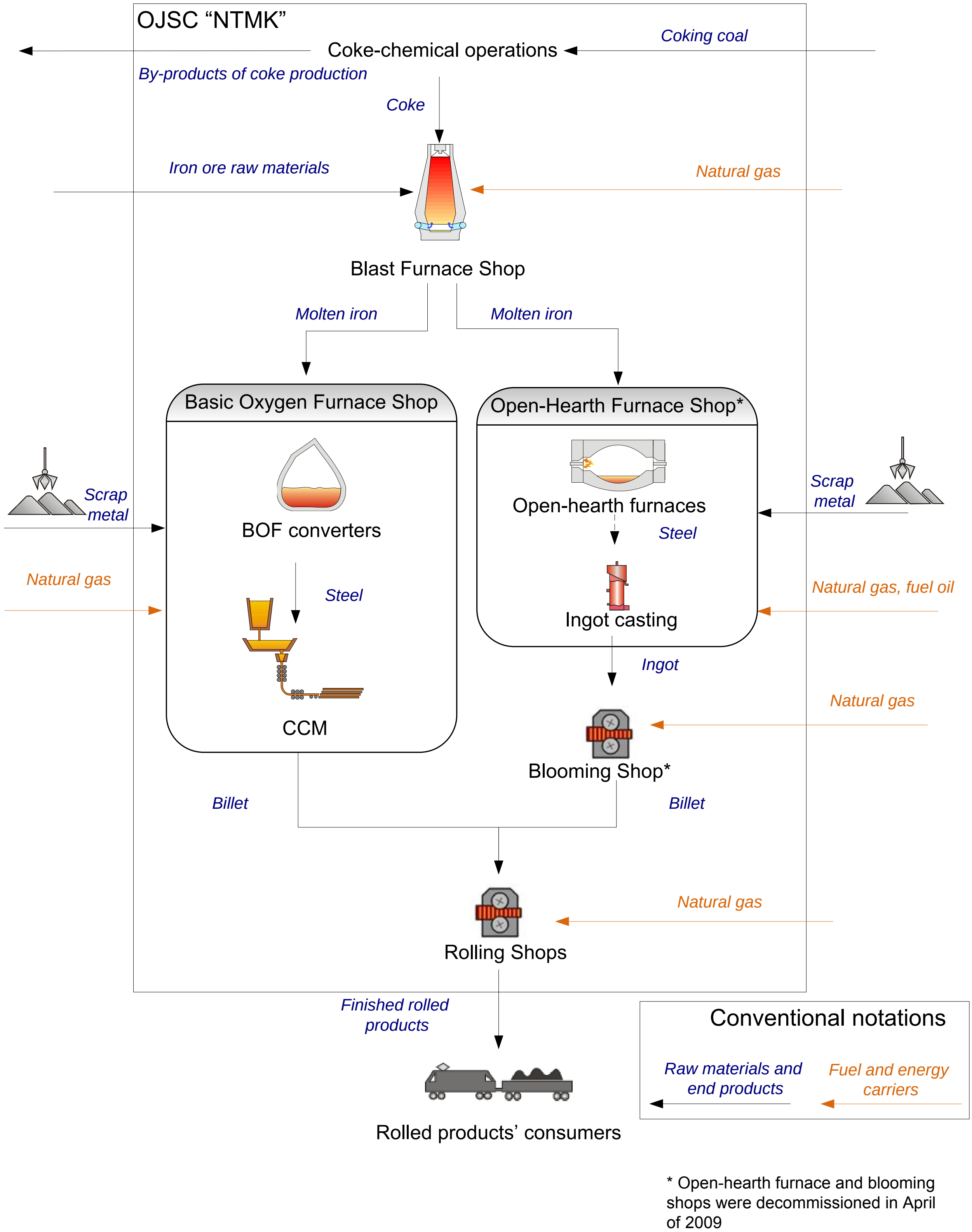

Figure A.1 Diagram of "NTMK" main flows of raw materials, fuel and energy carriers

Six BF are installed at the "NTMK" BFS with the following useful volumes:
BF #1 - 1242m^3;
BF #2 - 1242m^3;

BF #3 - 1513m^3;
BF #4 - 1513m^3;
BF #5 - 2200m^3 (prior to reconstruction – 1700m^3);
BF #6 - 2200m^3 (prior to reconstruction – 2700m^3).

In 1995, due to significant drop in demand for the integrated plant products, BF #6 was suspended and commissioned only as a result of this project realization.

During the "NTMK" blast furnace operations (BFO) the vanadium-containing iron-ore raw material is processed and two kinds of molten iron are produced: standard steelmaking molten iron and the natural alloy vanadium molten iron.

Until recently, "NTMK" steelmaking operations included basic oxygen furnace shop (BOFS) and open-hearth furnace shop (OHFS). Starting 1993, the OHF operations at "NTMK" are being gradually replaced with the production of steel in the oxygen converters, as this is less expensive and environmentally friendlier process. Decision on the permanent OHFS liquidation was made in April of 2009.

The converter steel is cast continuously at four continuous casting machines (CCM) of combined type with the total capacity of 4.1 mln tons of cast billet per annum.

The rolling operations include the H-beam shop, rail and structural steel mill, blooming mill, heavy section mill, wheel and tyre mill and ball-rolling mill, the equipment of which provides the manufacture of wide range of rolled metal products. The "NTMK" primary products are railway wheels and rails, products for construction purposes and pipe billet as well as the semi-finished steel products.

The roll mills and the refractory products operations are certified in compliance with DIN EN ISO 9001:2000. The "NTMK" products have multiple Russian and foreign certificates, including the certificate "On the "NTMK" recognition as the manufacturer of metal products (continuously cast slabs) in compliance with the Lloyd Register regulations".

"Evraz Group S. A." (www.evraz.com) is one of the world's largest vertically-integrated metallurgical and mining businesses.

In 2007 the enterprises of "Evraz Group" produces 16.4 mln tons of steel, 12.6 mln tons of molten iron and 15.2 mln tons of rolled metal products.

In addition to "NTMK", "Evraz Group" includes two major Russian steelmaking companies – "West Siberian" (Zapsib) and "Novokuznetsk" (NKMK) metallurgical works as well as the Dnepropetrovsk Iron and Steel Works in Ukraine and plants in Italy and Czech Republic. The company subsidiary "Evraz Inc. NA" unites the metallurgical assets of "Evraz Group" in the Northern America: "Evraz Oregon Steel", "Evraz Claymont Steel" and Ipsco's Canadian plate and pipe businesses. In the South Africa the presence of "Evraz Group" is constituted by "Highveld Steel and Vanadium Corporation", the integrated company involved in the steel and vanadium production. Besides, three cocking plants – "Bagleykoks", "Dneprokoks" and "Dneprodzerzhinsk Coke Chemical Plant" were acquired by "Evraz Group" in Ukraine.

The mining division of "Evraz Group" includes the iron ore mining complexes Evrazruda, Kachkanarsky (KGOK) and Vysokogorsky (VGOK) in Russia and the Sukhaya Balka iron ore mining and processing complex in Ukraine. "Evraz Group" also owns "Yuzhkuzbassugol" Company and 40% of stock of the leading manufacturer of coking coal in Russia – OJSC "Raspadskaya". The presence of own stock of iron ore and coal enables "Evraz Group" to act as the integrated steel producer: as of the beginning of 2009 the mining operations cover the company requirements in terms of iron ore (93%) and coking coal (100%).

"Evraz Group" is also an important player in the world vanadium market. Its vanadium business comprises "Strategic Minerals Corporation" in the United States, "Nikom" in the Czech Republic, and "Highveld Steel and Vanadium Corporation" in South Africa. "Evraz" also owns and operates the Nakhodka commercial sea port in the Far East of the Russian Federation.

"Evraz Group S.A." is a public company registered in Luxembourg. Since June 2005, 30.5% of its issued share capital in the form of GDRs is traded on the London Stock Exchange under the stock symbol EVR.

In the territory of the Russian Federation "Evraz Holding", having the authorities of the sole executive body, exercises the operational management of the "Evraz Group" main assets management.

Camco Carbon Russia Limited is a 100% subsidiary of Camco International Ltd. Camco International Limited a Jersey based public company listed on AIM in London. Camco International is the world leading carbon asset developer under both Joint Implementation and the Clean Development Mechanism of the Kyoto Protocol. Camco's project portfolio consists of more than 100 projects, generating altogether over 149 MT CO_2 eq. of GHG reductions. Camco operates in Eastern Europe, Africa, China, and Southeast Asia. The company has been actively operating in Russia since 2005.

A.4. Technical description of the project:

A.4.1. Location of the project:

OJSC "NTMK" is located in the Ural federal district in the territory of Sverdlovsk region.
The company location is presented in Figure A.4.

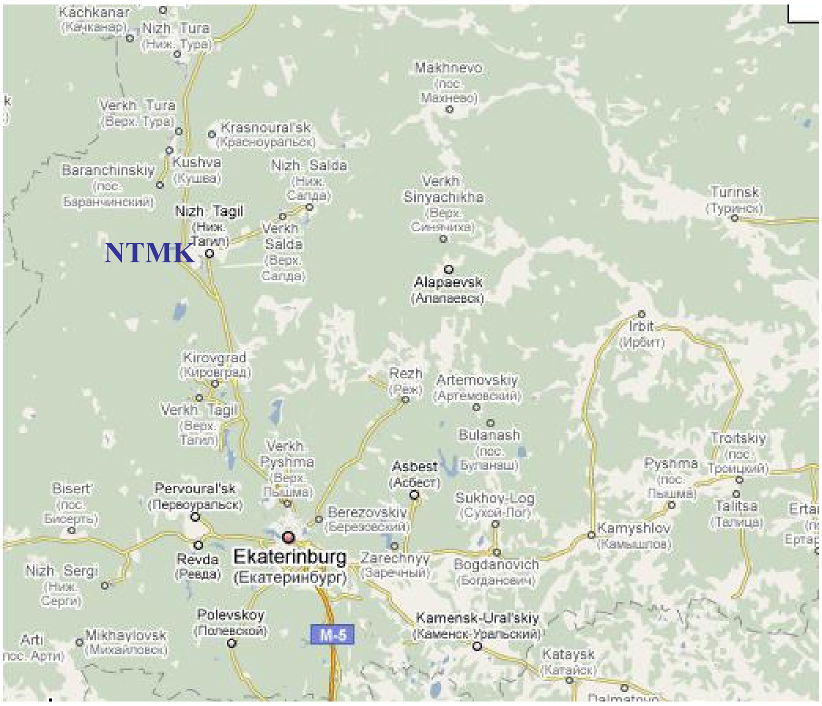

Figure A.4 "NTMK" location

A.4.1.1. Host Party(ies):

The Russian Federation

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

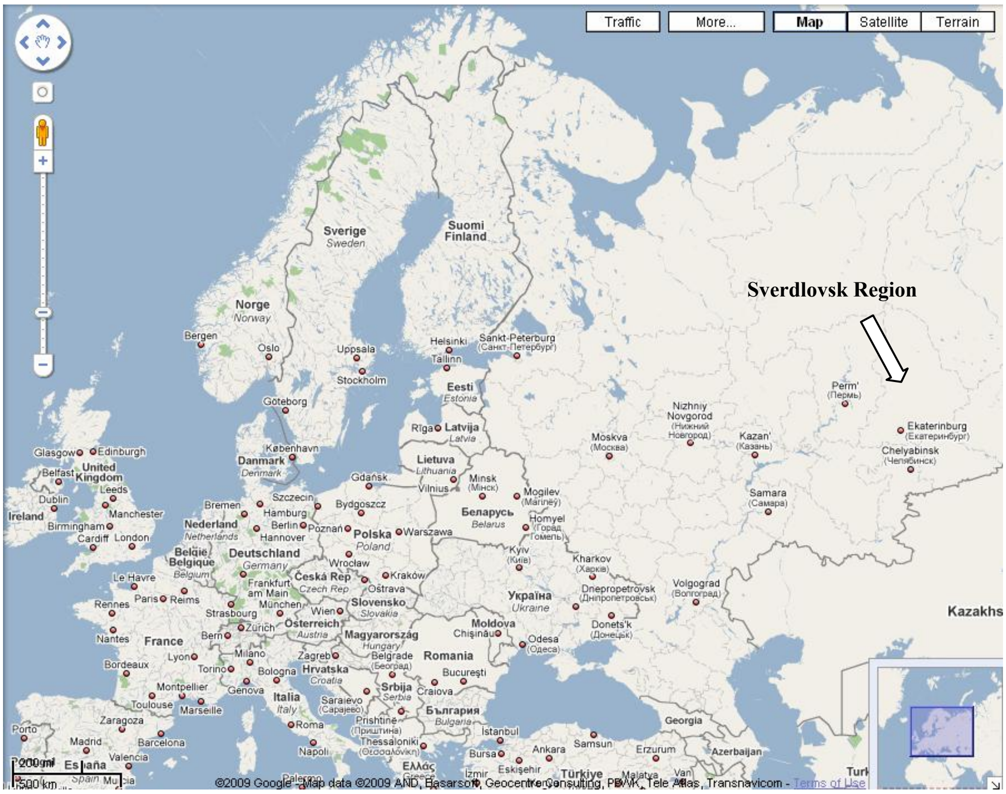

Figure A.5 Sverdlovsk region on the map

Sverdlovsk Region is a constituent of the Russian Federation, a part of the Ural federal district. Its administrative center is the city of Yekaterinburg.

The population of Sverdlovsk Region, as of January 1st of 2008, amounted to 4 395 600 people (5th place in Russia). The population density is 22.6 people per square km (estimate as of January 1st, 2007). The share of the urban population is over 83% (as of January 1st, 2006).

Ferrous and nonferrous metallurgy (31% and 19% of the domestic industrial output respectively), uranium enrichment, iron ore processing and machine building industry dominate in the industrial complex structure.

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

Nizhniy Tagil is a city in Russia and the administrative center of the Prigorodniy district of Sverdlovsk region, located 150km to the north-west of the city of Yekaterinburg.

The city population is 383.1 thousand people (as of 2005) and the city ranks second in Sverdlovsk region in terms of population headcount.

Time zone: GMT +5:00.

The city is divided into three urban districts – Dzerjinskiy, Leninskiy and Tagilstroevskiy. The main water artery is the Tagil River.

Minerals include ferriferous oxide, copper magnetites, manganese ore, gold, marble and marmorised limestone, diorites, sands and shales.

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

"NTMK" is located in the city of Nizhniy Tagil in the Sverdlovsk region of the Russian Federation. Its coordinates are 57° 55' 04" N, 60° 00' 32" E.

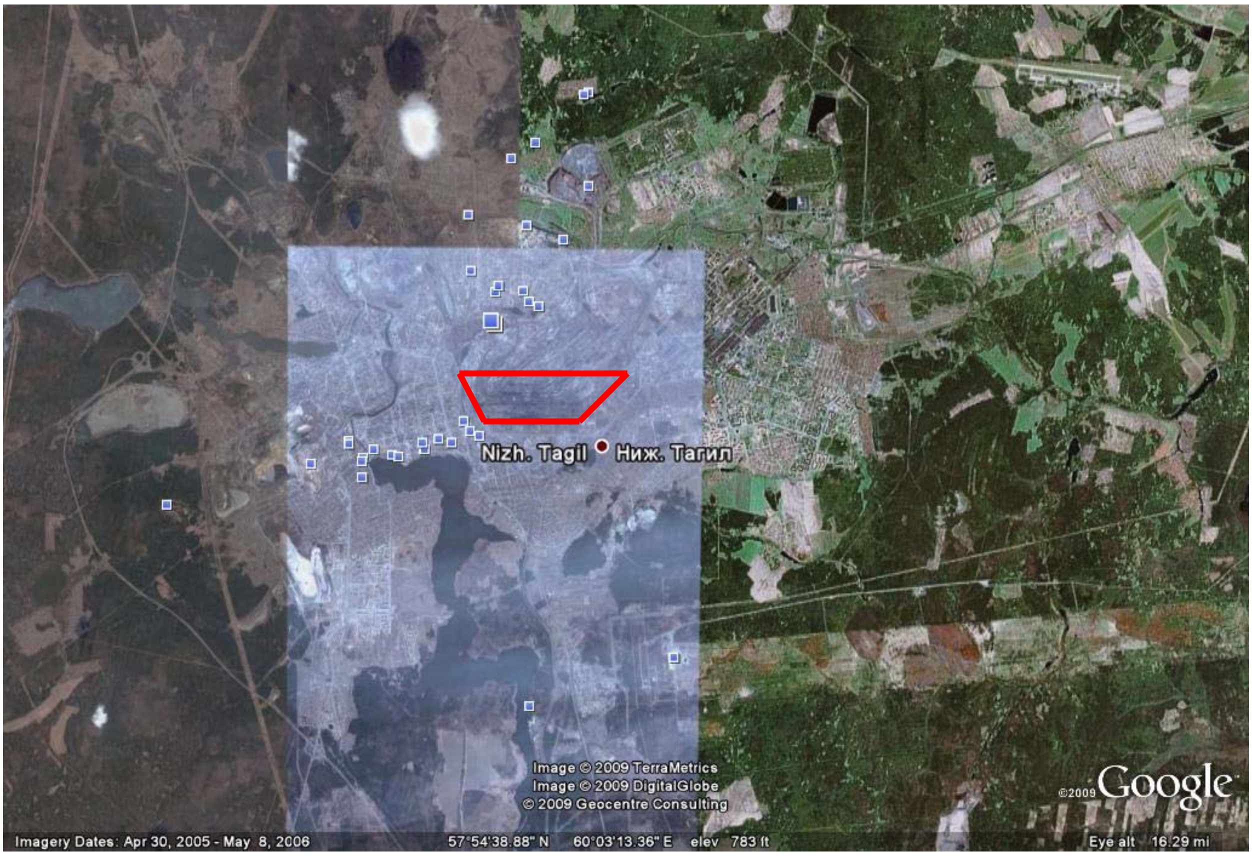

Figure A.6 The city of Nizhniy Tagil and "NTMK"

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

Blast furnace operations are one of the technological processes of the metallurgical company and are meant for the production of molten iron from iron ore raw material. Molten iron is the alloy iron with carbon with the carbon content of 4.5 – 5.0%, used as raw material in the steelmaking operations.

The "NTMK" BF #5 and #6 reconstruction project includes the replacement of key section of the blast furnace complex with more efficient ones from the resource consumption standpoint. The general operational workflow of the blast furnace and auxiliary shops and subdivisions – suppliers of the BF operations, does not change thereat.

The coke, made from the coal charging material during coke-chemical operations, is used as the fuel for the BF as well as the natural gas. Besides, the blast furnaces should be supplied with the energy carriers required for ensuring the normal molten iron production workflow: oxygen, hot blast furnace blow, water, electric power and steam (Fig. A.2).

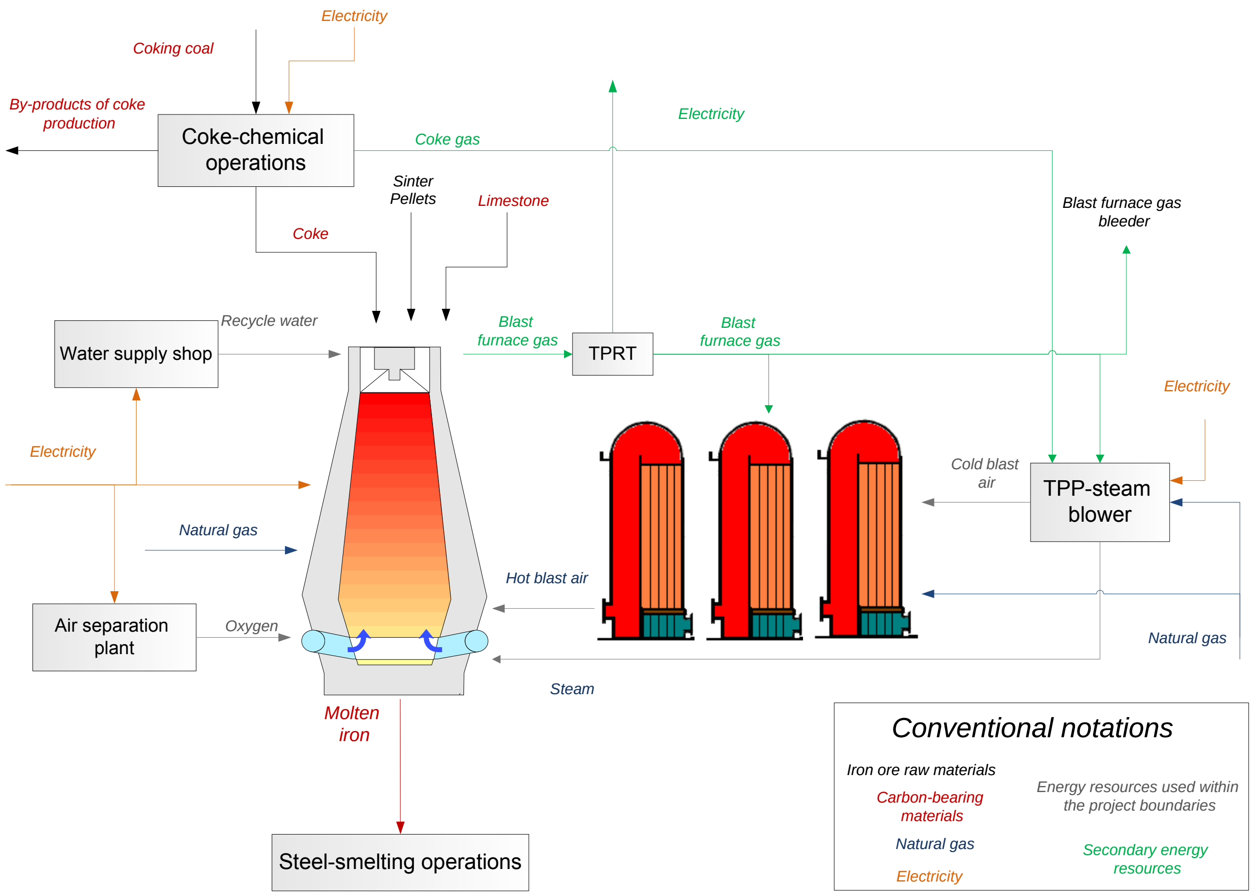

Figure A.2 General diagram of molten iron production at "NTMK"

Along with the iron ore raw material, coke and limestone are fed into the furnace. The coke is used in the BF as fuel and as reducing agent of ferrous oxides contained in the iron ore raw material. In order to ensure the efficient BF operation, prior to being fed into the furnace, the coke passes through screens, where the small-sized coke (undersized coke) is screened. The small-sized coke is burned at the iron and steel company as fuel.

The limestone is used as flux, reducing the temperature of slag smelting and facilitating the process of slag removal from the furnace.

To ensure the carbon coke combustion, the blast (compressed air heated in the stoves to the temperature of above 1100^0C) is continuously blown into the lower part of the furnace through the air tuyeres. The BF blast is enriched with oxygen for the intensification of combustion processes. Besides, for reducing coke consumption, natural gas is fed into the furnace through the tuyeres.

In order to prevent the BF brickwork erosion, the coolers are installed into the brickwork with the turnover cooling water circulating in them. The furnace is supplied with power for equipment operation and with steam for technological purposes.

BF gas, exiting the furnace, is the product of incomplete carbon coke combustion, and it is used in the stove and heat exchangers designed for heating the blast and at the enterprise thermal power plant (TPP) for steam generation. A part of the blast furnace gas is burned at the special blast furnace gas bleeder.

Coke is made during the coke-chemical operations by way of baking the mixture of coking coals without air access. During this process, the coking gas is extracted from the coal, and the by-products of coking (coal tar and benzol) are made from this gas. The purified coke gas is used for heating the coke furnace batteries and at the TTP as fuel.

Steam blower, supplying the blast furnace with air blast, uses the energy of steam, generated at the TPP. The mixture of blast furnace, coking and natural gases in burned in the TPP boilers as fuel.

Electric power is used at the air separation unit, generating the oxygen for the blast furnace, for the operations of the pumps, pumping the turnover water for the furnace cooling, at the steam blower and in the course of coke production.

Since the blast furnace is operated under pressure, installation of the top pressure recovery turbine (TPRT) at the furnace is possible, which will use the excessive pressure of the blast furnace gas for secondary power generation.

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:

The use of coking coal for coke and natural gas production at the BFS causes 93% of the total CO_2 emissions during molten iron production (Fig. A.3).

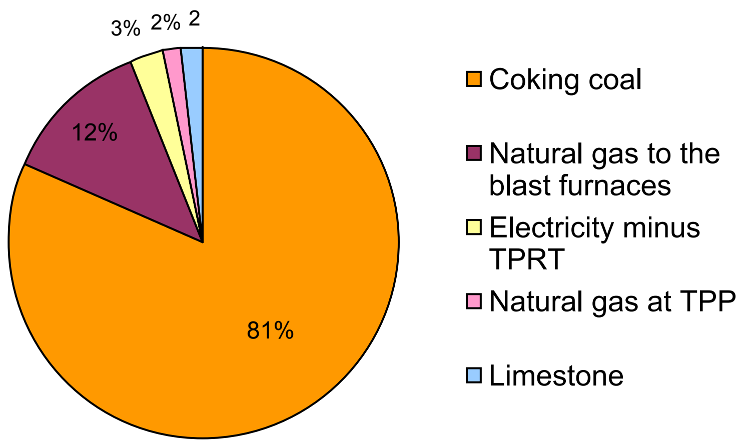

Figure A.3 The structure of CO_2 emissions during "NTMK" molten iron production broken down by the consumed materials, fuel and energy carriers.

Reduction of CO_2 emissions as a result of "NTMK" BF #5 and #6 reconstruction project realization is conditioned by the introduction of the following resource saving molten iron production technologies at the furnace:

— Change of furnace line (shape), which ensures the more uniform processing of the iron ore raw material with BF gases and, accordingly, higher degree of value-added use of carbon coke chemical energy;

— Introduction of the unique expert system of furnace operations control. This system tracks the alteration of the raw material parameters and furnace operations in the real time mode and adjusts them. This allows ensuring the optimal furnace run from the resource saving standpoint and excluding the influence of the "human factor" on furnace operations;

— Installation of the modern shaftless Kalugin stoves, providing the temperature increase of the blast blown into the furnace, thus reducing the coke consumption;

— Installation of Central Bell Less Top with rotary hopper, manufactured by "Paul Wurth" which allows higher control opportunity over the charging of materials into the furnace for ensuring maximum value-added use of gas thermal and chemical energy in the BF;

— Installation of top-pressure recovery turbine (TPRT) at the blast furnace #6, which uses the excess furnace gas pressure for generating secondary energy.

The acquired emission reduction cannot be achieved by any other way but through the realization of this Joint Implementation Project. The baseline assumes the preservation of the situation before the project realization with continuation of BF ##1-5 operations and suspension of BF #6.

A series of factors speak in favor of this development of situation along the baseline:

– This scenario represents the usual (business-as-usual) "NTMK" operations under the RF legislation;
– Continuation of BF ##1-5 operations does not require large investments for BF reconstruction;
– This scenario allows ensuring the BF molten iron output with the same quality as in the project scenario.

Realization of the "NTMK BF #5 and #6 reconstruction" project will result in the CO_2 emission reduction in the amount of 1 753 151 tons of CO_2 equivalent during the period of 2008-1012.

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

	Years
Length of the crediting period:	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	342 904
2009	352 530
2010	352 550
2011	352 573
2012	352 595
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	1 753 151
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	350 630

A.5. Project approval by the Parties involved:

According to Russian legislation, the letter of approval will be issued by the Russian Government on the basis of an expert statement issued by the AIE after the project has been determined against the JI criteria and requirements have been set forth on both international and domestic levels.

SECTION B. Baseline

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

While establishing the baseline and calculating the greenhouse gases emission reductions, the developer offers his own approach without approving it with any of the CDM methodologies, but definitely complying with the Decision 9/CMP.1, Annex C requirements. Everything related to the greenhouse gases emission assessment is sufficiently described and justified.

Baseline scenario

According to the baseline scenario BF #6 will not be reconstructed and commissioned. Operations of BF #5 will continue without its reconstruction and with preservation of the furnace useful volume of 1700m^3. The other furnaces (##1-4) will also continue their operations according to the baseline scenario.

In order to calculate the baseline BF ##1-5 performance figures, the data on the BF operations in 2001-2003 was used, i.e. the data for the last three years of operations before BF #6 was commissioned. Further on, the project activity significantly influenced the BFS operations. Throughout 2004-2009 BF ##2, 3, 1, 4 were consecutively shut down and BF #5 was reconstructed.

Average value of molten iron production in 2001-2003 at BF ##1-5 was 4.71 mln tons per annum (table B.1).

Table B.1

BFS molten iron production in 2001-2003

	2001	2002	2003	Average in 2001-2003	Share in total production volume, %
Blast furnace #1	856 653	856 841	848 637	854 044	18.1%
Blast furnace #2	881 896	864 016	910 345	885 419	18.8%
Blast furnace #3	919 695	912 047	863 907	898 550	19.1%
Blast furnace #4	997 304	1 029 540	1 132 898	1 053 247	22.4%
Blast furnace #5	973 037	1 038 278	1 048 366	1 019 894	21.6%
Total	4 628 585	4 700 722	4 804 153	4 711 153	100.0%

According to "NTMK" engineering department data, the 1st category capital repairs will be required for the continuation of baseline BFS operations throughout 2008-2012 for BF #1 and #4. During the 1st category capital repairs, the liquid smelting products are completely removed from BF, the entire fire proof lining is replaced and all equipment and constructions are inspected and repaired. The 1st category repairs should be carried out once in 14-16 years. However, the repairs' timing can be significantly adjusted thereat depending on the actual condition of BF.

Duration of the 1st category capital repairs, according to the "Provisions for the technical maintenance and repair of mechanical equipment of the USSR ferrous metallurgy system enterprises (TMR)" of 1983, amounts to 25-35 days. Thus, the BFS production decline during BF #1 and #4 repairs will be insignificant and will amount to less that 0.1 million tons of molten iron on an annualized basis.

In order to calculate the project emission reduction units, the total BFS baseline molten iron production is accepted as equal to the project production. Baseline distribution of the molten iron production volume among the furnaces is made proportionally to the share of each furnace in the total production volume according to the average data for 2001-2003 (table B.1).

Baseline molten iron production at each of the furnaces during 2008-2012, calculated based upon the data on the total project production volume, is presented in table B.2.

Table B.2

Baseline molten iron production volume within the project boundary

Parameter	2008	2009	2010	2011	2012
Blast furnace #1	871 434	624 988	624 988	624 988	624 988
Blast furnace #2	903 448	647 948	647 948	647 948	647 948
Blast furnace #3	916 846	657 557	657 557	657 557	657 557
Blast furnace #4	1 074 693	770 765	770 765	770 765	770 765
Blast furnace #5	1 040 661	746 357	746 357	746 357	746 357
Total within the project boundaries	**4 807 081**	**3 447 615**	**3 447 615**	**3 447 615**	**3 447 615**

Average annual values of the actual performance figures in 2001-2003 were taken as the basis for calculating the "NTMK" BFS baseline consumption of fuel, materials and energy carriers in 2008-2012 (table B.3).

Table B.3

"NTMK" BFS baseline performance figures

Parameter	Unit	Blast furnace #1	Blast furnace #2	Blast furnace #3	Blast furnace #4	Blast furnace #5
Carbon content in molten iron	%, weight	4.66	4.71	4.78	4.66	4.69
Specific consumption per 1 ton of molten iron						
Coke consumption	kg/t	496	510	495	479	496
Natural gas consumption	m^3/t	101	91	107	107	119
Limestone consumption	kg/t	54	58	54	53	49
Steam consumption	Gcal/t	0.065	0.055	0.060	0.054	0.055
Blast air consumption	m^3/t	1 251	1 348	1 267	1 341	1 327

Carbon content in the coking coal and limestone, CCO performance indicators and the data, needed for the calculation of natural gas and power consumption at TPP-steam blower, in the oxygen shop and water supply shop according to baseline scenario are accepted according to the "NTMK" data for 2006-2008 (tables B.4 and B.5).

Table B.4

"NTMK" CCO performance figures

Parameter	Unit	Average value for 2006-2008
CCO products yield from coking coal		
Coke	%	74.92%
Benzol	kg/t of coal	8.8
Naphthalene	kg/t of coal	1.9
Mass fraction of carbon in coking coal and by-products of CCO		
Coking coal	%	60.2%
Benzol	%	89.6%
Naphthalene	%	89.4%
Electricity consumption per 1 ton of coke	kW*hr/t	52.2
Steam consumption per 1 ton of coke	Kcal/t	356 333

Table B.5

"NTMK" oxygen shop, water supply shop and TPP-steam blower performance indicators

Parameter	Unit	Average value for 2006-2008
Steam consumption for blast air production	Gcal/thou.m.^{3}	0.149
Electricity consumption for blast air production	kW*hr/thou.m.^{3}	4.59
Electricity consumption for oxygen generation	kW*hr/thou.m.^{3}	630.0
Electricity consumption for recycle water generation	kW*hr/thou.m.^{3}	257.4
Natural gas consumption for steam generation	thou.m.^{3}/Gcal	0.074

Mass fraction of carbon in the limestone that is not established by "NTMK" is accepted according to IPCC Guidelines for National Greenhouse Gas Inventories at 12%.[1]

Project scenario

Project scenario specifies carrying out the following measures for the reduction of specific consumptions of fuel and energy carriers at "NTMK":

— Reconstruction of "NTMK" BF #6 with the reduction of the furnace useable volume from 2700m^3 to 2200m^3;

— Reconstruction of "NTMK" BF #5 with the increase of the furnace useable volume from 1700m^3 to 2200m^3.

[1] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 3: Industrial Processes and Product Use. Chapter 4: Metal Industry Emissions. p. 4.27

Table B.6

Key resource saving measures introduced during the OJSC "NTMK" BF #5 and #6 reconstruction process

№	Measures	Effect
1	Change of furnace line (sectional shape)	Ensuring more uniform processing of the iron ore raw material with the blast furnace gases and, accordingly, higher degree of the value-added use of carbon coke chemical energy.
2	Introduction of furnace expert control system.	The system monitors changes in the raw material parameters and furnace conditions, ensures effective and steady BF running and excludes the influence of "human factor"
3	Installation of Central Bell Less Top with rotary hopper manufactured by "Paul Wurth"	Enhancement of control over the charging of materials into the furnace for ensuring maximum value-added use of gas chemical and thermal energy in the blast furnace
4	Installation of the Kalugin stoves	Temperature increase of the blast blown into the furnace for coke consumption reduction
5	Installation of top-pressure recovery turbine (TPRT) at BF #6	Use of furnace gas excess pressure for electricity generation

According to the project scenario, reconstruction of the "NTMK" BF #5 and #6 makes it possible the shut down of BF #2, #3 and #4 that worked with higher fuel consumption and, accordingly, with higher CO_2 emission factor. In fact, the BF were suspended at the following dates:

BF #2 – September of 2005;

BF #3 – September of 2006;

BF #4 – January of 2009;

Besides, in November of 2008, due to the general reduction in the metal project demand, BF #1 was shut down.

The actual performance indexes of reconstructed BF #5 and #6, required for the calculation of project CO_2 emissions and the molten iron production volumes at BF #1 and #4 in 2008, are taken based on the "NTMK" BFS reports: "Fulfillment of the molten iron production plan" and "Consumption, entry and remains of raw materials, fuel and other resources" for 2008 and are presented in table B.7.

Specific consumption of fuel and energy at BF ##1 and 4, based on which the volume of the project CO_2 emissions is calculated, is taken as equal to the historical data for 2001-2003.

Table B.7

BFS performance figures in 2008

Parameter	Unit	Blast furnace #1	Blast furnace #4	Blast furnace #5	Blast furnace №6
Molten iron production	t/year	736 745	866 257	1 797 924	1 649 691
Carbon content in molten iron	%, weight	4.66	4.66	4.78	4.72
Consumption of fuel, materials and energy resources					
Coke consumption	kg/t	496	479	444	445
Natural gas consumption	m^3/t	101	107	134	128
Limestone consumption	kg/t	54	53	61	62
Steam consumption	Gcal/t	0.065	0.054	0.042	0.044
Electricity consumption	kW*hr/t	5	5	23	21
Oxygen consumption	m^3/t	69	56	73	56
Blast air consumption	m^3/t	1 251	1 341	1 166	1 250
Water consumption	m^3/t	15	15	14	14
Electricity generation at TPRT-12	kW*hr/t	-	-	-	22.2

Due to the OHFS shutdown in April of 2009, the "NTMK" demand for the blast furnace iron was significantly decreased. Currently, the company management is not planning another commissioning of BF #1 and #4, therefore it is accepted that in the period of 2009-2012 the molten iron production will be carried out at BF #5 and #6.

The ex-ante "NTMK" BF #5 and #6 project performance figures for 2009-2012 are taken from the average annual performance values in 2006-2008.

Table B.8

BF #5 and #6 ex-ante project performance figures (2009-2012)

Parameter	Unit	Blast furnace #5	Blast furnace №6
Molten iron production	t/year	1 739 357	1 464 722
Carbon content in molten iron	%, weight	4.74	4.75
Consumption of fuel, materials and energy resources			
Coke consumption	kg/t	461	460
Natural gas consumption	m^3/t	116	106
Limestone consumption	kg/t	61	63
Steam consumption	Gcal/t	0.036	0.036
Electricity consumption	kW*hr/t	23	21
Oxygen consumption	m^3/t	77	43
Blast air consumption	m^3/t	1 121	1 295
Water consumption	m^3/t	16	15
Electricity generation at TPRT-12	kW*hr/t	-	22.2

Carbon content in the coking coal and limestone, CCO performance indicators and the data, needed for the calculation of natural gas and power consumption at TPP-steam blower, in the oxygen and water supply shop according to project scenario correspond to the baseline scenario.

The volume of power, generated by the TPRT-12 installed at blast furnace #6 commissioned in 2007, is planned for the period of 2009-2012 according the actual data of 2008.

Calculation of CO_2 emissions at metallurgical enterprises is made by way of forming the equation of carbon balance during metal manufacture.

The carbon, coming into the project boundary, contained in materials and fuel, is either oxidized during metallurgical processes to the state of carbon dioxide (the products of incomplete combustion are practically fully burnt to CO_2 in compliance with the environmental legislation, which strictly regulates the CO emissions into the atmosphere), or remains in the end products. This allows for deriving the following carbon balance equation within the project boundary:

(B.1) $C_{material} + C_{fuel} = C_{CO2} + C_{output}$,

where $C_{material}$ – carbon weight in raw materials and consumables delivered into the project boundary, t;

C_{fuel} – carbon weight in the fuel used in the project boundary, t;

C_{CO2} – carbon, emitted into the atmosphere in the form of CO_2, t;

C_{output} – weight of carbon contained in the products of metallurgical company, leaving the project boundary, t.

Applying the transformation to this equation we have the following:

(B.2) $C_{CO2} = C_{material} + C_{fuel} - C_{output}$

Multiplying both parts of this equation by 44/12 (ratio of carbon and carbon dioxide weights) we derive the following ratio for calculating CO_2 emissions into the atmosphere (*E)*:

(B.3) $E = E_{material} + E_{fuel} - 44/12 \bullet C_{output}$,

where E – total CO_2 emissions into the atmosphere as a result of metal production within the project boundary, t;

$E_{material}$ – CO_2 emissions into the atmosphere due to the consumption of carbon-bearing materials within the project boundary, t;

E_{fuel} - CO_2 emissions into the atmosphere due to fuel burning within the project boundary, t;

C_{output} – weight of carbon, contained in the company's end products, which leave the project boundary, t.

For practical calculations the same equation is used in the following form:

(B.4) $E = \sum(FR_{fuel} \bullet EF_{fuel}) + 44/12 \bullet \sum(M_{material} \bullet \%C_{material}) - 44/12 \bullet \sum(P \bullet \%C_{product})$,

where FR_{fuel} – fuel consumption within the project boundary, t (m^3);

EF_{fuel} –fuel emission factor, t of CO_2 / t (m^3);

$M_{material}$ – consumption of carbon-bearing materials within the project boundary, t;

$\%C_{material}$ - mass fraction of carbon in material, %;

P – manufacture of end products within the project boundary, t;

$\%C_{product}$ – mass fraction of carbon in the end products, % .

During the calculation CO_2 emissions into the atmosphere, due to the BFS and supporting shops operations, a part of flows of materials and fuel can be taken out of the calculation:

- during the calculations by formula (B.4) only the flows, coming into the project boundary and leaving them, are registered, therefore one can take out of the calculation those flows and transformations of materials and fuels that are formed and used within the project boundary (coke, blast furnace gas, coke gas) since they do not influence the total carbon balance of the operations;

- incoming flows of materials with low carbon mass fraction, since their records have practically no influence in the calculation results (pellets and sinter).

During calculations of CO_2 emission reductions due to the realization of this project, the following flows of materials and energy carriers are considered:

- Flows coming into the project boundary:
  - Coking coal;
  - Natural gas;
  - Electric power (considered during project indirect emissions calculation);
  - Limestone;
- Flows leaving the project boundary:
  - Molten iron;
  - By-products of coal coking.

As is shown by the calculations presented in Section E of this document and based in the formula (B.4), the emission reductions as a result of this project realization in 2008-2012, compared to baseline, will amount to 1.75 mln tons of CO_2 (table B.9).

Table B.9

CO_2 emission reductions as a result of the project realization

Parameter	Unit	2008	2009	2010	2011	2012	Total for 2008-2012
Project emisions	tons of CO_2/year	7 283 521	5 114 936	5 113 020	5 110 831	5 108 641	27 730 949
Baseline emissions	tons of CO_2/year	7 626 424	5 467 466	5 465 570	5 463 403	5 461 236	29 484 100
Emission reduction	**tons of CO_2/year**	**342 904**	**352 530**	**352 550**	**352 573**	**352 595**	**1 753 151**

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:

Among the approved methodologies of the CDM there is not a single one that would fit this project, therefore the project developer has applied his own approach, which meets the requirements of the Decision 9/CMP.1, Annex B. For purposes of proving the project additionality alternative analysis, investment analysis and common practice analysis are used.

This section analyses the proposed project additionality, as well as the choice and justification of the baseline scenario.

Step #1. Identify the probable alternative options to the proposed project activity, which are in agreement with the legislation norms.

The choice of baseline scenario is based on the definition of the most probable project of alternative scenarios among the possible ones for the project participants, which ensures the manufacture of products, comparable in quality with the products, obtained as a result of the Project, and is in agreement with the requirements of the Russian Federation legislation.

The following possible scenarios, alternative to the Project, were identified:

1. Preservation of the current situation: continuation of BF #5 operations and BF #6 remains suspended;
2. Commissioning of BF #6 and continuation of BF #5 operations without any reconstructions;
3. BF #5 reconstruction without BF #6 commissioning;
4. BF #6 reconstruction without reconstructing BF #5 and without carbon financing;
5. Realization of projects on the nonblast-furnace ironmaking plants construction at “NTMK”;
6. Project realization without attracting carbon financing.

Given below is the estimate of the proposed scenarios with the purpose of identifying the opportunity for their consideration as the baseline in relation to the Project.

1. Preservation of the current situation: continuation of BF #5 operations and BF #6 remains suspended:

This scenario represents the usual (business-as-usual) continuation of the "NTMK" operations under the Russian legislation. This scenario allows ensuring the production of molten iron, comparable in quality with the molten iron produced as a result of project operations. Besides, this scenario does not require significant investments for the BF reconstruction, and only the 1st category capital repairs at BF ##1, 4 and 5 during the years of 2005-2012 will be needed. According to this scenario, the molten iron production is ensured at the level, which corresponds to the project scenario.

2. Commissioning of BF #6 and continuation of BF #5 operations without any reconstructions:

Since both iron-ore raw material and vanadium raw material, supplied from the Kachkanarskiy and Vysokogorniy mining and processing integrated works, which are a part of the "Evraz Group", are used as raw material at "NTMK" the BF should produce both regular steelmaking molten iron and vanadium molten iron. However, as the experience of BF #6 operations with the volume of 2700m^3 prior to its shutdown showed, during the vanadium molten iron making the furnace was working inefficiently. In particular, according to the USSR Academy of Science Institute of Metallurgy data, during the switching to the vanadium molten iron making, the dynamics of the BF operations was broken and the length of downtimes, related to the melting of tuyeres, was increased (from 0.8% of working time to 4.6%). As a result, BF capacity dropped by 10-15% and the labor intensity increased sharply. Therefore, this scenario cannot be considered as the baseline.

3. BF #5 reconstruction without BF #6 commissioning

This does not provide the "NTMK" steelmaking operations with the required volume of molten iron for the period of BF #5 reconstruction in 2002-2003. Based on the data, presented in table B.10 the maximum total volume of the molten iron production in BF ##1-4 amounts to 4.0 mln tons per annum with the actual demand for molten iron in 2002-2003 of 4.7-4.8 mln tons per annum.

Table B.10

Maximum BF ##1-4 molten iron output in 2001-2003, t/year

Blast furnace	Maximum production in 2001-2008
Blast firnace #1 (2006)	974 174
Blast furnace #2 (2003)	910 345
Blast furnace #3 (2004)	1 013 545
Blast furnace #4 (2003)	1 132 898
Total	4 030 962

Therefore this option cannot be viewed as the baseline scenario.

4. Realization of projects on the nonblast-furnace ironmaking plants construction at "NTMK":

Construction of industrial plants for production of hot-briquetted iron by Mydrex and HYL technology, which is the raw material for steelmaking in the Electric Furnace Steel-smelting Shops (EFSS), is one of the most environmentally friendly trends of ferrous metallurgy development. However, "NTMK" does not have its own arc-furnace steelsmelting facilities and the company's BOF shop cannot use the hot-briquetted iron as raw material. The construction cost of the EFSS with the capacity of about 1 mln tons of steel per annum is about $400 mln[1]. Therefore, the switch to steelmaking technology

[1] According to OJSC «Pervouralsky Novotrubny Works" (Sverdlovsk Region), which initiated the construction process of such facility. http://www.pntz.ru/espk/index.htm

according to the chain: plant for hot-briquetted steel production – electric arc furnace cannot be considered as baseline scenario due to high capital expenses.

5. BF #6 reconstruction without reconstructing BF #5 and carbon financing:
This scenario is one of the options of project realization without carbon financing. The possibility of this alternative realization as baseline scenario will be considered further during the investment analysis. This analysis is presented below in Step #2.

6. Project realization without attracting carbon financing:
The possibility of this alternative realization as baseline scenario will be considered further during the investment analysis. This analysis is presented below in Step #2.

Conclusion on step #1:

The following probable alternatives to the proposed project activity are defined:

- Preservation of the current situation, i.e. continuation of BF #6 conservation and BF #5 operations without reconstruction;
- Reconstruction of BF #6 without reconstruction of #5 and carbon financing;
- Realization of BF #5 and #6 reconstruction project without carbon financing.

Step #2. Investment analysis

During the analysis we will draw a comparison of investment indices of the alternatives, identified in step #1 and evaluate the impact of the additional funds from the Emission Reduction Units' sales on these indices. The project baseline is not considered during the investment analysis since it does not include capital expenditures and is not an investment project.

The investment analysis was performed with the following input data:

Planning horizon: 21 years;

Discount rate: 20% (own capital return rate accepted at "NTMK").

Table B.11

Alternative options' investment analysis

Scenario	Investments, $ mln	Discounted payback period, years	IRR, %	NPV, $ mln
BF #6 reconstruction without reconstructing BF #5 and carbon financing	125.7	no	19.0%	-4.5
Project scenario without carbon financing	281.9	no	18.9%	-6.2
Project scenario with carbon financing	281.9	16.8	20.5%	+2.8

Conclusion on step #2:

Identified alternatives to the proposed Project do not meet the profitability requirements and, according to the performed investment analysis, are not paid back within the planning horizon. The project payback within the planning horizon can be ensured only by means of including the additional funds, drawn from the sales of emission reduction units.

Step #3.Common practice analysis

By the moment of project realization commencement over 50 blast furnaces, constructed before the USSR disintegration, were operated in the Russian Federation according to the data of statistical digest "Technical and economic performance figures of furnaces and plants of the Russian iron and steel industry companies".

Ferrous metallurgy of Russia in the 90-ies of the XX century was working in the conditions of the systemic crisis of economics, sharp drop of the domestic metal products consumption, imperfect tax, credit and financial systems. This made a very negative impact on the industry production figures.

Table B.12

Russia ferrous industry production figures in 1990-2001

Products	Production in 2001, mln tons	Production in 1991, mln tons	Ratio of production in 2001 and 1991, %
Molten iron	47.1	59.4	79.3
Steel	59.0	89.6	65.8
Finished rolled products	47.1	63.7	73.9

Insignificant volumes of investments into the iron and steel industry have significantly constrained the process of the technical reconstruction.

Notwithstanding the fact that the wear level of business assets at the industry's enterprises amounted to 50%, the investments into the iron and steel industry in Russia on a 1 ton of steel basis (in comparative figures) in 1996-2000 amounted to 12-14 USD, in the US – about 30 USD and in the European Union countries – 25 USD. Largely it was explained by the issue that the debt financing of the projects was in fact not carried out because of the high crediting rate of the Russian banks (100-210% in 1993-1995 and 25-150% in 1996-2000)[1].

Ranking first in the world in terms of the employees' headcount (about 700 thousand people), the Russian iron and steel industry ranked only fourth in the steel production (according to the 2000 data: China – 128.5 mln tons, Japan – 106.4 mln tons, US – 101.0 mln tons, Russia – 59.1 mln tons).

The target program titled "Technical re-equipment and development of metallurgy in Russia planned for 1993-2000" was working in the ferrous metallurgy of Russia, which included the most important issues on the enterprises' reconstruction. Its completion level was less than 30% and it was funded mostly at the metallurgical companies' own expenses (the budget funds amounted to 2% only).

Construction of new manufacturing capacities for the production of cast pipe billet at OJSC "ZSMK" and OJSC "NLMK", mill "2000" and BOF shop at OJSC "MMK" was realized in compliance with this program. The activities for reconstruction of blast furnace facilities at the ferrous industry of Russia under this program were not carried out.

Among the primary goals of the current "Strategy of the RF ferrous metallurgy development for 2015" is the increase of steel casting volumes at continuous casting plants and reduction of steel production in open-hearth furnaces. Efficiency increase of blast furnaces' operations is not specified in the list of priority trends of enterprises' reconstruction.

According to the research of investment activity of the Ural Federal District companies, which was done by the "Expert" rating agency, over 100 projects were identified in the regional metallurgy, out of which only the project on the "NTMK" blast furnaces reconstruction can be referred to the projects oriented on the construction or reconstruction of molten iron production facilities[2].

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[1] M.I. Beskhmelnitsyn. Analytical memo on the condition of iron and steel industry in Russia. Buklketing of the RF Accounting Chamber, #9, 2002. http://www.ach.gov.ru/userfiles/bulletins/11-buleten_doc_files-fl-710.pdf

[2] "Expert Ural" #38 (255) http://www.expert.ru/printissues/ural/2006/38/investicionnye_proekty

Thus, the project of "NTMK" BF #5 and #6 reconstruction, including the complex introduction of new technologies of molten iron production and installation of modern equipment, is unique for the Russian metallurgical enterprises.

Conclusion on step #3:
The project of "NTMK" BF #5 and #6 reconstruction is not a common practice for the enterprises of the Russian metallurgical industry.

Thus, the analysis carried out in this section shows that the project scenario is the additional one. The project is not a common practice for the ferrous metallurgy enterprises, has significant barriers for realization and it would probably not be realized in the absence of the additional revenue drawn as a result of the emission reduction units' sales.

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

The following direct emission sources are included into the project boundary:
- Molten iron production at the "NTMK" BFS;
- Coke production during the "NTMK" CCO;
- Blast and steam generation at the "NTMK" TTP-steam blower;
- Oxygen generation at the "NTMK" air separation plant;
- Water supply shop supplying the BFS with circulation cooling water.

The power grids of the Russian Federation Unified Energy System (RF UES), generating electricity for the emission sources within the project boundary, are considered as the indirect emission sources.

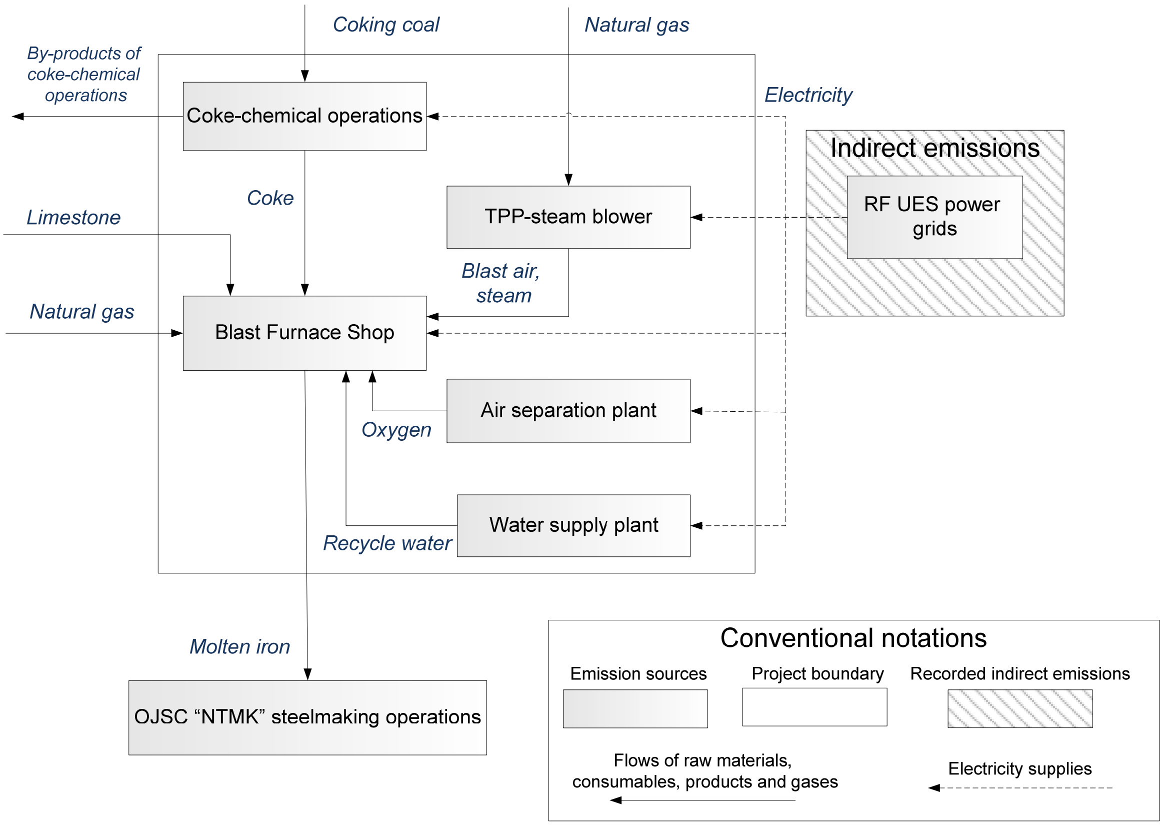

Figure B.2 Emission sources located within the project boundary and recorded indirect emissions

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 – 30/06/2009;
Baseline is developed by the specialists of "Camco Carbon Russia Limited";

- Contact person: Ryumin Oleg;
- E-mail: Russia@camcoglobal.com

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Project realization starting date: 2002
Project commissioning and start-up date: BF #6 – 7th of September of 2004;
BF #5 – 26th of September of 2006.

C.2. Expected operational lifetime of the project:

21 years

C.3. Length of the crediting period:

5 years: from 01.01.2008 till 31.12.2012

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

In the presented project CO_2 emissions monitoring plan the emissions due to the molten iron production within the project boundary are considered. Regardless of the point that the year of 2008 was the year of BF #1 and #4 operations shutdown, the monitoring plan considers the chance of their second commissioning in 2009-2012.

Calculation of actual direct project CO_2 emissions is based on the monitoring of molten iron production at BF #1, 4, 5, 6 and the consumed amounts of coke, limestone, natural gas, steam and air blast at BF #5 and 6.

For the calculation of the project consumption of coke, limestone, natural gas, steam and blast air at BF #1 and #4 the following equation is used:

(D.1) $C_{BF\,X\ PJ\,Y} = P_{BF\,X\,PJ\,Y} \bullet SC_{BF\ X\ PJ}$,

where $P_{BF\,X\,PJ\,Y}$ – project molten iron production at BF *x*, calculated during monitoring according to table D.1.1., t/year;

$SC_{BF\,X\,PJ}$ – specific consumption of coke, limestone, natural gas, steam and blast air at BF *x*, calculated in section B.1 (table B.7), kg (m^3, Gcal) /t;

X – BF number (##1 and 4).

The indirect emissions under this project are the CO_2 emissions at the RF UES power grids during generation of energy, consumed for molten iron production within the project boundary. For determination of the project indirect emissions, the monitoring of electricity, oxygen and recycle water at BF #5 and #6.

For the calculation of the project consumption of electricity, oxygen and recycle water at BF #1 and #4 the following equation is used:

(D.2) $C_{BF\,X\ PJ\,Y} = P_{BF\,X\,PJ\,Y} \bullet SC_{BF\ X\ PJ}$,

where $P_{BF\,X\,PJ\,Y}$ – project molten iron production at BF *x*, calculated during monitoring according to table D.1.1.1, t/year;

$SC_{BF\,X\,PJ}$ – specific consumption of electricity, oxygen and recycle water at BF *x*, calculated in section B.1 (table B.7), MW •hr (m^3) /t;

X – BF number (##1 and 4).

Baseline direct CO_2 emissions are taken from the data on the project molten iron production and specific consumption of coke, limestone, natural gas, steam and air blast calculated according to the baseline scenario in section B.1 of this document.

Baseline indirect emissions are taken from the data on the project molten iron production and specific amounts of the baseline use of electricity, coke, oxygen, water and blast air, established in section B.1 of this document.

Besides, in order to calculate the volume of CO_2 emissions as a result of natural gas consumption within the project boundary for both project and baseline scenarios, the monitoring of the net calorific value of the natural gas, supplied to "NTMK" is carried out.

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
Blast furnace #1								
P-1. $P_{BF\ 1\ PJ\ Y}$	*BF #1 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
Blast furnace #4								
P-2. $P_{BF\ 4\ PJ\ Y}$	*BF #4 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
Blast furnace #5								
P-3. $P_{BF\ 5\ PJ\ Y}$	*BF #5 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-4. $M_{Coke\ BF\ 5\ PJ\ Y}$	*BF #5 coke consumption*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	Aggregate of values from lines in reports "Dry skip coke" and "Dry coke losses"
P-5. $M_{Limestone\ BF\ 5\ PJ\ Y}$	*BF #5 limestone consumption*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-6. $FR_{NG\ BF\ 5\ PJ\ Y}$	*BF #5 natural gas consumption*	*BFS operations technical report*	*Thou.m.*^{3}	*(m)*	*monthly*	*100%*	*Electronic*	Aggregate of values from lines in reports "Natural gas" and "Natural gas used in the stove"
P-7. $C_{Steam\ BF\ 5\ PJ\ Y}$	*BF #5 steam consumption*	*BFS operations technical report*	*Gcal*	*(m)*	*monthly*	*100%*	*Electronic*	
P-8. $C_{Blast\ BF\ 5\ PJ\ Y}$	*BF #5 blast air consumption*	*BFS operations technical report*	*Thou.m.*^{3}	*(m)*	*monthly*	*100%*	*Electronic*	

P-9. $EC_{BF\ 5\ PJ\ Y}$	*BF #5 electricity consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	
P-10. $C_{Oxygen\ BF\ 5\ PJ\ Y}$	*BF #5 oxygen consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	Aggregate of values from lines in reports "Process oxygen", "High pressure oxygen" and "Oxygen for casthouse work"
P-11. $C_{Water\ BF\ 5\ PJ\ Y}$	*BF #5 recycle water consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	
Blast furnace #6								
P-12. $P_{BF\ 6\ PJ\ Y}$	*BF #6 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-13. $M_{Coke\ BF\ 6\ PJ\ Y}$	*BF #6 coke consumption*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	Aggregate of values from lines in reports "Dry skip coke" and "Dry coke losses"
P-14. $M_{Limestone\ BF\ 6\ PJ\ Y}$	*BF #6 limestone consumption*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-15. $FR_{NG\ BF\ 6\ PJ\ Y}$	*BF #6 natural gas consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	Aggregate of values from lines in reports "Natural gas" and "Natural gas used in the stove"
P-16. $C_{Steam\ BF\ 6\ PJ\ Y}$	*BF #6 steam consumption*	*BFS operations technical report*	*Gcal*	*(m)*	*monthly*	*100%*	*Electronic*	
P-17. $C_{Blast\ BF\ 6\ PJ\ Y}$	*BF #6 blast air consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	
P-18. $EC_{BF\ 6\ PJ\ Y}$	*BF #6 electricity consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	
P-19. $C_{Oxygen\ BF\ 6\ PJ\ Y}$	*BF #6 oxygen consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	Aggregate of values from lines in reports "Process oxygen", "High pressure oxygen" and "Oxygen for casthouse work"

P-20. $C_{Water\ BF\ 6\ PJ\ Y}$	*BF #6 recycle water consumption*	*BFS operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	
P-21. $EO_{TPRT\ PJ\ Y}$	*Electricity generation at BF #6 TPRT*	*Power grids and substations operations technical report*	*Thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic*	
OJSC "NTMK"								
P-22.$Q_{NG\ Y}$	*Net calorific value of the natural gas, supplied to "NTMK"*	*Passport (Quality certificate) of natural gas from the supplier*	*GJ/thou.m.^{3}*	*(m)*	*monthly*	*100%*	*Electronic / paper*	Average value is identified in the end of the year

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

According to the definition of the project boundary, the calculation of project CO_2 takes into account both direct CO_2 emissions at "NTMK" and indirect emissions at the RF UES power grids:

(D.3) $PE_Y = PE_{Direct\ Y} + PE_{Indirect\ Y}$
where PE_Y – total project CO_2 emissions, t/year;
$PE_{Direct\ Y}$ – direct project CO_2 emissions, t/year;
$PE_{Indirect\ Y}$ – indirect project CO_2 emissions, t/year.

Project direct CO_2 emissions

In order to calculate the direct CO_2 emissions within the project boundary at "NTMK", the carbon balance method is used, which is reviewed in Section B.1 of this document.

Monitoring of carbon entry through the project boundary is ensured by measurements of coke, limestone, natural gas, steam and air blast consumption at BFS. Monitoring of carbon exit through the project boundary is associated with the monitoring of molten iron production and coke consumption. This information is used for calculating the amount of carbon, contained in the molten iron and by-products of coke production (crude benzol and naphthalene).

Net calorific value of natural gas used at "NTMK" is taken from the quality passports (certificates) provided by natural gas suppliers.

The constants, related to the CCO, BFS and TPP-steam blower operations, which are calculated in section B.1 of this document and used for the calculation of actual project CO_2 emissions within the project boundary, are presented in table D.1.

Table D.1

Constants used for "NTMK" project CO_2 emissions monitoring

Parameter	Unit	Symbol	Value
Coke and Chemical by-product Production Operations (CPO)			
Coke yield from coking coal	%	$SO_{Coke\ Coking\ coal}$	74.92
Coking coal carbon content	%	$\%C_{Coking\ coal}$	60.2
Benzol yield from coking coal	kg/t of coal	SO_{Naph}	8.8
Naphthalene yield from coking coal	kg/t of coal	SO_{Benz}	1.9
Naphthalene carbon content	%	$\%C_{Naph}$	89.4
Benzol carbon content	%	$\%C_{Benz}$	89.6
Steam consumption per 1 ton of coke	Kcal/t	$SC_{Steam\ Coke}$	356.3
BFS			
Limestone carbon content	%	$\%C_{limestone}$	12.0
TPP-steam blower			
Specific natural gas consumption for steam generation at TPP-steam blower	Thou.m^3/Gcal	$SC_{NG\ Steam}$	0.074
Specific steam consumption for air blast production at TPP-steam blower	Gcal/m^3	$SC_{Steam\ blast}$	0.149
Natural gas emission factor	tons of CO_2/GJ	EF_{NG}	0.0561

The project emissions are calculated as the aggregate of CO_2 emissions due to "NTMK" BFS operations.

(D.4) $PE_{Direct\ Y} = PE_{BF\ 1\ Y} + PE_{BF\ 4\ Y} + PE_{BF\ 5\ Y} + PE_{BF\ 6\ Y}$,

where $PE_{BF\ 1\ Y}$ - CO_2 emissions due to BF #1 operations, t/year;

$PE_{BF\ 4\ Y}$ - CO_2 emissions due to BF #4 operations, t/year;

$PE_{BF\ 5\ Y}$ - CO_2 emissions due to BF #5 operations, t/year;

$PE_{BF\ 6\ Y}$ - CO_2 emissions due to BF #6 operations, t/year.

Calculation of actual CO_2 emissions due to "NTMK" BFS operations ($PE_{BF\ X\ Y}$) are made by the carbon balance method in the following manner:

(D.5) $PE_{BF\,X\,Y} = PE_{Coking\ Coal\ BF\,X\,Y} + PE_{Limestone\ BF\,X\,Y} + PE_{NG\ BF\,X\,Y} - 44/12 \cdot C_{output\ BF\,X\,PJ\,Y}$,
where $PE_{Coking\ Coal\ BF\,X\,Y}$ – project CO_2 emissions due to coking coal consumption for molten iron production at BF *x*, t/year;
$PE_{Limestone\ BF\,X\,Y}$ - project CO_2 emissions due to limestone consumption at BF *x*, t/year;
$PE_{NG\ BF\,X\,Y}$ – project CO_2 emissions due to natural gas consumption for molten iron production at BF *x*, t;
$C_{output\ BF\,X\,PJ\,Y}$ - weight of carbon in the BF *x* molten iron and by-products of the coke-chemical operations, released during the production of coke required for the BF operations, t/year;
x – BF number (#1,4,5,6).

Variables participating in the equation (D.5) are calculated by the following formulae:

(D.6) $PE_{Coking\ Coal\ BF\,X\,Y} = 44/12 \cdot (M_{Coke\ BF\,X\,PJ\,Y} / SO_{Coke\ Coking\ coal} \cdot \%C_{Coking\ coal})$,
where $M_{Coke\ BF\,X\,PJ\,Y}$ – project BF *x* coke consumption inclusive of the undersized coke, t/year;
$SO_{Coke\ Coking\ coal}$ – coke yield from coking coal at "NTMK", taken from table D.1, %;
$\%C_{Coking\ coal}$ – carbon content in coking coal, taken from table D.1, %;
x – BF number (#1,4,5,6).

(D.7) $PE_{Limestone\ BF\,X\,Y} = 44/12 \cdot (M_{Limestone\ BF\,X\,PJ\,Y} \cdot \%C_{Limestone})$,
where $M_{Limestone\ BF\,X\,PJ\,Y}$ – BF *x* limestone consumption, t/year;
$\%C_{Limestone}$ – carbon content in limestone, taken from table D.1, %;
x – BF number (#1,4,5,6).

(D.8) $PE_{NG\ BF\,X\,Y} = (FR_{NG\ BF\,X\,PJ\,Y} + SC_{NG\ Steam} \cdot (C_{Steam\ BF\,X\,PJ\,Y} + SC_{Steam\ Coke} \cdot M_{Coke\ BF\,X\,PJ\,Y} + SC_{Steam\ Blast} \cdot C_{Blast\ BF\,X\,PJ})) \cdot Q_{NG\ Y} \cdot EF_{NG}$,
where $FR_{NG\ BF\,X\,PJ\,Y}$ – BF *x* natural gas consumption, including its consumption on the stoves, thou.m^3/year;
$SC_{NG\ Steam}$ – specific natural gas consumption for steam generation at TPP-steam blower according to table D.1, m^3/Gcal;
$C_{Steam\ BF\,X\,PJ\,Y}$ – project steam consumption at BF *x* for technological purposes, Gcal/year;
$SC_{Steam\ Coke}$ – specific steam consumption for coke production, taken from table D.1, Gcal/t;
$M_{Coke\ BF\,X\,PJ\,Y}$ – BF *x* project coke consumption inclusive of the undersized coke, t/year;
$SC_{Steam\ Blast}$ – specific steam consumption for air blast generation taken from table D.1, Gcal /m^3;
$C_{Blast\ BF\,X\,PJ\,Y}$ – BF *x* project air blast consumption, m^3/year;
$Q_{NG\ Y}$ – net calorific value of natural gas used at "NTMK", GJ /thou.m^3;
EF_{NG} – natural gas emission factor, tons of CO_2/GJ;
x – BF number (#1,4,5,6).

(D.9) $C_{output\ BF\ X\ PJ\ Y} = P_{BF\ X\ PJ\ Y} \bullet \%C_{Iron\ BF\ X\ PJ} + M_{coke\ BF\ X\ PJ\ Y} / SO_{Coke\ Coking\ coal} \bullet (SO_{Naph} \bullet \%C_{Naph} + SO_{Benz} \bullet \%C_{Benz}),$

where $P_{BF\ X\ PJ\ Y}$ - BF *x* molten iron production, t/year;

$\%C_{Iron\ BF\ X\ PJ\ Y}$ – carbon content in BF *x* molten iron, %;

$M_{coke\ BF\ X\ PJ\ Y}$ – BF *x* project coke consumption inclusive of the undersized coke, t/year;

$SO_{Coke\ Coking\ coal}$ – coke yield from coking coal at “NTMK”, taken from table D.1, %;

SO_{Naph} – specific naphthalene yield per 1 ton of coking coal, taken from table D.1, t/t;

$\%C_{Naph}$ – carbon content in naphthalene, taken from table D.1 data, %;

SO_{Benz} – specific benzol yield per 1 ton of coking coal, taken from table D.1, t/t;

$\%C_{Benz}$ - carbon content in benzol, taken from table D.1 data, %;

x – BF number (#1,4,5,6).

Project scenario indirect emissions

Constants, needed for calculation of the total consumption of electricity, both project and baseline, are established, as is shown in section B.1, based on the actual data on “NTMK” operations in 2006-2008 and are presented in table D.2.

Table D.2

Constants used during “NTMK” project CO_2 emissions monitoring

Parameter	Units	Symbol	Value
Electricity consumption per 1 ton of coke	kW*hour/t	SEC_{Coke}	52.2
Electricity consumption for oxygen generation	kW*hour/thou.m^3	SEC_{Oxygen}	630.0
Electricity consumption for recycle water consumption	kW*hour/thou.m^3	SEC_{Water}	257.4
Electricity consumption for blast air production	kW*hour/thou.m^3	SEC_{Blast}	4.59

(D.10) $PE_{Indirect\ Y} = EC_{PJ\ Y} \bullet EF_{CO2\ grid}$,

where $EC_{PJ\ Y}$ - total electricity consumption within the project boundary, MW• hour/year.

$EF_{CO2\ grid}$ – CO_2 emission factors in the Russian Federation energy system, recommended by the Operational Guidelines for Project Design Documents of Joint Implementation Projects, which were calculated by the Ministry of Economic Affairs of the Netherlands in 2004[1], t CO_2/ GW•hour.

As per the Guidelines, the following emission factors are used in the calculations, recommended for the RF UES.

Table D.3

CO_2 emission factors during electricity generation in the RF UES

Parameter	Unit	2008	2009	2010	2011	2012
Emission factor for power grids	tons of CO_2/GW*hr	565	557	550	542	534

Total electricity consumption within the project boundary is calculated by the formula:

(D.11) $EC_{PJ\ Y} = EC_{BF\ PJ\ Y} + EC_{Coke\ PJ\ Y} + EC_{Oxygen\ PJ\ Y} + EC_{Water\ PJ\ Y} + EC_{Blast\ PJ\ Y} - EO_{TPRT\ PJ\ Y}$,

where $EC_{BF\ PJ\ Y}$ – BF #1,4,5,6 project electricity consumption, MW• hour/year;

$EC_{Coke\ PJ\ Y}$ - project electricity consumption within the project boundary for coke production, MW• hour/year;

$EC_{Oxygen\ PJ\ Y}$ – project electricity consumption within the project boundary for oxygen generation, MW• hour/year;

$EC_{Water\ PJ\ Y}$ – project electricity consumption within the project boundary for the supply of BF with recycle water, MW• hour/year;

$EC_{Blast\ PJ\ Y}$ – project electricity consumption within the project boundary for blast air generation, MW• hour/year;

$EC_{TPRT\ PJ\ Y}$ – project electricity generation at BF #6 TPRT, MW• hour/year.

Project electricity consumption at the "NTMK" BFS ($EC_{BF\ PJ\ Y}$) is calculated at the total consumption of electricity within the project boundary:

(D.12) $EC_{BF\ PJ\ Y} = EC_{BF\ 1\ PJ\ Y} + EC_{BF\ 4\ PJ\ Y} + EC_{BF\ 5\ PJ\ Y} + EC_{BF\ 6\ PJ\ Y}$,

where $EC_{BF\ 1\ PJ\ Y}$ – project BF #1 electricity consumption calculated by formula D.2 , MW• hour/year;

$EC_{BF\ 4\ PJ\ Y}$ – project BF #4 electricity consumption calculated by formula D.2 , MW• hour/year;

$EC_{BF\ 5\ PJ\ Y}$ – project BF #5 electricity consumption, MW• hour/year;

$EC_{BF\ 6\ PJ\ Y}$ – project BF #6 electricity consumption, MW• hour/year.

Project electricity consumption for coke production ($EC_{Coke\ PJ\ Y}$) is calculated as follows:

(D.13) $EC_{Coke\ PJ\ Y} = (M_{Coke\ BF\ 1\ PJ\ Y} + M_{Coke\ BF\ 4\ PJ\ Y} + M_{Coke\ BF\ 5\ PJ\ Y} + M_{Coke\ BF\ 6\ PJ\ Y}) \cdot SEC_{Coke}$,

[1] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Volume 1: General guidelines. Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004. p.43, Table B2

where $M_{Coke\ BF\ 1\ PJ\ Y}$ – project BF #1 coke consumption inclusive of the undersized coke calculated by formula D.2, t/year;
$M_{Coke\ BF\ 4\ PJ\ Y}$ – project BF #4 coke consumption inclusive of the undersized coke calculated by formula D.2, t/year;
$M_{Coke\ BF\ 5\ PJ\ Y}$ – project BF #5 coke consumption inclusive of the undersized coke, t/year;
$M_{Coke\ BF\ 6\ PJ\ Y}$ – project BF #6 coke consumption inclusive of the undersized coke, t/year;
SEC_{Coke} – specific consumption of electricity for coke production (table D.2), MW• hour/tons of coke.

Project electricity consumption for oxygen generation at the air separation plant ($EC_{Oxygen\ PJ\ Y}$) is calculated as follows:
(D.14) $EC_{Oxygen\ PJ\ Y} = (C_{Oxygen\ BF\ 1\ PJ\ Y} + C_{Oxygen\ BF\ 4\ PJ\ Y} + C_{Oxygen\ BF\ 5\ PJ\ Y} + C_{Oxygen\ BF\ 6\ PJ\ Y}) \cdot SEC_{Oxygen}$,
where $C_{Oxygen\ BF\ 1\ PJ\ Y}$ – project BF #1 total oxygen consumption calculated by formula D.2, thou.m ^{3}/year;
$C_{Oxygen\ BF\ 4\ PJ\ Y}$ – project BF #4 total oxygen consumption calculated by formula D.2, thou.m ^{3}/year;
$C_{Oxygen\ BF\ 5\ PJ\ Y}$ – project BF #5 total oxygen consumption, thou.m ^{3}/year;
$C_{Oxygen\ BF\ 6\ PJ\ Y}$ – project BF #6 total oxygen consumption, thou.m^3/year;
SEC_{Oxygen} – specific electricity consumption for oxygen generation (table D), MW• hour/thou.m^3.

Power consumption for the BFS supply with recycle water ($EC_{Water\ BF\ 5\ PJ\ Y}$) is calculated as follows:

(D.15) $EC_{Water\ PJ\ Y} = (C_{Water\ BF\ 1\ PJ\ Y} + C_{Water\ BF\ 4\ PJ\ Y} + C_{Water\ BF\ 5\ PJ\ Y} + C_{Water\ BF\ 6\ PJ\ Y}) \cdot SEC_{Water}$,
where $C_{Water\ BF\ 1\ PJ\ Y}$ – project BF #1 recycle water consumption calculated by formula D.2, thou.m^3/year;
$C_{Water\ BF\ 4\ PJ\ Y}$ – project BF #4 recycle water consumption calculated by formula D.2, thou.m^3/year;
$C_{Water\ BF\ 5\ PJ\ Y}$ – project BF #5 recycle water consumption, thou.m^3/year;
$C_{Water\ BF\ 6\ PJ\ Y}$ – project BF #6 recycle water consumption, thou.m^3/year;
SEC_{Water} – specific electricity consumption for the BFS recycle water supply (table D), MW• hour/thou.m^3.

Electricity consumption for the air blast generation ($EC_{Water\ PJ\ Y}$) is calculated as follows:

(D.16) $EC_{Blast\ PJ\ Y} = (C_{Blast\ BF\ 1\ PJ\ Y} + C_{Blast\ BF\ 4\ PJ\ Y} + C_{Blast\ BF\ 5\ PJ\ Y} + C_{Blast\ BF\ 6\ PJ\ Y}) \cdot SEC_{Blast,,}$
where $C_{Blast\ BF\ 1\ PJ\ Y}$ – project BF #1 air blast consumption calculated by formula D.2, thou.m ^{3}/year;
$C_{Blast\ BF\ 4\ PJ\ Y}$ – project BF #4 air blast consumption calculated by formula D.2, thou.m ^{3}/year;
$C_{Blast\ BF\ 5\ PJ\ Y}$ – project BF #5 air blast consumption, thou.m ^{3}/year;
$C_{Blast\ BF\ 5\ PJ\ Y}$ – project BF #6 air blast consumption, thou.m ^{3}/year;
SEC_{Blast} – specific electricity consumption for air blast generation (table D.2), MW•hour/thou.m^3.

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
P-1. $P_{BF\ 1\ PJ\ Y}$	*BF #1 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-2. $P_{BF\ 4\ PJ\ Y}$	*BF #4 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-3. $P_{BF\ 5\ PJ\ Y}$	*BF #5 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-12. $P_{BF\ 6\ PJ\ Y}$	*BF #6 molten iron production*	*BFS operations technical report*	*ton*	*(m)*	*monthly*	*100%*	*Electronic*	
P-22. $Q_{NG\ PJ\ Y}$	*Net calorific value of the natural gas, supplied to "NTMK"*	*Passport (Quality certificate) of natural gas from the supplier*	*GJ/thou.m.*^{3}	*(m)*	*monthly*	*100%*	*Electronic / paper*	Average value is identified in the end of the year

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

According to the project boundary definition, the baseline CO_2 calculation takes into account both direct CO_2 emissions at "NTMK" and indirect emissions at the RF UES power grids;

(D.17) $BE_Y = BE_{Direct\ Y} + BE_{Indirect\ Y}$

where BE_Y - total baseline CO_2 emissions, t/year;

$BE_{Direct\ Y}$ – baseline direct CO_2 emissions, t/year;

$BE_{Indirect\ Y}$ – baseline indirect CO_2 emissions, t/year.

Baseline direct CO_2 emissions

Total baseline molten iron production within the project boundary, as defined in section B.1, is equal to the project production at BF ##1,4,5 and 6. The BF shop baseline production distribution among BF ##1-5 is done proportionally to these furnaces' molten iron production data in 2001-2003 by the following formula:

(D.18) $P_{BF\,X\,BL\,Y} = (P_{BF\,1\,PJ\,Y} + P_{BF\,4\,PJ\,Y} + P_{BF\,5\,PJ\,Y} + P_{BF\,6\,PJ\,Y}) \bullet P_{BF\,X} / (\sum P_{BF\,1\text{-}5})$,
where $P_{BF\,1\,PJ\,Y}$ – BF #1 project molten iron production, t/year;
$P_{BF\,4\,PJ\,Y}$ – BF #4 project molten iron production, t/year;
$P_{BF\,5\,PJ\,Y}$ – BF #5 project molten iron production, t/year;
$P_{BF\,6\,PJ\,Y}$ - BF #6 project molten iron production, t/year;
$P_{BF\,X}$ – average production for each BF (##1-5) in 2001-2003 according to table B.7, t/year;
$\sum P_{BF\,1\text{-}5}$ – total molten iron production by BF ##1-5 according to the average data for 2001-2003 (4.711 t/year);
x – BF number (##1-5).

Specific baseline consumption of materials, fuel and energy carriers and carbon content in the molten iron of BF ##1-5 is calculated in section B.1 and are presented in table B.3. The constants, related to the coke production operations, BF shop and TPP-steam blower according to baseline and project scenario are presented in table D.1.

Baseline direct emissions are calculated as the aggregate of CO_2 emissions of "NTMK" BF ##1-5:

(D.19) $BE_{Direct\,Y} = \sum (BE_{BF\,X\,Y})$,
where $BE_{BF\,X\,Y}$ - CO_2 emissions due to the operations of BF x, t/year;
x – BF number (##1-5).

CO_2 emissions due to the operations of each of the BF are calculated as follows:

(D.20) $BE_{BF\,X\,Y} = BE_{Coking\,Coal\,BF\,X\,Y} + BE_{Limestone\,BF\,X\,Y} + BE_{NG\,BF\,X\,Y} - 44/12 \bullet C_{output\,BF\,X\,BL\,Y}$,
where $BE_{Coking\,Coal\,BF\,X\,Y}$ – baseline CO_2 emissions due to the consumption of coking coal for molten iron production, t/year;
$BE_{Limestone\,BF\,X\,Y}$ – baseline CO_2 emissions due to the limestone consumption by BF x, t/year;
$BE_{NG\,BF\,X\,Y}$ – baseline CO_2 emissions due to due to natural gas consumption for molten iron production at BF x, t/year;
$C_{output\,BF\,X\,BL\,Y}$ - weight of carbon in the BF x molten iron and by-products of the coke-chemical operations, released during the production of coke required for the BF operations, t/year;
x – BF number (##1-5).

Variables participating in the equation (D.20), are calculated by the following formulae:

(D.21) $BE_{Coking\ Coal\ BF\ X\ Y} = 44/12 \cdot SC_{coke\ BF\ X\ BL} \cdot P_{BF\ X\ BL\ Y} \cdot \%C_{Coking\ coal} / SO_{Coke\ Coking\ coal}$,
where $SC_{coke\ BF\ X\ BL\ Y}$ – specific consumption of coke at BF x inclusive of the undersized coke, (table B.3), t/t;
$P_{BF\ X\ BL\ Y}$ – baseline molten iron production at BF x, t/year;
$\%C_{Coking\ coal}$ – carbon content in coking coal, taken from table D.1 data, %;
$SO_{Coke\ Coking\ coal}$ – coke yield from coking coal at "NTMK", calculated by table D.1 data, %;
x – BF number (##1-5).

(D.22) $BE_{Limestone\ BF\ X\ Y} = 44/12 \cdot (SC_{limestone\ BF\ X\ BL} \cdot P_{BF\ X\ BL\ Y} \cdot \%C_{limestone})$,
where $SC_{limestone\ BF\ X\ BL\ Y}$ – baseline specific limestone consumption at BF x (table B.3), t/t;
$P_{BF\ X\ BL\ Y}$ – baseline molten iron production at BF x, t/year;
$\%C_{limestone}$ – carbon content in limestone taken from table D.1 data, %;
x – BF number (##1-5).

(D.23) $BE_{NG\ BF\ X\ Y} = (SFR_{NG\ BF\ X\ BL\ Y} + SC_{NG\ Steam} \cdot (SC_{Steam\ BF\ X\ BL} + SC_{Steam\ Coke} \cdot SC_{Coke\ BF\ X\ BL\ Y} + SC_{Steam\ Blast} \cdot SC_{Blast\ BF\ X\ BL\ Y})) \cdot P_{BF\ X\ BL\ Y} \cdot Q_{NG\ Y} \cdot EF_{NG}$,
where $SFR_{NG\ BF\ X\ BL\ Y}$ – baseline specific consumption of natural gas at BF x (table B.3), thou.m^3/t;
$SC_{NG\ Steam}$ – specific consumption of natural gas for steam generation at TPP-steam blower, taken from table D.1 data, m^3/Gcal;
$SC_{Steam\ BF\ X\ BL\ Y}$ – specific consumption of steam at BF x for technological purposes calculated in section B.1, Gcal/t;
$SC_{Steam\ Coke}$ – baseline specific consumption of steam for coke production, taken from table D.1 data, Gcal/t;
$SC_{coke\ BF\ X\ BL\ Y}$ – baseline specific consumption of coke at BF x inclusive of the undersized coke (table B.3), t/t;
$SC_{Steam\ Blast}$ – specific steam consumption for generation of blast air, taken from table D.1 data, Gcal/m^3;
$SC_{Blast\ BF\ X\ BL\ Y}$ – baseline specific blast air consumption at BF x (table D.1), m^3/t;
$P_{BF\ X\ BL\ Y}$ – BF x baseline molten iron production, t/year;
$Q_{NG\ Y}$ – net calorific value of natural gas, used at "NTMK", GJ/thou.m.^{3};
EF_{NG} – natural gas emission factor, tons of CO_2/GJ;
x – BF number (##1-5).

(D.24) $C_{output\ BF\ X\ BL\ Y} = P_{BF\ X\ BL\ Y} \cdot \%C_{Iron\ BF\ X\ BL\ Y} + SC_{coke\ BF\ X\ BL\ Y} / SO_{Coke\ Coking\ coal} \cdot (SO_{Naph} \cdot \%C_{Naph} + SO_{Benz} \cdot \%C_{Benz})$,
where $P_{BF\ X\ BL\ Y}$ - baseline molten iron production at BF x, t/year;
$\%C_{Iron\ BF\ X\ BL\ Y}$ – baseline carbon content in molten iron of BF x (table B.3), %;
$SC_{coke\ BF\ X\ BL\ Y}$ – baseline specific coke consumption at BF x inclusive of the undersized coke (table B.3), t/t;

$SO_{Coke\ Coking\ coal}$ – coke yield from coking coal at “NTMK”, taken from table D.1 data, %;
SO_{Naph} – specific naphthalene yield per 1 ton of coking coal, taken from table D.1 data, t/t;
$\%C_{Naph}$ – carbon content in naphthalene, taken from table D.1 data, %;
SO_{Benz} – specific benzol yield per 1 ton of coking coal, taken from table D.1 data, t/t;
$\%C_{Benz}$ - carbon content in benzol, taken from table D.1 data, %;
x – BF number, (##1-5).

Baseline indirect emissions

Annual baseline CO_2 emissions during electricity generation at the RF power grids, which is used for molten iron production within the project boundary ($BE_{Indirect\ Y}$), are calculated in the same manner as the project scenario:

(D.25) $BE_{Indirect\ Y} = EC_{BL\ Y} \bullet EF_{CO2\ grid}$,
where $EC_{BL\ Y}$ - total electricity consumption within the project boundary, MW• hour/year.
$EF_{CO2\ grid}$ – CO_2 emission factors in the RF energy system, recommended by the Operational Guidelines for Project Design Documents of Joint Implementation Projects, which were calculated by the Ministry of Economic Affairs of the Netherlands in 2004[1], t CO_2/ MW•hour.

Total baseline electricity consumption within the project boundary is calculated by the formula:

(D.26) $EC_{BL\ Y} = EC_{BF\ BL\ Y} + EC_{Coke\ BL\ Y} + EC_{Oxygen\ BL\ Y} + EC_{Water\ BL\ Y} + EC_{Blast\ BL\ Y}$,
where $EC_{BF\ BL\ Y}$ – BF baseline electricity consumption within the project boundary, MW• hour/year;
$EC_{Coke\ BL\ Y}$ – baseline electricity consumption within the project boundary for coke production, MW• hour/year;
$EC_{Oxygen\ BL\ Y}$ – baseline electricity consumption within the project boundary for oxygen generation, MW• hour/year;
$EC_{Water\ BL\ Y}$ – baseline electricity consumption within the project boundary for BF supply with recycle water, MW• hour/year;
$EC_{Blast\ BL\ Y}$ – baseline electricity consumption within the project boundary for blast air generation, MW• hour/year.

“NTMK” baseline electricity consumption in the BFS ($EC_{BF\ BL\ Y}$) is calculated as follows:

(D.27) $EC_{BF\ BL\ Y} = \sum (P_{BF\ X\ BL\ Y} \bullet SEC_{BF\ X\ BL\ Y})$,
where $P_{BF\ X\ BL\ Y}$ – BF x baseline molten iron production, calculated by formula D.18, t/year;
$SEC_{BF\ X\ BL\ Y}$ – BF x baseline specific electricity consumption (table B.3), MW• hour/t;

[1] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Volume 1: General guidelines. Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004. p.43, Table B2

x – BF number (##1-5).

Baseline electricity consumption for coke production ($EC_{Coke\ BL\ Y}$) is calculated as follows:

(D.28) $EC_{Coke\ BL\ Y} = \sum (P_{BF\ X\ BL\ Y} \bullet SC_{Coke\ BF\ X\ BL\ Y}) \bullet SEC_{Coke}$,
where $P_{BF\ X\ BL\ Y}$ – BF x baseline molten iron production, calculated by formula D.18, t/year;
$SC_{Coke\ BF\ X\ BL\ Y}$ – BF x baseline specific coke consumption (table B.3), t/t;
SEC_{Coke} – specific electricity consumption for coke production (table D.2), MW• hour/tons of coke;
x – BF number (##1-5).

Baseline electricity consumption for oxygen generation at the air separation plant ($EC_{Oxygen\ BL\ Y}$) is calculated as follows:

(D.29) $EC_{Oxygen\ BL\ Y} = \sum (P_{BF\ X\ BL\ Y} \bullet SC_{Oxygen\ BF\ X\ BL}) \bullet SEC_{Oxygen}$,
where $P_{BF\ X\ BL\ Y}$ – baseline BF x molten iron production, calculated by formula D.18, t/year;
$SC_{Oxygen\ BF\ X\ BL\ Y}$ – BF x baseline specific oxygen consumption (table B.3), thou.m. ^{3}/t;
SEC_{Oxygen} – specific electricity consumption for oxygen generation (table D.2), MW•hour/thou.m^3;
x – BF number (##1-5).

Electricity consumption for the BFS recycle water supply ($EC_{Water\ BL\ Y}$) is calculated as follows:

(D.30) $EC_{Water\ BL\ Y} = \sum (P_{BF\ X\ BL\ Y} \bullet SC_{Water\ BF\ X\ BL}) \bullet SEC_{Water}$,
where $P_{BF\ X\ BL\ Y}$ – BF x baseline molten iron production, calculated by formula D.18, t/year;
$SC_{Water\ BF\ X\ BL\ Y}$ – BF x baseline specific water consumption (table B.3), thou.m^3/t;
SEC_{Water} – specific electricity consumption for the BFS water supply (table D.2), MW• hour/thou.m^3;
x – BF number (##1-5).

Electricity consumption for blast air generation ($EC_{Blast\ BL\ Y}$) is calculated as follows:

(D.31) $EC_{Blast\ BL\ Y} = \sum (P_{BF\ X\ BL\ Y} \bullet SC_{Blast\ BF\ X\ BL}) \bullet SEC_{Blast}$,
where $P_{BF\ X\ BL\ Y}$ – BF x baseline molten iron production, calculated by formula D.18 t/year;
$SC_{Blast\ BF\ X\ BL\ Y}$ – BF x baseline specific air Blast consumption (table B.3), thou.m^3/t;
SEC_{Blast} – specific electricity consumption for Blast air generation (table D.2), MW• hour/thou. m^3;
x – BF number (##1-5).

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:

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

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:

Not applicable.

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

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):

Reductions of CO_2 emissions due to the project realization are calculated by the formula:

(D.32) $ER_Y = BE_Y - PE_{Y,}$
where ER_Y – CO_2 emission reductions, t/year;
BE_Y – baseline CO_2 emissions, t/year;
PE_Y – CO_2 emission reduction during the project realization, t/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:

Within "NTMK" structure there is the Environmental Protection Department (EPD). In its operations this department is governed by the active legislation, orders and instructions from the "NTMK" General Director and the regulations of the Service of State Environmental Control of Natural Resources Committee. EPD includes well-trained personnel, does not require additional technical equipment and is well able to facilitate the proper production environmental monitoring of the project.

The EPD exercises control over:

- Emission of contaminants into the atmosphere;
- Quality of waste and technical water;
- Utilization, storage, relocation and burial of production wastes.

Analytical control over the various kinds of environmental impacts due to the BFS operations is exercised in compliance with the existing regulations. Control over the emission of contaminants into the atmosphere is exercised in line with the "Schedule for control over the compliance with the established MPE values".

The specialized EPD laboratory, which holds the accreditation certificate issued by ROSS RU. 0001.512 529 dd. 03.11.2003, exercises the instrumental control by way of collecting and analyzing samples of emitted contaminants directly from the sources. The data is summarized and tabulated in the reports where all the necessary detailed information is reflected, including the information on the areas covered in this project.

The company reports in compliance with the following official annual statistical forms:

- 2-tp (air) *Data on the atmosphere air protection*, including the information on the amount of the collected and neutralized atmospheric pollutants, detailed emissions of specific contaminants, number of emission sources, measures for reduction of emissions into the atmosphere and emissions from separate groups of contamination sources;
- 2-tp (water management) *Data on the water usage,* including the information on the water consumption from natural sources, discharge of waste water and content of contaminants in the water, capacity of water treatment facilities etc.;
- 2-tp (wastes) *Data on the generation, use, neutralization, transportation and emplacement of production and consumption wastes,* including the annual balance of the wastes management separately for their types and hazard classes.

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.
P-1. $P_{BF\ 1\ PJ\ Y}$ *P-2.* $P_{BF\ 4\ PJ\ Y}$ *P-3.* $P_{BF\ 5\ PJ\ Y}$ *P-12.* $P_{BF\ 6\ PJ\ Y}$	*Low*	*Molten iron production is measured at the wagon weighbridge VESTO-SD20, AVP-VP-SD. Weighbridge is calibrated by employees of "NTMK" Process Automation Shop. Weighbridge is calibrated once in 12 months*
P-4. $M_{coke\ BF\ 5\ PJ\ Y}$ *P-5.* $M_{limestone\ BF\ 5\ PJ\ Y}$ *P-13.* $M_{coke\ BF\ 6\ PJ\ Y}$ *P-14.* $M_{limestone\ BF\ 6\ PJ\ Y}$	*Low*	*Consumption of materials is measured at the weight feeder DV-10.* *The metering unit is calibrated by employees of "NTMK" Process Automation Shop. Weighbridge is calibrated once in 12 months*
P-6. $FR_{NG\ BF\ 5\ PJ\ Y}$ *P-7.* $C_{Steam\ BF\ 5\ PJ\ Y}$ *P-8.* $C_{Blast\ BF\ 5\ PJ\ Y}$	*Low*	*BF #5 consumption of natural gas, steam and blast air is measured by the SITRANS transformers.* *The metering devices are calibrated by employees of "NTMK" Process Automation Shop. Calibration frequency is once in 36 months*
P-15. $FR_{NG\ BF\ 6\ PJ\ Y}$ *P-16.* $C_{Steam\ BF\ 6\ PJ\ Y}$ *P-17.* $C_{Blast\ BF\ 6\ PJ\ Y}$	*Low*	*BF #6 consumption of natural gas, steam and blast air is measured by the SITRANS transformer.* *The metering devices are calibrated by employees of "NTMK" Process Automation Shop. Calibration frequency is once in 36 months*

P-9. $EC_{BF\ 5\ PJ\ Y}$ *P-18. $EC_{BF\ 6\ PJ\ Y}$*	*Low*	*Consumption of electricity is measured by electricity meters SAZU-I670M, SR4U-I673MB and SET-4TMO2.2. Meters are calibrated by employees of "NTMK" Process Automation Shop. Calibration frequency of SAZU-I670M and SR4U-I673MB is once in 48 months, SET-4TMO2.2 – once in 120 months.*
P-10. $C_{Oxygen\ BF\ 5\ PJ\ Y}$ *P-19. $C_{Oxygen\ BF\ 6\ PJ\ Y}$*	*Low*	*Oxygen consumption is measured by thermal energy flow meter IM-2300.* *The metering unit is calibrated by employees of "NTMK" Process Automation Shop. Calibration frequency - once in 36 months*
P-11. $C_{Water\ BF\ 5\ PJ\ Y}$ *P-20. $C_{Water\ BF\ 6\ PJ\ Y}$*	*Low*	*Water consumption at BF #5 and #6 is measured by electromagnetic flow meter OPTIFLUKS and AVV transformer. The metering unit is calibrated by employees of "NTMK" Process Automation Shop. Calibration frequency of OPTIFLUKS electromagnetic flow meter is 48 months, AVV transformer – 26 months.*
P-21. $EO_{TPRT\ PJ\ Y}$	*Low*	*PTRT electricity generation is measured by electricity meter SET-4TM #08051487. The meter is calibrated by employees of "NTMK" Process Automation Shop. Calibration frequency – 60 months.*
P-22. $Q_{NG\ Y}$	*Low*	*Lower heating values are monthly provided to "NTMK" Chief Power Engineer Office from natural gas supplier*

The acquisition procedure and quality of the parameters specified above are regulated by the Quality Management System (QMS), which is implemented at "NTMK" and certified for compliance with the ISO 9001:2000 standard requirements. The QMS, along with the set procedures for the technological processes' monitoring according to the Russian state standards and norms (GOSTs), ensures the acquisition of accurate data on the quality of technology and energy processes under the Project implementation at "NTMK" with low level of uncertainty.

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

The operational and management monitoring system takes into maximum account the existing "NTMK" reporting systems and is presented in figure D.1 below.

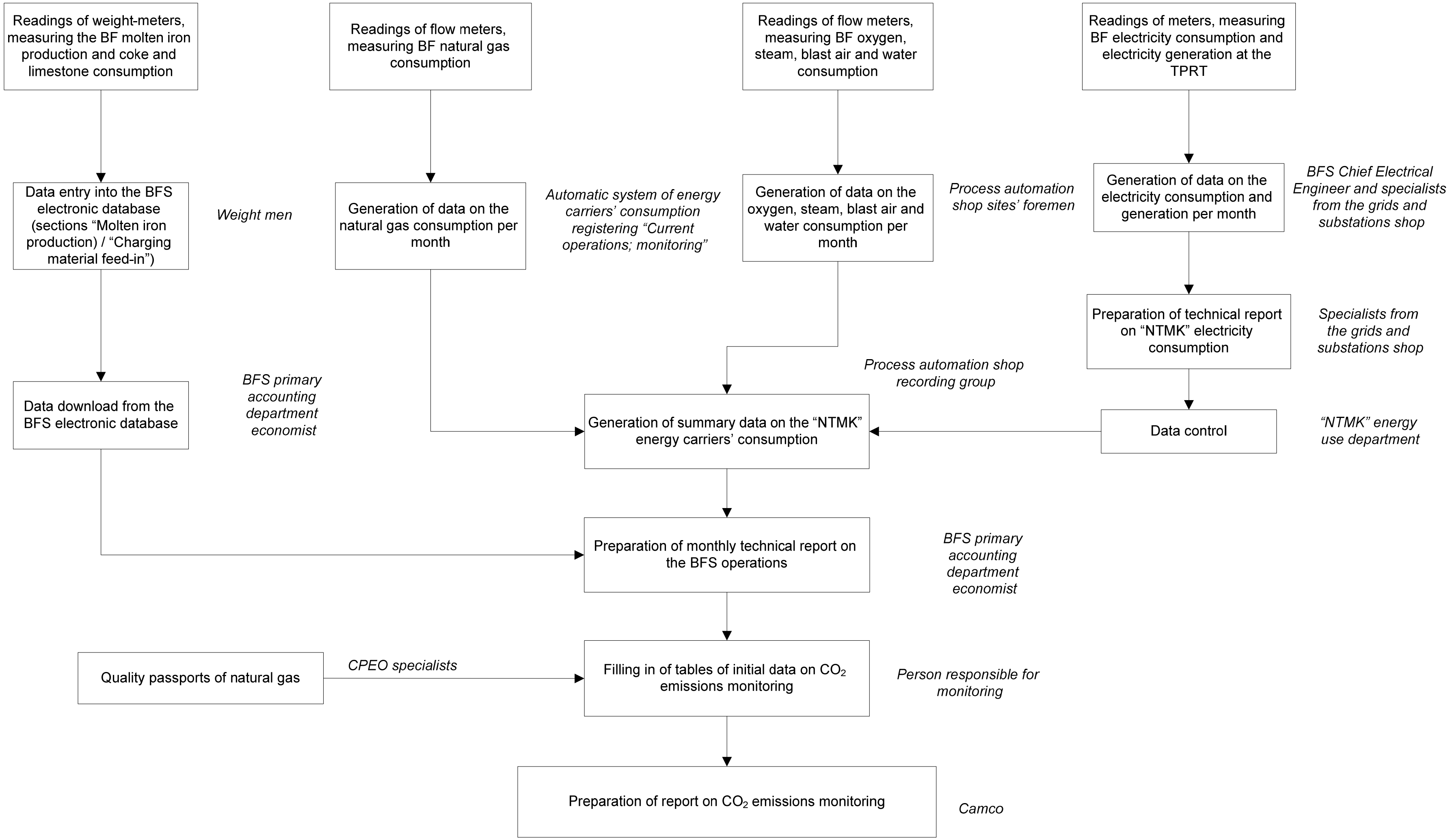

Figure D.1. Diagram of CO_2 emissions monitoring system at "NTMK"

Stages of CO_2 emissions monitoring at “NTMK”:

1. Data on BFS molten iron production and BF #5 and #6 consumption of coke and limestone is registered in the automatic system of the materials' weights registering and saved in the BFS database (database sections on “Molten iron production” and “Charging material infeed”).
2. Based on the downloads from database, the BFS primary accounting department economist enters data on molten iron production and coke and limestone consumption into the monthly BFS operations technical report.
3. Based on the readings of oxygen, blast air and water flowmeters, installed at BF #5 and #6, the Process Automation Shop foremen establish the values of BF #5 and #6 consumption of oxygen, blast air and water per month.
4. Based on the readings of natural gas flowmeters, installed at BF #5 and #6, the automatic system of energy carriers' registering (“Monitoring of current activities”) establishes the values of BF #5 and #6 natural gas consumption per month.
5. Based on the BF #5 and #5 electricity consumption meters and TPRT electricity generation meters readings, the BFS Chief Electrician jointly with the Grids and Substations Shop specialists establishes the values of BF #5 and #6 electricity consumption and TPRT electricity generation per month.
6. Based on the data acquired in p. 5, the Grids and Substations Shop specialists prepare monthly technical report on the “NTMK” electricity consumption.
7. “NTMK” electricity consumption department audits “NTMK” electricity consumption monthly technical report and submits the data to the Process Automation Shop registering group.
8. Based on the data acquired in pp. 3, 4 and 7 the Process Automation Shop registering group establishes the summary data on “NTMK” energy carriers' consumption and submits the data on BF #5 and #6 energy carriers' consumption to the BFS primary accounting department economist.
9. BFS primary accounting department economist forms data for drafting monthly BFS operations technical report.
10. Chief Power Engineer Office (CPEO) specialists provide the person, responsible for monitoring, with the natural gas quality certificates.
11. Based on the data from pp. 2, 9 and 10, the person, responsible for monitoring, fills in the form to prepare the report on the CO_2 emissions monitoring and hands the form over to Camco. The person, responsible for monitoring, ensures the storage of data, needed for the calculation of the emission reduction units, on the electronic and paper media until 2014 in the order, which will be established by the plant “Regulations for the order of CO_2 emissions monitoring at “NTMK”.
12. Based on the methods, specified in sections D.1.1.2 and D.1.1.4, Camco makes calculation of the emission reduction units and prepares the report on the JI project monitoring.

The template for submitting the initial data for the preparation of the CO_2 emissions report is presented in Annex 3 – “Monitoring plan”.

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

Monitoring plan was developed by the specialists of “Camco Carbon Russia Limited”:

- Contact person: Ryumin Oleg
- E-mail: Russia@camcoglobal.com

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

In order to calculate "NTMK" project CO_2 emissions, the carbon balance technique, presented in section B.1 of this document, is applied.

During calculations of project CO_2 emissions, the following flows of materials and energy carriers are considered:

- Flows coming into the project boundary:
  - Coking coal;
  - Natural gas;
  - Electricity (considered during indirect emissions' calculation);
  - Limestone;
- Flows leaving the project boundary:
  - Molten iron;
  - By-products of coal coking.

Project direct CO_2 emissions

As is shown in section B.1 of this document, project molten iron production and consumption of materials, fuel and energy carriers at BF #1,4,5 and 6 are taken from the actual data of furnaces' operations.

BF #5 and #6 performance figures for 2008 are taken from the shop operations' report, and the prediction for 2009-2012 is based on the average BF #5 and #6 performance figures in 2006-2008.

BF #1 and #4 molten iron production in 2008 is taken from the shop operations' report, and the specific consumption of materials, fuel and energy carriers, in compliance with section B.1, is based on the average data of BF operations in 2001-2003.

Data on #1,4,5 and 6 molten iron production and composition and on specific consumption of materials, fuel and energy carriers is presented in table E.1. Data on coke consumption is given inclusive of the undersized coke and natural gas consumption includes the volume of gas consumed for the BF stoves heating.

Table E.1

“NTMK” BFS project performance

Parameter	Unit	2008	2009	2010	2011	2012
Blast furnace #1						
Molten iron production	t/year	736 745	0	0	0	0
Carbon content in molten iron	%, weight	4.66	0	0	0	0
Specific consumption of fuel, materials and energy carriers per 1 ton of molten iron						
Coke consumption	kg/t	496	0	0	0	0
Natural gas consumption	m^3/t	101	0	0	0	0
Limestone consumption	kg/t	54	0	0	0	0
Steam consumption	Gcal/t	0.065	0	0	0	0
Blast air consumption	m^3/t	1251	0	0	0	0
Blast furnace #4						
Molten iron production	t/year	866 257	0	0	0	0
Carbon content in molten iron	%, weight	4.66	0	0	0	0
Specific consumption of fuel, materials and energy carriers per 1 ton of molten iron						
Coke consumption	kg/t	479	0	0	0	0
Natural gas consumption	m^3/t	107	0	0	0	0
Limestone consumption	kg/t	53	0	0	0	0
Steam consumption	Gcal/t	0.054	0	0	0	0
Blast air consumption	m^3/t	1341	0	0	0	0
Blast furnace #5						
Molten iron production	t/year	1 739 357	1 797 924	1 797 924	1 797 924	1 797 924
Carbon content in molten iron	%, weight	4.74	4.78	4.78	4.78	4.78
Specific consumption of fuel, materials and energy carriers per 1 ton of molten iron						
Coke consumption	kg/t	461	444	444	444	444
Natural gas consumption	m^3/t	116	134	134	134	134
Limestone consumption	kg/t	61	61	61	61	61
Steam consumption	Gcal/t	0.036	0.042	0.042	0.042	0.042
Blast air consumption	m^3/t	1121	1166	1166	1166	1166
Blast furnace #6						
Molten iron production	t/year	1 464 722	1 649 691	1 649 691	1 649 691	1 649 691
Carbon content in molten iron	%, weight	4.75	4.72	4.72	4.72	4.72
Specific consumption of fuel, materials and energy carriers per 1 ton of molten iron						
Coke consumption	kg/t	460	445	445	445	445
Natural gas consumption	m^3/t	106	128	128	128	128
Limestone consumption	kg/t	63	62	62	62	62
Steam consumption	Gcal/t	0.036	0.044	0.044	0.044	0.044
Blast air consumption	m^3/t	1 295	1 250	1 250	1 250	1 250

In order to calculate the project gross annual consumption of materials, fuel and energy carriers, listed in table E.1, the following equation is applied:

(E.1) $C_{PJ\,Y} = P_{BF\,1\,PJ\,Y} \bullet SC_{BF\,1\,PJ\,Y} + P_{BF\,4\,PJ\,Y} \bullet SC_{BF\,4\,PJ\,Y} + P_{BF\,5\,PJ\,Y} \bullet SC_{BF\,5\,PJ\,Y} +$
$+ P_{BF\,6\,PJ\,Y} \bullet SC_{BF\,6\,PJ\,Y}$,
where $P_{BF\,1\,PJ\,Y}$ – BF #1 project molten iron production (table E.1), t/year;
$SC_{BF\,1\,PJ\,Y}$ – BF #1 specific consumption of fuel, materials and energy carriers (table E.1), kg (m^3, Gcal)/t;
$P_{BF\,4\,PJ\,Y}$ – BF #4 project molten iron production (table E.1), t/year;
$SC_{BF\,4\,PJ\,Y}$ – BF #4 specific consumption of fuel, materials and energy carriers (table E.1), kg (m^3, Gcal)/t;
$P_{BF\,5\,PJ\,Y}$ – BF #5 project molten iron production (table E.1), t/year;
$SC_{BF\,5\,PJ\,Y}$ – BF #5 specific consumption of fuel, materials and energy carriers (table E.1), kg (m^3, Gcal)/t;
$P_{BF\,6\,PJ\,Y}$ – BF #6 project molten iron production (table E.1), t/year;
$SC_{BF\,6\,PJ\,Y}$ – BF #6 specific consumption of fuel, materials and energy carriers (table E.1), kg (m^3, Gcal)/t.

Project total molten iron production and gross consumption of fuel, materials and energy carriers are presented in table E.2.

Table E.2

BFS project performance

Parameter	Unit	2008	2009	2010	2011	2012
Total molten iron production	t/year	4 807 081	3 447 615	3 447 615	3 447 615	3 447 615
Coke consumption	t/year	2 256 267	1 532 990	1 532 990	1 532 990	1 532 990
Natural gas consumption	thou.m^3/year	524 415	452 682	452 682	452 682	452 682
Limestone consumption	t/year	284 320	212 504	212 504	212 504	212 504
Steam consumption	Gcal/year	209 479	147 549	147 549	147 549	147 549
Blast ait consumption	thou.m^3/year	5 929 953	4 157 343	4 157 343	4 157 343	4 157 343

Project CO_2 emissions due to coking coal consumption are calculated as follows:

(E.2) $PE_{Coking\,Coal\ \ Y} = 44/12 \bullet M_{Coke\ PJ\,Y} / SO_{Coking\,Coal\,Coke} \bullet \%C_{Coking\,Coal}$,
where $M_{Coke\ PJ\,Y}$ - project coke consumption (table E.2), t/year;
$SO_{Coking\,Coal\,Coke}$ – specific yield of coke from coking coal, determined in section B.1 of the project documentation (table B.4), 74.92%;
$\%C_{Coking\,Coal}$ – mass fraction of carbon in coking coal determined in section B.1 of the project documentation (table B.4), 60.2%.

Calculation results of CO_2 emissions due to coking coal consumption within the project boundary are presented in table E.3.

Table E.3

Project CO_2 emissions due to coking coal consumption

Parameter	Unit	2008	2009	2010	2011	2012
Coke consumption	t/year	2 256 267	1 532 990	1 532 990	1 532 990	1 532 990
Coking coal consumption	t/year	3 011 568	2 046 169	2 046 169	2 046 169	2 046 169
CO_2 emissions due to coking coal consumption	**tons of CO_2/year**	**6 647 535**	**4 516 577**	**4 516 577**	**4 516 577**	**4 516 577**

Project emissions of CO_2 due to limestone consumption are calculated as follows:

(E.3) $PE_{Limestone\ Y} = 44/12 \bullet M_{Limestone\ PJ\ Y} \bullet \%C_{Limestone}$,

where $M_{Limestone\ PJ\ Y}$ - project annual limestone consumption (table E.2), t/year.

$\%C_{Limestone}$ – mass fraction of carbon in coking coal accepted at 12% based on the data from the 2006 IPCC guidelines for national greenhouse gas inventories [1].

Calculation results of CO_2 emissions due to BF limestone consumption are presented in table E.4.

Table E.4

Project CO_2 emissions due to limestone consumption

Parameter	Unit	2008	2009	2010	2011	2012
Limestone consumption	t/year	284 320	212 504	212 504	212 504	212 504
CO_2 emissions due to limestone consumption	**tons of CO_2/year**	**125 101**	**93 502**	**93 502**	**93 502**	**93 502**

In order to calculate CO_2 emissions due to natural gas consumption we shall determine its consumption within the project boundary. Natural gas is used:

- In the blast furnace shop -
  - It is blown into the blast furnaces in order to save the coke for molten iron production,
  - It is fed into the stoves to increase the blast air temperature;
- At the TPP-steam blower for the generation of steam -
  - used for the BFS process needs;
  - used in the coke-chemical operations;
  - used for generation of blast air at the air blowers.

The amount of TPP-steam blower steam consumed within the project boundary ($C_{Steam\ PJ\ Y}$) is calculated by the formula:

(E.4) $C_{Steam\ PJ\ Y} = C_{Steam\ BF\ PJ\ Y} + SC_{Steam\ Coke} \bullet M_{Coke\ PJ\ Y} + SC_{Steam\ Blast} \bullet C_{Blast\ PJ\ Y}$,

where $C_{Steam\ BF\ PJ\ Y}$ – project steam consumption at the BFS (table E.2), Gcal/year;

$SC_{Steam\ Coke}$ – specific steam consumption for coke production, accepted according to table B.4 at the level of 356.3 Kcal/t of coke;

$M_{Coke\ PJ\ Y}$ – project coke consumption in the BFS (table E.2), t/year;

$SC_{Steam\ Blast}$ – specific steam consumption for blast air production, determined based on the data from LLC "NTMK-Energo" (table B.4) at 0.149 Gcal/thou.m^3;

$C_{Blast\ PJ\ Y}$ –project BFS blast air consumption (table E.2), m^3/year

Calculation results of steam consumption during blast furnace and coke-chemical operations and at TPP-steam blower within the project boundary are presented in table E.5.

[1] 2006 IPCC Guidelines for national greenhouse inventories. Volume 3 Industrial Processes and Product Use. Chapter 4 Metal Industry Emissions. p.4.27 table 4.3

Table E.5

Project steam consumption calculation

Parameter	Unit	2008	2009	2010	2011	2012
Steam consumption in the BFS	Gcal/year	209 479	147 549	147 549	147 549	147 549
Coke consumprion	t/year	2 256 267	1 532 990	1 532 990	1 532 990	1 532 990
Steam consumption in the CCO operations	Gcal/year	803 983	546 255	546 255	546 255	546 255
Blast air consumption	thou.m^3/year	5 929 953	4 157 343	4 157 343	4 157 343	4 157 343
Steam consumption at TPP-steam blower for blast air production	Gcal/year	883 563	619 444	619 444	619 444	619 444
Total steam consumption within the project boundaries	Gcal/year	1 897 025	1 313 249	1 313 249	1 313 249	1 313 249

Total consumption of natural gas within the project boundary is calculated by the formula:

(E.5) $FR_{NG\ PJ\ Y} = FR_{NG\ BF\ PJ\ Y} + SC_{NG\ Steam} \bullet C_{Steam\ PJ\ Y}$,
where $FR_{NG\ BF\ PJ\ Y}$ – project natural gas consumption in the BFS (table E.2), m^3/year;
$C_{Steam\ PJ\ Y}$ - project steam consumption within the project boundary (table E.5), Gcal/year;
$SC_{NG\ Steam}$ – specific natural gas consumption for steam production, determined based on the data from LLC “NTMK-Energo” at 74 m^3/Gcal.

Calculation results of natural gas consumption in the BFS and TPP-steam blower for steam generation are presented in table E.6.

Table E.6

Project natural gas consumption

Parameter	Unit	2008	2009	2010	2011	2012
BFS natural gas consumption	thou.m^3/year	524 415	452 682	452 682	452 682	452 682
TPP-steam blower natural gas consumption for steam generation	thou.m^3/year	140 380	97 180	97 180	97 180	97 180
Total natural gas consumption within the project boundaries	thou.m^3/year	664 795	549 862	549 862	549 862	549 862

CO_2 emissions due to natural gas consumption are calculated by the following formula:

(E.6) $PE_{NG} = FR_{NG\ PJ\ Y} \bullet EF_{NG}$,
where $FR_{NG\ PJ\ Y}$ – annual project natural gas consumption within the project boundary, (table E.6), thou.m^3/year;
EF_{NG} - natural gas emission factor, tons of CO_2/thou.m^3.

Natural gas emission factor is taken from standard emission factors of energy carriers according to 2006 IPCC guidelines for national greenhouse gas inventories[1]. Natural gas net calorific value is accepted according to LLC “NTMK-Energo” average data for 2006-2008.

[1] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Energy. Chapter 2 Stationary combustion. p 2.16

Table E.7

"NTMK" natural gas emission factor

Parameter	Unit	Value
Natural gas lower heating value	GJ/thou.m.^{3}	33.23
Natural gas emission factor	tons of CO_2/GJ	0.0561
	tons of CO_2/thou.m.^{3}	**1.86**

Calculation results of CO_2 emissions due to natural gas consumption within the project boundary are presented in table E.8.

Table E.8

Project emissions due to the consumption of natural gas within the project boundary

Parameter	Unit	2008	2009	2010	2011	2012
Natural gas consumption within the project boundaries	thou.m^3/year	664 795	549 862	549 862	549 862	549 862
CO_2 emissions due to natural gas consumption	**tons of CO_2/year**	**1 239 129**	**1 024 902**	**1 024 902**	**1 024 902**	**1 024 902**

Part of the carbon, brought into the project boundary by coking coal, limestone and natural gas, remains in the product – molten iron and by-products of coke-chemical operations (naphthalene and benzol). Weight of carbon, contained in the end products that leave the project boundary is calculated by the following formula:

(E.7) $C_{output\ PJ\ Y} = C_{output\ Iron\ PJ\ Y} + C_{output\ Coking\ product\ PJ\ Y,}$

where $C_{output\ Iron\ PJ\ Y}$ - weight of carbon remaining in molten iron, t/year;

$C_{output\ Coking\ product\ PJ\ Y,}$ – weight of carbon remaining in the by-products of coke-chemical operations, t/year.

The components, participating in formula E.7, are calculated in the following manner:

(E.8) $C_{output\ Iron\ PJ\ Y} = \sum (P_{BF\ X\ PJ\ Y} \bullet \%C_{Iron\ BF\ X\ PJ\ Y})$,

where $P_{BF\ X\ PJ\ Y}$ – BF x project molten iron production (table E.1), t/year;

$\%C_{Iron\ BF\ X\ PJ\ Y}$ – project mass fraction of carbon in BF x molten iron, %;

x – BF number (#1,4,5,6).

(E.9) $C_{output\ Coking\ product\ PJ\ Y} = M_{Coke\ PJ\ Y} / SO_{Coke\ Coking\ coal} \bullet (SO_{Naph} \bullet \%C_{Naph} + SO_{Benz} \bullet \%C_{Benz}),$

where $M_{Coke\ PJ\ Y}$ - project coke consumption (table E.2), t/year;

$SO_{Coke\ Coking\ coal}$ – "NTMK" coke yield from coking coal according to table B.4 data - 74.92%;

SO_{Naph} – specific naphthalene yield per 1 ton of coking coal according to table B.4 data, t/t;

$\%C_{Naph}$ – carbon content in naphthalene determined according to table B.4 data, %;

SO_{Benz} – specific yield of benzol per 1 ton of coking coal, determined by table B.4 data, t/t;

$\%C_{Benz}$ – carbon content in benzol, determined by table B.4 data, %.

Calculations of CO_2 emission reductions by formulae (E.7-9) are presented in tables E.9-11.

Table E.9

Project weight of carbon remaining in the molten iron

Parameter	Unit	2008	2009	2010	2011	2012
Blast furnace #1	t/year	34 357	-	-	-	-
Blast furnace #2	t/year	-	-	-	-	-
Blast furnace #3	t/year	-	-	-	-	-
Blast furnace #4	t/year	40 396	-	-	-	-
Blast furnace #5	t/year	82 446	86 001	86 001	86 001	86 001
Blast furnace #6	t/year	69 574	77 865	77 865	77 865	77 865
Total weight of carbon remaining in molten iron	t/year	226 773	163 866	163 866	163 866	163 866

Table E.10

Project weight of carbon remaining in the by-products of coking

Parameter	Unit	2008	2009	2010	2011	2012
Coking coal consumption	t/year	3 011 568	2 046 169	2 046 169	2 046 169	2 046 169
Coking products yield						
Benzol	t/year	26 401	17 938	17 938	17 938	17 938
Naphthalene	t/year	5 722	3 888	3 888	3 888	3 888
Weight of carbon remaining in benzol	t/year	23 647	16 067	16 067	16 067	16 067
Weight of carbon remaining in naphthalene	t/year	5 117	3 477	3 477	3 477	3 477
Total weight of carbon remaining in the CCO by-products	t/year	28 764	19 543	19 543	19 543	19 543

Table E.11

Project weight of carbon remaining in the products

Parameter	Unit	2008	2009	2010	2011	2012
Weight of carbon remaining in molten iron	t/year	226 773	163 866	163 866	163 866	163 866
Weight of carbon remaining in coking products	t/year	28 764	19 543	19 543	19 543	19 543
Total weight of carbon remaining in coking products	**t/year**	**255 537**	**183 410**	**183 410**	**183 410**	**183 410**

Project CO_2 emissions are calculated in the following way:

(E.10) $PE_{Direct\ Y} = PE_{Coking\ Coal\ Y} + PE_{Limestone\ Y} + PE_{NG\ Y} - 44/12 \bullet C_{output\ PJ\ Y}$,

where $PE_{Coking\ Coal\ Y}$ – project emissions of CO_2 due to coking coal consumption within the project boundary, t/year;

$PE_{Limestone\ Y}$ – project CO_2 emissions due to limestone consumption within the project boundary, t/year;

$PE_{NG\ Y}$ - project CO_2 emissions due to natural gas consumption within the project boundary, t/year;

$C_{output\ PJ\ Y}$ - weight of carbon in the molten iron, produced within the project boundary and in by-products of the coke-chemical operations, released during the production of coke, needed for molten iron production, t/year.

Calculation results of project direct CO_2 emissions within the project boundary are presented in table E.12.

Table E.12

Project direct CO_2 emissions

Parameter	Unit	2008	2009	2010	2011	2012
CO_2 emissions due to coking coal consumption	tons of CO_2/year	6 647 535	4 516 577	4 516 577	4 516 577	4 516 577
CO_2 emissions due to limestone consumption	tons of CO_2/year	125 101	93 502	93 502	93 502	93 502
CO_2 emissions due to natural gas consumption	tons of CO_2/year	1 239 129	1 024 902	1 024 902	1 024 902	1 024 902
Weight of carbon remaining in the project products in tons of CO_2 equivalent	tons of CO_2/year	-936 970	-672 502	-672 502	-672 502	-672 502
Total direct emissions within the project boundaries	**tons of CO_2/year**	**7 074 794**	**4 962 479**	**4 962 479**	**4 962 479**	**4 962 479**

Project indirect CO_2 emissions

The project indirect emissions are emissions of CO_2 at the RF UES power grids during generation of electricity consumed for molten iron production within the project boundary.

Within the project boundary the electricity is consumed for:

- BF electrical equipment operation;
- Coke-chemical operations;
- Air separation plant for oxygen generation;
- Water supply shop for BF supply with recycle water;
- At TTP-steam blower for blast air generation.

The amount of project indirect emissions is decreased by the volume of electricity, generated by BF #6 TPRT.

Project specific consumption of electricity, oxygen and recycle water at BF #1,4,5,6 and electricity generation by TPRT in 2008-2012 are calculated in section B.1 and presented in table E.13.

Table E.13

BFS project performance indicators

Parameter	Unit	2008 г.	2009 г.	2010 г.	2011 г.	2012 г.
Blast furnace #1						
Electricity consumption	kW*hr/t	5.0	-	-	-	-
Oxygen consumption	m^3/t	69.0	-	-	-	-
Recycle water consumption	m^3/t	14.7	-	-	-	-
Blast furnace #4						
Electricity consumption	kW*hr/t	5.0	-	-	-	-
Oxygen consumption	m^3/t	55.7	-	-	-	-
Recycle water consumption	m^3/t	14.7	-	-	-	-
Blast furnace #5						
Electricity consumption	kW*hr/t	23.0	23.0	23.0	23.0	23.0
Oxygen consumption	m^3/t	77.0	73.3	73.3	73.3	73.3
Recycle water consumption	m^3/t	16.0	13.7	13.7	13.7	13.7
Blast furnace #6						
Electricity consumption	kW*hr/t	21.0	21.3	21.3	21.3	21.3
Oxygen consumption	m^3/t	43.0	56.3	56.3	56.3	56.3
Recycle water consumption	m^3/t	15.0	13.7	13.7	13.7	13.7
Electricity generation at the TPRT	kW*hr/t	22.2	22.2	22.2	22.2	22.2

Total annual project consumption of electricity, oxygen and recycle water is calculated by the following equation:

(E.11) $C_{PJ\,Y} = P_{BF\,1\,PJ\,Y} \bullet SC_{BF\,1\,PJ\,Y} + P_{BF\,4\,PJ\,Y} \bullet SC_{BF\,4\,PJ\,Y} + P_{BF\,5\,PJ\,Y} \bullet SC_{BF\,5\,PJ\,Y} +$
$+ P_{BF\,6\,PJ\,Y} \bullet SC_{BF\,6\,PJ\,Y}$,

where $P_{BF\,1\,PJ\,Y}$ – BF #1 project molten iron production (table E.1), t/year;

$SC_{BF\,1\,PJ\,Y}$ – BF #1 specific consumption of electricity, oxygen and recycle water (table E.13), kW• hour (m^3) /t;

$P_{BF\,4\,PJ\,Y}$ – BF #5 project molten iron production (table E.1), t/year;

$SC_{BF\,4\,PJ\,Y}$ – BF #5 specific consumption of electricity, oxygen and recycle water (table E.13), kW• hour (m^3) /t;

$P_{BF\,5\,PJ\,Y}$ – BF #5 project molten iron production (table E.1), t/year;

$SC_{BF\,5\,PJ\,Y}$ – BF #5 specific consumption of electricity, oxygen and recycle water (table E.13), kW• hour (m^3) /t;

$P_{BF\,6\,PJ\,Y}$ – BF #6 project molten iron production (table E.1), t/year;

$SC_{BF\,6\,PJ\,Y}$ – BF #6 specific consumption of electricity, oxygen and recycle water (table E.13), kW• hour (m^3) /t;

Electricity generation by BF #6 TPRT is calculated by the formula:

(E.12) $EO_{TPRT\,PJ\,Y} = P_{BF\,6\,PJ\,Y} \bullet SEO_{TPRT\,PJ\,Y}$,

where $P_{BF\,6\,PJ\,Y}$ – BF #6 project molten iron production (table E.1), t/year;

$SEO_{TPRT\,PJ\,Y}$ – specific generation of electricity by BF #6 TPRT per 1 ton of molten iron (table E.13), kW•hour/t.

Calculation results of annual project consumption of electricity, oxygen and recycle water and electricity generation by TPRT are presented in table E.14.

Table E.14

Annual project consumption of electricity, oxygen and recycle water and project electricity generation by TPRT

Parameter	Unit	2008	2009	2010	2011	2012
Electricity consumption	MW*hr/year	78 779	76 546	76 546	76 546	76 546
Oxygen consumption	thou.m^3 /year	295 971	224 780	224 780	224 780	224 780
Recycle water consumption	thou.m^3 /year	73 311	47 117	47 117	47 117	47 117
Electricity generation at the TPRT-12	MW*hr/year	32 539	36 648	36 648	36 648	36 648

Project electricity consumption for coke production is calculated as follows:

(E.13) $EC_{Coke\,PJ\,Y} = M_{Coke\,PJ\,Y} \bullet SEC_{Coke}$,

where $M_{Coke\,PJ\,Y}$ – BFS project coke consumption (table E.2), t/year;

SEC_{Coke} – specific electricity consumption for coke production, established in table B.4 by the CCO specialists at the level of 52.2 kW•hour/ton of coke.

Calculation results of electricity consumption for coke production are presented in table E.15.

Table E.15

Project electricity consumption for coke production

Parameter	Unit	2008	2009	2010	2011	2012
Coke consumption during blast furnace operations	t/year	2 256 267	1 532 990	1 532 990	1 532 990	1 532 990
Electricity consumption during CCO	MW*hr/ton	0.0522	0.0522	0.0522	0.0522	0.0522
Electricity consumption for coke production	MW*hr/year	117 852	80 073	80 073	80 073	80 073

Project electricity consumption for oxygen generation at the air separation plant is calculated as follows:

(E.14) $EC_{Oxygen\ PJ\ Y} = C_{Oxygen\ PJ\ Y} \bullet SEC_{Oxygen}$,

where $C_{Oxygen\ PJ\ Y}$ – BFS oxygen consumption according to table E.13 data, thou.m^3/year;

SEC_{Oxygen} – specific electricity consumption for oxygen generation calculated in table B.5 according to the “NMTK” oxygen generation data – 630 kW*hour/thou.m^3.

Calculation results of electricity consumption for oxygen generation at the air separation plant are presented in table E.16.

Table E.16

Project electricity consumption for oxygen generation at the air separation plant

Parameter	Unit	2008	2009	2010	2011	2012
BF oxygen consumption	thou.m^3 /year	295 971	224 780	224 780	224 780	224 780
Specific electricity consumption for oxygen generation at the air separation plant	MW*hr/thou.m^3	0.630	0.630	0.630	0.630	0.630
Electricity consumption for oxygen generation at the air separation plant	MW*hr/year	186 461	141 612	141 612	141 612	141 612

Project electricity consumption for the BFS supply recycle water is calculated as follows:

(E.15) $EC_{Water\ PJ\ Y} = C_{Water\ PJ\ Y} \bullet SEC_{Water}$,

where $C_{Water\ PJ\ Y}$ - BF #5 and #6 water consumption according to table E.13 data, thou.m^3/year;

SEC_{Water} – specific electricity consumption for the BFS water supply according to the LLC “NTMK-Energo” data – 257.4 kW•hour/thou.m^3.

Calculation results of electricity consumption for the BFS recycle water supply are presented in table E.17.

Table E.17

Project electricity consumption for BF #5 and #6 recycle water supply

Parameter	Unit	2008	2009	2010	2011	2012
BF recycle water consumption	thou.m^3 /year	73 311	47 117	47 117	47 117	47 117
Specific electricity consumption for BF supply with recycle water	MW*hr/thou.m^3	0.257	0.257	0.257	0.257	0.257
Electricity consumption for BF supply with recycle water	MW*hr/year	18 873	12 130	12 130	12 130	12 130

Total project electricity consumption ($EC_{PJ\ Y}$) is calculated as follows:

(E.16) $EC_{PJ\ Y} = EC_{BF\ PJ\ Y} + EC_{Coke\ PJ\ Y} + EC_{Oxygen\ PJ\ Y} + EC_{Water\ PJ\ Y} - EO_{TPRT\ PJ\ Y}$

where $EC_{BF\ PJ\ Y}$ – project electricity consumption at blast furnaces within the project boundary (table E.14), MW• hour/year;

$EC_{Coke\ PJ\ Y}$ – project electricity consumption for coke production within the project boundary (table E.15), MW• hour/year;

$EC_{Oxygen\ PJ\ Y}$ – project electricity consumption for oxygen production within the project boundary (table E.16), MW• hour/year;

$EC_{Water\ PJ\ Y}$ – project electricity consumption within the project boundary for BF supply with recycle water (table E.17), MW• hour/year;

$EC_{TPRT\ PJ\ Y}$ – project TPRT electricity generation within the project boundary (table E.14), MW• hour/year.

Calculation results of electricity consumption within the project boundary, inclusive of the TPRT electricity generation, are presented in table E.18.

Table E.18

Project electricity consumption

Parameter	Unit	2008	2009	2010	2011	2012
BF electricity consumption	MW*hr/year	78 779	76 546	76 546	76 546	76 546
Electricity consumption for coke production	MW*hr/year	117 852	80 073	80 073	80 073	80 073
Electricity consumption for oxygen generation at the air separation plant	MW*hr/year	186 461	141 612	141 612	141 612	141 612
Electricity consumption for BF supply with recycle water	MW*hr/year	18 873	12 130	12 130	12 130	12 130
Electricity generation at the TPRT	MW*hr/year	**-32 539**	**-36 648**	**-36 648**	**-36 648**	**-36 648**
Total electricity consumption within the project boundaries minus the electricity generated at the TPRT	MW*hr/year	369 427	273 712	273 712	273 712	273 712

Annual project CO_2 emissions during electricity generation at the RF power grids, consumed for molten iron production within the project boundary ($PE_{Indirect\ Y}$) is calculated as follows:

(E.17) $PE_{Indirect\ Y} = EC_{PJ\ Y} \bullet EF_{CO2\ grid}$,

where $EC_{PJ\ Y}$ – total electricity consumption within the project boundary, MW•hour/year.

$EF_{CO2\ grid}$ – CO_2 emission factors in the RF energy system, recommended by the Operational Guidelines for Project Design Documents of Joint Implementation Projects, which were calculated by the Ministry of Economic Affairs of the Netherlands in 2004[1], tons of CO_2/MW•hour.

Calculation results of CO_2 emissions during generation of electricity, consumed within the project boundary, are presented in table E. 19.

[1] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Volume 1: General guidelines. Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004. p.43, Table B2

Table E.19

Project indirect CO_2 emissions

Parameter	Unit	2008	2009	2010	2011	2012
Electricity consumption within the project boundaries	MW*hr/year	369 427	273 712	273 712	273 712	273 712
Power grids' emission factor	tons of CO_2/MW*hr	0.565	0.557	0.550	0.542	0.534
Indirect emissions within the project boundaries	**tons of CO_2/year**	**208 726**	**152 458**	**150 542**	**148 352**	**146 162**

Total project CO_2 emissions (PE_Y) are calculated by way of summing up of project emissions direct and indirect emissions.

(E.18) $PE_Y = PE_{Direct\ Y} + PE_{Indirect\ Y}$,

where $PE_{Direct\ Y}$ – project direct CO_2 emissions, t/year;

$PE_{Indirect\ Y}$ – project indirect CO_2 emissions, t/year.

Table E.20

Total project CO_2 emissions

Parameter	Unit	2008	2009	2010	2011	2012	Total
Direct emissions	tons of CO_2/year	7 074 794	4 962 479	4 962 479	4 962 479	4 962 479	26 924 709
Indirect emissions	tons of CO_2/year	208 726	152 458	150 542	148 352	146 162	806 240
Total	**tons of CO_2/year**	**7 283 521**	**5 114 936**	**5 113 020**	**5 110 831**	**5 108 641**	**27 730 949**

E.2. Estimated leakage:

No leakages as per the project

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

Table E.21

Total project CO_2 emissions

Parameter	Unit	2008	2009	2010	2011	2012	Total for 2008-2012
Total project CO2 emissions	tons of CO_2/year	7 283 521	5 114 936	5 113 020	5 110 831	5 108 641	**27 730 949**

E.4. Estimated baseline emissions:

In order to calculate the "NTMK" both baseline and project CO_2 emissions, the carbon balance method is applied, which is reviewed in section B.1 of this document.

During calculations of baseline CO_2 emissions the same flows of materials and energy carriers as in project scenario are considered:

- Flows coming into the project boundary:
  - Coking coal;
  - Natural gas;
  - Electricity (considered during indirect emissions' calculation);
  - Limestone;
- Flows leaving the project boundary:
  - Molten iron;
  - By-products of coal coking.

As is demonstrated in section B.1 of this document, the production of molten iron, consumption of materials, fuel and energy carriers for BF ##1-5 are taken from the average data of BF operations in 2001-2003.

The aggregate value of BF ##1, 4 and 5 project production is used as the ex-ante baseline production value for the calculation of CO_2 emissions. Baseline distribution of the molten iron production volume among the furnaces is made proportionally to the share of each furnace in the total production volume according to the average data for 2001-2003.

Baseline production at each of the BF (BF ##1-5) - ($P_{BF\ X\ BL\ Y}$) – is calculated by the formula:

(E.19) $P_{BF\ X\ BL\ Y} = (P_{BF\ 1PJ\ Y} + P_{BF\ 4\ PJ\ Y} + P_{BF\ 5PJ\ Y} + P_{BF\ 6\ PJ\ Y}) \bullet P_{BF\ X} / (\sum P_{BF\ 1\text{-}5})$,

where $P_{BF\ 1\ PJ\ Y}$ - BF #1 project molten iron production (table E.1), t/year;

$P_{BF\ 4\ PJ\ Y}$ - BF #4 project molten iron production (table E.1), t/year;

$P_{BF\ 5\ PJ\ Y}$ - BF #5 project molten iron production (table E.1), t/year;

$P_{BF\ 6\ PJ\ Y}$ - BF #6 project molten iron production (table E.1), t/year;

$\sum P_{BF\ 1\text{-}5}$ – total molten iron production by BF ##1-5 according to the average data for 2001-2003 – 4.711 thou.t/year;

$P_{BF\ X}$ – production at on of the furnaces (BF ##1-5) according to the average data for 2001-2003 (table E.7), t/year.

Calculation results of baseline molten iron production at BF ##1-5 in 2008-1012 are presented in table E.22.

Table E.22

"NTMK" BF ##1-5 baseline molten iron production

Parameter	2008	2009	2010	2011	2012
Blast furnace #1	871 434	624 988	624 988	624 988	624 988
Blast furnace #2	903 448	647 948	647 948	647 948	647 948
Blast furnace #3	916 846	657 557	657 557	657 557	657 557
Blast furnace #4	1 074 693	770 765	770 765	770 765	770 765
Blast furnace #5	1 040 661	746 357	746 357	746 357	746 357
Total within the project boundaries	**4 807 081**	**3 447 615**	**3 447 615**	**3 447 615**	**3 447 615**

Data on the molten iron composition and specific consumption of materials, fuel and energy carriers at BF ##1-5, established in section B.1 of this document, are presented in table E.23.

Table E.23

"NTMK" BF ##1-5 baseline performance figures

Parameter	Unit	Blast furnace #1	Blast furnace #2	Blast furnace #3	Blast furnace #4	Blast furnace #5
Carbon content in molten iron	%, weight	4.66	4.71	4.78	4.66	4.69
Specific consumption per 1 ton of molten iron						
Coke consumption	kg/t	496	510	495	479	496
Natural gas consumption	m^3/t	101	91	107	107	119
Limestone consumption	kg/t	54	58	54	53	49
Steam consumption	Gcal/t	0.065	0.055	0.060	0.054	0.055
Blast air consumption	m^3/t	1 251	1 348	1 267	1 341	1 327

For calculation of baseline annual gross consumption of the materials, fuel and energy carriers, listed in table E.23, the following equation is used:

(E.20) $C_{BL\ Y} = P_{BF\ 1\ BL\ Y} \bullet SC_{BF\ 1\ BL\ Y} + P_{BF\ 2\ BL\ Y} \bullet SC_{BF\ 2\ BL\ Y} + P_{BF\ 3\ BL\ Y} \bullet SC_{BF\ 3\ BL\ Y} + P_{BF\ 4\ BL\ Y} \bullet SC_{BF\ 4\ BL\ Y} + + P_{BF\ 5\ BL\ Y} \bullet SC_{BF\ 5\ BL\ Y}$,

where $P_{BF\ 1\ BL\ Y}$ – BF #1 baseline molten iron production (table E.22), t/year;

$SC_{BF\ 1\ BL\ Y}$ – BF #1 baseline specific consumption of materials ant energy carriers per 1 ton of molten iron (table E.23), kg (m^3, Gcal)/t;

$P_{BF\ 2\ BL\ Y}$ – BF #2 baseline molten iron production (table E.22), t/year;

$SC_{BF\ 2\ BL\ Y}$ – BF #2 baseline specific consumption of fuel, materials and energy carriers (table E.23), kg (m^3, Gcal)/t;

$P_{BF\ 3\ BL\ Y}$ – BF #3 baseline molten iron consumption (table E.22), t/year;

$SC_{BF\ 3\ BL\ Y}$ – BF #3 baseline specific consumption of fuel, materials and energy carriers per 1 ton of molten iron (table E.23), kg (m^3, Gcal)/t;

$P_{BF\ 4\ BL\ Y}$ – BF #4 baseline molten iron production, (tablee E.22), t/year;

$SC_{BF\ 4\ BL\ Y}$ – BF #4 baseline specific consumption of fuel, materials and energy carriers per 1 ton of molten iron (table E.23), kg (m^3, Gcal)/t;

$P_{BF\ 5\ BL\ Y}$ – BF #5 baseline molten iron production, (table E.22), t/year;

$SC_{BF\ 5\ BL\ Y}$ – BF #5 baseline specific consumption of fuel, materials and energy carriers per 1 ton of molten iron (table E.23), kg (m^3, Gcal)/t.

Calculation results of gross annual baseline consumption of materials, fuel and energy carriers are presented in table E.24.

Table E.24

Baseline fuel, materials and energy consumption for molten iron production

Parameter	Unit	2008	2009	2010	2011	2012
Total molten iron production	t/year	4 807 081	3 447 615	3 447 615	3 447 615	3 447 615
Coke consumption	t/year	2 378 739	1 706 020	1 706 020	1 706 020	1 706 020
Natural gas consumption	thou.m^3/year	507 780	364 177	364 177	364 177	364 177
Limestone consumption	t/year	257 857	184 934	184 934	184 934	184 934
Steam consumption	Gcal/year	276 617	198 388	198 388	198 388	198 388
Blast ait consumption	thou.m^3/year	6 291 779	4 512 433	4 512 433	4 512 433	4 512 433

Baseline CO_2 emissions due to coking coal consumption are calculated as follows:

(E.21) $BE_{Coking\ Coal\ Y} = 44/12 \bullet M_{Coke\ BL\ Y} / SO_{Coke\ Coking\ coal} \bullet \%C_{Coking\ Coal,}$
where $M_{Coke\ BL\ Y}$ - baseline coke consumption, (table E.24), t;
$SO_{Coke\ Coking\ coal}$ – specific coke yield from coking coal, calculated in section B.1 of design document (table B.4) – 74.92%;
$\%C_{Coking\ Coal}$ – mass fraction of carbon in coking coal, established in section B.1 of design document (table B.4) – 60.2%.

Table E.25

Baseline CO_2 emissions due to coking coal consumption

Parameter	Unit	2008	2009	2010	2011	2012
Coke consumption	t/year	2 378 739	1 706 020	1 706 020	1 706 020	1 706 020
Coking coal consumption	t/year	3 175 038	2 277 122	2 277 122	2 277 122	2 277 122
CO_2 emissions due to coking coal consumption	**tons of CO_2/year**	**7 008 368**	**5 026 367**	**5 026 367**	**5 026 367**	**5 026 367**

Baseline CO_2 emissions due to limestone consumption are calculated as follows:

(E.22) $BE_{Limestone\ Y} = 44/12 \bullet M_{Limestone\ BL\ Y} \bullet \%C_{Limestone,}$
where $M_{Limestone\ BL\ Y}$ - baseline annual limestone consumption (table E.24), t/year;
$\%C_{Limestone}$ – mass fraction of carbon in coking coal acepted at the level of 12% according to the data from the IPCC Guidelines for National Greenhouse Gases Inventories 2006 [1].

Table E.26

CO_2 emissions due to limestone consumption

Parameter	Unit	2008	2009	2010	2011	2012
Limestone consumption	t/year	257 857	184 934	184 934	184 934	184 934
CO_2 emissions due to limestone consumption	**tons of CO_2/year**	**113 457**	**81 371**	**81 371**	**81 371**	**81 371**

For calculation of CO_2 emissions due to natural gas consumption we shall establish the baseline consumption of steam ($C_{Steam\ BL\ Y}$) and natural gas ($FR_{NG\ BL\ Y}$) within the project boundary.

(E.23) $C_{Steam\ BL\ Y} = C_{Steam\ BF\ BL\ Y} + SC_{Steam\ Coke} \bullet M_{Coke\ BL\ Y} + SC_{Steam\ Blast} \bullet C_{Blast\ BL\ Y},$
where $C_{Steam\ BF\ BL\ Y}$ – BFS baseline steam consumption (table E.24), Gcal/year;
$SC_{Steam\ Coke}$ – specific steam consumption for coke production amounting to 367 Kcal/ton of coke, according to the CCO specialists' data;
$M_{Coke\ BL\ Y}$ – BFS baseline coke consumption (table E.24), t/year;
$SC_{Steam\ Blast}$ – specific steam consumption for blast air generation, accepted according to "NTMK-Energo" data at 0.149 Gcal/thou.m^3;
$C_{Blast\ BL\ Y}$ – BFS baseline blast air consumption (table E.24), m^3/year.

Calculations of steam consumption in the BF operations, CCO and at TPP-steam blower are presented in table E.27.

[1] 2006 IPCC Guidelines for national greenhouse inventories. Volume 3 Industrial Processes and Product Use. Chapter 4 Metal Industry Emissions. p.4.27 table 4.3

Table E.27

Baseline steam consumption

Parameter	Unit	2008	2009	2010	2011	2012
Steam consumption in the BFS	Gcal/year	276 617	198 388	198 388	198 388	198 388
Coke consumprion	t/year	2 378 739	1 706 020	1 706 020	1 706 020	1 706 020
Steam consumption in the CCO operations	Gcal/year	847 624	607 912	607 912	607 912	607 912
Blast air consumption	thou.m^3/year	6 291 779	4 512 433	4 512 433	4 512 433	4 512 433
Steam consumption at TPP-steam blower for blast air production	Gcal/year	937 475	672 352	672 352	672 352	672 352
Total steam consumption within the project boundaries	Gcal/year	2 061 716	1 478 653	1 478 653	1 478 653	1 478 653

Total natural gas consumption within the project boundary is calculated by the formula:

(E.24) $FR_{NG\ BL\ Y} = FR_{NG\ BF\ BL\ Y} + SC_{NG\ Steam} \bullet C_{Steam\ BL\ Y}$,

where $FR_{NG\ BF\ BL\ Y}$ – BFS baseline natural gas consumption (table E.24), m^3/year;

$C_{Steam\ BL\ Y}$ - baseline steam consumption within the project boundary (table E.24), Gcal/year;

$SC_{NG\ Steam}$ – specific natural gas consumption for steam generation at TPP-steam blower, accepted according to “NTMK-Energo” data at 74 m^3/Gcal.

Calculation results of BFS and TPP-steam blower natural gas consumption for steam generation are presented in table E.28.

Table E.28

Baseline natural gas consumption

Parameter	Unit	2008	2009	2010	2011	2012
BFS natural gas consumption	thou.m^3/year	507 780	364 177	364 177	364 177	364 177
TPP-steam blower natural gas consumption for steam generation	thou.m^3/year	152 567	109 420	109 420	109 420	109 420
Total natural gas consumption within the project boundaries	thou.m^3/year	660 347	473 598	473 598	473 598	473 598

Baseline CO_2 emissions due to natural gas consumption are calculated by the formula:

(E.25) $BE_{NG\ Y} = FR_{NG\ BL\ Y} \bullet EF_{NG}$,

where $FR_{NG\ BL\ Y}$ – annual baseline natural gas consumption within the project boundary, thou.m^3/year;

EF_{NG} - natural gas emission factor, established in table E.7 for “NTMK” conditions as 1.86 tons of CO_2/ thou.m^3.

Baseline calculation results of CO_2 emissions due to natural gas consumption within the project boundary are presented in table E.29.

Table E.29

Baseline CO_2 emissions due to natural gas consumption within the project boundary

Parameter	Unit	2008	2009	2010	2011	2012
Natural gas consumption within the project boundaries	thou.m^3/year	660 347	473 598	473 598	473 598	473 598
CO_2 emissions due to natural gas consumption	**tons of CO_2/year**	**1 230 837**	**882 750**	**882 750**	**882 750**	**882 750**

Part of the carbon brought into the project boundary by coking coal, limestone and natural gas, remains in the product – molten iron and by-products of CCO (benzol and naphthalene). Weight of carbon, contained in the end products that leave the project boundary, is calculated by the following formula:

(E.26) $C_{output\ BL\ Y} = C_{output\ Iron\ BL\ Y} + C_{output\ Coking\ product\ BL\ Y}$,

where $C_{output\ Iron\ BL\ Y}$ - weight of carbon remaining in the molten iron in tons, t/year;

$C_{output\ Coking\ product\ BL\ Y}$ – weight of carbon remaining in the CCO by-products, t/year.

The components of formula E.27 are calculated as follows:

(E.27) $C_{output\ Iron\ BL\ Y} = P_{BF\ 1\ BL\ Y} \bullet \%C_{Iron\ BF\ 1\ BL\ Y} + P_{BF\ 2\ BL\ Y} \bullet \%C_{Iron\ BF\ 2\ BL\ Y} + P_{BF\ 3\ BL\ Y} \bullet \%C_{Iron\ BF\ 3\ BL\ Y} + P_{BF\ 4\ BL\ Y} \bullet \%C_{Iron\ BF\ 4\ BL\ Y} + P_{BF\ 5BL\ Y} \bullet \%C_{Iron\ BF\ 5\ BL\ Y}$,

where $P_{BF\ 1\ BL\ Y}$ – BF #1 baseline molten iron production (table E.22), t/year;

$\%C_{Iron\ BF\ 1\ BL\ Y}$ – baseline mass fraction of carbon in the BF #1 molten iron (table E.23), %;

$P_{BF\ 2\ BL\ Y}$ – BF #2 baseline molten iron production (table E.22), t/year;

$\%C_{Iron\ BF\ 2\ BL\ Y}$ – baseline mass fraction of carbon in the BF #2 molten iron (table E.23), %;

$P_{BF\ 3\ BL\ Y}$ – BF #3 baseline molten iron production (table E.22), t/year;

$\%C_{Iron\ BF\ 3\ BL\ Y}$ – baseline mass fraction of carbon in the BF #3 molten iron (table E.23), %;

$P_{BF\ 4\ BL\ Y}$ – BF #4 baseline molten iron production (table E.22), t/year;

$\%C_{Iron\ BF\ 4\ BL\ Y}$ – baseline mass fraction of carbon in the BF #4 molten iron (table E.23), %;

$P_{BF\ 5\ BL\ Y}$ – BF #5 baseline molten iron production (table E.221), t/year;

$\%C_{Iron\ BF\ 5\ BL\ Y}$ – baseline mass fraction of carbon in the BF #5 molten iron (table E.23), %.

(E.28) $C_{output\ Coking\ product\ BL\ Y} = M_{Coke\ BL\ Y} / SO_{Coke\ Coking\ coal} \bullet (SO_{Naph} \bullet \%C_{Naph} + SO_{Benz} \bullet \%C_{Benz})$,

where $M_{Coke\ BL\ Y}$ - baseline coke consumption (table E.23), t/year;

$SO_{Coke\ Coking\ coal}$ – “NTMK” coke yield from coking coal established in section B.2 – 74,92%;

SO_{Naph} – specific naphthalene yield per 1 ton of coking coal, according to table B.4 data, t/t;

$\%C_{Naph}$ – carbon content in naphthalene, established according to table B.4 data, %;

SO_{Benz} – specific benzol yield per 1 ton of coking coal established according to table B.4 data, t/t;

$\%C_{Benz}$ – carbon content in benzol, established according to table B.4 data %.

Calculation results of CO_2 emission reductions by the formulae (E.26-28) are presented in tables E.30-32

Table E.30

Weight of carbon remaining in the BF molten iron

Parameter	Unit	2008	2009	2010	2011	2012
Blast furnace #1	t/year	40 638	29 145	29 145	29 145	29 145
Blast furnace #2	t/year	42 583	30 540	30 540	30 540	30 540
Blast furnace #3	t/year	43 795	31 409	31 409	31 409	31 409
Blast furnace #4	t/year	50 117	35 943	35 943	35 943	35 943
Blast furnace #5	t/year	48 807	35 004	35 004	35 004	35 004
Total weight of carbon remaining in molten iron	t/year	225 939	162 042	162 042	162 042	162 042

Table E.31

Baseline weight of carbon remaining in the coking by-products

Parameter	Unit	2008	2009	2010	2011	2012
Coking coal consumption	t/year	3 175 038	2 277 122	2 277 122	2 277 122	2 277 122
Coking products yield						
Benzol	t/year	27 835	19 963	19 963	19 963	19 963
Naphthalene	t/year	6 033	4 327	4 327	4 327	4 327
Weight of carbon remaining in benzol	t/year	24 930	17 880	17 880	17 880	17 880
Weight of carbon remaining in naphthalene	t/year	5 395	3 869	3 869	3 869	3 869
Total weight of carbon remaining in the CCO by-products	t/year	30 326	21 749	21 749	21 749	21 749

Table E.32

Baseline weight of carbon remaining in the products

Parameter	Unit	2008	2009	2010	2011	2012
Weight of carbon remaining in molten iron	t/year	225 939	162 042	162 042	162 042	162 042
Weight of carbon remaining in coking products	t/year	30 326	21 749	21 749	21 749	21 749
Total weight of carbon remaining in coking products	**t/year**	**256 264**	**183 791**	**183 791**	**183 791**	**183 791**

Baseline CO_2 emissions are calculated as follows:

(E.29) $BE_Y = BE_{Coking\ Coal\ Y} + BE_{Limestone\ Y} + BE_{NG\ Y} - 44/12 \bullet C_{output\ BL\ Y}$,

where $BE_{Coking\ Coal\ Y}$ – baseline CO_2 emissions due to coking coal consumption within the project boundary, t/year;

$BE_{Limestone\ Y}$ - baseline CO_2 emissions due to limestone consumption within the project boundary, t/year;

$BE_{NG\ Y}$ - baseline CO_2 emissions due to natural gas consumption within the project boundary, t/year;

$C_{output\ BL\ Y}$ - weight of carbon in the molten iron produced within the project boundary and by-products of the coke-chemical operations, released during the production of coke needed for molten iron production, t/year .

Calculation results of baseline direct CO_2 emissions within the project boundary are presented in table E.33.

Table E.33

Baseline direct CO_2 emissions

Parameter	Unit	2008	2009	2010	2011	2012
CO_2 emissions due to coking coal consumption	tons of CO_2/year	7 008 368	5 026 367	5 026 367	5 026 367	5 026 367
CO_2 emissions due to limestone consumption	tons of CO_2/year	113 457	81 371	81 371	81 371	81 371
CO_2 emissions due to natural gas consumption	tons of CO_2/year	1 230 837	882 750	882 750	882 750	882 750
Weight of carbon remaining in the project products in tons of CO_2 equivalent	tons of CO_2/year	-939 635	-673 902	-673 902	-673 902	-673 902
Total direct emissions within the project boundaries	**tons of CO_2/year**	**7 413 027**	**5 316 586**	**5 316 586**	**5 316 586**	**5 316 586**

Baseline indirect emissions' calculations

The baseline indirect emissions are the CO_2 emissions at the RF UES power grids during generation of electricity, consumed for molten iron production within the project boundary.

Within the project boundary the electricity is consumed for:

- BF electrical equipment operation;
- Coke-chemical operations;
- Air separation plant for oxygen generation;
- Water supply shop for BF supply with recycle water;
- At TTP-steam blower for blast air generation.

Baseline specific consumption of electricity, oxygen and recycle water at BF ##1-5 in 2008-2012 are presented in table E.34.

Table E.34

BF #1-5 baseline performance figures

Parameter	Unit	Blast furnace #1	Blast furnace #2	Blast furnace #3	Blast furnace #4	Blast furnace #5
Electricity consumption	kW*hr/t	5.0	5.3	5.7	5.0	5.0
Oxygen consumption	m^3/t	69	63	65	56	93
Recycle water consumption	m^3/t	14.7	14.7	15.0	14.7	14.3

For the calculation of baseline total consumption of electricity, oxygen and recycle water the following equation is used:

$$(E.30)\ C_{BL\ Y} = P_{BF\ 1\ BL\ Y} \cdot SC_{BF\ 1\ BL\ Y} + P_{BF\ 2\ BL\ Y} \cdot SC_{BF\ 2\ BL\ Y} + P_{BF\ 3\ BL\ Y} \cdot SC_{BF\ 3\ BL\ Y} + P_{BF\ 4\ BL\ Y} \cdot SC_{BF\ 4\ BL\ Y} + P_{BF\ 5\ BL\ Y} \cdot SC_{BF\ 5\ BL\ Y},$$

where $P_{BF\ 1\ BL\ Y}$ – BF #1 baseline molten iron production (table E.22), t/year;

$SC_{BF\ 1\ BL\ Y}$ – BF #1 baseline specific consumption of electricity, oxygen and recycle water per 1 ton of molten iron (table E.34), kW•hour (m^3)/t;

$P_{BF\ 2\ BL\ Y}$ – BF #2 baseline molten iron production (table E.22), t/year;

$SC_{BF\ 2\ BL\ Y}$ – BF #2 baseline specific consumption of electricity, oxygen and recycle water per 1 ton of molten iron (table E.34), kW•hour (m^3)/t;

$P_{BF\ 3\ BL\ Y}$ – BF #3 baseline molten iron production (table E.22), t/year;

$SC_{BF\ 3\ BL\ Y}$ – BF #3 baseline specific consumption of electricity, oxygen and recycle water per 1 ton of molten iron (table E.34), kW•hour (m^3)/t;

$P_{BF\ 4\ BL\ Y}$ – BF #4 baseline molten iron production (table E.22), t/year;

$SC_{BF\ 4\ BL\ Y}$ – BF #4 baseline specific consumption of electricity, oxygen and recycle water per 1 ton of molten iron (table E.34), kW•hour (m^3)/t;
$P_{BF\ 5\ BL\ Y}$ – BF #5 baseline molten iron production (table E.22), t/year;
$SC_{BF\ 5\ BL\ Y}$ – BF #5 baseline specific consumption of electricity, oxygen and recycle water per 1 ton of molten iron (table E.34), kW•hour (m^3)/t.

Calculation results by formula E.30 are presented in table E.35.

Table E.35

Total baseline consumption of electricity, oxygen and recycle water for molten iron production

Parameter	Unit	2008	2009	2010	2011	2012
Electricity consumption	MW*hr/year	24 948	17 892	17 892	17 892	17 892
Oxygen consumption	thou.m^3 /year	333 900	239 471	239 471	239 471	239 471
Recycle water consumption	thou.m^3 /year	70 463	50 535	50 535	50 535	50 535

Baseline electricity consumption for coke production is calculated as follows:

(E.31) $EC_{Coke\ BL\ Y} = M_{Coke\ BL\ Y} \bullet SEC_{Coke}$,
where $M_{Coke\ BL\ Y}$ - BF ##1-5 coke consumption according to table E.24, t/year;
SEC_{Coke} – specific consumption of electricity for coke production, established in table B.4 according to CCO specialists' data at 52.2 kW•hour/ton of coke.

Calculation results of electricity consumption for coke production are presented in table E.36.

Table E.36

Baseline electricity consumption for coke production

Parameter	Unit	2008	2009	2010	2011	2012
Coke consumption during blast furnace operations	t/year	2 378 739	1 706 020	1 706 020	1 706 020	1 706 020
Electricity consumption during CCO	MW*hr/ton	0.0522	0.0522	0.0522	0.0522	0.0522
Electricity consumption for coke production	MW*hr/year	124 249	89 111	89 111	89 111	89 111

Baseline electricity consumption for oxygen generation at the air separation plant is calculated as follows:

(E.32) $EC_{Oxygen\ BL\ Y} = C_{Oxygen\ BL\ Y} \bullet SEC_{Oxygen}$,
where $C_{Oxygen\ BL\ Y}$ – BF ##1-5 oxygen consumption according to table E.35, thou.m^3/year;
SEC_{Oxygen} – specific electricity consumption for oxygen generation established in table B.5 according to the oxygen generation data – 630 kW*hour/ thou.m^3.

Calculation results of electricity consumption for oxygen generation at the air separation plant are presented in table E.37.

Table E.37

Baseline electricity consumption for oxygen generation at the air separation plant

Parameter	Unit	2008	2009	2010	2011	2012
BF oxygen consumption	thou.m^3 /year	333 900	239 471	239 471	239 471	239 471
Specific electricity consumption for oxygen generation at the air separation plant	MW*hr/thou.m^3	0.630	0.630	0.630	0.630	0.630
Electricity consumption for oxygen generation at the air separation plant	MW*hr/year	210 357	150 867	150 867	150 867	150 867

Baseline electricity consumption for BFS recycle water supply is calculated as follows:

(E.33) $EC_{Water\ BL\ Y} = C_{Water\ BL\ Y} \bullet SEC_{Water}$,
where $C_{Water\ BL\ Y}$ – BF ##1-5 water consumption according to table E.35, thou.m^3/year;
SEC_{Water} – specific electricity consumption for BSF recycle water supply established in table B.5 according to “NTMK-Energo” data – 257.4 kW•hour/thou.m^3.

Calculation results of electricity consumption for BFS recycle water supply are presented in table E.38.

Table E.38

Baseline BF #5 and #6 electricity consumption for BFS recycle water supply

Parameter	Unit	2008	2009	2010	2011	2012
BF recycle water consumption	thou.m^3 /year	70 463	50 535	50 535	50 535	50 535
Specific electricity consumption for BF supply with recycle water	MW*hr/thou.m^3	0.257	0.257	0.257	0.257	0.257
Electricity consumption for BF supply with recycle water	MW*hr/year	18 139	13 009	13 009	13 009	13 009

Total baseline electricity consumption ($EC_{BL\ Y}$) is calculated as follows:

(E.34) $EC_{BL\ Y} = EC_{BF\ BL\ Y} + EC_{Water\ BL\ Y} + EC_{Oxygen\ BL\ Y} + EC_{Coke\ BL\ Y}$,
where $EC_{BF\ BL\ Y}$ – baseline BF electricity consumption within the project boundary (table E. 35), MW• hour/year;
$EC_{Coke\ BL\ Y}$ – baseline BF electricity consumption for coke production within the project boundary (table E.36), MW• hour/year;
$EC_{Oxygen\ BL\ Y}$ – baseline electricity consumption for oxygen generation within the project boundary (table E.37), MW• hour/year;
$EC_{Water\ BL\ Y}$ – baseline electricity consumption for the BFS recycle water supply within the project boundary (table E.38), MW• hour/year.

Calculation results of baseline electricity consumption within the project boundary are presented in table E.39.

Table E.39

Baseline electricity consumption

Parameter	Unit	2008	2009	2010	2011	2012
BF electricity consumption	MW*hr/year	24 948	17 892	17 892	17 892	17 892
Electricity consumption for coke production	MW*hr/year	124 249	89 111	89 111	89 111	89 111
Electricity consumption for oxygen generation at the air separation plant	MW*hr/year	210 357	150 867	150 867	150 867	150 867
Electricity consumption for BF supply with recycle water	MW*hr/year	18 139	13 009	13 009	13 009	13 009
Total electricity consumption within the project boundaries minus the electricity generated at the TPRT	MW*hr/year	377 693	270 880	270 880	270 880	270 880

Indirect project CO_2 emissions during electricity generation at the RF UES power grids, which is consumed for the molten iron production within the project boundary ($BE_{Indirect\ Y}$), are calculated as follows:

(E.35) $BE_{Indirect\ Y} = EC_{BL\ Y} \bullet EF_{CO2\ grid}$,

where $EC_{BL\ Y}$ - total electricity consumption within the project boundary, MW• hour/year.

$EF_{CO2\ grid}$ – CO_2 emission factors in the RF energy system, recommended by the Operational Guidelines for Project Design Documents of Joint Implementation Projects, which were calculated by the Ministry of Economic Affairs of the Netherlands in 2004[1], tons of CO_2/MW•hour.

Calculation results of baseline indirect CO_2 emissions are presented in table E.40.

Table E.40

CO_2 emissions during generation of electricity consumed within the project boundary

Parameter	Unit	2008	2009	2010	2011	2012
Electricity consumption within the project boundaries	MW*hr/year	377 693	270 880	270 880	270 880	270 880
Power grids' emission factor	tons of CO_2/MW*hr	0.565	0.557	0.550	0.542	0.534
Indirect emissions within the project boundaries	**tons of CO_2/year**	**213 397**	**150 880**	**148 984**	**146 817**	**144 650**

Total baseline CO_2 emissions

Total emissions of CO_2 (BE_Y) are calculated by way of summing up the baseline direct and indirect emissions.

(E.36) $BE_Y = BE_{Direct\ Y} + BE_{Indirect\ Y}$,

where BE_Y – total baseline CO_2 emissions, t/year;

$BE_{Direct\ Y}$ - baseline direct CO_2 emissions, t/year;

$BE_{Indirect\ Y}$ - baseline indirect CO_2 emissions, t/year.

[1] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Volume 1: General guidelines. Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004. p.43, Table B2

Table E.41

Total baseline CO_2 emissions

Parameter	Unit	2008	2009	2010	2011	2012	Total
Direct emissions	tons of CO_2/year	7 413 027	5 316 586	5 316 586	5 316 586	5 316 586	28 679 373
Indirect emissions	tons of CO_2/year	213 397	150 880	148 984	146 817	144 650	804 727
Total	**tons of CO_2/year**	**7 626 424**	**5 467 466**	**5 465 570**	**5 463 403**	**5 461 236**	**29 484 100**

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

(E.37) $ER_Y = BE_Y - PE_Y$,

where ER_Y – project reduction of CO_2 emissions, t/year;

BE_Y – total baseline CO_2 emissions, t/year;

PE_Y – total project CO_2 emissions, t/year.

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

Table E.42

Calculation results of CO_2 emission reductions

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	7 283 521	0	7 626 424	342 904
2009	5 114 936	0	5 467 466	352 530
2010	5 113 020	0	5 465 570	352 550
2011	5 110 831	0	5 463 403	352 573
2012	5 108 641	0	5 461 236	352 595
Total (tones of CO2 equivalent)	27 730 949	0	29 484 100	1 753 151

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:

Emissions of contaminants into the atmosphere by the blast furnaces, according to the data of the "NTMK" Environmental Protection Department as of prior to the project realization in 2002, are presented in table F.1.

Table F.1

BF emissions of contaminants into the atmosphere for 2002, t/year

#	Contaminant	BF #2	BF #3	BF #4	BF #5
1	Nitrogen dioxide	17.2293	24.7858	22.5977	26.6285
2	Nitrogen oxide	4.7754	8.2526	6.379	11.0338
3	Hydrogen cyanide	1.4001	1.2961	1.4687	1.6159
4	Sulphurous anhydride	138.5387	143.5282	154.1034	145.1373
5	Carbon oxide	571.8639	1360.0200	998.8597	6131.4401
6	Solid substances	655.3637	721.6591	732.6749	729.3356
	TOTAL:	**1389.1711**	**2259.5418**	**1916.0834**	**7045.1912**
	Molten iron production, thou.t/year	864	912	1030	1038

BF reconstruction includes the realization of the following actions focused on the reduction of negative environmental impact:

- dust and gas mixture from the bins of the Central Bell Less Top with rotary hopper, after the pressure is balanced, is discharged not into the atmosphere, but into the special drip catcher of gas cleaning unit, where the mixture is cleaned from dust;
- BF cast house chutes are made of highly resistant molded concrete, which allows for significant increase of the chutes' service life period and the arrangement of the chutes' covers. The aspiration system with air cleaning in the electric filter is designed in the chutes' covers;
- installation of the modern shaftless Kalugin stoves ensures the complete avoidance of gas under-combustion and thus the sharp reduction of the CO_2 emissions in the gas ducts and excludes the unorganized emissions into the atmosphere;
- implementation of the up-to-date conveyor belt feeding, inclined chutes, telescopic devices for loading and unloading of materials and industrial vacuum cleaners significantly reduces the forming of dust in the BF charging material feeding circuits;
-dust emissions from the charging material feeding system are fed to the aspiration system with air cleaning in the electric filters.

According to the design documents, after the BF reconstruction the ground level concentrations of gaseous matters and the sprays of solids and their constituents will be significantly lower than the accepted sanitary standards.

Reduction of specific contaminants' emissions into the atmosphere after BF #5 and #6 reconstruction project realization is presented in table F.2.

Table F.2

Reduction of BF #5 and #6 specific contaminants' emissions into the atmosphere in 2007 – 2008

#	Contaminant	BFS, 2002	BF #5 and #6 after reconstruction		Emission reduction against 2002, %
			2007	2008	
1	Nitrogen dioxide	0.024	0.010	0.012	-49%
2	Nitrogen oxide	0.008	0.005	0.006	-29%
3	Hydrogen cyanide	0.002	-	-	-100%
4	Sulphurous anhydride	0.151	0.029	0.031	-80%
5	Carbon oxide	2.358	0.408	0.478	-80%
6	Solid substances	0.739	0.365	0.326	-56%
	Total	**3.281**	**0.816**	**0.852**	**-74%**

The existing recycle water systems allow for accepting the reconstructed BF #5 and #6 water consumption without additional construction of water treatment facilities.

The existing system of wastes collection and disposal ensures the complete disposal of wastes as the secondary iron ore raw material at the regional sinter plants.

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:

In compliance with the Russian legislation, the working design of BF #5 and #6 reconstruction includes the section titled "Environmental protection" with the realized project environmental impact assessment. This section was prepared by the "Nikomproekt" design institute (T-69735-П32) for BF #6 reconstruction, and by the LLC 'Metpromproekt" (MPP-01-RP-P3.3) for BF #5 reconstruction project.

SECTION G. Stakeholders' comments

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

The established procedures for the JI projects do not require comments from stakeholders. This notwithstanding, the project was presented to local authorities and public community.

In compliance with the Federal Laws of the Russian Federation dd. 10.01.2002, #7-FL "On Environmental Protection" and dd. 23.11.1995, #174-FL "On Ecological Expertise", by the resolution of Mayor of Nizhniy Tagil dd. 11.08.2003 #567 "On the public opinion study regarding the construction of objects by "NTMK" the public hearings were held on the project of BF #6 reconstruction.

The hearings were participated by senior specialists of "NTMK", representatives of the City of Nizhniy Tagil administration, design and city public organizations and the city residents (in total over 100 people).

During the hearings the information was presented on the environmental and social aspects of the BF #6 reconstruction realization project and the answers to the questions were given. The minutes were drafted following the results of the hearings where it was registered that the project was feasible both for "NTMK" and the city.

The public opinion research was done on the BF #5 reconstruction project in compliance with the requirements of the above mentioned federal laws and the resolution of the mayor of Nizhniy Tagil №520 dd. 10.07.2006 "On the research of the public opinion on the "NTMK" capital construction objects".

The public opinion study was carried out by way of publishing the materials on the project in the newspapers "Tagilskiy metallurg" dd. August 9th of 2006 (# 93) and "Tagilskiy rabochiy" dd. August 11th of 2006 (# 146). In addition to the project information, the publications also specified that in the department of ecology and natural resources' use the phone calls reception was arranged with questions regarding the BF #5 reconstruction project realization.

Following the results of the public opinion study there were no objections to the realization of the project, which is registered in the minutes.

Annex 1

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Annex 2

BASELINE INFORMATION

Baseline molten iron production

Parameter	2008	2009	2010	2011	2012
Blast furnace #1	871 434	624 988	624 988	624 988	624 988
Blast furnace #2	903 448	647 948	647 948	647 948	647 948
Blast furnace #3	916 846	657 557	657 557	657 557	657 557
Blast furnace #4	1 074 693	770 765	770 765	770 765	770 765
Blast furnace #5	1 040 661	746 357	746 357	746 357	746 357
Total within the project boundaries	**4 807 081**	**3 447 615**	**3 447 615**	**3 447 615**	**3 447 615**

Baseline "NTMK" OHFS performance figures

Parameter	Unit	Blast furnace #1	Blast furnace #2	Blast furnace #3	Blast furnace #4	Blast furnace #5
Carbon content in molten iron	%, weight	4.66	4.71	4.78	4.66	4.69
Specific consumption per 1 ton of molten iron						
Coke consumption	kg/t	496	510	495	479	496
Natural gas consumption	m^3/t	101	91	107	107	119
Limestone consumption	kg/t	54	58	54	53	49
Steam consumption	Gcal/t	0.065	0.055	0.060	0.054	0.055
Blast air consumption	m^3/t	1 251	1 348	1 267	1 341	1 327

KEY FACTORS INFLUENCING THE EMISSION REDUCTION UNITS' CALCULATION

Data/Parameter	$P_{BF\ 1\ PJ\ Y}$ $P_{BF\ 4\ PJ\ Y}$ $P_{BF\ 5\ PJ\ Y}$ $P_{BF\ 6\ PJ\ Y}$
Data unit	t
Description	Molten iron production at blast furnaces #1,4,5 and 6
Time of determination/monitoring	Monthly
Source of data (to be) used	Blast furnace shop operations technical report
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured on the weighbridge VESTO-SD20, AVP-VP-SD
QA/QC procedures (to be) applied	Weighbridge will be calibrated by the specialists of "NTMK" Process Automation Shop. Calibration frequency – once a year
Any comment	

Data/Parameter	$M_{Coke\ BF\ 5\ PJ\ Y}$ $M_{Limestone\ BF\ 5\ PJ\ Y}$ $M_{Coke\ BF\ 6\ PJ\ Y}$ $M_{Limestone\ BF\ 6\ PJ\ Y}$
Data unit	t
Description	BF #5 and #6 coke and dolomite consumption
Time of determination/monitoring	Monthly
Source of data (to be) used	Blast furnace shop operations technical report
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by the weightfeeder DV-10
QA/QC procedures (to be) applied	Weightfeeder will be calibrated by the specialists of "NTMK" Process Automation Shop. Calibration frequency – once a year
Any comment	

Data/Parameter	$FR_{NG\ BF\ 5\ PJ\ Y}$ $FR_{NG\ BF\ 6\ PJ\ Y}$

Data unit	m^3
Description	BF #5 and #6 natural gas consumption
Time of determination/monitoring	Monthly
Source of data (to be) used	Blast furnace shop operations technical report
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by SITRANS and ABB transformers
QA/QC procedures (to be) applied	Transformers will be calibrated by the specialists of “NTMK” Process Automation Shop. Calibration frequency – once in 36 months
Any comment	

Data/Parameter	$C_{Steam\ BF\ 5\ PJ\ Y}$ $C_{Steam\ BF\ 6\ PJ\ Y}$
Data unit	Gkal
Description	BF #5 and #6 steam consumption
Time of determination/monitoring	Monthly
Source of data (to be) used	Blast furnace shop operations technical report
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by SITRANS and ABB transformers
QA/QC procedures (to be) applied	Transformers will be calibrated by the specialists of “NTMK” Process Automation Shop. Calibration frequency – once in 36 months
Any comment	

Data/Parameter	$C_{Blast\ BF\ 5\ PJ\ Y}$ $C_{Blast\ BF\ 6\ PJ\ Y}$
Data unit	m^3
Description	BF #5 and #6 blast air consumption
Time of determination/monitoring	Monthly
Source of data (to be) used	Blast furnace shop operations technical

	report
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by SITRANS and ABB transformers
QA/QC procedures (to be) applied	Transformers will be calibrated by the specialists of "NTMK" Process Automation Shop. Calibration frequency – once in 36 months
Any comment	

Data/Parameter	$SO_{Coke\ Coking\ coal}$
Data unit	%
Description	Coke yield from coking coal
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	74.92
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values according to 2001-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$\%C_{Coking\ coal}$
Data unit	%
Description	Carbon content in coking coal
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	60.2
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	SO_{Naph}
Data unit	kg/t
Description	Naphthalene yield from coking coal
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	1.9
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	SO_{Benz}
Data unit	kg/t
Description	Benzol yield from coking coal
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	8.8
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$\%C_{Naph}$
Data unit	%
Description	Carbon content in naphthalene
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	89.4
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data

QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$\%C_{Benz}$
Data unit	%
Description	Carbon content in benzol
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	89.6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Steam\ Coke}$
Data unit	kcal/t
Description	Steam consumption per 1 ton of coke
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	356.3
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$\%C_{limestone}$
Data unit	%
Description	Carbon content in limestone
Time of determination/monitoring	
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 3. Chapter 4: Metal Industry Emissions. p. 4.27

Value of data applied (for ex ante calculations/determinations)	12.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	IPCC recommended parameter value
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{NG\ Steam}$
Data unit	Thou.m^3/Gcal
Description	Specific natural gas consumption for steam generation at TPP-steam blower
Time of determination/monitoring	
Source of data (to be) used	LLC "NTMK-Energo"
Value of data applied (for ex ante calculations/determinations)	0.074
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Steam\ Blast}$
Data unit	Gcal/m^3
Description	Specific steam consumption for blast air generation at TPP-steam blower
Time of determination/monitoring	
Source of data (to be) used	LCC "NTMK-Energo"
Value of data applied (for ex ante calculations/determinations)	0.149
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	EF_{NG}
Data unit	tons of CO_2/GJ

Description	Natural gas emission factor
Time of determination/monitoring	
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Energy. p 2.16.
Value of data applied (for ex ante calculations/determinations)	0.0561
Justification of the choice of data or description of measurement methods and procedures (to be) applied	IPCC recommended parameter value
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$EC_{BF\ 5\ PJ\ Y}$ $EC_{BF\ 6\ PJ\ Y}$
Data unit	MW•hour
Description	BF #5 and #6 electricity consumption
Time of determination/monitoring	Monthly
Source of data (to be) used	BFS operations technical report
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by the electricity meters SAZU-I670M, SR4U-I673MB, SET-4TMO2.2
QA/QC procedures (to be) applied	Meters will be calibrated by the specialists of "NTMK" Process Automation Shop. Calibration frequency of SAZU-I670M and SR4U-I673MB meters – once in 48 months. Calibration frequency of SET-4TMO2.2 – once in 120 months
Any comment	

Data/Parameter	$C_{Oxygen\ BF\ 5\ PJ\ Y}$ $C_{Oxygen\ BF\ 6\ PJ\ Y}$
Data unit	m^3
Description	BF #5 and #6 oxygen consumption
Time of determination/monitoring	Monthly
Source of data (to be) used	BFS operations technical report

Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by the heat and energy controller IM-2300
QA/QC procedures (to be) applied	Meter will be calibrated by the specialists of “NTMK” Process Automation Shop. Calibration frequency – once in 36 months
Any comment	

Data/Parameter	$C_{Water\ BF\ 5\ \ PJ\ Y}$ $C_{Water\ BF\ 6\ PJ\ Y}$
Data unit	m^3
Description	BF #5 and #6 recycle water consumption
Time of determination/monitoring	Monthly
Source of data (to be) used	BFS operations technical report
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by OPTIFLUKS flowmeter and AVV transformer
QA/QC procedures (to be) applied	Meters will be calibrated by the specialists of “NTMK” Process Automation Shop. Calibration frequency of OPTIFLUKS electro-magnetic flowmeter is once in 48 months and calibration frequency of AVV transformer is once in 36 months
Any comment	

Data/Parameter	$EO_{\ TPRT\ PJ\ Y}$
Data unit	MW•hour
Description	BF #6 TPRT electricity generation
Time of determination/monitoring	Monthly
Source of data (to be) used	Technical report on the grids and substations shop operations
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measured by the electricity meter SET-4TM #08051487
QA/QC procedures (to be) applied	Meter will be calibrated by the specialists of “NTMK” Process Automation Shop. Calibration frequency – once in 60 months

Any comment	

Data/Parameter	SEC_{Coke}
Data unit	kW•hour/t
Description	Electricity consumption per 1 ton of coke
Time of determination/monitoring	
Source of data (to be) used	CCO Chief Engineer data
Value of data applied (for ex ante calculations/determinations)	52.2
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	SEC_{Oxygen}
Data unit	kW•hour/thou.m^3
Description	Electricity consumption for oxygen generation
Time of determination/monitoring	
Source of data (to be) used	"NTMK" oxygen production operations data
Value of data applied (for ex ante calculations/determinations)	630.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	SEC_{Water}
Data unit	kW•hour/thou.m^3
Description	Electricity consumption for recycle water production
Time of determination/monitoring	
Source of data (to be) used	LCC "NTMK-Energo" data
Value of data applied (for ex ante calculations/determinations)	257.4

Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	SEC_{Blast}
Data unit	kW•hour/thou.m^3
Description	Electricity consumption for blast air generation
Time of determination/monitoring	
Source of data (to be) used	LCC “NTMK-Energo” data
Value of data applied (for ex ante calculations/determinations)	4.59
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average value based on 2006-2008 data
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Coke\ BF\ 1\ BL\ Y}$ $SC_{Coke\ BF\ 2\ BL\ Y}$ $SC_{Coke\ BF\ 3\ BL\ Y}$ $SC_{Coke\ BF\ 4\ BL\ Y}$ $SC_{Coke\ BF\ 5\ BL\ Y}$
Data unit	kg/t
Description	BF ##1-5 baseline coke consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SC_{Coke\ BF\ 1\ BL\ Y}$ - 496 $SC_{Coke\ BF\ 2\ BL\ Y}$ - 510 $SC_{Coke\ BF\ 3\ BL\ Y}$ - 495 $SC_{Coke\ BF\ 4\ BL\ Y}$ - 479 $SC_{Coke\ BF\ 5\ BL\ Y}$ - 496
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Limestone\ BF\ 1\ BL\ Y}$ $SC_{Limestone\ BF\ 2\ BL\ Y}$ $SC_{Limestone\ BF\ 3\ BL\ Y}$ $SC_{Limestone\ BF\ 4\ BL\ Y}$ $SC_{Limestone\ BF\ 5\ BL\ Y}$
Data unit	kg/t
Description	BF ##1-5 baseline dolomite consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SC_{Limestone\ BF\ 1\ BL\ Y}$ - 54 $SC_{Limestone\ BF\ 2\ BL\ Y}$ - 58 $SC_{Limestone\ BF\ 3\ BL\ Y}$ - 54 $SC_{Limestone\ BF\ 4\ BL\ Y}$ - 53 $SC_{Limestone\ BF\ 5\ BL\ Y}$ - 49
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SFR_{NG\ BF\ 1\ BL\ Y}$ $SFR_{NG\ BF\ 2\ BL\ Y}$ $SFR_{NG\ BF\ 3\ BL\ Y}$ $SFR_{NG\ BF\ 4\ BL\ Y}$ $SFR_{NG\ BF\ 5\ BL\ Y}$
Data unit	m^3/t
Description	BF ##1-5 baseline natural gas consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SFR_{NG\ BF\ 1\ BL\ Y}$ - 101 $SFR_{NG\ BF\ 2\ BL\ Y}$ - 91 $SFR_{NG\ BF\ 3\ BL\ Y}$ - 107 $SFR_{NG\ BF\ 4\ BL\ Y}$ - 107 $SFR_{NG\ BF\ 5\ BL\ Y}$ - 119
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Steam\ BF\ 1\ BL\ Y}$ $SC_{Steam\ BF\ 2\ BL\ Y}$ $SC_{Steam\ BF\ 3\ BL\ Y}$ $SC_{Steam\ BF\ 4\ BL\ Y}$ $SC_{Steam\ BF\ 5\ BL\ Y}$
Data unit	Gcal/t
Description	BF ##1-5 baseline steam consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SC_{Steam\ BF\ 1\ BL\ Y}$ - 0.065 $SC_{Steam\ BF\ 2\ BL\ Y}$ - 0.055 $SC_{Steam\ BF\ 3\ BL\ Y}$ - 0.060 $SC_{Steam\ BF\ 4\ BL\ Y}$ - 0.054 $SC_{Steam\ BF\ 5\ BL\ Y}$ - 0.055
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Blast\ BF\ 1\ BL\ Y}$ $SC_{Blast\ BF\ 2\ BL\ Y}$ $SC_{Blast\ BF\ 3\ BL\ Y}$ $SC_{Blast\ BF\ 4\ BL\ Y}$ $SC_{Blast\ BF\ 5\ BL\ Y}$
Data unit	m^3/t
Description	BF #5 and #6 baseline blast air consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SC_{Blast\ BF\ 1\ BL\ Y}$ - *1251* $SC_{Blast\ BF\ 2\ BL\ Y}$ - *1348* $SC_{Blast\ BF\ 3\ BL\ Y}$ - *1267* $SC_{Blast\ BF\ 4\ BL\ Y}$ - *1341* $SC_{Blast\ BF\ 5\ BL\ Y}$ - *1327*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SEC_{BF\ 1\ BL\ Y}$ $SEC_{BF\ 2\ BL\ Y}$ $SEC_{BF\ 3\ BL\ Y}$ $SEC_{BF\ 4\ BL\ Y}$ $SEC_{BF\ 5\ BL\ Y}$
Data unit	MW•hour/t
Description	BF ##1-5 baseline electricity consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SEC_{BF\ 1\ BL\ Y}$ - 5.0 $SEC_{BF\ 2\ BL\ Y}$ - 5.3 $SEC_{BF\ 3\ BL\ Y}$ - 5.7 $SEC_{BF\ 4\ BL\ Y}$ - 5.0 $SEC_{BF\ 5\ BL\ Y}$ - 5.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Oxygen\ BF\ 1\ BL\ Y}$ $SC_{Oxygen\ BF\ 2\ BL\ Y}$ $SC_{Oxygen\ BF\ 3\ BL\ Y}$ $SC_{Oxygen\ BF\ 4\ BL\ Y}$ $SC_{Oxygen\ BF\ 5\ BL\ Y}$
Data unit	m^3/t
Description	BF ##1-5 baseline electricity consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SC_{Oxygen\ BF\ 1\ BL\ Y}$ - 69 $SC_{Oxygen\ BF\ 2\ BL\ Y}$ - 63 $SC_{Oxygen\ BF\ 3\ BL\ Y}$ - 65 $SC_{Oxygen\ BF\ 4\ BL\ Y}$ - 56 $SC_{Oxygen\ BF\ 5\ BL\ Y}$ - 93
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$SC_{Water\ BF\ 1\ BL\ Y}$ $SC_{Water\ BF\ 2\ BL\ Y}$ $SC_{Water\ BF\ 3\ BL\ Y}$ $SC_{Water\ BF\ 4\ BL\ Y}$ $SC_{Water\ BF\ 5\ BL\ Y}$
Data unit	m^3/t
Description	BF ##1-5 baseline recycle water consumption
Time of determination/monitoring	
Source of data (to be) used	BFS operations technical reports for 2001-2003
Value of data applied (for ex ante calculations/determinations)	$SC_{Water\ BF\ 1\ BL\ Y}$ - 14.7 $SC_{Water\ BF\ 2\ BL\ Y}$ - 14.7 $SC_{Water\ BF\ 3\ BL\ Y}$ - 15.0 $SC_{Water\ BF\ 4\ BL\ Y}$ - 14.7 $SC_{Water\ BF\ 5\ BL\ Y}$ - 14.3
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average values of these parameters in 2001-2003 based on the BFS operations reports
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	$EF_{CO2\ grid}$
Data unit	tons of CO_2/GW/hour
Description	Emission factor during power generation in the RF energy system
Time of determination/monitoring	2004 г.
Source of data (to be) used	Operational Guidelines for Project Design Documents of Joint Implementation Projects. Volume 1: General guidelines. Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004. p.43, Table B2
Value of data applied (for ex ante calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Standard emission factor during power generation in the RF energy system
QA/QC procedures (to be) applied	
Any comment	

Annex 3
MONITORING PLAN

Initial data reporting form for preparation of CO_2 emissions monitoring report

ID number	Symbol	Data variable	Measuring unit	Value	Comment
P-1.	$P_{BF\ 1\ PJ\ Y}$	*BF #1 molten iron production*	*ton*		
P-2.	$P_{BF\ 4\ PJ\ Y}$	*BF #4 molten iron production*	*ton*		
P-3.	$P_{BF\ 5\ PJ}$	*BF #5 molten iron production*	*ton*		
P-4.	$M_{Coke\ BF\ 5\ PJ}$	*BF #5 coke consumption*	*ton*		
P-5.	$M_{Limestone\ BF\ 5\ PJ}$	*BF #5 dolomite consumption*	*ton*		
P-6.	$FR_{NG\ BF\ 5\ PJ}$	*BF #5 natural gas consumption*	*Thou.m^3*		
P-7.	$C_{Steam\ BF\ 5\ PJ}$	*BF #5 steam consumption*	*Gcal*		
P-8.	$C_{Blast\ BF\ 5\ PJ\ Y}$	*BF #5 Blast air consumption*	*Thou.m^3*		
P-9.	$EC_{BF\ 5\ PJ\ Y}$	*BF #5 electricity consumption*	*MW• hour*		
P-10.	$C_{Oxygen\ BF\ 5\ PJ\ Y}$	*BF #5 oxygen consumption*	*Thou.m^3*		
P-11.	$C_{Water\ BF\ 5\ PJ\ Y}$	*BF #5 recycle water consumption*	*Thou.m^3*		
P-12.	$P_{BF\ 6\ PJ\ Y}$	*BF #6 molten iron production*	*ton*		
P-13.	$M_{Coke\ BF\ 6\ PJ\ Y}$	*BF #6 coke consumption*	*ton*		
P-14.	$M_{Limestone\ BF\ 6\ PJ\ Y}$	*BF #6 limestone consumption*	*ton*		
P-15.	$FR_{NG\ BF\ 6\ PJ\ Y}$	*BF #6 natural gas consumption*	*Thou.m^3*		
P-16.	$C_{Steam\ BF\ 6\ PJ\ Y}$	*BF #6 steam consumption*	*Gcal*		
P-17.	$C_{Blast\ BF\ 6\ PJ\ Y}$	*BF #6 Blast air consumption*	*Thou.m^3*		
P-18.	$EC_{BF\ 6\ PJ\ Y}$	*BF #6 electricity consumption*	*MW• hour*		
P-19.	$C_{Oxygen\ BF\ 6\ PJ\ Y}$	*BF #6 oxygen consumption*	*Thou.m^3*		
P-20.	$C_{Water\ BF\ 6\ PJ\ Y}$	*BF #6 recycle water consumption*	*Thou.m^3*		
P-21.	$EO_{TPRT\ PJ\ Y}$	*BF #6 TPRT electricity generation*	*MW• hour*		
P-22.	$Q_{NG\ Y}$	*Net calorific value of natural gas supplied to "NTMK"*	*GJ/thou.m^3*		