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

CONTENTS

SECTION A. General description of the project

A.1. Title of the project:

Implementation of modern technologies of sinter production and blast furnaces charging at OJSC MMK

Sectoral Scope: 9 (Metal Production)

Version: 1.6

October 19, 2010

A.2. Description of the project:

The Magnitogorsk Iron and Steel Works OJSC (MMK) is the largest enterprise of Russia's iron and steel industry and one of the world's largest steel producers. MMK's plant in Russia is a steel producing complex encompassing the entire production chain, from preparation of iron ore to downstream processing of rolled steel. MMK turns out the broad range of steel products with a predominant share of downstream value added goods. A significant portion of its output is exported to various parts of the world.

Project scenario

The proposed Joint Implementation project considers complex resource-saving effect of construction of sinter cooling and stabilization units (SCaSU) at sintering plants #2 and #3 and sequential installation of bell-less top chargers (BLT) at blast furnaces #4, 6, 9,10,2.

Thus project implementation generated reductions of CO_2 emissions due to reduction of skip metallurgical coke consumption at blast furnaces of OJSC "MMK". This coke is produced at MMK from coking coal and used in the blast furnace process as a fuel and a chemical reducing agent.

Situation existed before project realization, steps and effects of project implementation

Before project implementation the sintering plants #2 and #3 produced a hot sintering mix (agglomerate), which contained more than 11% of fine fraction at the moment of feeding the mix into the blast furnace bin. Raw mix was charged in the agglomeration machines (sintering machines) for fritting and breaking-in. The agglomerate was transported to the blast furnaces and charged into blast furnaces with the double bell charger. During transportation the agglomerate naturally cooled and partly crushed, which increased the mass content of fine fraction (with diameter less than 5 mm).

Several project measures have been implemented at MMK to reduce consumption of coke. One of these measures involved improvements in preparation of agglomerate. As the result nowadays the sintering plants #2 and #3 are able to produce cooled and stabilized agglomerate with fine fraction content of 8.3%[1], which directly reduce the consumption of coke on the blast furnaces. Stabilization of agglomerate means its mechanical treatment, crushing, cooling and grating.

Production of cooled and stabilized agglomerate is the most important measure, which leads to direct savings of coke during blast furnace melting due to improved gas flow through the blast furnace and therefore better conditions for coke oxidation. Besides, less charging material is wasted as dust and slug.

[1] According to Standard of organization SO MMK 2031-2007 Technical requirements of iron-ore raw materials, sintering ore, concentrate, agglomerate

After implementation of this measure, the modern bell-less top chargers could be installed on the blast furnaces and better manage the placement of solid materials at the mouth of blast furnace. This also reduces consumption of coke in the blast furnaces (see more detailed explanation in section A.4.3.).

During the study of the proposals of the equipment manufacturers for sinter cooling and stabilization units, Austrian company “Voest-Alpine AG” was selected as the supplier of technology and equipment. In December of 2004, a supply contract was signed between OJSC “MMK” and Voest-Alpine AG.[2] In December of 2006, the agglomerate cooler was commissioned at sintering plant 3. In July of 2007, a similar cooler was commissioned at sintering plant 2. These plants have identical technological chains of production of stabilized and cooled agglomerate, but the technical specifications of installed equipment differ slightly to account for different numbers of agglomeration machines at each plant.

In August of 2004 OJSC “MMK” signed a contract with Paul Wurth, a world leading company in production of bell-less top chargers. Under the contract, seven chargers were to be supplied.[3] The first BLT was installed at blast surface #4 in November of 2006. The second BLT was installed at blast surface #6 in March of 2007. The third was installed at the blast surface #9 in December of 2007. The fourth was installed at blast surface #10 in August of 2008. The fifth was installed at blast surface #2 in March of 2010. Although BLT may be used as the instruments for management of blast furnace process, they cannot automatically improve the blast furnace performance indicators. The BLT at blast furnaces #9, #10 had worked only a short period of time before the economic crisis of 2008-2009 loomed up. The resulting economy of coke consumption by blast furnace #9 is observed but quite modest and by blast furnace #10 is absent today. This is explained in particular by fact that furnaces #9 and #10 are big ones and historically had been showing the better performance than small ones (#2,4,6). The comparison period of work of blast furnace #2 with BLT charger is small but the sufficient economy of coke consumption by this blast furnace is already observed.

Even before the ratification of the Kyoto Protocol by the Russian Federation in 2004 OJSC “MMK” had seriously considered the possibility to raise income via sale of emission reduction units (ERUs) to be generated by the given JI project (Annex 7). For this purpose a top-management of MMK established a JI project implementation working group, which was meeting on monthly basis, identifying potential project scenarios and estimating the expected emission reductions. This working group actively communicated with governmental authorities: Ministry of Economic Development of the Russian Federation (MED), Ministry of Natural Resources (MNR), State Duma. Various pertinent issues were discussed: clarification of the provisions of the KP with regard to the proposed project, GHG emission inventory, JI project registration procedures. As a result of project implementation, total emission reductions in 2009-2012 were estimated as 1,335,508 tons of CO_2-eq.

Baseline scenario

In the absence of the considered Joint Implementation (JI) project MMK would continue application of the existing technology of production of hot non-stabilized agglomerate and continue utilization of the double bell chargers at blast furnaces #4,6,9,10,2.

A.3. Project participants:

Table 3.1. Project participants

Party involved	Legal entity project participant	Please indicate if

[2] http://www.mmk.ru/rus/press/news/article.wbp?article-id=AD18B069-AC10-1004-0055-E55F8A21BDB2

[3] http://www.mmk.ru/rus/press/news/article.wbp?article-id=6F51FF64-AC10-1004-0075-D6AB026B99A2

	(as applicable)	the Party involved wishes to be considered as project participant (Yes/No)
Party A: (host) Russian Federation	OJSC "Magnitogorsk Iron and Steel Works"	No
Party B: To be determined at the later stage	Carbon Trade & Finance SICAR S.A.	No

OJSC "Magnitogorsk iron and steel works (MMK)" is the largest steelmaking enterprise in the Russian Federation. Its share in the sales of metal production on domestic market is about 20%. This company is a large full cycle metallurgy plant, which begins with preparation of iron ore raw materials and ends up with advanced processing of ferrous metals. This company currently produces the largest mix of metal products among all ironworks of the Russian Federation and CIS countries. Considerable part of its products is exported to different countries.[4]

In 2009 OJSC "MMK" smelted 9,618,000 tons of steel and produced 8,764,000 tons of hot rolled metal. The record output of commercial production, reached in 2007 was 12,200,000 tons. The reduction in output was caused by overall recession in Russian metallurgy sector as the result of economic crisis.

Carbon Trade & Finance SICAR S.A. is a joint venture of Gazprombank (Russia) and Commerzbank (Germany). This joint venture was established to facilitate investments in rapidly developing greenhouse gas emission reduction markets. The company is registered in Luxemburg and invests in greenhouse gas emission reduction projects in Russia and CIS countries.

Carbon Trade & Finance SICAR S.A. offers complex solutions to its customers: from risk management to consultations on carbon project financing to direct procurement of emission reduction units. Carbon Trade & Finance SICAR S.A. develops financial derivative products for financial institutions, governments and buyers, which have accepted binding emission reduction obligations. Carbon Trade & Finance SICAR S.A. has established its subsidiary CTF Consulting LLC in Moscow, which offers a comprehensive portfolio of consulting services in the area of JI project development, preparation and support.

Carbon Trade & Finance SICAR S.A. is a buyer of ERUs generated by the Project.

A.4. Technical description of the project:

A.4.1. Location of the project:

Urals Federal District, Chelyabinsk Region, Magnitogorsk city.

A.4.1.1. Host Party(ies):

The Russian Federation

[4] http://www.mmk.ru/rus/about/info/index.wbp

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

Chelyabinsk Region is one with the most developed economies in the Russian Federation. It takes the 4th place in Russia in the shipped value of processing sectors, the 11th place in the gross regional product, the 13th place in capital investment, and the 9th place in dwelling construction.

The ironworks of Chelyabinsk Region produce 30.8% of output of steel in Russia, 27% of rolled metal, and 15.4% of steel pipes.

Chelyabinsk Region occupies 88,500 square kilometers, or 0.5% of the territory of the Russian Federation. About 3.5 million people permanently reside in Chelyabinsk Region (2.5% of Russian population). The region is highly urbanized; the proportion of urban population reaches 81.4%.

Fig.A.4.1.2.1 Chelyabinsk Region on the map of the Russian Federation

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

Magnitogorsk city. Industrial site of OJSC “MMK”.

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

Magnitogorsk city is located in the south-west part of Chelyabinsk Region, near the border with Bashkiria Republic. The city was built at the foot of Magnitnaya Mountain, in the eastern slopes of South Urals, on the both sides of river Ural (the right bank is in Europe, the left bank is in Asia).

The distance between Magnitogorsk and Chelyabinsk is 417 km by rail, and 303 km by the road via Verkhneuralsk. The distance between Magnitogorsk and Moscow is 1,916 km by rail, and 2,020 km by highway.

The city occupies the territory of 376 km^2, it stretches by 27 km in north-south direction and by 20 km in east-west direction. The absolute elevation is 310 m above sea level. The population of Magnitogorsk is

409,400 inhabitants (2009).[5] MMK is located on the left bank of river Ural, and occupies a large plot of land. Legal address of the company is: Chelyabinsk Region, Magnitogorsk, Kirova Street, 93.

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

The proposed project includes major improvement in technology of production of agglomerate, and installation of bell-less tops at blast furnaces # 4,6,9,10,2 of MMK. The following activities are provided:

- Installation of sinter cooling and stabilization units (SCaSU) at sintering plants #2 and #3;
- Installation of bell-less top chargers at blast furnaces #4,6,9,10,2.

Table A.4.2.1. Project implementation schedule

Date	Activity
November 2006	Installation of BLT at BF #4
December 2006	Installation of SCaSU at SP #3
March 2007	Installation of BLT at BF #6
July 2007	Installation of SCaSU at SP #2
December 2007	Installation of BLT at BF #9
August 2010	Installation of BLT at BF #10
March 2010	Installation of BLT at BF #2

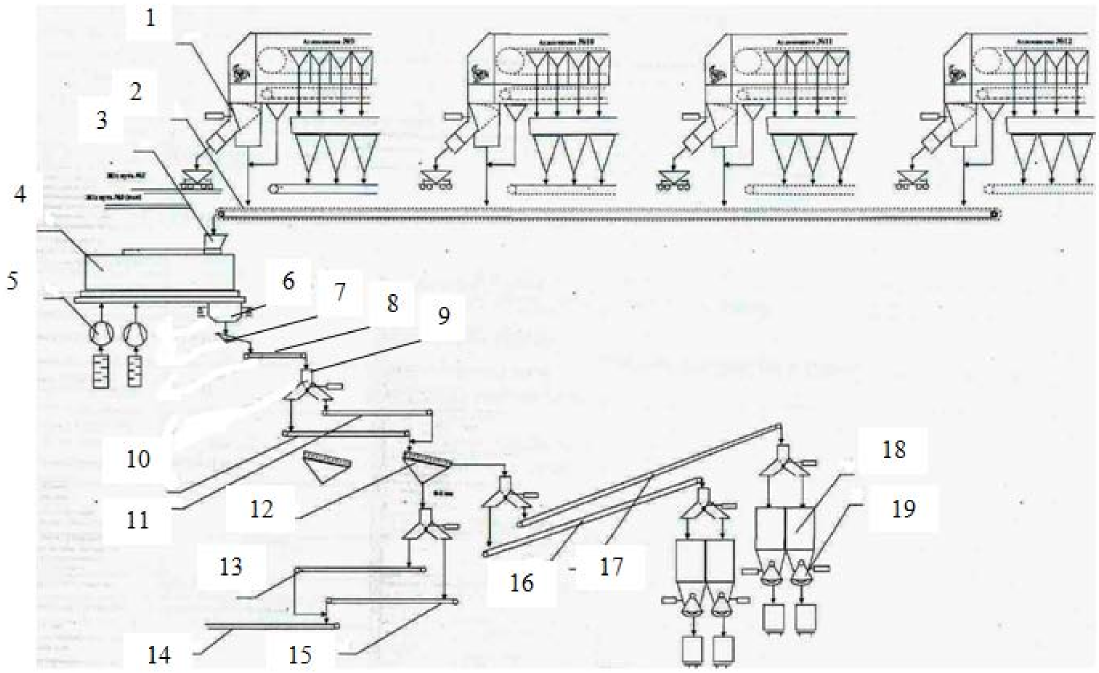
Equipment and principle of operation of sinter cooling and stabilization units

The following basic and auxiliary technological equipment has been installed at sintering plants #2 and #3 of MMK:

- Plate feeder with capacity 750 tons per hour;
- Loop cooler with capacity 750 tons per hour;
- Vibration feeder with dimensions 2400 x 1800 mm;
- Cooling fans with capacity 270 nm^3/s;
- Vibration grate with capacity 750 tons per hour;
- Belt conveyors for cooling of agglomerate, with capacity 650 tons per hour;
- Return belt conveyors with capacity 300 tons per hour;
- Belt conveyor for dust transportation, with capacity 5 tons per hour.

There were no other changes in the technological chain at the sintering plants.

Fig. A.4.2.1. Plan of technological chain at agglomerate stabilization unit of sintering plant 3



1. 1 - unloading ditch; 2 - plate conveyor; 3 – loading bin; 4 – loop cooler; 5 – fans; 6 – unloading bin; 7 – vibration feeder; 9 – shuttle; 8, 10, 11, 13, 14, 15, 16, 17 – conveyors; 12 – vibration grates; 18 – loading bins; 19 – valves.

After passing the existing agglomeration machines the agglomerated cake with temperature 800°C is unloaded through the roll crusher from the plate conveyor to the loop cooler. The belt conveyor feeds cooled agglomerate to the loading unit and then to the screening plant. After screening, stabilized agglomerate goes to the blast furnace plant. The screened dust is caught by electric filters of the aspiration unit and transported by the return conveyor to the beginning of the technological chain.

Bell-less top charger equipment and principle of operation

BLT consists of the following units:

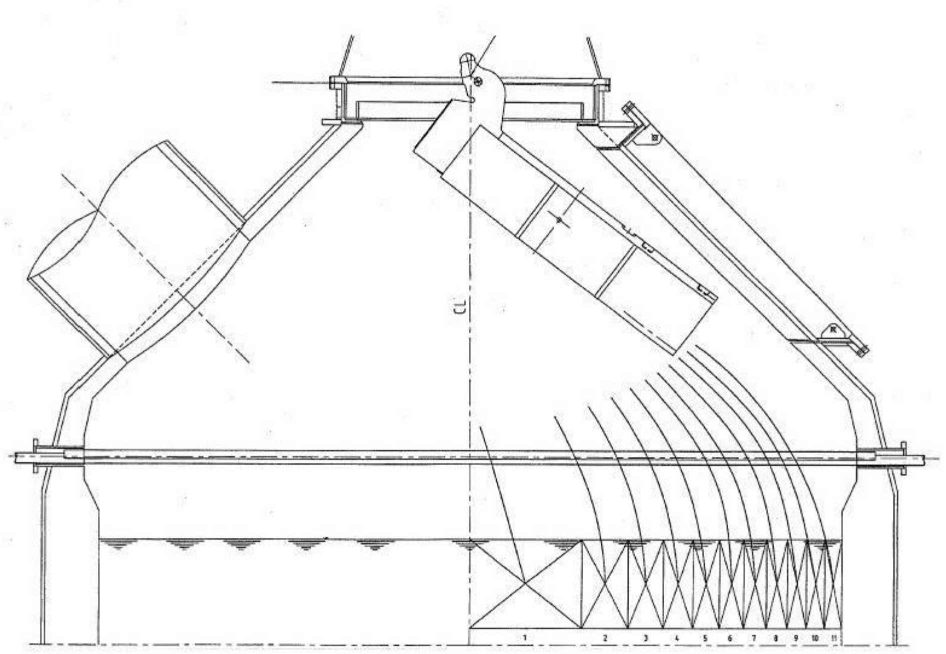
- Two receiving cones;
- Furnace charge bin with volume 13 m^3;
- Valve block with one charge gate and one gas-tight valve;
- Main reduction gear, located inside the furnace and cooled by purified nitrogen;
- Rotating tray with variable tilt angle.

Agglomerate from the skip metallurgical is poured out in the receiving cone of the charge bin through the opened upper gas-tight valve until the required level is reached (there are two radar level gauges which alarm about that). Then the exhaust valve (which equalizes the pressures between the furnace and ambient air) closes and the upper gas-tight valve at the receiving cone also closes. The second gas-tight valve remains in the closed position. Then the valve, which equalizes the pressures between the blast furnace and the bin, opens up. After the gauge signals that the pressures are equalized, the lower gas-tight valve opens up. Then the charge gate opens up and the Agglomerate is poured through the tray to the furnace.

Tilt angle, direction of rotation of the tray and rate of opening of the charge gate are formed by the charging program. The main advantage of tray-type BLT is the possibility of charging in any spot of level during circular charging (see Fig. A.4.2.2.).

It should be noted that the peculiarity of BLT charger is the compound reduction gear located inside the furnace. So cooled and purified nitrogen is needed with the greater pressure then the pressure of gas above the blast furnace mouth.

Fig. A.4.2.2. Tray feeder and formation of ring-shaped loading zones



A bell-less top charger makes charging process more manageable, so that any desired profiles of furnace charge materials can be obtained. A blast furnace with BLT charger may use fine fractions of coke (coke nut) and iron ore, which is hardly possible with a bell charger. Thus, a blast furnace with BLT consumes less skip metallurgical coke, and generates less dust and slug.

The personnel and experts who work at the blast furnace plant and in sintering plants were trained to operate new equipment.

- Voest-Alpine AG administered a training course under its equipment supply contract for supply of sinter cooling and stabilization units for sintering plants #2 and #3;
- Paul Wurth administered a training course under its equipment supply contract for supply of chargers for blast furnaces.

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 aim of the blast furnace process is to produce iron (an alloy of Fe with carbon (up to 4,5%)). The basic feed for blast furnaces at MMK is fuel (skip metallurgical coke and natural gas) and agglomerate (sintered mix of ferric oxides contained in ore and fluxes).

The coke and agglomerate are charged in turn from the top of the blast furnace by two skip metallurgicals. Natural gas and oxygen-enriched blowing are blown in the bottom of the blast furnace through tuyers. Therefore the main condition for blast furnace process is the continuous opposite motion of coke and agglomerate (charging materials) and ascending flow of gases that ensure chemical reactions of oxidation-reduction between carbon of coke/natural gas and ferric oxides.

As the sequence the performance and efficiency of the blast furnace depends a lot on the proper allocation of the gases and charging materials inside it, in particular on the granulometric content of the charging materials and the profile of their charging and further motion (redistribution). In particular, there should be more agglomerate near the wall of blast furnace and more coke in the centre. The amount of small fractions of agglomerate near the wall should be reduced to the extent possible.

The main difference between double bell chargers (DBC) used in the baseline scenario and bell-less top (BLT) chargers installed in the project is that the BLT allows unloading the required amount of each constituent material in the furnace charge in a specified ring-shaped area along the blast furnace mouth radius. Under given technological conditions, the required profile of furnace charge surface is attained. Contrariwise, the bell chargers provide the fixed trajectory of charging, whereas all materials are loaded into a narrow ring-shaped zone. Then charging materials move uncontrollably across the surface of the blast furnace mouth.

Implementation of the project reduces specific consumption of skip metallurgical coke in the blast furnace by two main reasons:

1. Installation of a sinter cooling and stabilization units improves the efficiency and performance of the blast furnace process because cold agglomerate less disintegrates and besides fine fraction of sinter cake is screened out at SCaSU and does not come to the blast furnace plant.
2. Installation of bell-less tops allows to efficiently organize the process of materials charging and manage the proper distribution of coke and agglomerate by perimeter and circle of the blast furnace. This improves the gas flow and therefore efficiency of chemical reactions inside.

Besides the reduction of skip metallurgical coke consumption reduce as well the CO_2 emissions due to metallurgical coke production at the by-product coke plant of MMK. There are three sources of CO_2 emissions resulting from metallurgical coke production: (1) stoving of coal charge (with carbon content about 80%) in the coke ovens, (2) consumption of natural gas, blast furnace gas and coke oven gas for heating of coke ovens, (3) utilization (burning) of formed coke breeze and coke nut (by-products of metallurgical coke production) at the sintering plant and other departments of MMK.

In the absence of the proposed project, blast furnaces at MMK would have remained equipped with the double bell chargers. They would have consumed hot non-stabilized agglomerate. Continuation of this process does not require additional investments and presents a financially feasible option for MMK (refer to section B.2). The double bell chargers are widely used in the blast furnace process because they are simple and able to work under increased pressure of gas above the blast furnace mouth. They can be easily installed on any blast furnace, irrespective of its volume. However bell chargers consume more coke per ton of steel produced than modern BLT. Therefore the specific consumption of skip metallurgical coke per ton of pig iron and respective CO_2 emissions in the baseline would be higher than in the project, which is monitored through the comparison of the actual parameters with averaged historical performance of each blast furnace inside delineated project boundaries.

Introduction of any enterprise-level legally binding GHG emission reduction requirements is not expected in the Russian Federation in the near future. This is why agglomeration plant and blast furnace process modernization projects are now undertaken by private businesses solely upon consideration of projects' economic effectiveness, risks and barriers.

Section B.2 of this document shows that MMK had enough economic incentives to continue using hot agglomerate and bell chargers (they are partly used today) instead of undertaking a major technological modernization. When the decision about installation of sinter cooling and stabilization units and bell-less top (BLT) chargers was made, additional income from ERU sales via JI mechanism was seriously considered. The enterprise took every step in this direction during several past years.

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

Table A.4.3.1. Estimated amount of emission reductions over the crediting period of 2008-2012

	Years
Length of the crediting period:	4 years
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	0
2009	234 483
2010	333 580
2011	383 722
2012	383 722
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	1 335 508
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	333 877

Table A.4.3.1-2 Estimated amount of emission reductions over the crediting period of 2013-2020 (if the extension of crediting period for this project is approved by the Russian Federation)

	Years
Length of the commitment period:	8 years
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2013	383 722
2014	383 722
2015	383 722
2016	383 722
2017	383 722
2018	383 722
2019	383 722
2020	383 722
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	3 069 777

Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	383 722

A.5. Project approval by the Parties involved:

Russian Federation as a Host Party may issue a Letter of Approval (LoA) for JI project only after receipt of the positive determination opinion from the Accredited Independent Entity (AIE). Following this LoA the project participants will apply for a Letter of Approval from the Sponsor Country to be chosen.

SECTION B. Baseline

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

According to Appendix B to Decision 9/CMP.1 (refer to the Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005.) and JI Guidance on criteria for baseline setting and monitoring, Version 02, Project developer uses JI specific approach for description and justification of the selected baseline. This JI specific approach comprises the following steps:

Step 1. Identification and description of selected approach to baseline setting

Project developer uses JI specific approach for description and justification of the selected baseline. This is based on the requirements of Paragraph 9(a) of JI Guidance on criteria for baseline setting and monitoring, Version 02.
A baseline was identified by listing and describing plausible future scenarios on the basis of conservative assumptions and selecting the most plausible one.

The following rules have been applied for description of the most plausible baseline scenario:

1. Selection of feasible alternatives which could potentially serve as a baseline;

2. Justification of elimination of less likely alternatives, either technically or economically.

We described and analyzed all alternatives and selected the most plausible alternative as the baseline.

For the establishing the baseline and further development of additionality proofs in the section B.2. we directly took into account:

- Sectoral reform policies and legislation in steel industry.

Ministry of Industry of the Russian Federation set the following goals of development of steel industry: “to meet growing demand of the domestic, CIS (Commonwealth of Independent States) and international markets for steel products; to meet the requirements of metal-processing industries in terms of quality and quantity in the whole range of metal products; to accelerate innovative development and modernization of steel industry, to increase its economic efficiency, environmental safety, energy-savings and resource-savings, competitiveness, import substitution and raw material security”[6].

The main goals of MMK are: preservation of long-term competitiveness at international markets of rolled metal; getting leading positions in development and implementation of new technologies; improvement of quality of metal products and introduction of new products to meet consumer demands and expectations; increasing efficiency of production; and reduction of negative environmental impacts.[7] This set of goals fully corresponds to the goals of state policy in the area of industrial development.

This project concerns reconstruction of individual production plants of MMK, where additional legislative requirements do not apply.

- Economic situation in Russian steel industry and predicted demand.

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[6] http://www.minprom.gov.ru/activity/metal/strateg/2

[7] http://www.mmk.ru/rus/about/strategy/index.wbp

Installation of BLT on blast furnaces increases their output. Estimates of project emission reduction does not consider any increase in blast furnace output. Reduced consumption of coke and natural gas during pig iron smelting was calculated for the baseline scenario (Section D). We assumed that the volume of pig iron production did not depend upon implementation of this project. We assumed that this volume would reduce its maximum projected value under the baseline scenario. Smelting of pig iron in the blast furnaces, equipped with the double bell chargers, should meet the predicted demand for steel produced at MMK. This enterprise is the largest steel producer in the Russian Federation. Its share in total domestic sales of steel products is 20%.

- Technological aspects of pig iron smelting in blast furnaces with DBC and BLT.

Technological parameters of blast furnaces with BLT are described in Section A.4.2. Emission estimates were based on all aspects of performance of these furnaces, including emissions from the consumption of pure nitrogen, which is used for cooling of BLT reduction gear. Nitrogen is not used by blast furnaces with the double bell chargers.

- Availability of capital to MMK (including investment barriers).

This aspect was considered during additionality proof (Section B.2).

- Local availability of technology/techniques and equipment.

Voest-Alpine AG and Paul Wurth have been working in Russian market since 1999 and 2000, respectively[8, 9]. They are reliable business partners with excellent credentials.

- Price and availability of fuel.

Both baseline and project scenarios envisage that coke will be partly substituted by natural gas due to economic considerations as natural gas is cheaper than coke. Section D provides some details on this issue.

Step 2. Application of the approach chosen

We selected decision-made year 2004 as the base year during consideration of feasible alternatives of reconstruction of sintering plants and blast furnaces at MMK. The following alternatives have been considered:

1. Continued production of hot non-stabilized agglomerate at sintering plants #2 and #3 and operation of blast furnaces #4,6,9,10,2 equipped with the double bell chargers;
2. Use of pulverized coal as a coke substitute in blast furnace plant;
3. Construction of sinter cooling and stabilization units at sintering plants #2 and #3 and sequential installation of bell-less top chargers at blast furnaces #4, 6, 9,10,2.

Russian legislation does not contain any barriers, which would preclude realization of any off these alternatives.

Elimination of unlikely alternatives (either technically or economically)

1. Continued production of hot non-stabilized agglomerate at sintering plants #2 and #3 and operation of blast furnaces #4,6,9,10, 2 equipped with the double bell chargers

[8] http://www.urm.ru/ru/75-journal51-article278

[9] http://www.kommersant.ru/doc.aspx?DocsID=1342122

No modernization is undertaken under this alternative.

All requirements of Russian environmental law would be met under this scenario. Russian law does not regulate CO_2 emissions and does not demand reductions of these emissions.

The double bell chargers are widely used because they are durable and can work for a very long periods of time, under proper maintenance schedule. These chargers are simple in design and can work under increased gas pressure above the blast furnace mouth. They may be installed at a blast furnace of any volume.

In 2005 the blast furnace #4 underwent Type I capital repair and reconstruction, which included replacement of main blast-furnace spouts. New spouts were made from heat-resistant concrete. For the first time, agglomerate was transported inside BFP by a belt transporter, instead of plate transporter. There were some changes in construction of blast furnace hearth and well, including construction of so-called “ceramic well” which protects carbonaceous walls of blast furnace hearth and well from incoming moisture and oxygen.

A time since blast furnace blowing after Type I capital repair until the next one is up to 15 years (normally 10-12 years). The duration of the campaign of blast furnace increases in case of use of new, more resistant refractory materials: high-aluminous bricks and carbide blocks, improving the preparation of raw materials, timely preventive screening of equipment and interim repairs. These measures would guarantee accident-free operation of blast furnace and production of required quantity and quality of pig iron. Thus the preventative maintenance would allow the blast furnaces #4,6,9,10,2 equipped with double bell charges to operate during the whole crediting period.

This alternative is the most likely baseline scenario, for the following reasons:

- Required quantity and quality of pig iron will be produced for basic oxygen furnace plant and electric furnace plant without a costly and large-scale reconstruction;
- This option does not require production of cooled and stabilized agglomerate.

2. <u>Use of pulverized coal as a coke substitute in blast furnace plant</u>

Injection of pulverized coal is a prospective energy-saving solution in the blast furnace process. Pulverized coal may replace up to 100% of natural gas and up to 40% of coke consumed by a blast furnace. Implementation of this option increases output of the blast furnace, and temperature regime of blast furnace hearth can be easily managed[10].

The technological equipment for preparation and injection of pulverized coal includes the following units:

- Coal storage with special system for preparation of raw coal;
- Coal pulverization unit;
- Distribution and dosing unit.

Injection of pulverized coal has the following advantages:

- Less coke is consumed (saving may reach 20%);

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[10] http://www.kalugin.biz/ru/technologies/pulverized-coal.pdf

- Blast furnace output increases up to 10%;
- Coke can be replaced by low-cost non-coking coals;
- Net cost of pig iron production decreases by 3-8%;
- Reduction of coke production means benefits for the environment.

MMK has considered this alternative of further development of the blast furnace process. However, this option would have required a major and costly reconstruction of the blast furnace plant. MMK management did not accept this option, and channeled limited investments into several other development projects (reconstruction of section mills, construction of electric arc furnace plant). Besides, MMK produces its own coke to meet the demands of the works. For these reasons, we eliminated this scenario from the list of plausible alternatives.

3. Construction of sinter cooling and stabilization units at sintering plants #2 and #3 and sequential installation of bell-less top chargers at blast furnaces #4, 6, 9,10,2

This alternative was implemented at MMK in 2006-2010 and resulted in resource savings and GHG emission reduction. Implementation of this scenario involved significant technical and financial risks for MMK, as we describe in Section B.2.

Description of selected baseline:

Comparison of alternative scenarios rendered only two alternatives as the most plausible pathways of further development of the blast furnace process at blast furnaces #4,6,9,10,2:

Alternative 1 (proposed baseline scenario)

Continued production of hot non-stabilized agglomerate at sintering plants #2 and #3 and operation of blast furnaces #4,6,9,10,2 equipped with the double bell chargers.

Alternative 2 (proposed project scenario)

Construction of sinter cooling and stabilization units at sintering plants #2 and #3 and sequential installation of bell-less top chargers at blast furnaces #4, 6, 9,10,2.

To prove additionality of the proposed project, we conducted analysis of barriers and investment analysis in Section B.2.

Selection of *Alternative 1* scenario as the baseline corresponds to “Guidance on criteria for baseline setting and monitoring”, version 02), in particular:

These baseline covers all GHG emissions, which are under control of project participants, substantial in their volumes, and correctly determined in the project

The baseline conditions include all CO_2 emissions from coke production and the blast furnaces. These emission sources lie within project boundaries.

Approach to calculate baseline emissions

The following principles were applied for baseline emission calculations:

1. Performance of the blast furnaces # 4, 6, 9, 10, 2 is defined based on three-year period before project implementation and relevant parameters are fixed ex-ante. The annual technical reports of blast furnace plant of MMK for the period of 2004-2006 (i.e. before installation of the SCaSU and bell-less top chargers) are used to determine a consumption of skip metallurgical coke (on dry mass) and natural gas as well as pig iron production by blast furnaces # 4, 6, 9, 10, 2. These data were used to calculate and fix ex-ante the average baseline specific consumption of skip metallurgical coke and NG per ton of pig iron produced in each of these furnaces.
2. Since the actual production of pig iron in the project may be higher than in comparison period of 2004-2006 and no changes of the working volume of the blast furnaces were done the historical maximal output of BF #4 and # 9 (date of 1988 year), BF #6 (date of 1990 year), BF # 10 (date of 1987) BF #2 (average value of historical data for the period of 2004-2006) equipped with double bell charges has been determined.
3. On the basis of actual pig iron production (which is limited for the baseline by maximal output of BF # 4, 6, 9, 10, 2) and average baseline specific consumption of dry skip metallurgical coke and NG per ton of pig iron produced the gross consumption of dry skip metallurgical coke and natural gas is calculated for each of the furnace. Based on these data and taking into account the actual carbon content in metallurgical coke and natural gas the total CO_2 emissions from consumption of dry skip metallurgical coke and natural gas in the baseline at BF #4,6,9,10, 2 are calculated. In case the actual production of pig iron by any of the blast furnaces would be higher than its historical maximal output, the mathematical reduction of related CO_2 emissions is done.
4. CO_2 emissions from production in BPCP of MMK of the skip metallurgical coke consumed in the baseline by BF #4,6,9,10, 2 are calculated on the basis of specific CO_2 emission factor per ton of produced metallurgical coke. This emission factor is calculated as well for other JI project developed by CTF, Ltd. –"Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works", PDD had passed determination by Bureau Veritas Certification[11] (for the principles of estimation see also Annex 4) and is taken as a link.
5. Finally total CO_2 baseline emissions are calculated.

The following data were used to calculate baseline CO_2 emissions: consumption of raw materials, production inputs and energy resources; projected output of pig iron; carbon content in production inputs and fuels. This information has been used by MMK during internal corporate monitoring and inventory for many years; it is well documented in the reports of the enterprise. Therefore, the level of uncertainty of baseline emission estimates is minimal.

Justification regarding the conservativeness of historical maximal output for BF #4,6,9,10,2

Pig iron production by BF #4,6,9,10 during the years of baseline definition (2004-2006) was significantly below than nowadays and below the historical maximum, which is limited by working volume of a blast furnace (for blast furnaces #4, 6 the volume is 1370 m^3, for blast furnaces #9, 10 is 2014 m^3). The working volume of the blast furnaces remains unchanged since years of recorded maximal output: BF #4 and # 9 – 1988 year, BF #6 – 1990 year, BF # 10 – 1987 year.

Since OJSC "MMK" has commissioned the Electric-Arc Furnace Plant of total capacity of 4 mln. tones of liquid steel per year instead of 2 mln. tones per year open-hearth furnace plant the demand in pig iron should rise (the EAF furnaces are able to consume up to 40% of pig iron). The plan of pig iron

[11]http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

production for 2010 is 10.260.690 tones of pig iron while for 2005 the production was 9.654.642 tones, for 2006 – 9.732.639 tones.

Therefore it is obvious that MMK has intention to increase pig iron production in coming years that is to be covered by existing blast furnaces mainly by BF #4,6,9,10. Besides the performance of other blast furnaces should vary it cannot be stable because blast furnace process is a complex system, therefore the loading and output of BF #4,6,9,10 should have increased anyhow to compensate the cut of output on the others.

Considering a blast furnace with the double bell charger and working on hot non-stabilized agglomerate, the goal of production augmentation could only be reached by intensification of blast furnace process therefore in the baseline conditions the increase of pig iron output would lead to further growth of coke consumption. Therefore the fixing ex-ante of the baseline specific consumption of skip metallurgical coke and NG per ton of pig iron produced by BF #4,6,9,10,2 based on average performance of 2004-2006 is appropriate and conservative.

Because Russian steel industry had experienced a downturn since 1991 and production had been increasing gradually since 1997 until year 2008, to define a real baseline capacity the data of 1987-1990 years were analyzed for BF #4,6,9,10 when Magnitogorsk Metallurgical Works yet worked in the conditions of planned economy. The analysis has demonstrated that period of 1985-1990 was characterized by the highest recorded production of pig iron at Magnitogorsk Metallurgical Works (year 1985 – 11.395.000 tones, year 1990 – 11.612.000 tones).

It should be additionally noted that there is a tendency of deterioration of coke quality in years 2009-2010 in comparison with years 2004-2006. It takes place due to absence of enough number mining enterprises under control of MMK group. The worsen quality lead to increase of the coke consumption therefore in the baseline conditions the coke consumption at BF #4,6,9,10,2 would be higher than now. However the methodology applied in the project context does not consider this “non-material” difference and operates with actual monitored coke consumption in comparison with the historic average value of 2004-2006 to keep the conservativeness. For example, in Soviet time the quality of coke was rather better than now because the distribution of coke had been centralized and there was no market competition for coking coal.

The maximal recorded production by blast furnace #2 was registered in 2006, i.e. within the range of years used to define the baseline. Therefore in line with conservative approach the average production in years 2004-2006 was considered as maximal one.

Thus the mentioned approach to define historical maximal output for BF #4,6,9,10,2 and apply it for baseline emission calculation according to formulae in section D is justified as conservative.

Key information and data used to establish the baseline

Data/parameter	Consumption of dry skip metallurgical coke in BF #4 under the baseline ($M_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL}$)
Data unit	t/yr
Description	Data about consumption of dry skip metallurgical coke in BF #4 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #4
Time of determination/ monitoring	Three-year average (2004-2006)

Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	481,348
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of natural gas in BF #4 under the baseline ($FC_{NG\_BF\ 4\ averaged\ BL}$)
Data unit	th. m^3/year
Description	Data about consumption of NG in BF #4 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #4
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	103,017
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Production of pig iron in BF #4 under the baseline ($P_{pig\ iron\_BF\ 4\ averaged\ BL}$)
Data unit	t/yr
Description	Data about production of pig iron in BF #4 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #4
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	1,011,173
Justification of the choice of data or description of measurement methods and	This parameter is determined according to the selected approach of baseline emission calculations, as described above

procedures (to be) applied	
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of dry skip metallurgical coke in BF #4 under the baseline ($SM_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL}$)
Data unit	kg/t
Description	Specific consumption is calculated on the basis of consumption of dry skip metallurgical coke in BF #4 and pig iron production in BF #4, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	476.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of NG in BF #4 under the baseline ($SFC_{NG\_BF\ 4\ averaged\ BL}$)
Data unit	m^3/t
Description	Specific consumption is calculated on the basis of gross consumption of natural gas in BF #4 and pig iron production in BF #4, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	101.9
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of dry skip metallurgical coke in BF #6 under

	the baseline ($M_{skip\ metallurgical\_coke\_BF\ 6\ averaged\ BL}$)
Data unit	t/yr
Description	Data about consumption of dry skip metallurgical coke in BF #6 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #6
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	515,482
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of NG in BF #6 under the baseline ($FC_{NG\_BF\ 6\ averaged\ BL}$)
Data unit	th. m^3/year
Description	Data about consumption of NG in BF #6 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #6
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	116,505
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Production of pig iron in BF #6 under the baseline ($P_{pig\ iron\_BF\ 6\ averaged\ BL}$)
Data unit	t/yr
Description	Data about production of pig iron in BF #6 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #6
Time of determination/ monitoring	Three-year average (2004-2006)

Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	1,089,226
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of dry skip metallurgical coke in BF #6 under the baseline ($SM_{skip\ metallurgical\_coke\_BF\ 6\ averaged\ BL}$)
Data unit	kg/t
Description	Specific consumption is calculated on the basis of consumption of dry skip metallurgical coke in BF #6 and pig iron production in BF #6, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	473.3
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of NG in BF #6 under the baseline ($SFC_{NG\_BF\ 6\ averaged\ BL}$)
Data unit	m^3/t
Description	Specific consumption is calculated on the basis of consumption of dry skip metallurgical coke in BF #6 and pig iron production in BF #6, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	107.0

Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of dry skip metallurgical coke in BF #9 under the baseline ($M_{\text{skip metallurgical\_coke\_BF 9 averaged BL}}$)
Data unit	t/yr
Description	Data about consumption of dry skip metallurgical coke in BF #9 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #9
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	668,984
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of natural gas in BF #9 under the baseline ($FC_{\text{NG\_BF 9 averaged BL}}$)
Data unit	th. m^3/year
Description	Data about consumption of NG in BF #9 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #9
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	142,514
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Production of pig iron in BF #9 under the baseline ($P_{pig\ iron\_BF\ 9\ averaged\ BL}$)
Data unit	t/yr
Description	Data about production of pig iron in BF #9 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #9
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	1,492,464
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of dry skip metallurgical coke in BF #9 under the baseline ($SM_{skip\ metallurgical\_coke\_BF\ 9\ averaged\ BL}$)
Data unit	kg/t
Description	Specific consumption is calculated on the basis of consumption of dry skip metallurgical coke in BF #9 and pig iron production in BF #9, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	448.2
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of NG in BF #9 under the baseline ($SFC_{NG\_BF\ 9\ averaged\ BL}$)
Data unit	m^3/t
Description	Specific consumption is calculated on the basis of gross consumption of natural gas in BF #9 and pig iron production in BF #9, equipped with the double bell charger

Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	95.5
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of dry skip metallurgical coke in BF #2 under the baseline ($M_{skip\ metallurgical\_coke\_BF\ 2\ averaged\ BL}$)
Data unit	t/yr
Description	Data about consumption of dry skip metallurgical coke in BF #2 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #2
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	552,198
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of natural gas in BF #2 under the baseline ($FC_{NG\_BF\ 2\ averaged\ BL}$)
Data unit	th. m^3/year
Description	Data about consumption of NG in BF #2 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #2
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	123,167

Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Production of pig iron in BF #2 under the baseline ($P_{pig\ iron\_BF\ 2\ averaged\ BL}$)
Data unit	t/yr
Description	Data about production of pig iron in BF #2 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #2
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	1,182,901
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of dry skip metallurgical coke in BF #2 under the baseline ($SM_{skip\ metallurgical\_coke\_BF\ 2\ averaged\ BL}$)
Data unit	kg/t
Description	Specific consumption is calculated on the basis of consumption of dry skip metallurgical coke in BF #2 and pig iron production in BF #2, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	466.8
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of NG in BF #2 under the baseline ($SFC_{NG\_BF 2averaged BL}$)
Data unit	m^3/t
Description	Specific consumption is calculated on the basis of gross consumption of natural gas in BF #2 and pig iron production in BF #2, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	104.1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of dry skip metallurgical coke in BF #10 under the baseline ($M_{skip metallurgical\_coke\_BF 10 averaged BL}$)
Data unit	t/yr
Description	Data about consumption of dry skip metallurgical coke in BF #10 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #10
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	661,148
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Consumption of natural gas in BF #10 under the baseline ($FC_{NG\_BF 10 averaged BL}$)
Data unit	th. m^3/year
Description	Data about consumption of NG in BF #10 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #10

Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	131,324
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Production of pig iron in BF #10 under the baseline ($P_{pig\ iron\_BF\ 10\ averaged\ BL}$)
Data unit	t/yr
Description	Data about production of pig iron in BF #10 equipped with the double bell charger are needed for calculation of specific coke consumption by BF #10
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	1,525,061
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of dry skip metallurgical coke in BF #10 under the baseline ($SM_{skip\ metallurgical\_coke\_BF\ 10\ averaged\ BL}$)
Data unit	kg/t
Description	Specific consumption is calculated on the basis of consumption of dry skip metallurgical coke in BF #10 and pig iron production in BF #10, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	433.5

Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Specific consumption of NG in BF #10 under the baseline ($SFC_{NG\_BF\ 10\ averaged\ BL}$)
Data unit	m^3/t
Description	Specific consumption is calculated on the basis of gross consumption of natural gas in BF #10 and pig iron production in BF #10, equipped with the double bell charger
Time of determination/ monitoring	Three-year average (2004-2006)
Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	86.1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	No additional comments

Data/parameter	Maximum production of pig iron in BF #4 under the baseline ($P_{max\ pig\ iron\ BF\ 4\ BL}$)
Data unit	t/yr
Description	Maximum output of blast furnace with the double bell charger is needed to calculate baseline emissions
Time of determination/ monitoring	Historical maximum reached in 1988
Source of data (to be) used	An original technical report of 1988 received in MMK Technological Department
Value of data applied (for ex ante calculation/ determinations)	1,217,400
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	See Justification regarding the conservativeness of historical maximal output for BF #4,6,9,10,2 above.

Data/parameter	Maximum production of pig iron in BF #6 under the baseline ($P_{\text{max pig iron BF 6 BL}}$)
Data unit	t/yr
Description	Maximum output of blast furnace with the double bell charger is needed to calculate this parameter
Time of determination/ monitoring	Historical maximum reached in 1990
Source of data (to be) used	An original technical report of 1990 received in MMK Technological Department
Value of data applied (for ex ante calculation/ determinations)	1,110,700
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	See Justification regarding the conservativeness of historical maximal output for BF #4,6,9,10,2 above.

Data/parameter	Maximum production of pig iron in BF #9 under the baseline ($P_{\text{max pig iron BF 9 BL}}$)
Data unit	t/yr
Description	Maximum output of blast furnace with the double bell charger is needed to calculate baseline emissions
Time of determination/ monitoring	Historical maximum reached in 1988
Source of data (to be) used	An original technical report of 1988 received in MMK Technological Department
Value of data applied (for ex ante calculation/ determinations)	1,768,000
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	See Justification regarding the conservativeness of historical maximal output for BF #4,6,9,10,2 above.

Data/parameter	Maximum production of pig iron in BF #2 under the baseline ($P_{\text{max pig iron BF 2 BL}}$)
Data unit	t/yr
Description	Maximum output of blast furnace with the double bell charger is needed to calculate baseline emissions
Time of determination/ monitoring	Three-year average (2004-2006)

Source of data (to be) used	Archive data, BFP technical reports for 2004-2006
Value of data applied (for ex ante calculation/ determinations)	1,182,901
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	The averaged production of pig iron in 2004-2006 is higher than planned for 2010, after installation of bell-less charger. Maximum production of pig iron in BF #2 was reached in 2006 i.e. due to comparison years historical period and equals to 1,254,842 tons of pig iron. For conservativeness the figure of 1,182,901 is considered as maximum and therefore if the actual production of pig iron based on monitoring results would be higher – the respective additional results will not be accounted (see section D for formulae).

Data/parameter	Maximum production of pig iron in BF #10 under the baseline ($P_{max\ pig\ iron\ BF\ 10\ BL}$)
Data unit	t/yr
Description	Maximum output of blast furnace with the double bell charger is needed to calculate baseline emissions
Time of determination/ monitoring	Historical maximum reached in 1987
Source of data (to be) used	An original technical report of 1987 received in MMK Technological Department
Value of data applied (for ex ante calculation/ determinations)	1,789,600
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not applicable for fixed ex-ante parameters
Any comment	See Justification regarding the conservativeness of historical maximal output for BF #4,6,9,10,2 above.

Data/parameter	Carbon content of metallurgical coke ($\%C_{metallurgical\ coke\_PJ}$)
Data unit	% by mass
Description	This parameter is calculated by analytical method
Time of determination/ monitoring	Two times a day

Source of data (to be) used	Protocols of BPCP lab
Value of data applied (for ex ante calculation/ determinations)	Not applicable
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above.
QA/QC procedures (to be) applied	Refer to Section D.2.
Any comment	No additional comments

Data/parameter	Carbon content of natural gas (C_{NG_PJ})
Data unit	kgC/m^3
Description	This parameter is calculated on the basis of chemical composition of natural gas
Time of determination/ monitoring	Monthly
Source of data (to be) used	Quality passport of natural gas
Value of data applied (for ex ante calculation/ determinations)	Not applicable
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above.
QA/QC procedures (to be) applied	Refer to Section D.2.
Any comment	No additional comments

Data/parameter	Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP ($SPE_{metallurgical\_coke}$)
Data unit	t CO_2/t
Description	The source of the value of this parameter is Monitoring Report of the JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works"[12]. Calculation method is described in Annex 4.
Time of determination/ monitoring	Quarterly
Source of data (to be) used	Calculation of this parameter is based on measurements of input and output flows of carbon-containing materials during production of metallurgical coke in BPCP.
Value of data applied (for ex ante calculation/ determinations)	Not applicable

[12] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above.
QA/QC procedures (to be) applied	Refer to Section D.2.
Any comment	No additional comments

Data/parameter	Average value of CO_2 emission factor for electricity produced at MMK ($EF_{own\ generation\ PJ}$)
Data unit	t CO_2/MWh
Description	The source of the value of this parameter is Monitoring Report of the JI project “Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works”[13]. Calculation method is described in Annex 5.
Time of determination/ monitoring	Quarterly
Source of data (to be) used	This parameter is calculated from the data on fuel consumption at MMK electric power plants, carbon content of fuel, and electric supply
Value of data applied (for ex ante calculation/ determinations)	Not applicable
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is determined according to the selected approach of baseline emission calculations, as described above.
QA/QC procedures (to be) applied	Refer to Section D.2.
Any comment	No additional comments

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:

For demonstration that the project provides reductions in emissions by sources that are additional to any that would otherwise occur, the following step-wise approach was used:

Step 1. Identification and description of the approach applied

Additionality of the proposed project shall be proved in accordance with requirement 2(a) of Annex 1 of JI Guidance on criteria for baseline setting and monitoring, version 02.

Justification of additionality is done in several steps, after consideration of economic attractiveness of alternative technologies implemented elsewhere in blast furnace process and at sintering plants.

Selection of plausible alternatives for the baseline scenario and their legislative implications

Step 2. Application of the approach chosen

[13] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

In Section B.1, we described and scrutinized all plausible alternative scenarios and selected those two which are most likely, as the baseline and project scenarios of development of sintering plant/blast furnace process.

Alternative 1 (proposed baseline scenario)

Continued production of hot non-stabilized agglomerate at sintering plants #2 and #3 and operation of blast furnaces #4,6,9,10,2 equipped with the double bell chargers.

Alternative 2 (proposed project scenario)

Construction of sinter cooling and stabilization units at sintering plants #2 and #3 and sequential installation of bell-less top chargers at blast furnaces #4, 6, 9,10,2.

Step 3. Provision of additionality proofs

Identification of significant barriers to project implementation

Barrier 1. Discrepancy between actual and projected consumption of coke

As we noted above an installation of BLT at blast furnaces is a management instrument, which should be effectively utilized. Installation of BLT cannot automatically improve BF indicators of technological process. Even though reduction in coke consumption can be observed, it occurred gradually over time. Coke consumption in BF is affected by numerous technological and economic factors, which are closely related to each other. Thus, there is a considerable probability that projected installation of SCaSU and BLT may not bring about the expected reductions in coke consumption, or it may take a very long time to achieve the estimated reductions. This rises uncertainty in project results, and may be interpreted as a barrier to project implementation.

To illustrate this point, let us recall that seven BLT were to be installed under the contract between MMK and Paul Wurth in 2004. However, only five BLT chargers had been actually installed on the blast furnaces by the spring of 2010. Three of these five have demonstrated actual reductions in coke consumption, one have demonstrated quite modest result in reduction of coke consumption and one have not demonstrated the result in reduction of coke consumption relative to the three-year average coke consumption of the same furnaces with the DBC, prior to the modernization; we took these averages as the baseline.

Below the actual coke consumption under the baseline conditions is considered.

Option 1

Baseline:

- Years 2004-2006 for all project BFs

Project:

- Years 2007-2009 for BF #4 and BF #6
- Years 2008-2009 for BF #9
- Year 2009 for BF #10
- Year 2010 for BF #2 (actual data of April, May, June)

Table B.2.1. Comparison of baseline and project dry skip metallurgical coke consumption data and actual economy of coke under Option 1

Baseline

Indicator	Units	BF 2	BF 4	BF 6	BF 9	BF 10	Average for five furnaces
Consumption of dry skip metallurgical coke in blast furnaces	kg per ton of pig iron	466.9	476.0	473.2	448.4	433.7	**459.7**

Project

Indicator	Units	BF 2	BF 4	BF 6	BF 9	BF 10	Average for five furnaces
Consumption of dry skip metallurgical coke in blast furnaces	kg per ton of pig iron	432.5	453.8	461.0	440.8	434.2	**444.5**

Saving of coke consumption in 2007-2009 (2010 for BF #2)

Indicator	Units	BF 2	BF 4	BF 6	BF 9	BF 10	Average for five furnaces
Consumption of dry skip metallurgical coke in blast furnaces	kg per ton of pig iron	34.4	22.2	12.2	7.6	-0.5	**15.2**

Option 2

Baseline:

- Years 2004-2006 for BFs # 4,6,9,10

Project:

- Year 2009 for BFs # 4,6,9,10

Table B.2.2 Comparison of baseline and project scenarios; economy of coke consumption under Option 2

Data variable	Data unit	BF 4	BF 6	BF 9	BF 10	Average for five furnaces
Consumption of dry skip metallurgical coke in blast furnaces	kg per ton of pig iron	476.0	473.2	448.4	433.7	**457.8**

Data variable	Data unit	BF 4	BF 6	BF 9	BF 10	Average for five

						furnaces
Consumption of dry skip metallurgical coke in blast furnaces	kg per ton of pig iron	436.4	438.9	434.4	434.2	**436.0**

Data variable	Data unit	BF 4	BF 6	BF 9	BF 10	Average for five furnaces
Consumption of dry skip metallurgical coke in blast furnaces	kg per ton of pig iron	39.6	34.4	14.0	-0.5	**17.5**

Thus, one may compare projected and actual values of specific consumption of coke per ton of produced pig iron. The projected economy is the sum of two effects: the effect of SCaSU installation is 14 kg/t and the effect of BLT installation is 10 kg/t. Total economy is 24 kg/t. The projected reductions of specific consumption of skip metallurgical coke was reached only for two furnaces from five where the BLT had been installed however in average the results are far below than projected.

Investment analysis

Each project's attractiveness for investors was considered close to the moment when the equipment procurement contracts were signed: in August of 2004 for BLT and in February of 2005 of SCaSU. All calculations included corrected capital costs of construction-assembly works.

In 2004, the management of MMK considered possibility to sell ERUs, provided that the proposed technological modernization project would be approved as a JI project, at the sale price of $10 per ton of CO_2 (at that time, 10$ was equal to 7.9 Euro, and the exchange rate was 37 Russian Rubles / Euro). MMK economists assessed the potential for ERU sales at that time and concluded that project implementation would generate 331 100 tons of CO_2-eq. of emission reductions per annum for SCaSU deployment component and 99 400 tCO_2-eq/year for BLT installation component. Additional income from ERU sales was estimated about 126 million Rubles per year (see Annex 7, the letter of Mr. V. F. Rashnikov, Director General of MMK, to State Duma of the Russian Federation, dated 17.11.2004). We included those figures into the analysis to demonstrate the effect of ERUs sale.

Table B.2.3. Input data for investment analysis of SCaSU deployment at sintering plants #2 and #3

	Data variable and unit	Value
Energy and resource prices:		
1.	Metallurgical coke, RUR/t	3,462
2.	Iron in metallurgical furnace charge, RUR/t	3,915
3.	Electricity, RUR/MWh	1,100
Economy of raw materials in the result of project implementation that had been expected		

1.	Metallurgical coke, kg/t	14
2.	Iron (Fe) in metallurgical furnace charge, kg/t	14.5
Capital costs, 1000 RUR		2,508,391
Exchange rate, Euro/RUR		37.0
Annual discounting rate%		8.0
Time horizon of investment analysis		12

The results of investment analysis are summarized in Table B.2.4.[14]

Table B.2.4. Results of investment analysis for SCaSU deployment at sintering plants #2 and #3, as of February 2005

Indicator	Internal rate of return (IRR), %	Net present value (NPV), thousand Rubles	Payback period (simple), years	Discounted payback period, years	Minimum IRR needed for project approval by MMK management, %
Without ERU sales	8	79 358	8.6	> 12	8
With ERU sales	10	315 185	7.8	11.5	8

The results of the investment analysis showed that economic indicators of the proposed project without ERU sales had borderline character and could not be regarded attractive from MMK managers' standpoint. ERU sales would increase project's NPV, bring the expected payback period back within the time horizon, and increase IRR up to the acceptable level (above 8%).

The original investment analysis for installation of BLT at the first three blast furnaces is demonstrated below. The actual installation of BLT took place in the same period of time with SCaSU deployment at sintering plants #2 and #3 therefore this analysis is representative one.

Table B.2.5. Input data for investment analysis of installation of BLT at BF #4, #6 and #10[15] (as of August 2004)

	Data variable and unit	Data unit
Energy and resource prices:		
1.	Metallurgical coke, RUR/t	3,297
Economy of raw materials in the result of project implementation that had been expected		
1.	Metallurgical coke, kg/t	10
Contingent variable costs per ton of pig iron, RUR		200

[14] These results were produced by simulation models, which MMK experts use for investment analysis and project appraisal.

[15] By initial plans of MMK the BF #10 should have been third blast furnace for BLT installation, however in further the single-type BF #9 was equipped the third instead of BF #10.

Pig iron production, t/y	3,700,000
Capital costs, 1000 RUR	837.6
Discounting rate, %	8.0
Time horizon for investment analysis	15

The results of investment analysis are summarized in Table B.2.6.[16]

Table B.2.6. Results of investment analysis of project scenario, BLT installation component, as of August 2004

Indicator	Internal rate of return (IRR), %	Net present value (NPV), thousand Rubles	Payback period (simple), years	Discounted payback period, years	Minimum IRR needed for project approval by MMK management, %
Value	7.8	-8 870	8.8	Project is not paid-off	8

The results of the investment analysis showed that economic indicators of this component would be not attractive for MMK managers. Furthermore, the expected economy of coke consumption (10 kg per ton of pig iron) was assumed to be an immediate result of installation of BLT at the three blast furnaces. This is not correct assumption, as operation experience showed, because the reductions in coke consumption could only be achieved during several year period after project realization.

Sensitivity analysis

Sensitivity analysis generally concludes a sound investment analysis. Below we report the results of sensitivity analysis of both components of the investment project: deployment of SCaSU at sintering plants #2 and #3, and installation of BLT at BF #4, #6 and #10.

Regarding the first component (deployment of SCaSU at sintering plants #2 and #3), we conducted analysis of sensitivity of economic indicators to the variations in coke saving and capital costs.

Table B.2.7. Variations in coke saving

Absolute (kg/t) and percentage change in projected coke saving	12.6 (-10%)	14.0 (0%)	15.4 (+10%)
IRR, %	7.0	8.0	9.0
Discounted payback period, years	> 12	> 12	11.9
Simple payback	9,1	8,6	8,2

[16] The results were produced by simulation models, which MMK experts use for investment analysis and project appraisal.

period, years			

Table B.2.8. Variations in capital costs

Absolute (thousand RUR) and percentage change in projected capital costs	2 257 552 (-10%)	2 508 391 (0%)	2 759 230 (+10%)
IRR, %	10.0	8.0	7.0
Discounted payback period, years	11.5	> 12	> 12
Simple payback period, years	7,9	8,6	9,3

Regarding the second component (installation of BLT at BF #4, #6 and #10), we conducted analysis of sensitivity of economic indicators to variations in coke consumption and capital costs.

Table B.2.9. Variations in coke consumption

Absolute (kg/t) and percentage change in projected coke saving per ton of pig iron	9.0 (-10%)	10.0 (0%)	11.0 (+10%)
IRR, %	6.3	7.8	9.3
Discounted payback period, years	> 15	> 15	> 15
Simple payback period, years	9.3	8.8	8.0

Table B.2.10. Variations in capital costs

Absolute (thousand RUR) and percentage change in projected capital costs	753.8 (-10%)	837.6 (0%)	921.3 (+10%)
IRR, %	9.5	7.8	6.4
Discounted payback period, years	> 15	> 15	> 15
Simple payback period, years	8.0	8.8	9.6

According to OJSC “MMK” practice the attractive project shall:

- Have pay-back period of 3-5 years, and/or
- As a result of its implementation lead in new kind of products or improve quality of existing ones, or

- Realize a strategic aim of the company's development.

The considered project does not result in new products appearance and does not improve the quality of pig iron, and does not present a strategic mission – this is a classic resource-saving measure leading among other to reduction of CO_2 emission.

The sensitivity analysis demonstrates that indicators of economic efficiency of the project vary not significantly during changes of key parameters (coke consumption/economy and capital costs). This confirms that project is not considered to be financially attractive within the reasonable range of parameters variation (plus/minus 10%).

With increase of coke saving for 10% the IRR of SCaSU at sintering plants #2 and #3 project is 9.0% but the discounted pack-back period is 11.9 years. With increase of coke saving for 10% the IRR of BLT project is 9.3% but the discounted pack-back period is more than 15 years, i.e. project does not cover the expenditure . Reduction of capital costs for 10% would increase IRR for SCaSU project up to 10.0 % and for BLT project up to 9.5%, but the discounted pack-back period for the projects is 11.5 and more than 15 years respectively. The other variants of comparison leave both IRR and pay-back period indicator out of the admissible range.

As mentioned it should be noted than attractiveness of the project is defined as collection of multiple parameters and only IRR indicator cannot be the only basis for positive consideration. Besides to reach the significant reduction of coke from two measures (SCaSU and BLT) simultaneously is not likely as well as to reduce capital costs on 10%. In any case the pay-back period limitation will predominate.

Thus the provided analysis confirms that project does not attend to financially attractive investment category and have some implementation risks connected with changes in investment costs and reaching of the projected specific coke consumption rate, i.e. additional one. The use of additional cash from ERUs sell was considered the opportunity to reduce risks from the project implementation.

Common practice analysis

This section considers several Russian steel works, which have implemented similar technological modernization projects.

OJSC "Novolipetsk Metallurgical Combine"(NMC)

OJSC NMC is one of the world's greatest iron and steel works with full cycle. It produces pig iron, slab steel, cold-rolled and hot-rolled steel, zinc-coated steel, dynamo steel sheets, transformer steel and polymer-coated steel. In 2008, this company sold its products to more than 70 countries in Europe, South and North America, Asia, Africa, and Middle East. The share of this company in domestic steel production is about 15%.

OJSC NMC completed assembly works at its new blast furnace in the third quarter of 2009. It was planned to complete assembly of a blast-furnace jacket, weight-bearing and support system, BLT and gas scrubbers by the end of 2009.[17] NMC implemented this modernization project jointly with Paul Wurth (Luxemburg) and UZTM Company (Yekaterinburg).

This project involved modernization of NMC BF 7, which produces 3.4 million tons of pig iron per year. This is the largest blast furnace built in Russia during the last 20 years. NMC intended to implement modern technical solutions to achieve high output, resource savings, and fully automated process.

[17] http://www.nlmk.ru/media_centre/press_releases/id-657.html

OJSC "Tulachermet"

This company is one of the largest of this kind in Russia, and the biggest Russian exporter of commercial iron, producing more than 2 million tons of metal per year.[18] It exports commercial iron to CIS, Western Europe, America, and Asia.

Capital reconstruction of Tulachermet BF 1 involved installation of a BLT, under a decision, which was made a long time ago, and announced in the Internet.[19] Tulachermet signed an equipment procurement contract ned with Paul Wurth. In the end of 2009, Paul Wurth representatives visited the plant with inspection of equipment storage conditions at Tulachermet. However, BLC has not yet been installed at BF 1 of Tulachermet, and for this reason we shall not consider this project.

OJSC Kosogorsky Iron and Steel Works

OJSC Kosogorsky Iron and Steel Works is one of the oldest in Russia. It was founded in 1897. This company is one of the largest steel works in Tula region, but it is smaller than some other iron and steel giants of the Russian Federation. This company does not run its own sintering plant. Yet, it is one of the leading Russian producers of pure cast iron, ferromanganese, industrial and art castings. Its products are widely used in machine-building, metallurgy and construction[20].

In the end of 2009, this company began commissioning and adjustment works, installing BLT at its BF 1. This BLT was purchased from Paul Wurth. Most works have been completed, including erection of metallic supports, and assembling of BLT components. BLT tests were about to begin. Uralmach company (Yekaterinburg) produced a furnace charge bin with wearproof plates, mounted it on the support columns, and commissioned it for reception and locking of furnace charge[21].

OJSC "Severstal Russian Steel" (Cherepovets Iron and Steel Works")

"Severstal Russian Steel" Industrial Division is one of the largest steel producers in Russia. This division consists of six segments: steel, sales, wire, tube, service and scrap metal.

In 2006, Severstal undertook a first-rate capital reconstruction, which involved a revamp of its BF 5. The working volume of this blast furnace is now 5,500 m^3. This reconstruction included several changes in the furnace construction. In particular, the blast furnace hearth and bottom were coated with heat-resistant microporous flux, which made the hearth more durable. The furnace cooling system was equipped with brass heat exchangers installed in the under notch zone. The belt of the main conveyor was replaced. A bell-less charger, manufactured by Paul Wurth, was installed at BF 5. These measures greatly improved both furnace output and pig iron quality[22].

OJSC "Nizhni Tagil Iron and Steel Works"

Nizhni Tagil Iron and Steel Works (Russian abbreviation NTMK) is a member of Eurasia Group C.A. This plant is located in the town of Nizhni Tagil in the Urals, and has a full metallurgical cycle. In 2004-2006, NTMK reconstructed its BF 6 and BF 5, and installed a BLT at these blast furnaces. This BLT were purchased from Paul Wurth. (PDD «Reconstruction of the OJSC "Nizhniy Tagil Iron and Steel

[18] http://www.tulachermet.ru/okompan.htm

[19] http://www.advis.ru/cgi-bin/new.pl?A1BD4527-400C-5441-952C-152CE9F77A57

[20] http://www.kmz-tula.ru/index1.html

[21] http://www.kmz-tula.ru/news-20091210.html

[22] http://www.severstal.ru/old/docs/openness/presscentre/news/200901161553-1004.htm

Works" blast furnaces #5 and #6, Russian Federation"). This document was posted at the website of JI Supervisory Committee in 2009[23]. We shall not consider this project.

Resume:

Construction of additional sinter cooling and stabilization units at operating sintering plants is a unique project to be implemented only at MMK. Such project is implemented in Russian Federation for the first time.

Although the first through bell-less top was constructed a long time ago (Paul Wurth company installed and tested the first BLT in Japanese city of Hamborn at BF 4 in 1972), and since then many such chargers have been constructed initially in Japan, and later elsewhere in the world, this innovative technology was not implemented in USSR and later in the Russian Federation.

Today, bell-less top along with other modern equipment are installed only at newly constructed or fundamentally renovated blast furnaces. We surveyed more than 10 largest Russian steel works in 2010. Only two of these except MMK (Severstal and NTMK) have implemented and commissioned BLT technology. The described above NTMK project was registered as a Joint Implementation project.

We conclude that MMK project, which implemented both SCaSU and BLT technologies in 2006-2010, was the first of its kind and still unique for Russian steel making industry. This constitutes a proof of its additionalily.

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

The project boundaries include:

- By-product coke plant
- Blast-furnace plant: blast furnaces # 4,6,9,10,2
- Sintering plant: SCaSU at plants #2 and #3
- Own power generation capacities of MMK: CHPP, CPP, SABPP, turbine section in the steam plant, gas recovery section in the steam plant

Table B. 3.1. Emission sources under baseline and project

	Emission source	Gas	Included/not included	Comments
Baseline	By-product coke plant	CO_2	Included	Carbon-containing materials (furnace charge, blast furnace gas, coke oven gas, natural gas) are consumed during production of coke for BF #4,6,9,10, 2
	Blast furnace plant	CO_2	Included	Carbon-containing material and fuel (metallurgical coke and natural gas) are used for production of pig iron in BF #4,6,9,10, 2

[23] http://ji.unfccc.int/JI_Projects/DB/C94UAR3UWKO2UYUKSNMQTEMWIDILLR/PublicPDD/SPKJBHTPGZRIJRKDI4BX2QEDCATXZZ/view.html

Project	By-product coke plant	CO_2	Included	Carbon-containing materials (furnace charge, blast furnace gas, coke oven gas, natural gas) are consumed during production of coke for BF #4,6,9,10, 2
	Blast furnace plant. Use of skip metallurgical coke and natural gas	CO_2	Included	Carbon-containing material and fuel (metallurgical coke and natural gas) are used for production of pig iron in BF #4,6,9,10,2
	Blast furnace plant. Periodical use of coke breeze fraction 10-25 mm (coke nut)	CO_2	Excluded	Utilization of coke breeze fraction 10-25 mm (coke nut) reduces the consumption of skip metallurgical coke. However in the absence of the project it would be burnt anyhow. See detailed justification in section D.1.
	Own power generation capacities of MMK: CHPP, CPP, SABPP, turbine section in the steam plant, gas recovery section in the steam plant	CO_2	Included	Electricity generation requires burning of blast furnace gas, coke oven gas, natural gas, and power plant coal (only at CHPP). This electricity is consumed by SCaSU and used for production of pure nitrogen for bell-less chargers at BF #4,6,9,10,2. As a conservative assumption, this project does not consider imports of electricity from Unified Energy Systems of Urals power grid.

Diagram B 3.1 Project boundaries. Project scenario

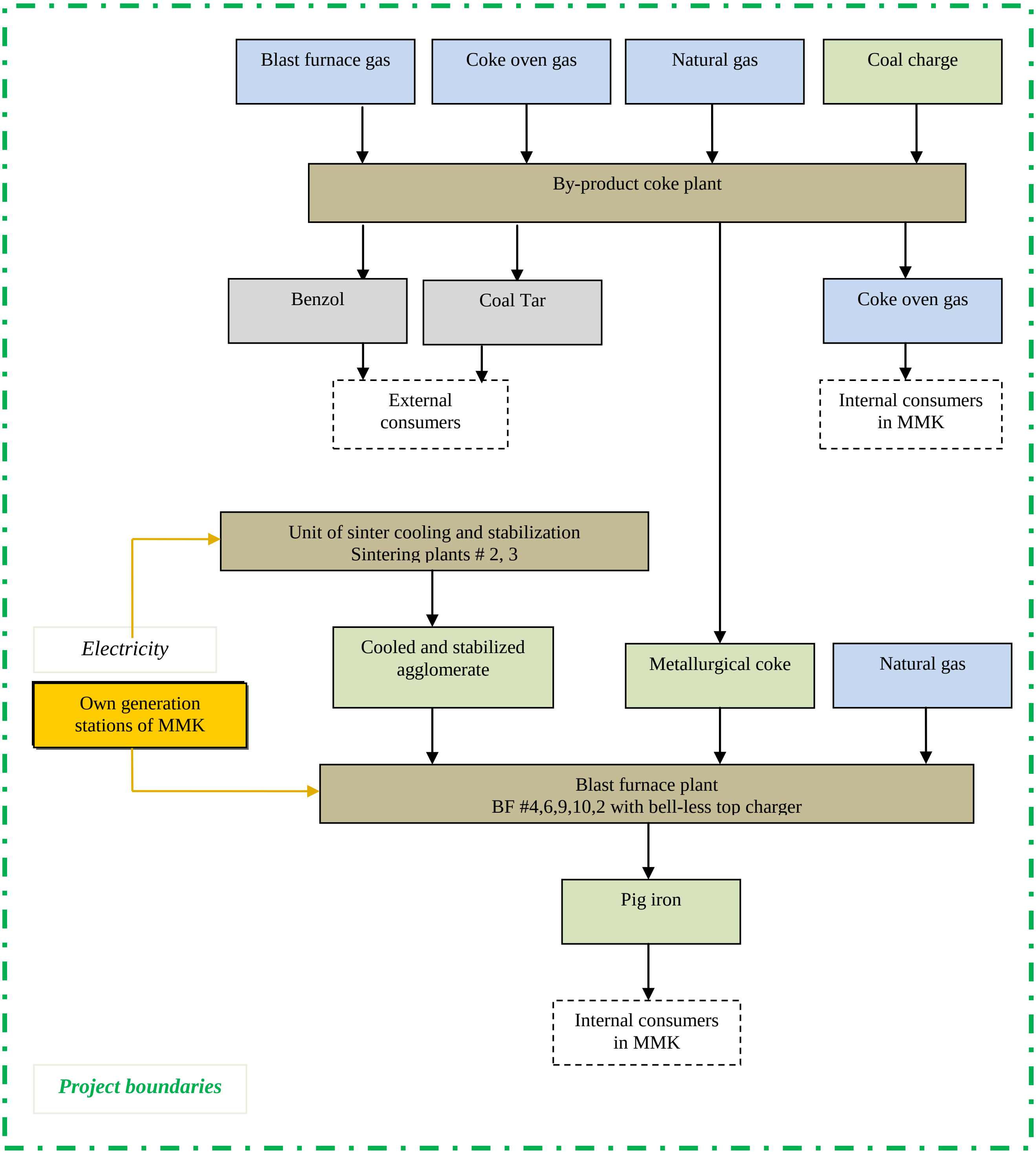
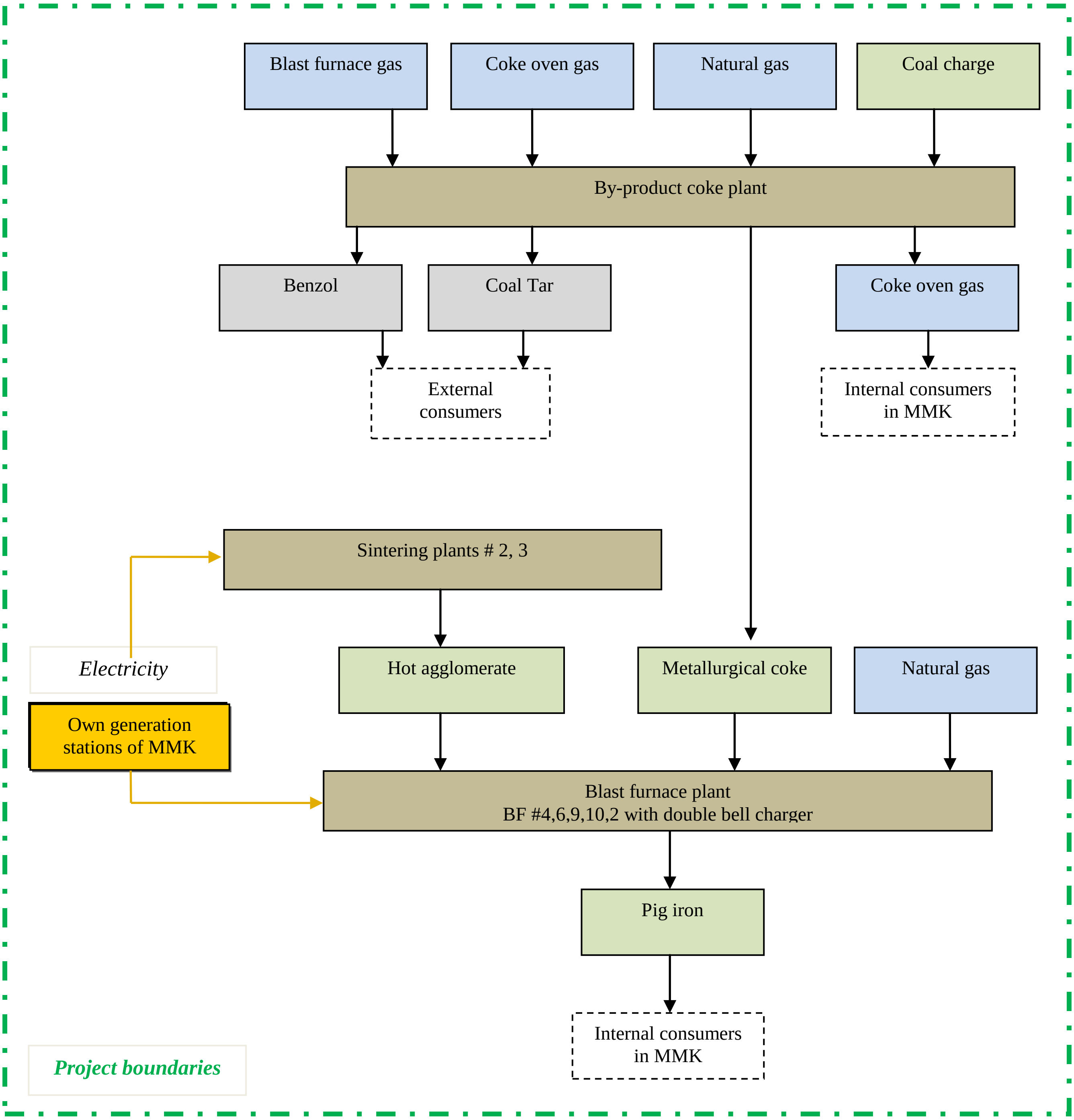


Diagram B 3.2 Project boundaries. The baseline scenario



- this plant/source is beyond the project boundaries

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

Baseline setting date: 27/09/2010

Baseline calculations were performed by:

“CTF Consulting”, LLC
Moscow, Baltchug Street 7, Business-center “Baltchug Plaza”, office 629;
Contact person: Konstantin Myachin, Carbon Project Manager
Ph: +7 495 984 59 51
Fax: +7 495 984 59 52
e-mail: konstantin.myachin@carbontradefinance.com

“CTF Consulting”, LLC is not a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

August 27, 2004

C.2. Expected operational lifetime of the project:

Operation lifetime of the project is 16 years/ 192 months between 2006 and 2020

C.3. Length of the crediting period:

4 years / 48 months from 01.01.2009 to 31.12.2012.

Could be extended up to the maximum period between 01.01.2013 and 31.12.2020 (eight years extra) if the extension of crediting period for this project is approved by the Russian Federation.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

According to Appendix B to Decision 9/CMP.1 (refer to the Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005) and JI Guidance on criteria for baseline setting and monitoring, Version 02 project monitoring plan comprises the following steps:

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

PDD developer uses its JI specific approach of GHG emissions monitoring under the project and the baseline, according to Paragraph 9(a) of JI Guidance on criteria for baseline setting and monitoring, Version 02.

Project CO_2 emissions are calculated as follows:

1. Based on technical reports of Blast Furnace Plant the actual consumption of dry skip metallurgical coke and natural gas in BF #4,6,9,10, 2 is defined. If production of pig iron in the project would exceed a maximum output of pig iron by BF #4,6,9,10, 2 in the baseline scenario, the consumption of coke and natural gas will be mathematically reduced and for production of excess amount of pig iron in the project not to be considered. Based on actual carbon content in metallurgical coke and natural gas the project CO_2 emissions from consumption of dry skip metallurgical coke and natural gas at BF #4,6,9,10, 2 are calculated.
2. The emissions from production of skip metallurgical coke consumed at BF #4,6,9,10, 2 are calculated on the basis of specific CO_2 emission factor per ton of metallurgical coke produced by BPCP. This emission factor is calculated by carbon balance for coke production at BPCP, as described in PDD “Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works”. This PDD had been determined by independent expertise (determination) by Bureau Veritas[24] (Annex 4 of this PDD describes calculation methods).
3. The next step is calculation of CO_2 emissions from consumption of electricity by SCaSU and CO_2 emissions from consumption of electricity during production of pure nitrogen required to cool down the BLT reduction gear at BF #4,6,9,10,2. The basis for that are the consumption of electricity by SCaSU at the sintering plants #2 and #3 and the consumption of electricity for production of consumed pure nitrogen (no mathematic reduction depending on the iron production is done for conservativeness reason) and CO_2 emission factor for electricity produced at MMK , as described in PDD

[24] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

"Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works". This PDD had been determined by independent expertise (determination) by Bureau Veritas[25] (Annex 5 of this PDD describes calculation methods).

4. Finally, total project CO_2 emissions are summed up.

To calculate the difference between the project emissions and the baseline emissions, we used fixed historical specific coefficients, which described blast furnace operation under the baseline scenario, because the double bell chargers have already been dismantled from BF #4,6,9,10,2 (Annex 2). At the same time the carbon contents of coke and natural gas are measured directly as part of monitoring. Thus, our approach combined historic specific coefficients of consumption of production inputs and actual carbon content in raw materials and fuels (Step 2).

Baseline CO_2 emissions are calculated as follows:

1. Performance of the blast furnaces # 4, 6, 9, 10, 2 based on three-year period before project implementation is defined and relevant parameters are fixed ex-ante. The annual technical reports of blast furnace plant of MMK for the period of 2004-2006 (i.e. before installation of the SCaSU and bell-less top chargers) are used to determine a consumption of skip metallurgical coke (on dry mass) and natural gas as well as pig iron production by blast furnaces # 4, 6, 9, 10, 2. These data were used to calculate and fix ex-ante the average baseline specific consumption of skip metallurgical coke and NG per ton of pig iron produced for each of these furnaces.
2. Since the actual production of pig iron in the project may be higher than in comparison period of 2004-2006 and no changes of the working volume of the blast furnaces were done the historical maximal output of BF #4 and # 9 (date of 1988 year), BF #6 (date of 1990 year), BF # 10 (date of 1987) BF #2 (average value of historical data for the period of 2004-2006) equipped with double bell charges has been determined.
3. On the basis of actual pig iron production (which is limited for the baseline by maximal output of BF # 4, 6, 9, 10, 2) and average baseline specific consumption of dry skip metallurgical coke and NG per ton of pig iron produced the gross consumption of dry skip metallurgical coke and natural gas is calculated for each of the furnace. Based on these data and taking into account the actual carbon content in metallurgical coke and natural gas the total CO_2 emissions from consumption of dry skip metallurgical coke and natural gas in the baseline at BF #4,6,9,10, 2 are calculated. In case the actual production of pig iron by any of the blast furnaces would be higher than its historical maximal output, the mathematical reduction of related CO_2 emissions is done.
4. CO_2 emissions from production in BPCP of MMK of the skip metallurgical coke consumed in the baseline by BF #4,6,9,10, 2 are calculated on the basis of specific CO_2 emission factor per ton of produced metallurgical coke. This emission factor is calculated as well for other JI project developed by CTF, Ltd. –"Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works", PDD had passed determination by Bureau Veritas Certification[26] (for the principles of estimation see also Annex 4) and is taken as a link.

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[25] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

[26] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

5. Finally total CO_2 baseline emissions are summed up.

Step 2. Application of the approach chosen

According to Guidelines for users of the JI PDD form, Version 04 the application of monitoring plan needs to explicitly and clearly distinguish:

a. Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination;

b. Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), but that are not already available at the stage of determination; and

c. Data and parameters that are monitored throughout the crediting period.

In the project context the application is following:

Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination

Table D.1.1. Data and parameters, which remain fixed over the credit period, and are available at the determination stage

№	Data variable and unit	Notation	Value	Data source
1.	Maximum output of pig iron in BF #4 in the baseline, th. tons	$P_{max\ pig\ iron\ BF\ 4\ BL}$	1,217.4	Maximum output of BF #4 was reached in 1988. Data from technical reports of blast furnace plant of Magnitogorsk metallurgical works here and in rows beneath.
2.	Maximum output of pig iron in BF #6 in the baseline, th. tons	$P_{max\ pig\ iron\ BF\ 6\ BL}$	1,110.7	Maximum output of BF #6 was reached in 1990
3.	Maximum output of pig iron in BF #9 in the baseline, th. tons	$P_{max\ pig\ iron\ BF\ 9\ BL}$	1,768.0	Maximum output of BF #9 was reached in 1988
4.	Maximum output of pig iron in BF #10 in the baseline, th. tons	$P_{max\ pig\ iron\ BF\ 10\ BL}$	1,789.6	Maximum output of BF #9 was reached in 1987

Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), but that are not already available at the stage of determination

Table D.1.2. Data and parameters, which remain fixed over the credit period, and are not available at the determination stage

№	Data variable and unit	Notation	Value	Data source
1.	Consumption of dry skip metallurgical coke in BF #4 under the baseline, averaged over 2004-2006, t	$M_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL}$	481,348	These parameters are considered to be not available at the determination stage as had been calculated on the basis of historical data from technical reports of years 2004-2006 of blast furnace plant of MMK. See Annex 2 as well.
2.	Production of pig iron in BF #4 in the baseline, averaged over 2004-2006, t	$P_{pig\ iron\ BF\ 4\ averaged\ BL}$	1,011.2	
3.	Consumption of NG in BF #4 in the baseline, averaged over 2004-2006, th. m^3/year	$FC_{NG\_BF\ 4\ averaged\ BL}$	103,017	
4.	Consumption of dry skip metallurgical coke in BF #6 in the baseline, averaged over 2004-2006, t	$M_{skip\ metallurgical\_coke\_BF\ 6\ averaged\ BL}$	515,482	
5.	Production of pig iron in BF #6 in the baseline, averaged over 2004-2006, t	$P_{pig\ iron\ BF\ 6\ averaged\ BL}$	1,089.2	
6.	Consumption of NG in BF #6 in the baseline, averaged over 2004-2006, th. m^3/year	$FC_{NG\_BF\ 6\ averaged\ BL}$	116,505	
7.	Consumption of dry skip metallurgical coke in BF #9 under the baseline, averaged over 2004-2007, t	$M_{skip\ metallurgical\_coke\_BF\ 9\ averaged\ BL}$	668,984	
8.	Production of pig iron in BF #9 in the baseline, averaged over 2004-2007, t	$P_{pig\ iron\ BF\ 9\ averaged\ BL}$	1,492,464	
9.	Consumption of NG in BF #9 in the baseline, averaged over 2004-2007, th. m^3/year	$FC_{NG\_BF\ 4\ averaged\ BL}$	142,514	

10.	Consumption of dry skip metallurgical coke in BF #2 under the baseline, averaged over 2005-2009, t	$M_{skip\ metallurgical\_coke\_BF2\ averaged\ BL}$	552,198	
11.	Production of pig iron in BF #2 in the baseline, averaged over 2005-2009, t	$P_{pig\ iron\ BF\ 2\ averaged\ BL}$	1,182,901	
12.	Consumption of NG in BF #2 in the baseline, averaged over 2005-2009, th. m^3/year	$FC_{NG\_BF\ 2\ averaged\ BL}$	123,167	
13.	Consumption of dry skip metallurgical coke in BF #10 under the baseline, averaged over 2005-2009, t	$M_{skip\ metallurgical\_coke\_BF10\ averaged\ BL}$	661,148	
14.	Production of pig iron in BF #10 in the baseline, averaged over 2005-2009, t	$P_{pig\ iron\ BF\ 10\ averaged\ BL}$	1,525,061	
15.	Consumption of NG in BF #10 in the baseline, averaged over 2005-2009, th. m^3/year	$FC_{NG\_BF\ 10\ averaged\ BL}$	131,324	
16.	Specific consumption of dry skip metallurgical coke in BF #4, kg/t	$SM_{skip\ metallurgical\_coke\_BF4\ averaged\ BL}$	476.0	
17.	Specific consumption of NG in BF #4, m^3/t	$SFC_{NG\_BF\ 4\ averaged\ BL}$	101.9	
18.	Specific consumption of dry skip metallurgical coke in BF #6, kg/t	$SM_{skip\ metallurgical\_coke\_BF6\ averaged\ BL}$	473.3	
19.	Specific consumption of NG in BF #6, m^3/t	$SFC_{NG\_BF\ 6\ averaged\ BL}$	107.0	
20.	Specific consumption of dry skip metallurgical coke in BF #9, kg/t	$SM_{skip\ metallurgical\_coke\_BF9\ averaged\ BL}$	448.2	
21.	Specific consumption of NG in BF #9, m^3/t	$SFC_{NG\_BF\ 9\ averaged\ BL}$	95.5	

22.	Specific consumption of dry skip metallurgical coke in BF #2, kg/t	SM $_{skip\ metallurgical\_ coke\ \_BF\ 2\ averaged\ BL}$	466.8	
23.	Specific consumption of NG in BF #2, m^3/t	SFC $_{NG\_BF\ 2\ averaged\ BL}$	104.1	
24.	Specific consumption of dry skip metallurgical coke in BF #10, kg/t	SM $_{skip\ metallurgical\_ coke\ \_BF\ 10\ averaged\ BL}$	433.5	
25.	Specific consumption of NG in BF #10, m^3/t	SFC $_{NG\_BF\ 10\ averaged\ BL}$	86.1	
26.	Maximum output of pig iron in BF #2 in the baseline, th. tons	P $_{max\ pig\ iron\ BF\ 2\ BL}$	1,182.901	This parameter is considered to be not available at the determination stage as had been calculated on the basis of average historical data of pig iron production in 2004-2006.

The three-years averaging period is reasonable and conservative to define and fix ex-ante the consumption of dry skip metallurgical coke under the baseline as:

- blast furnace is a continuously working aggregate and the longer the period for consideration, the more reliable characteristics can be recorded;

- impact of the fluctuation of coke quality (which do not depend on the project implementation, see beneath), loading of the blast furnace and other irrelevant factors is reduced;

- in the blast furnace the skip metallurgical coke consumption is connected with the natural gas consumption, both are carbon containing materials, therefore the longer period of averaging of both parameters gives more authentic data.

Current practice of CDM (approved methodologies AM0044, AM0061, ACM0007, etc.) confirms that three year averaging period can be used in JI specific approach as well.

Data and parameters that are monitored throughout the crediting period

Described in Sections D.1.1. and D 1.1.3. below.

<u>Analysis and assumptions</u>

Besides projected improvements in the gas dynamics and the blast furnace process, there are other factors, which have an influence on skip metallurgical coke consumption in the blast furnace:

- Consumption of coke nut;
- Changes in coke quality.

Justification of exclusion of coke nut as emission source due to its consumption in blast furnaces in the project

A raw material for coke production is a coking coal. Coke batteries produce gross coke. After coke quenching fine fractions (coke nut and coke breeze) are screened out and metallurgical coke is transported to the blast furnace plant. There the metallurgical coke is additionally screened and coke nut/coke breeze are again separated. Coke breeze (fraction of 0-10 mm) is fully consumed at the sintering plant as a fuel for agglomeration machines. The sintering plant also sometimes consume coke nut (fraction 10-25 mm), but the additional milling is required. The excess of coke nut is sold to other industries, e.g., metallurgical plants, where it is used as a high-carbon fuel or as a component for production of carbon-bearing powder. Therefore it turns into CO_2 emissions during its utilization either at the sintering plant or outside and there is no carbon sink related to formation and further use of coke nut. See furthermore Diagram D.1.1.1 and Diagram D.1.1.2.

The implementation of the sinter cooling and stabilization units project at sintering plants #2 and #3 resulted in reduction of formation of fine fraction of agglomerate and therefore improved the gas flow inside the blast furnace. This measure allowed to use some coke nut in the charging of blast furnaces together with coke, which earlier was impossible and coke nut had not been specially added into the blast furnaces (in the baseline). The addition of the coke nut thereby reduces consumption of the skip metallurgical coke (replacement coefficient is 1 kg of coke breeze for 0.68 kg of skip metallurgical coke).

To simplify the monitoring and being in line with conservativeness principles the utilization of the coke nut in the blast furnace is not considered as the project emission source for production of the iron because of the following reasons:

- Magnitogorsk metallurgical works is a full cycle metal production complex “from ore to rolled metal” with own coke production facilities included into the project boundary. MMK produces metallurgical coke (fraction more than 25 mm) only for consumption in own blast furnaces, there is no sale of metallurgical coke outside which eliminates potential leakages related to metallurgical coke;
- Percentage of formation of coke nut and coke breeze during screening of gross coke in BPCP and metallurgical coke in BFP depends on the quality of raw materials for coke production and in this connection with quality of produced coke. In this respect project implementation cannot impact. Besides the screening of gross coke and metallurgical coke is performed in the project the same way as in the baseline nor additional equipment has been installed;
- In the baseline the consumption of skip metallurgical coke is higher than in the project and accordingly the total baseline formation of coke nut shall be more than in the project. Therefore the CO_2 emissions from utilization of coke nut in the baseline are higher than in the project.

- There is a direct connection between demand of skip metallurgical coke for blast furnaces of MMK and consumption of coking coal for production of metallurgical coke at BPCP. The reduction of consumption of skip metallurgical coke due to its partial replacement by own coke nut would result in reduction of coking coal purchase and prevent associated CO_2 emissions related to the metallurgical coke production;
- Use of relatively small amounts of coke nut in the blast furnaces in comparison with total formation of coke nut and coke breeze at MMK does not impact to the fuel balance of sintering plant because it uses coke nut as a periodical addition to the main fuel (coke breeze fraction 0-10 mm) and as a rule there is an excess of fraction 10-25 mm at MMK which is sold. Sintering plant of MMK does not use imported coke breeze or metallurgical coke that eliminates potential leakages.

Thereby it is demonstrated that exclusion of coke nut as project emission source during its consumption in blast furnaces reduces baseline emissions and therefore it is conservative.

Diagram D.1.1.1 Material flows related to use of coke at MMK. Baseline situation

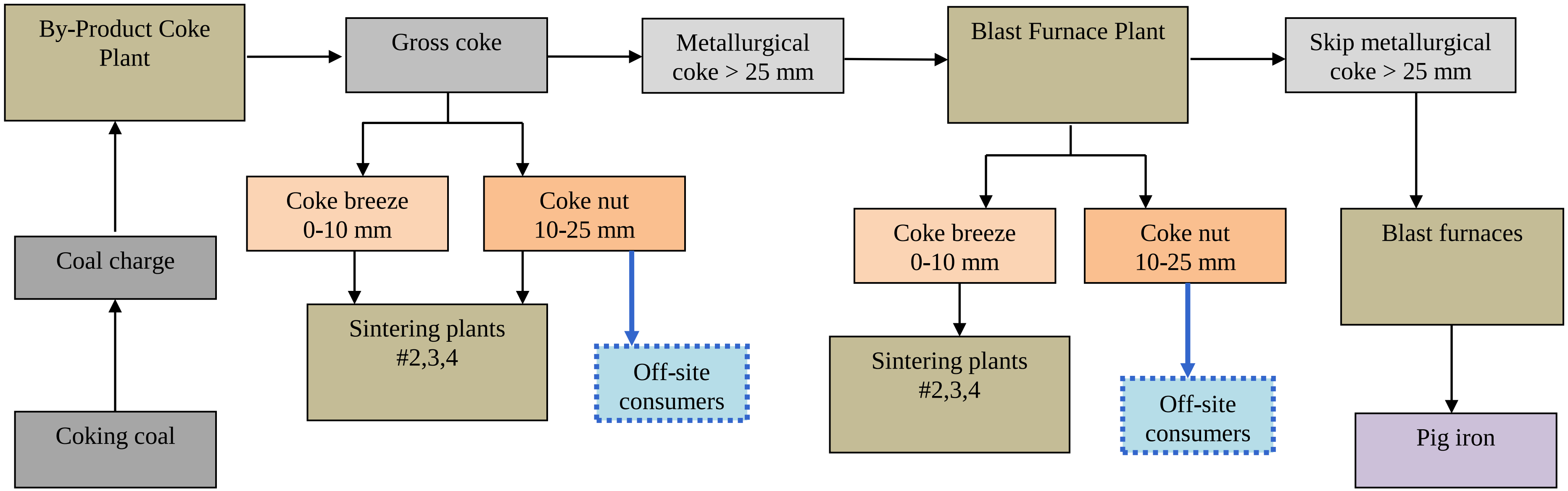
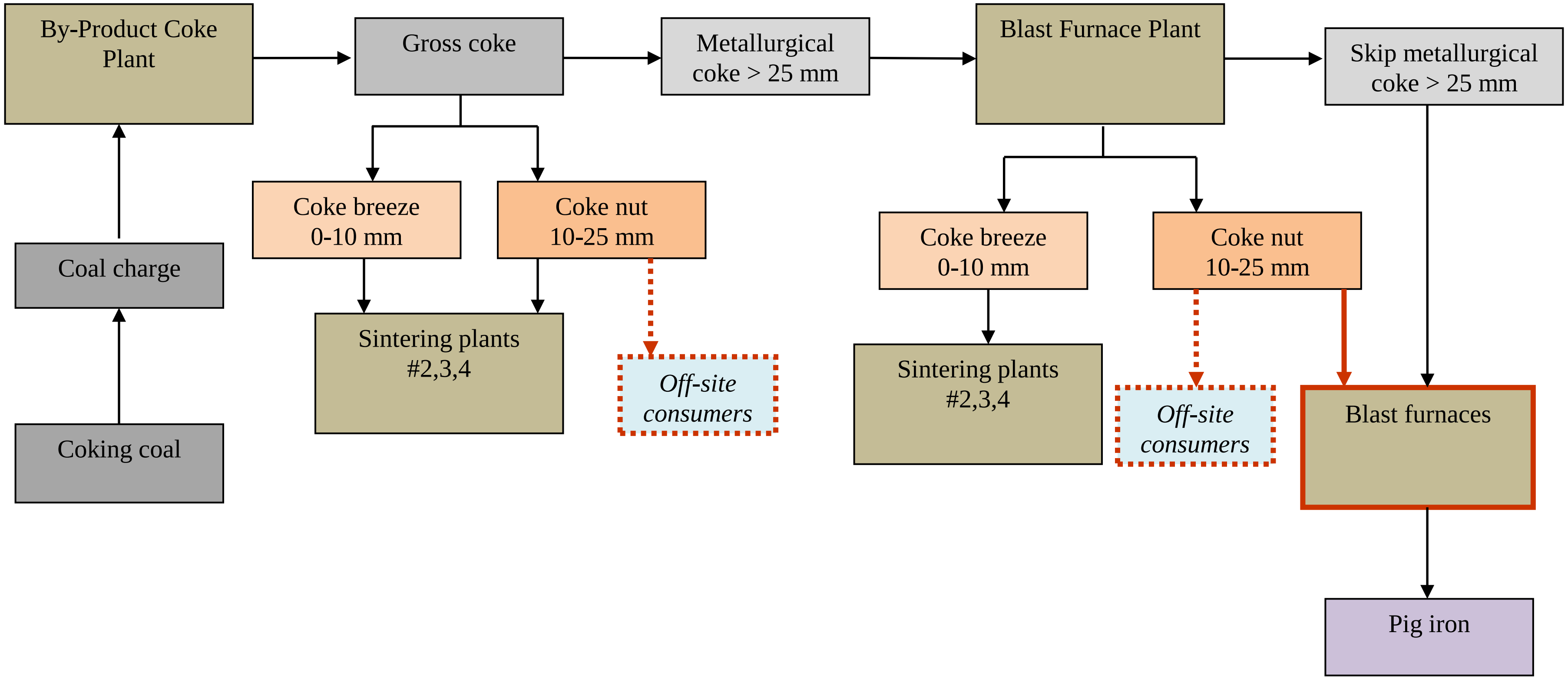


Diagram D.1.1.1 Material flows related to use of coke at MMK. Project situation



Justification of disregard of possible fluctuations in skip metallurgical coke consumption as a result of coke quality changes

The quality of metallurgical coke is defined by a wide number of parameters like sulfur content, ash content, strengths, abradability, etc. that are consequence of chemical content and characteristics of raw material (coking coal). To account the influence of coke quality for the long period of time is enough complex and not reasonable because coke quality changes with any purchase batch and longer periods for comparison (like 2-3 years) reduce the uncertainly in this respect.

Besides it is noticed that quality of coke in 2009-2010 is worse that is the period of years 2004-2006 where the baseline historic parameters have been fixed. This is explained by the fact that MMK company in the absence of enough number of own coking coal enterprises is forced to buy the coking coal at the market where quality of the coke is in the direct connection with its price. Therefore it seems to be conservative to compare the actual monitored consumption of coke and natural gas in comparison with the fixed ex-ante values of 2004-2006. This approach excludes from consideration a “non-material” reduction of coke consumption and thus we operate only with real performance of the blast furnaces within project boundary. It is logic to propose that with the baseline technologies the use of coke with worse quality would result in growth of the specific skip metallurgical coke consumption by blast furnaces in comparison with more flexible project technologies. However to keep the conservativeness such reduction of coke consumption is not considered and therefore the quality of coke is left outside the project methodology.

Analysis of consumption of other energy resources

SCaSU were added to the existing technological chains of production of hot agglomerate at sintering plants #2 and #3. While SCaSU consumes electricity, it does not consume any other energy resources.

Blast furnaces consume such production inputs as air blast, technological oxygen, water, electricity and steam.
Technological oxygen is added to air blast to intensify melting process. Re-circulated water and cooling water are needed for prevention of overheating of heat-resistant blast-furnace masonry. Electricity is needed to power the blast furnace equipment. Steam is needed for various technological uses. To avoid double counting, we did not consider consumption of blast furnace gas and coke oven gas for air blast heating. Blast furnace gas is a product of combustion of coke and natural gas in the blast furnace. Coke oven gas is formed during coke production.

Table D.1.3. Specific consumption of energy resources by BF #4,6,9,10,2 under the baseline and project

№	Data variable and unit	***Baseline (averaged for 2005-2006)***	***Project scenario (for 2009)***
1.	Water consumption, m^3 per ton of pig iron	22.05	21.80
2.	Total electricity consumption, kWh per ton of pig iron	4.92	4.80

3.	Consumption of air blast, th. m^3 per ton of pig iron	2.45	2.39
4.	Consumption of pure nitrogen, th. m^3 per ton of pig iron	0.00	11.766

Table D.1.4. Specific stream consumption, Mcal per ton of pig iron by blast furnaces under the baseline and project

	BF #1	BF #2	BF #4	BF #6	BF #7	BF #8	BF #9	BF #10	BF #1,2,7,8 (with DBC)	BF #4,6,9,10 (with BLT charger)
Baseline (averaged for 2005-2006)	26,85	37,21	36,69	41,43	39,56	54,04	39,25	34,79	39,41	38,04
Project scenario (for full year, 2009)	49,1	51,5	22,2	46,1	59,8	41,0	38,4	46,6	50,35	38,32

Table D.1.5. Specific oxygen consumption, th. m^3 per ton of pig iron by blast furnaces under the baseline and project

	BF #1	BF #2	BF #4	BF #6	BF #7	BF #8	BF #9	BF #10	BF #1,2,7,8 (with DBC)	BF #4,6,9,10[27] (with BLT charger)
Baseline (averaged for 2005-2006)	65,25	110,45	112,13	114,05	112,35	111,2	139,5	133,17	99,83	124,71
Project scenario (for full year, 2009)	81,9	151,3	137,2	146,9	155,6	125,8	135,6	135,1	128,65	138,7

The data in Table D.1.5 indicate that project implementation will generate reductions in consumption of water, air blast and electricity. For this reason, we did not consider these parameters during calculation of emission reductions. As illustrated the data of tables D.1.6., D.1.7 specific stream and oxygen consumption have increased by all blast furnaces. But the growth of specific stream and oxygen consumption have been more considerably by blast furnaces with DBC. So,

[27] The BLT at the blast furnace #2 has been installed in March 2010, so it had not been operational in 2009.

increase of these parameters is a result of intensification of smelting process and it is not related to installation of BLT. Therefore, we did not consider specific consumption of stream and oxygen during calculation of emission reductions. Increase in consumption of pure nitrogen is a direct result of BLT installation. For this reason, we included this parameter in calculations of project emissions.

Consumption of production inputs, raw materials, energy resources, and output of commercial products are routinely monitored by MMK by the system of corporate monitoring and reporting. These parameters are measured in accordance with applicable standards and rules of iron and steel industry of Russia, and international standarts (MMK is certified under ISO 9001 standard). All required parameters are available within the internal monitoring and accounting implemented at MMK, and CO_2 emission monitoring does not require any changes in this system.

The majority of measured indicators, required for CO_2 emission monitoring, are regularly measured by direct analyses in Central Lab of MMK or calculated on the basis of chemical composition of carbon-containing substances (composition of natural gas is taken from its technical passport, issued by the supplier).

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
Production of metallurgical coke at BPCP								
P-1	**SPE** **metallurgical_coke** Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP	Calculation spreadsheet for Monitoring report for JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel	t CO_2/t	c	Quarterly	All	Electronic/ paper	Monitoring report for JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works" is prepared by CTF

		Works"						Consulting and passes verification procedure annually. The calculation spreadsheet is prepared quarterly.
Production of pig iron in BF #4								
P-2	**M** $_{skip\ metallurgical\_coke\_BF\ 4\ PJ}$ Consumption of dry skip metallurgical coke in BF #4	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-3	**FC** $_{NG\_BF\ 4\ PJ}$ Consumption of NG in BF #4	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-4	**%C** $_{metallurgical\ coke\_PJ}$ Carbon content in metallurgical coke	CL (BPCP Lab)	% by weight	m	2 times per day	All	Electronic/ paper	Measurement results are averaged out
P-5	**C** $_{NG\_PJ}$ Carbon content in NG	Department of chief power engineer	kgC/m^3	c	Monthly	All	Electronic	This parameter is calculated on the basis of chemical composition of natural gas, as specified in the technical

								passport issued by the supplier
P-6	**V** $_{pure\ N2\_BF4}$ Consumption of pure nitrogen in BF #4	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-7	**P** $_{pig\ iron\ BF\ 4\ PJ}$ Production of pig iron in BF #4	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
Production of pig iron in BF #6								
P-8	**M** $_{skip\ metallurgical\_coke\_BF\ 6\ PJ}$ Consumption of dry skip metallurgical coke in BF #6	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-9	**FC** $_{NG\_BF\ 6\ PJ}$ Consumption of NG in BF #6	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-10	**V** $_{pure\ N2\_BF6}$ Consumption of pure nitrogen in BF #6	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-11	**P** $_{pig\ iron\ BF\ 6\ PJ}$	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued

	Production of pig iron in BF #6							monthly and confirmed by Technological Department
Production of pig iron in BF #9								
P-12	**M** **skip metallurgical_ coke_BF 9 PJ** Consumption of dry skip metallurgical coke in BF #9	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-13	**FC** **NG_BF 9 PJ** Consumption of NG in BF #9	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-14	**V** **pure N2_BF9** Consumption of pure nitrogen in BF #9	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-15	**P** **pig iron BF 9 PJ** Production of pig iron in BF #9	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
Production of pig iron in BF #2								
P-16	**M** **skip metallurgical_ coke_BF 2 PJ** Consumption of dry skip	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological

	metallurgical coke in BF #2							Department
P-17	**FC** $_{NG\_BF\ 2\ PJ}$ Consumption of NG in BF #2	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-18	**V** $_{pure\ N2\_BF2}$ Consumption of pure nitrogen in BF #2	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-19	**P** $_{pig\ iron\ BF\ 2\ PJ}$ Production of pig iron in BF #2	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
Production of pig iron in BF #10								
P-20	**M** $_{skip\ metallurgical\_coke\_BF\ 10\ PJ}$ Consumption of dry skip metallurgical coke in BF #10	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-21	**FC** $_{NG\_BF\ 10\ PJ}$ Consumption of NG in BF #10	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
P-22	**V** $_{pure\ N2\_BF10}$	BFP	th. m^3	m	Continuously	All	Electronic/ paper	BFP Technical

	Consumption of pure nitrogen in BF #10							Report is issued monthly and confirmed by Technological Department
P-23	**P** $_{pig\ iron\ BF\ 10\ PJ}$ Production of pig iron in BF #10	BFP	t	m	Continuously	All	Electronic/ paper	BFP Technical Report is issued monthly and confirmed by Technological Department
Sinter cooling and stabilization unit of sintering plant #2								
P-23	**EC** $_{CSU\ AF\ 2}$ Electricity consumption by SCaSU at SP #2	Technological Department	kWh	m	Continuously	All	Electronic/ paper	MMK Report on Electricity Consumption
Sinter cooling and stabilization unit of sintering plant #3								
P-24	**EC** $_{CSU\ AF\ 3}$ Electricity consumption by SCaSU at SP #3	Technological Department	kWh	m	Continuously	All	Electronic/ paper	MMK Report on Electricity Consumption
Electricity consumption at MMK								
P-25	**EF** $_{own\ generation\_PJ}$ Average value of CO2 emission factor for generation of electricity by own power generating capacities of MMK	Calculation spreadsheet for Monitoring report for JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works"	tCO_2/MWh	c	Quarterly	All	Electronic/ paper	Monitoring report for JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works" is prepared by CTF Consulting and passes

								verification procedure annually. The calculation spreadsheet is prepared quarterly.
P-26	**SEC** $_{\text{pure N2}}$ Specific electricity consumption during production of pure nitrogen	Technological Department	MWh/th. m^3	c	Monthly	All	Electronic/ paper	MMK Report on Electricity Consumption

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

Total reduced emissions from consumption of dry skip metallurgical coke in BF #4, production of this metallurgical coke in BPCP, consumption of NG in BF #4

$$PE_{\text{coke, NG for BF4 reduced}} = M_{\text{skip metallurgical coke\_BF 4 reduced PJ}} * \%C_{\text{metallurgical coke\_PJ}} /100 * 44/12 + M_{\text{skip metallurgical coke\_BF 4 reduced PJ}} * SPE_{\text{metallurgical coke}} + FC_{\text{NG\_BF 4 reduced PJ}} * C_{\text{NG\_PJ}} * 44/12 \quad \text{(D.1.1.2.-1)}$$

Where:

$PE_{\text{coke, NG for BF4 reduced}}$ – Project emissions from consumption of dry skip metallurgical coke in BF #4, production of this metallurgical coke in BPCP, consumption of NG in BF #4, reduced, th. tones CO_2

$M_{\text{skip metallurgical\_ coke \_BF 4 reduced PJ}}$ – Project consumption of dry skip metallurgical coke in BF #4, reduced, tones

$\%C_{\text{metallurgical coke\_PJ}}$ – Carbon content in metallurgical coke, % by weight

$SPE_{\text{metallurgical\_coke}}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tons CO_2/t

$FC_{\text{NG\_BF 4 reduced PJ}}$ – Project consumption of NG in BF #4, reduced, th. m^3

$C_{\text{NG\_PJ}}$ – Carbon content in NG, kgC/ m^3

$$M_{skip\ metallurgical\ coke\_BF\ 4\ reduced\ PJ} = M_{skip\ metallurgical\ coke\_BF\ 4\ PJ} * K_1$$
(D.1.1.2.-2)

Where:
$M_{skip\ metallurgical\_\ coke\ \_BF\ 4\ reduced\ PJ}$ – Project emissions from consumption of dry skip metallurgical coke in BF #4, reduced, tones
$M_{skip\ metallurgical\ coke\ \_BF\ 4\ PJ}$ – Project emissions from consumption of dry skip metallurgical coke in BF #4, tones
K_1 – Project adjustment coefficient for BF #4

$$K_1 = 1 \text{ if } P_{pig\ iron\ BF\ 4\ PJ} <= P_{max\ pig\ iron\ BF\ 4\ BL} \quad \textbf{(D.1.1.2.-3)}$$
$$K_1 = P_{max\ pig\ iron\ BF\ 4\ BL} / P_{pig\ iron\ BF\ 4\ PJ} \text{ if } P_{pig\ iron\ BF\ 4\ PJ} > P_{max\ pig\ iron\ BF\ 4\ BL}$$

Where:
$P_{max\ pig\ iron\ BF\ 4\ BL}$ – Maximum production of pig iron in BF #4 under the baseline scenario (**1217.4** thousand tons in 1988), tones
$P_{pig\ iron\ BF\ 4\ PJ}$ – Project production of pig iron in BF #4, tones

$$FC_{NG\_BF\ 4\ reduced\ PJ} = FC_{NG\_BF\ 4\ PJ} * K_1 \quad \textbf{(D.1.1.2.-4)}$$

Where:
$FC_{NG\_BF\ 4\ reduced\ PJ}$ – Project consumption of NG in BF #4, reduced, th. m^3
$FC_{NG\_BF\ 4\ PJ}$ – Project consumption of NG in BF #4, th. m^3
K_1 – Project adjustment coefficient for BF #4 (refer to D.1.1.2.-3)

Total reduced emissions from consumption of dry skip metallurgical coke in BF #6, production of this metallurgical coke in BPCP, consumption of NG in BF #6

$$PE_{coke,\ NG\ for\ BF6\ reduced} = M_{skip\ metallurgical\_coke\_BF\ 6\ reduced\ PJ} * \%C_{metallurgical\ coke\_PJ} /100 * 44/12 + M_{skip\ metallurgical\ coke\_BF\ 6\ reduced\ PJ} * SPE_{metallurgical\ coke\_} + FC_{NG\_BF\ 6\ reduced\ PJ} * C_{NG\_PJ} * 44/12$$
(D.1.1.2.-5)

Where:

$PE_{coke,\ NG\ for\ BF6\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #6, production of this metallurgical coke in BPCP, consumption of NG in BF #6, reduced, th. tones CO_2
$M_{skip\ metallurgical\_\ coke\ \_BF\ 6\ reduced\ PJ}$ – Project consumption of dry skip metallurgical coke in BF #6, reduced, tones
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$FC_{NG\_BF\ 6\ reduced\ PJ}$ – Project consumption of NG in BF #6, reduced, th. m^3/year
C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$\mathbf{M_{skip\ metallurgical\ coke\_BF\ 6\ reduced\ PJ} = M_{skip\ metallurgical\ coke\_BF\ 6\ PJ} * K_2} \quad \mathbf{(D.1.1.2.\text{-}6)}$$

Where:
$M_{skip\ metallurgical\_\ coke\ \_BF\ 6\ reduced\ PJ}$ – Project consumption of dry skip metallurgical coke in BF #6, reduced, tones
$M_{skip\ metallurgical\_\ coke\ \_BF\ 6\ PJ}$ – Project consumption of dry skip metallurgical coke in BF #6, tones
K_2 – Project adjustment coefficient for BF #6

$$\mathbf{K_2 = 1\ if\ P_{pig\ iron\ BF\ 6\ PJ} <= P_{max\ pig\ iron\ BF\ 6\ BL}} \quad \mathbf{(D.1.1.2.\text{-}7)}$$
$$\mathbf{K_2 = P_{max\ pig\ iron\ BF\ 6\ BL} / P_{pig\ iron\ BF\ 6\ PJ}\ if\ P_{pig\ iron\ BF\ 6\ PJ} > P_{max\ pig\ iron\ BF\ 6\ BL}}$$

Where:
$P_{max\ pig\ iron\ BF\ 6\ BL}$ – Maximal production of pig iron in BF #6 under the baseline scenario (**1110.7** thousand tons in 1990), tones
$P_{pig\ iron\ BF\ 6\ PJ}$ – Project production of pig iron in BF #6, tones

$$\mathbf{FC_{NG\_BF\ 6\ reduced\ PJ} = FC_{NG\_BF\ 6\ PJ} * K_2} \quad \mathbf{(D.1.1.2.\text{-}8)}$$

Where:
$FC_{NG\_BF\ 6\ reduced\ PJ}$ – Project consumption of NG in BF #6, reduced, th. m^3
$FC_{NG\_BF\ 6\ PJ}$ – Project consumption of NG in BF #6, th. m^3
K_2 – Project adjustment coefficient for BF #6 (see D.1.1.2.-7)

Total reduced emissions from consumption of dry skip metallurgical coke in BF #9, production of this metallurgical coke in BPCP, consumption of NG in BF #9

$$PE_{coke,\ NG\ for\ BF9\ reduced} = M_{skip\ metallurgical\ coke\_BF\ 9\ reduced\ PJ} * \%C_{metallurgical\ coke\_PJ} /100 * 44/12 + M_{skip\ metallurgical\ coke\_BF\ 9\ reduced\ PJ} * SPE_{metallurgical\ coke} + FC_{NG\_BF\ 9\ reduced\ PJ} * C_{NG\_PJ} * 44/12$$

(D.1.1.2.-9)

Where:

$PE_{coke,\ NG\ for\ BF9\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #9, production of this metallurgical coke in BPCP, consumption of NG in BF #9, reduced, th. tones CO_2

$M_{skip\ metallurgical\_\ coke\ \_BF\ 9\ reduced\ PJ}$ – Project consumption of dry skip metallurgical coke in BF #9, reduced, tones

$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight

$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t

$FC_{NG\_BF\ 9\ reduced\ PJ}$ – Project consumption of NG in BF #9, reduced, th. m^3

C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$M_{skip\ metallurgical\ coke\_BF\ 9\ reduced\ PJ} = M_{skip\ metallurgical\ coke\_BF\ 9\ PJ} * K_3$$

(D.1.1.2.-10)

Where:

$M_{skip\ metallurgical\_\ coke\ \_BF\ 9\ reduced\ PJ}$ – Project emissions from consumption of dry skip metallurgical coke in BF #9, reduced, tones

$M_{skip\ metallurgical\ coke\ \_BF\ 9\ PJ}$ – Project emissions from consumption of dry skip metallurgical coke in BF #9, tones

K_3 – Project adjustment coefficient for BF #9

$$K_3 = 1 \text{ if } P_{pig\ iron\ BF\ 9\ PJ} <= P_{max\ pig\ iron\ BF\ 9\ BL} \quad \textbf{(D.1.1.2.-11)}$$
$$K_3 = P_{max\ pig\ iron\ BF\ 9\ BL} / P_{pig\ iron\ BF\ 9\ PJ} \text{ if } P_{pig\ iron\ BF\ 9\ PJ} > P_{max\ pig\ iron\ BF\ 9\ BL}$$

Where:

$P_{max\ pig\ iron\ BF\ 9\ BL}$ – Maximum production of pig iron in BF #9 under the baseline scenario (**1768.0** thousand tons in 1988), tones

$P_{pig\ iron\ BF\ 9\ PJ}$ – Project production of pig iron in BF #9, tones

$$FC_{NG\_BF\ 9\ reduced\ PJ} = FC_{NG\_BF\ 9\ PJ} * K_3 \quad \textbf{(D.1.1.2.-12)}$$

Where:

$FC_{NG\_BF\ 9\ reduced\ PJ}$ – Project consumption of NG in BF #9, reduced, th. m^3
$FC_{NG\_BF\ 9\ PJ}$ – Project consumption of NG in BF #9, th. m^3
K_3 – Project adjustment coefficient for BF #6 (refer to D.1.1.2.-11)

Total reduced emissions from consumption of dry skip metallurgical coke in BF #2, production of this metallurgical coke in BPCP, consumption of NG in BF #2

$$PE_{coke,\ NG\ for\ BF2\ reduced} = M_{skip\ metallurgical\ coke\_BF\ 2\ reduced\ PJ} * \%C_{metallurgical\ coke\_PJ} /100 * 44/12 + M_{skip\ metallurgical\ coke\_BF\ 2\ reduced\ PJ} * SPE_{metallurgical\ coke} + FC_{NG\_BF\ 2\ reduced\ PJ} * C_{NG\_PJ} * 44/12 \quad (D.1.1.2.-13)$$

Where:
$PE_{coke,\ NG\ for\ BF\ 2\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #2, production of this metallurgical coke in BPCP, consumption of NG in BF #2, reduced, th. tones CO_2
$M_{skip\ metallurgical\_\ coke\ \_BF\ 2\ reduced\ PJ}$ – Project consumption of dry skip metallurgical coke in BF #2, reduced, tones
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$FC_{NG\_BF\ 2\ reduced\ PJ}$ – Project consumption of NG in BF #2, reduced, th. m^3/year
C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$M_{skip\ metallurgical\ coke\_BF\ 2\ reduced\ PJ} = M_{skip\ metallurgical\ coke\_BF\ 2\ PJ} * K_4 \quad (D.1.1.2.-14)$$

Where:
$M_{skip\ metallurgical\_\ coke\ \_BF\ 2\ reduced\ PJ}$ – Project emissions from consumption of dry skip metallurgical coke in BF #2, reduced, tones
$M_{skip\ metallurgical\ coke\ \_BF\ 2\ PJ}$ – Project emissions from consumption of dry skip metallurgical coke in BF #2, tones
K_4 – Project adjustment coefficient for BF #2

$$K_4 = 1 \text{ if } P_{pig\ iron\ BF\ 2\ PJ} <= P_{pig\ iron\_BF\ 2\ averaged\ BL} \quad (D.1.1.2.-15)$$
$$K_4 = P_{pig\ iron\_BF\ 2\ averaged\ BL} / P_{pig\ iron\ BF\ 2\ PJ} \text{ if } P_{pig\ iron\ BF\ 2\ PJ} > P_{pig\ iron\_BF\ 2\ averaged\ BL}$$

Where:

$P_{\text{pig iron\_BF 2 averaged BL}}$ – Production of pig iron in BF #2 under the baseline, averaged over 2004-2006 (**1,182.901** thousand tons).
$P_{\text{pig iron BF 2 PJ}}$ – Project production of pig iron in BF #2, tones

$$FC_{\text{NG\_BF 2 reduced PJ}} = FC_{\text{NG\_BF 2 PJ}} * K_4 \quad \textbf{(D.1.1.2.-16)}$$

Where:
$FC_{\text{NG\_BF 2 reduced PJ}}$ – Project consumption of NG in BF #2, reduced, th. m^3
$FC_{\text{NG\_BF 2 PJ}}$ – Project consumption of NG in BF #2, th. m^3
K_4 – Project adjustment coefficient for BF #2 (refer to D.1.1.2.-15)

Total reduced emissions from consumption of dry skip metallurgical coke in BF #10, production of this metallurgical coke in BPCP, consumption of NG in BF #10

$$PE_{\text{coke, NG for BF10 reduced}} = M_{\text{skip metallurgical coke\_BF 10 reduced PJ}} * \%C_{\text{metallurgical coke\_PJ}} /100 * 44/12 + M_{\text{skip metallurgical coke\_BF 10 reduced PJ}} * SPE_{\text{metallurgical coke}} + FC_{\text{NG\_BF 10 reduced PJ}} * C_{\text{NG\_PJ}} * 44/12 \quad \textbf{(D.1.1.2.-17)}$$

Where:
$PE_{\text{coke, NG for BF 10 reduced}}$ – Project emissions from consumption of dry skip metallurgical coke in BF #10, production of this metallurgical coke in BPCP, consumption of NG in BF #10, reduced, th. tones CO_2
$M_{\text{skip metallurgical\_ coke \_BF 10 reduced PJ}}$ – Project consumption of dry skip metallurgical coke in BF #10, reduced, tones
$\%C_{\text{metallurgical coke\_PJ}}$ – Carbon content in metallurgical coke, % by weight
$SPE_{\text{metallurgical\_coke}}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$FC_{\text{NG\_BF 10 reduced PJ}}$ – Project consumption of NG in BF #10, reduced, th. m^3/year
$C_{\text{NG\_PJ}}$ – Carbon content in NG, kgC/ m^3

$$M_{\text{skip metallurgical coke\_BF 10 reduced PJ}} = M_{\text{skip metallurgical coke\_BF 10 PJ}} * K_5 \quad \textbf{(D.1.1.2.-18)}$$

Where:
$M_{\text{skip metallurgical\_ coke \_BF 10 reduced PJ}}$ – Project emissions from consumption of dry skip metallurgical coke in BF #10, reduced, tones
$M_{\text{skip metallurgical coke \_BF 10 PJ}}$ – Project emissions from consumption of dry skip metallurgical coke in BF #10, tones

K_5 – Project adjustment coefficient for BF #10

$$\mathbf{K_5 = 1 \text{ if } P_{pig\ iron\ BF\ 10\ PJ} <= P_{max\ pig\ iron\ BF\ 10\ BL}} \quad \textbf{(D.1.1.2.-19)}$$
$$\mathbf{K_5 = P_{max\ pig\ iron\ BF\ 10\ BL} / P_{pig\ iron\ BF\ 10\ PJ} \text{ if } P_{pig\ iron\ BF\ 10\ PJ} > P_{max\ pig\ iron\ BF\ 10\ BL}}$$

Where:
$P_{max\ pig\ iron\ BF\ 10\ BL}$ – Maximum production of pig iron in BF #10 under the baseline scenario (**1789.6** thousand tons in 1987), tones
$P_{pig\ iron\ BF\ 10\ PJ}$ – Project production of pig iron in BF #10, tones

$$\mathbf{FC_{NG\_BF\ 10\ reduced\ PJ} = FC_{NG\_BF\ 10\ PJ} * K_5} \quad \textbf{(D.1.1.2.-20)}$$

Where:
$FC_{NG\_BF\ 10\ reduced\ PJ}$ – Project consumption of NG in BF #10, reduced, th. m^3
$FC_{NG\_BF\ 10\ PJ}$ – Project consumption of NG in BF #10, th. m^3
K_5 – Project adjustment coefficient for BF #10 (refer to D.1.1.2.-19)

Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP (**SPE** $_{metallurgical\_coke}$) were estimated by carbon balance for BPCP, using all carbon-containing inputs and outputs (materials and fuels). Calculation method is described in PDD for JI project “Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works”. [28] This method is described in Annex 4. Unit emission factor is taken from Monitoring Report of this Project.

CO_2 PROJECT EMISSIONS FROM THE ELECTRICITY CONSUMPTION

CO_2 Project Emissions from Electricity Consumption by sinter cooling and stabilization units (SCaSU) at sintering plants #2 and #3

$$\mathbf{PE_{EC\ CSU\ AF\ 2.3} = \sum EC_{CSU\ AF\ 2.3} * EF_{own\ generation\_PJ}} \quad \textbf{(D.1.1.2.-21)}$$

Where:
$PE_{EC\ CSU\ AF\ 2.3}$ - CO_2 project emissions from electricity consumption by SCaSU, th. tones CO_2
$\sum EC_{CSU\ AF\ 2.3}$ – Total electricity consumption by SCaSU at SP #2 and SP #3, MWh

[28] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

$EF_{own\ generation\_PJ}$ - Average CO_2 emission factor for electricity generation at MMK, tCO_2/MWh
The value of CO_2 emission factor for electricity generation at MMK (**$EF_{own\ generation\_PJ}$**) is calculated on the basis of fuel consumption data (coke oven gas, blast furnace gas, natural gas, power station coal) at MMK own electricity generating capacities: CHPP, CPP, SABPP, turbine section in the steam plant, gas recovery section in the steam plant. The details are provided in PDD for JI Project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works"[29] and in Annex 4.

$$\sum EC_{CSU\ AF\ 2.3} = EC_{CSU\ AF\ 2} + EC_{CSU\ AF\ 3} \quad \text{(D.1.1.2.-22)}$$

Where:
$\sum EC_{CSU\ AF\ 2.3}$ – Total electricity consumption by SCaSU at SP #2 and SP #3, MWh
$EC_{CSU\ AF\ 2}$ – Electricity consumption by SCaSU at SP #2, MWh
$EC_{CSU\ AF\ 3}$ – Electricity consumption by SCaSU at SP #3, MWh

CO_2 emissions from electricity consumption for production of pure nitrogen

$$PE_{EC\_pure\ N2} = EC_{pure\ N2} * EF_{own\ generation\_PJ} \quad \text{(D.1.1.2.-23)}$$

Where:
$PE_{EC\_pure\ N2}$ – CO_2 emissions from electricity consumption for production of pure nitrogen, th. tones CO_2
$EC_{pure\ N2}$ – Electricity consumption for production of pure nitrogen, MWh
$EF_{own\ generation\_PJ}$ - Average CO_2 emission factor for electricity production at MMK, tCO_2/MWh

$$EC_{pure\ N2} = (V_{pure\ N2\_BF4} + V_{pure\ N2\_BF6} + V_{pure\ N2\_BF9} + V_{pure\ N2\_BF2} + V_{pure\ N2\_BF10}) * SEC_{pure\ N2} \quad \text{(D.1.1.2.-24)}$$

Where:
$EC_{pure\ N2}$ – Electricity consumption for production of pure nitrogen, MWh
$V_{pure\ N2\_BF4}$ – Consumption of pure nitrogen in BF #4, th. m^3
$V_{pure\ N2\_BF6}$ – Consumption of pure nitrogen in BF #6, th. m^3

[29] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQCEVWW7EHHU3EW75Z32/view.html

$V_{pure\ N2\_BF9}$ – Consumption of pure nitrogen in BF #9, th. m^3
$V_{pure\ N2\_BF2}$ – Consumption of pure nitrogen in BF #2, th. m^3
$V_{pure\ N2\_BF10}$ – Consumption of pure nitrogen in BF #10, th. m^3
$SEC_{pure\ N2}$ – Specific electricity consumption for production of pure nitrogen, MWh/ th. m^3

Total project CO_2 emissions from electricity consumption

$$PE_{EC} = PE_{EC\ CSU\ AF\ 2.3} + PE_{EC\_pure\ N2} \quad \textbf{(D.1.1.2.-25)}$$

Where:
PE_{EC} – Total project CO_2 emissions from electricity consumption, th. tones CO_2
$PE_{EC\ CSU\ AF\ 2.3}$ - CO_2 emissions from electricity consumption at SCaSU at SP #2 and SP #3, th. tones CO_2
$PE_{EC\_pure\ N2}$ – CO_2 emissions from electricity consumption during production of pure nitrogen, th. tones CO_2

TOTAL PROJECT EMISSIONS

$$PE = PE_{coke,\ NG\ for\ BF4\ reduced} + PE_{coke,\ NG\ for\ BF6\ reduced} + PE_{coke,\ NG\ for\ BF9\ reduced} + PE_{coke,\ NG\ for\ BF2\ reduced} + PE_{coke,\ NG\ for\ BF10\ reduced} + PE_{EC} \quad \textbf{(D.1.1.2.-26)}$$

Where:
PE – Project CO_2 emissions from implementation of all project measures, th. tones CO_2
$PE_{coke,\ NG\ for\ BF4\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #4, production of this metallurgical coke in BPCP, consumption of NG in BF #4, reduced, th. tones CO_2
$PE_{coke,\ NG\ for\ BF6\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #6, production of this metallurgical coke in BPCP, consumption of NG in BF #6, reduced, th. tones CO_2
$PE_{coke,\ NG\ for\ BF9\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #9, production of this metallurgical coke in BPCP, consumption of NG in BF #9, reduced, th. tones CO_2
$PE_{coke,\ NG\ for\ BF2\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #2, production of this metallurgical coke in BPCP, consumption of NG in BF #2, reduced, th. tones CO_2
$PE_{coke,\ NG\ for\ BF10\ reduced}$ – Project emissions from consumption of dry skip metallurgical coke in BF #10, production of this metallurgical coke in BPCP, consumption of NG in BF #10, reduced, th. tones CO_2
PE_{EC} – Total project CO_2 emissions from electricity consumption, th. tones CO_2

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-6	**$\%C_{metallurgical\ coke\_PJ}$** Carbon content in metallurgical coke	CL (BPCP Lab)	% by weight	m	2 times per day	All	Electronic/ paper	Measurement results are averaged out
P-7	**C_{NG_PJ}** Carbon content in NG	Department of chief power engineer	kgC/m^3	c	Monthly	All	Electronic	This parameter is calculated on the basis of chemical composition of natural gas, as specified in the technical passport issued by the supplier

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

Total CO_2 emissions from consumption of dry skip metallurgical coke in BF #4, production of this metallurgical coke in BPCP, consumption of NG in BF #4, in the baseline

$$BE_{coke,\ NG\ for\ BF4} = SM_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL} * P_{pig\ iron\ BF\ 4\ BL} * \%C_{metallurgical\ coke\_PJ} / 100 * 44/12 + SM_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL} * P_{pig\ iron\ BF\ 4\ BL} * SPE_{metallurgical\ coke} + SFC_{NG\_BF\ 4\ averaged\ BL} * P_{pig\ iron\ BF\ 4\ BL} * C_{NG\_PJ} * 44/12$$

(D.1.1.4.-1)

Where:

$BE_{coke,\ NG\ for\ BF4}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #4, production of this metallurgical coke in BPCP, consumption of NG in BF #4, th. tones CO_2

$SM_{skip\ metallurgical\_\ coke\ \_BF\ 4\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #4, averaged for 2004-2006, kg/t pig iron

$P_{pig\ iron\ BF\ 4\ BL}$ – Baseline production of pig iron in BF #4, tones

$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight

$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t

$SFC_{NG\_BF\ 4\ averaged\ BL}$ – Specific baseline consumption of NG in BF #4, averaged for 2004-2006, m^3/ t pig iron

C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$P_{pig\ iron\ BF\ 4\ BL} = P_{pig\ iron\ BF\ 4\ PJ} \text{ if } P_{pig\ iron\ BF\ 4\ PJ} <= P_{max\ pig\ iron\ BF\ 4\ BL} \quad \text{(D.1.1.4.-2)}$$
$$P_{pig\ iron\ BF\ 4\ BL} = P_{max\ pig\ iron\ BF\ 4\ BL} \text{ if } P_{pig\ iron\ BF\ 4\ PJ} > P_{max\ pig\ iron\ BF\ 4\ BL}$$

Where:

$P_{pig\ iron\ BF\ 4\ BL}$ – Baseline production of pig iron in BF #4, tones

$P_{max\ pig\ iron\ BF\ 4\ BL}$ – Maximum baseline production of pig iron in BF #4, tones (**1217.4** thousand tons in 1988)

$P_{pig\ iron\ BF\ 4\ PJ}$ – Project production of pig iron in BF #4, tones

$$SM_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL} = M_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL} / P_{pig\ iron\ BF\ 4\ averaged\ BL} \quad \text{(D.1.1.4.-3)}$$

Where:

$SM_{skip\ metallurgical\_\ coke\ \_BF\ 4\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #4, averaged for 2004-2006, kg/t pig iron

$M_{skip\ metallurgical\_coke\_BF\ 4\ averaged\ BL}$ - Baseline consumption of dry skip metallurgical coke in BF #4, averaged for 2004-2006, t

$P_{pig\ iron\ BF\ 4\ averaged\ BL}$ – Baseline production of pig iron in BF #4, averaged for 2004-2006, t

$$SFC_{NG\_BF\ 4\ averaged\ BL} = FC_{NG\_BF\ 4\ averaged\ BL} / P_{pig\ iron\ BF\ 4\ averaged\ BL} \quad \text{(D.1.1.4.-4)}$$

Where:

$SFC_{NG\_BF\ 4\ averaged\ BL}$ – Specific baseline consumption of NG in BF #4, averaged for 2004-2006, m^3/ t pig iron

$FC_{NG\_BF\ 4\ averaged\ BL}$ – Baseline consumption of NG in BF #4, averaged for 2004-2006, m^3

$P_{pig\ iron\ BF\ 4\ averaged\ BL}$ – Baseline production of pig iron in BF #4, averaged for 2004-2006, t

Total CO_2 emissions from consumption of dry skip metallurgical coke in BF #6, production of this metallurgical coke in BPCP, consumption of NG in BF #6, in the baseline

$$BE_{coke,\ NG\ for\ BF6} = SM_{skip\ metallurgical\ coke\_BF\ 6\ averaged\ BL} * P_{pig\ iron\ BF\ 6\ BL} * \%C_{metallurgical\ coke\_PJ} /100 * 44/12 + SM_{skip\ metallurgical\_\ coke\_BF\ 6\ averaged\ BL} * P_{pig\ iron\ BF\ 6\ BL} * SPE_{metallurgical\ coke} + SFC_{NG\_BF\ 6\ averaged\ BL} * P_{pig\ iron\ BF\ 6\ BL} * C_{NG\_PJ} * 44/12 \quad (D.1.1.4.-5)$$

Where:

$BE_{coke,\ NG\ for\ BF6}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #6, production of this metallurgical coke in BPCP, consumption of NG in BF #6, th. tones CO_2
$SM_{skip\ metallurgical\_\ coke\ \_BF\ 6\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #6, averaged for 2004-2006, kg/t pig iron
$P_{pig\ iron\ BF\ 6\ BL}$ – Baseline production of pig iron in BF #6, tones
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$SFC_{NG\_BF\ 6\ averaged\ BL}$ – Specific baseline consumption of NG in BF #6, averaged for 2004-2006, m^3/ t pig iron
C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$P_{pig\ iron\ BF\ 6\ BL} = P_{pig\ iron\ BF\ 6\ PJ} \text{ if } P_{pig\ iron\ BF\ 6\ PJ} <= P_{max\ pig\ iron\ BF\ 6\ BL} \quad (D.1.1.4.-6)$$
$$P_{pig\ iron\ BF\ 6\ BL} = P_{max\ pig\ iron\ BF\ 6\ BL} \text{ if } P_{pig\ iron\ BF\ 6\ PJ} > P_{max\ pig\ iron\ BF\ 6\ BL}$$

Where:

$P_{pig\ iron\ BF\ 6\ BL}$ – Baseline production of pig iron in BF #6, tones
$P_{max\ pig\ iron\ BF\ 6\ BL}$ – Maximum baseline production of pig iron in BF #6, tones (**1110.7** thousand tons in 1990)
$P_{pig\ iron\ BF\ 6\ PJ}$ – Project production of pig iron in BF #6, tones

$$SM_{skip\ metallurgical\_coke\_BF\ 6\ averaged\ BL} = M_{skip\ metallurgical\_coke\_BF\ 6\ averaged\ BL} / P_{pig\ iron\ BF\ 6\ averaged\ BL} \quad (D.1.1.4.-7)$$

Where:

$SM_{skip\ metallurgical\_\ coke\ \_BF\ 6\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #6, averaged for 2004-2006, kg/t pig iron
$M_{skip\ metallurgical\_coke\_BF\ 6\ averaged\ BL}$ - Baseline consumption of dry skip metallurgical coke in BF #6, averaged for 2004-2006, t
$P_{pig\ iron\ BF\ 6\ averaged\ BL}$ – Baseline production of pig iron in BF #6, averaged for 2004-2006, t

$$SFC_{NG\_BF\ 6\ averaged\ BL} = FC_{NG\_BF\ 6\ averaged\ BL} / P_{pig\ iron\ BF\ 6\ averaged\ BL} \quad \textbf{(D.1.1.4.-8)}$$

Where:
$SFC_{NG\_BF\ 6\ averaged\ BL}$ – Specific baseline consumption of NG in BF #6, averaged for 2004-2006, m^3/ t pig iron
$FC_{NG\_BF\ 6\ averaged\ BL}$ – Baseline consumption of NG in BF #6, averaged for 2004-2006, m^3
$P_{pig\ iron\ BF\ 6\ averaged\ BL}$ – Baseline production of pig iron in BF #6, averaged for 2004-2006, t

Total CO_2 emissions from consumption of dry skip metallurgical coke in BF #9, production of this metallurgical coke in BPCP, consumption of NG in BF #9, in the baseline

$$BE_{coke,\ NG\ for\ BF\ 9} = SM_{skip\ metallurgical\_coke\_BF\ 9\ averaged\ BL} * P_{pig\ iron\ BF\ 9\ BL} * \%C_{metallurgical\ coke\_PJ} /100 * 44/12 + SM_{skip\ metallurgical\_coke\_BF\ 9\ averaged\ BL} * P_{pig\ iron\ BF\ 9\ BL} * SPE_{metallurgical\ coke} + SFC_{NG\_BF\ 9\ averaged\ BL} * P_{pig\ iron\ BF\ 9\ BL} * C_{NG\_PJ} * 44/12 \quad \textbf{(D.1.1.4.-9)}$$

Where:
$BE_{coke,\ NG\ for\ BF\ 9}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #9, production of this metallurgical coke in BPCP, consumption of NG in BF #9, th. tones CO_2
$SM_{skip\ metallurgical\_\ coke\ \_BF\ 9\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #9, averaged for 2004-2006, kg/t pig iron
$P_{pig\ iron\ BF\ 9\ BL}$ – Baseline production of pig iron in BF #9, tones
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$SFC_{NG\_BF\ 9\ averaged\ BL}$ – Specific baseline consumption of NG in BF #9, averaged for 2004-2006, m^3/ t pig iron
C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$P_{pig\ iron\ BF\ 9\ BL} = P_{pig\ iron\ BF\ 9\ PJ} \text{ if } P_{pig\ iron\ BF\ 9\ PJ} <= P_{max\ pig\ iron\ BF\ 9\ BL} \quad \textbf{(D.1.1.4.-10)}$$
$$P_{pig\ iron\ BF\ 9\ BL} = P_{max\ pig\ iron\ BF\ 9\ BL} \text{ if } P_{pig\ iron\ BF\ 9\ PJ} > P_{max\ pig\ iron\ BF\ 9\ BL}$$

Where:
$P_{pig\ iron\ BF\ 9\ BL}$ – Baseline production of pig iron in BF #9, tones
$P_{max\ pig\ iron\ BF\ 9\ BL}$ – Maximum baseline production of pig iron in BF #9, tones (**1768.0** thousand tons in 1988)
$P_{pig\ iron\ BF\ 9\ PJ}$ – Project production of pig iron in BF #9, tones

$$SM_{skip\ metallurgical\_coke\_BF\ 9\ averaged\ BL} = M_{skip\ metallurgical\_coke\_BF\ 9\ averaged\ BL} / P_{pig\ iron\ BF\ 9\ averaged\ BL} \quad (D.1.1.4.-11)$$

Where:
$SM_{skip\ metallurgical\_\ coke\ \_BF\ 9\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #9, averaged for 2004-2006, kg/t pig iron
$M_{skip\ metallurgical\_coke\_BF\ 9\ averaged\ BL}$ - Baseline consumption of dry skip metallurgical coke in BF #9, averaged for 2004-2006, t
$P_{pig\ iron\ BF\ 9\ averaged\ BL}$ – Baseline production of pig iron in BF #9, averaged for 2004-2006, t

$$SFC_{NG\_BF\ 9\ averaged\ BL} = FC_{NG\_BF\ 9\ averaged\ BL} / P_{pig\ iron\ BF\ 9\ averaged\ BL} \quad (D.1.1.4.-12)$$

Where:
$SFC_{NG\_BF\ 9\ averaged\ BL}$ – Specific baseline consumption of NG in BF #9, averaged for 2004-2006, m^3/ t pig iron
$FC_{NG\_BF\ 9\ averaged\ BL}$ – Baseline consumption of NG in BF #9, averaged for 2004-2006, m^3
$P_{pig\ iron\ BF\ 9\ averaged\ BL}$ – Baseline production of pig iron in BF #9, averaged for 2004-2006, t

Total CO_2 emissions from consumption of dry skip metallurgical coke in BF #2, production of this metallurgical coke in BPCP, consumption of NG in BF #2, in the baseline

$$BE_{coke,\ NG\ for\ BF\ 2} = SM_{skip\ metallurgical\_coke\_BF\ 2\ averaged\ BL} * P_{pig\ iron\ BF\ 2\ BL} * \%C_{metallurgical\ coke\_PJ} /100 * 44/12 + SM_{skip\ metallurgical\_coke\_BF\ 2\ averaged\ BL} * P_{pig\ iron\ BF\ 2\ BL} * SPE_{metallurgical\ coke} + SFC_{NG\_BF\ 2\ averaged\ BL} * P_{pig\ iron\ BF\ 2\ BL} * C_{NG\_PJ} * 44/12 \quad (D.1.1.4.-13)$$

Where:
$BE_{coke,\ NG\ for\ BF2\ averaged}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #2, production of this metallurgical coke in BPCP, consumption of NG in BF #2, th. tones CO_2
$SM_{skip\ metallurgical\_\ coke\ \_BF\ 2\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #2, averaged for 2004-2006, kg/t pig iron
$P_{pig\ iron\ BF\ 2\ BL}$ – Baseline production of pig iron in BF #2, tones
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$SFC_{NG\_BF\ 2\ averaged\ BL}$ – Specific baseline consumption of NG in BF #2, averaged for 2004-2006, m^3/ t pig iron
C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$P_{pig\ iron\ BF\ 2\ BL} = P_{pig\ iron\ BF\ 2\ PJ} \text{ if } P_{pig\ iron\ BF\ 2\ PJ} <= P_{pig\ iron\_BF\ 2\ averaged\ BL}$$
$$P_{pig\ iron\ BF\ 2\ BL} = P_{pig\ iron\_BF\ 2\ averaged\ BL} \text{ if } P_{pig\ iron\ BF\ 2\ PJ} > P_{pig\ iron\_BF\ 2\ averaged\ BL} \quad \text{(D.1.1.4.-14)}$$

Where:
$P_{pig\ iron\ BF\ 2\ BL}$ – Baseline production of pig iron in BF #2, tones
$P_{pig\ iron\_BF\ 2\ averaged\ BL}$ – Production of pig iron in BF #2 under the baseline, averaged over 2004-2006 (**1,182.901** thousand tons)
$P_{pig\ iron\ BF\ 2\ PJ}$ – Project production of pig iron in BF #2, tones

$$SM_{skip\ metallurgical\_coke\_BF\ 2\ averaged\ BL} = M_{skip\ metallurgical\_coke\_BF\ 2\ averaged\ BL} / P_{pig\ iron\ BF\ 2\ averaged\ BL} \quad \text{(D.1.1.4.-15)}$$

Where:
$SM_{skip\ metallurgical\_\ coke\ \_BF\ 2\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #2, averaged for 2004-2006, kg/t pig iron
$M_{skip\ metallurgical\_coke\_BF\ 2\ averaged\ BL}$ - Baseline consumption of dry skip metallurgical coke in BF #2, averaged for 2004-2006, t
$P_{pig\ iron\ BF\ 2\ averaged\ BL}$ – Baseline production of pig iron in BF #2, averaged for 2004-2006, t

$$SFC_{NG\_BF\ 2\ averaged\ BL} = FC_{NG\_BF\ 2\ averaged\ BL} / P_{pig\ iron\ BF\ 2\ averaged\ BL} \quad \text{(D.1.1.4.-16)}$$

Where:
$SFC_{NG\_BF\ 2\ averaged\ BL}$ – Specific baseline consumption of NG in BF #2, averaged for 2004-2006, m^3/ t pig iron
$FC_{NG\_BF\ 2\ averaged\ BL}$ – Baseline consumption of NG in BF #2, averaged for 2004-2006, m^3
$P_{pig\ iron\ BF\ 2\ averaged\ BL}$ – Baseline production of pig iron in BF #2, averaged for 2004-2006, t

Total CO_2 emissions from consumption of dry skip metallurgical coke in BF #10, production of this metallurgical coke in BPCP, consumption of NG in BF #10, in the baseline

$$BE_{coke,\ NG\ for\ BF\ 10} = SM_{skip\ metallurgical\_coke\_BF\ 10\ averaged\ BL} * P_{pig\ iron\ BF\ 10\ BL} * \%C_{metallurgical\ coke\_PJ} /100 * 44/12 + SM_{skip\ metallurgical\_coke\_BF\ 10\ averaged\ BL} * P_{pig\ iron\ BF\ 10\ BL} * SPE_{metallurgical\ coke} + SFC_{NG\_BF\ 10\ averaged\ BL} * P_{pig\ iron\ BF\ 10\ BL} * C_{NG\_PJ} * 44/12 \quad \text{(D.1.1.4.-17)}$$

Where:

$BE_{coke,\ NG\ for\ BF\ 10}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #10, production of this metallurgical coke in BPCP, consumption of NG in BF #10, th. tones CO_2
$SM_{skip\ metallurgical\_\ coke\ \_BF\ 10\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #10, averaged for 2004-2006, kg/t pig iron
$P_{pig\ iron\ BF\ 10\ BL}$ – Baseline production of pig iron in BF #10, tones
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in metallurgical coke, % by weight
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$SFC_{NG\_BF\ 10\ averaged\ BL}$ – Specific baseline consumption of NG in BF #10, averaged for 2004-2006, m^3/ t pig iron
C_{NG_PJ} – Carbon content in NG, kgC/ m^3

$$P_{pig\ iron\ BF\ 10\ BL} = P_{pig\ iron\ BF\ 10\ PJ} \text{ if } P_{pig\ iron\ BF\ 10\ PJ} <= P_{max\ pig\ iron\ BF\ 10\ BL}$$
$$P_{pig\ iron\ BF\ 10\ BL} = P_{max\ pig\ iron\ BF\ 10\ BL} \text{ if } P_{pig\ iron\ BF\ 10\ PJ} > P_{max\ pig\ iron\ BF\ 10\ BL} \quad \textbf{(D.1.1.4.-18)}$$

Where:
$P_{pig\ iron\ BF\ 10\ BL}$ – Baseline production of pig iron in BF #10, tones
$P_{max\ pig\ iron\ BF\ 10\ BL}$ – Maximum baseline production of pig iron in BF #10, tones (**1789.6** thousand tons in 1987)
$P_{pig\ iron\ BF\ 10\ PJ}$ – Project production of pig iron in BF #10, tones

$$SM_{skip\ metallurgical\_coke\_BF\ 10\ averaged\ BL} = M_{skip\ metallurgical\_coke\_BF\ 10\ averaged\ BL} / P_{pig\ iron\ BF\ 10\ averaged\ BL} \quad \textbf{(D.1.1.4.-19)}$$

Where:
$SM_{skip\ metallurgical\_\ coke\ \_BF\ 10\ averaged\ BL}$ – Baseline specific consumption of dry skip metallurgical coke in BF #10, averaged for 2004-2006, kg/t pig iron
$M_{skip\ metallurgical\_coke\_BF\ 10\ averaged\ BL}$ - Baseline consumption of dry skip metallurgical coke in BF #10, averaged for 2004-2006, t
$P_{pig\ iron\ BF\ 10\ averaged\ BL}$ – Baseline production of pig iron in BF #10, averaged for 2004-2006, t

$$SFC_{NG\_BF\ 10\ averaged\ BL} = FC_{NG\_BF\ 10\ averaged\ BL} / P_{pig\ iron\ BF\ 10\ averaged\ BL} \quad \textbf{(D.1.1.4.-20)}$$

Where:
$SFC_{NG\_BF\ 10\ averaged\ BL}$ – Specific baseline consumption of NG in BF #10, averaged for 2004-2006, m^3/ t pig iron
$FC_{NG\_BF\ 10\ averaged\ BL}$ – Baseline consumption of NG in BF #10, averaged for 2004-2006, m^3
$P_{pig\ iron\ BF\ 10\ averaged\ BL}$ – Baseline production of pig iron in BF #10, averaged for 2004-2006, t

TOTAL BASELINE CO_2 EMISSIONS

$$BE = BE_{coke, NG for BF4} + BE_{coke, NG for BF6} + BE_{coke, NG for BF 9} + BE_{coke, NG for BF 2} + BE_{coke, NG for BF 10} \quad \textbf{(D.1.1.4.-21)}$$

Where:

BE – Baseline CO2 emissions, th. tones CO_2

$BE_{coke, NG for BF4 averaged}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #4, production of this metallurgical coke in BPCP, consumption of NG in BF #4, th. tones CO_2

$BE_{coke, NG for BF6 averaged}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #6, production of this metallurgical coke in BPCP, consumption of NG in BF #6, th. tones CO_2

$BE_{coke, NG for BF9 averaged}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #9, production of this metallurgical coke in BPCP, consumption of NG in BF #9, th. tones CO_2

$BE_{coke, NG for BF2 averaged}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #2, production of this metallurgical coke in BPCP, consumption of NG in BF #2, th. tones CO_2

$BE_{coke, NG for BF10 averaged}$ – Baseline emissions from consumption of dry skip metallurgical coke in BF #10, production of this metallurgical coke in BPCP, consumption of NG in BF #10, th. tones CO_2

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

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

Not applicable

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

Not applicable

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

The proposed project may have technological leakage effects in the result of:
1. Transportation of raw materials and products in the result of project implementation;
2. Transportation of natural gas and electricity;
3. Operations of decommissioned equipment beyond the project boundaries.

The volume of production of pig iron in the result of project implementation increased, and coke consumption decreased. Therefore, the transported quantities of raw materials and energy resources decreased relatively to the baseline. Fugitive emissions during transportation of electricity are insignificant and not included, because the generating capacities (owned by MMK) and consuming capacities (i.e. SCaSU) are located close enough to each other at the project implementation site. This project does not involve any equipment, which could be considered the source of emission leakages. We conclude that this project does not require estimation of emission leakages in the monitoring plan.

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):

The following formula shall be used to calculate emission reductions:

$$ER_y = BE_y - PE_y \quad \text{(D.1.4.-1)}$$

Where:
ER_y – Emission reduction in the period y, t CO_2-eq
BE_y – Baseline emissions in the period y, t CO_2-eq
PE_y – Project emissions in the period y, t CO_2-eq

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:

In accordance with requirements of Articles 14, 22 of the Federal Law on environmental protection # 7-FZ OJSC "MMK" has the approved Maximum Permissible Emissions (MPE) document. This document is approved by Chelyabinsk Regional Department of Technological and Environmental Surveillance of Rostechnadzor. This decision is valid for one year. Under this decision the harmful emissions permit was issued. This permit quantified impacts to the atmosphere by OJSC "MMK".

For confirmation of MPE the air emissions were estimated by OJSC "Magnitogorsk GIPROMEZ" in accordance with Russian "Guidelines for calculation of industrial emissions of air pollutants" (OND-86)[30]. These estimations were based on OJSC "MMK" Emission Inventory and Emission Sources Report done by Federal State Unitary Enterprise "All-Russian Institute for Carbon Chemistry" in Yekaterinburg (2008). This report was approved according to the established procedure.

Laboratory for Control of Air Quality of OJSC "MMK" performs environmental monitoring according to the monitoring schedule.

According to the provisions of Russian environmental law (Federal Law №7-FZ of 10.01.2002 "On Environmental Protection"), environmental experts and managers of polluting enterprises must have qualifications in environmental protection and environmental safety. Functions of the Department of environmental protection are ensuring compliance with environmental quality standards, obtaining government permits for emissions and discharges of hazardous substances, disposal of waste.

[30] http://www.vsestroi.ru/snip_kat/ad977f56010639c6e1ba95802d182677.php

In accordance with referred above Federal Law OJSC “MMK” has the approved Maximum Permissible Discharge of Sewage document (MPDS) and Permissible Norm of Producing and Placement of Wastes document (PNPPW). In these documents procedure of collecting and archiving of information on the environmental impacts is defined.

There is a monitoring plan in MPDS document, which is defined the monitoring parameters, frequency of measurement for each parameter and responsible personnel. Monitoring plan is approved by OJSC “MMK”. In PNPPW document list and quantity of produced wastes, frequency of producing, places of storage and responsible personnel are defined. This document is approved by OJSC “MMK”.

Considering the above we can conclude that OJSC “MMK” conduct the periodic monitoring of the environment impacts. The enterprise also has an environmental management system certified by ISO 14001.

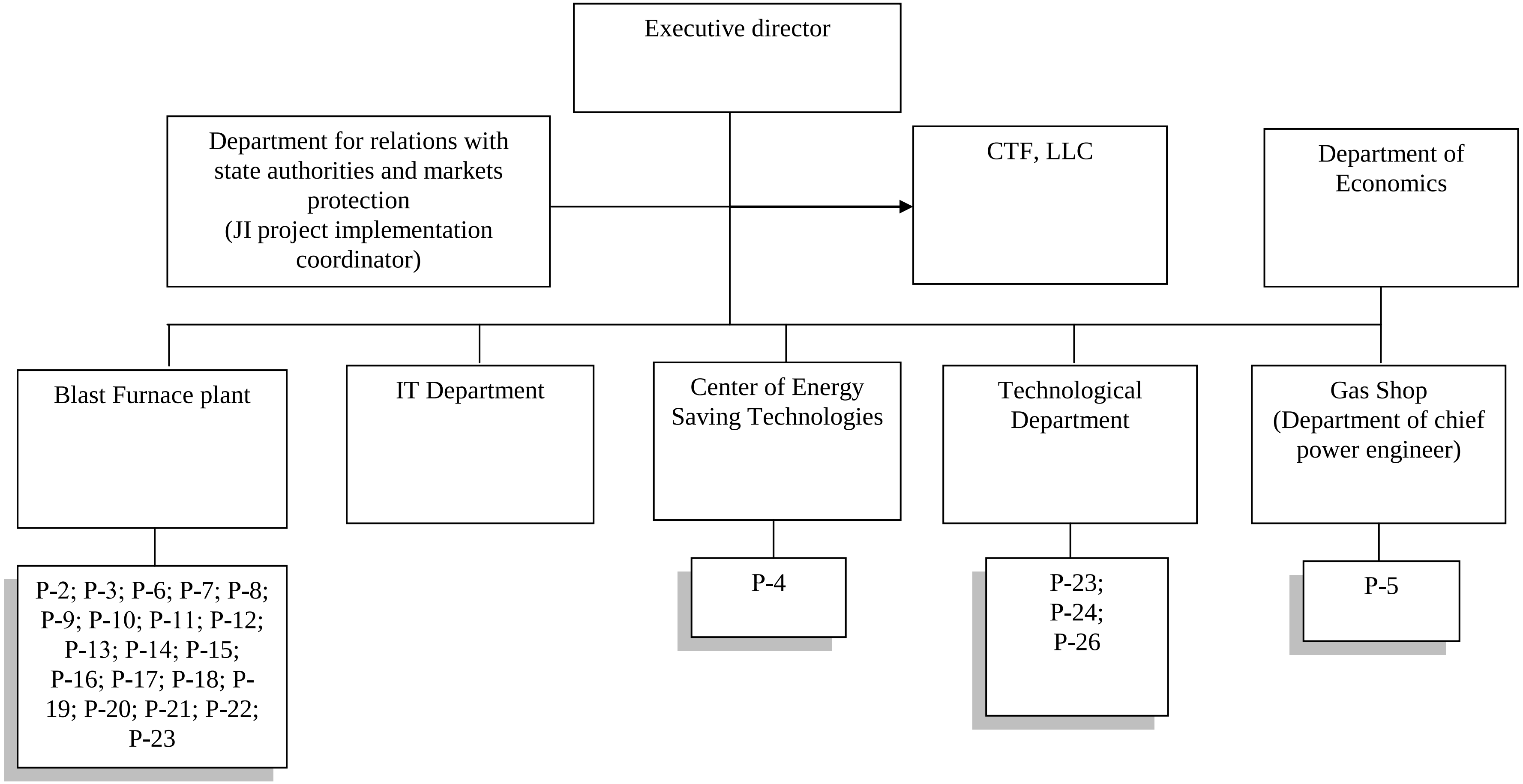
D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table D.1.1.1. P-1 $SPE_{metallurgical\_coke}$	Low	Specific CO_2 emissions per ton of dry metallurgical coke produced in PBCP are estimated by carbon balance method, considering all carbon-containing inputs and outputs of the production process. Consumption of most raw material and fuels is measured directly. The procedure of calculations is described in PDD of JI Project “Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works”.
P-2 $M_{skip\ metallurgical\_coke\_BF\ 4\ PJ}$ P-8 $M_{skip\ metallurgical\_coke\_BF\ 6\ PJ}$ P-12 $M_{skip\ metallurgical\_coke\_BF\ 9\ PJ}$ P-16 $M_{skip\ metallurgical\_coke\_BF\ 2\ PJ}$ P-20 $M_{skip\ metallurgical\_coke\_BF\ 10\ PJ}$	Low	Dry skip metallurgical coke is weighed in the weighing funnels with strain sensor, then moisture content is measured and dry weight of metallurgical coke is calculated in the technical department.

P-3 $FC_{NG\_BF\ 4\ PJ}$ P-9 $FC_{NG\_BF\ 6\ PJ}$ P-13 $FC_{NG\_BF\ 9\ PJ}$ P-17 $FC_{NG\_BF\ 2\ PJ}$ P-21 $FC_{NG\_BF\ 10\ PJ}$	Low	Consumption of natural gas is calculated by SPG-762 calculator; pressure differential is measured by Yokogava Eja110a pressure gauges.
P-4 $\%C_{metallurgical\ coke\_PJ}$	Low	Carbon content in metallurgical coke is measured by LECO SC144DR carbon analyzer.
P-5 C_{NG_PJ}	Low	Carbon content in NG is calculated on the basis of chemical composition of natural gas, specified in the shipment passport issued by the gas supplier.
P-6 $V_{pure\ N2\_BF4}$ P-10 $V_{pure\ N2\_BF6}$ P-14 $V_{pure\ N2\_BF9}$ P-18 $V_{pure\ N2\_BF2}$ P-22 $V_{pure\ N2\_BF10}$	Low	Consumption of pure nitrogen for cooling of BLT charger reduction gear is measured by gas flow meters.
P-7 $P_{pig\ iron\ BF\ 4\ PJ}$ P-11 $P_{pig\ iron\ BF\ 6\ PJ}$ P-15 $P_{pig\ iron\ BF\ 9\ PJ}$ P-19 $P_{pig\ iron\ BF\ 2\ PJ}$ P-23 $P_{pig\ iron\ BF\ 10\ PJ}$	Low	Production of pig iron is monitored by weighing on the railway scales 4580-P-200, 4180-P-250, 236-B-250 at the BFP weighing station.
P-23 $EC_{CSU\ AF\ 2}$ P-24 $EC_{CSU\ AF\ 3}$	Low	Electricity consumption of each sinter cooling and stabilization unit is measured individually, and separately from other units, which consume electricity. SCaSU at SP 2 receives electricity from two feeders of 66G substation. SCaSU at SP 3 receives electricity from two feeders of 66B substation. All input feeders are equipped with active and reactive electricity meters. These meters are tested once every 5 or 6 years. Substation and meter types: f66G-01 active electricity meter C6805V, accuracy rating 0.5; f66B-01 active electricity meter CA3U-I670M, accuracy rating 2.0; reactive electricity meter CR4U-I673M, accuracy rating 2.0; active electricity meter CA3U-I670D, accuracy rating 2.0.
P-25 $EF_{own\ generation\_PJ}$	Low	Average value of CO_2 emission factor for electricity, generated at MMK, is calculated on the basis of fuel consumption (blast furnace gas, coke oven gas, natural gas, and power station coal) measured at own power generation capacities of MMK: CHPP, CPP, SABPP, turbine section in the steam plant, and gas recovery section in the steam plant. Details are provided in PDD of JI Project “Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works”.
P-26 $SEC_{pure\ N2}$	Low	Center for Energy Saving Technologies (CEST) experts calculate this parameter on the basis of electricity consumption per specific volume of pure nitrogen generated by the oxygen compressor plant.

MMK Calibration lab calibrates all electricity meters. Federal State Department "Magnitogorsk Center for Standardization, Metrology and Certification" inspects these meters under the corresponding agreements with MMK. The schedule of trial inspections and calibration is approved by Chief Metrological Engineer of MMK. All data are stored in the annual "Journals of inspections and calibration of metering devices".

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

Diagram D.3.1: Management structure of monitoring process



Organization of monitoring process

To ensure the proper monitoring and reporting process for the JI project OJSC “MMK” will establish the special internal procedure as a part of its certified quality management system (QMS). Following order is described according to the draft of the procedure.

The MMK’s structural departments which have a function of processing monitoring data and preparation of secondary reporting forms referred in the monitoring plan of the considered JI project are responsible for the allocation of these reporting forms (which are also part of MMK QMS) to the special folders at the MMK corporate server. Departments send reporting forms to the Department for relations with state authorities and markets protection every month.

For the protection of this information MMK’s IT department established a procedure of the documents upload, back-up, access limitation and deletion prohibition.

Storing of all secondary reporting forms related to the monitoring of JI project and monitoring reports (period from 1 January 2008 to December 31, 2012) shall be done until January 1, 2015.

Every quarter all the relevant data is transferred to CTF Consulting LLC. Within 10 working days after receipt of the complete set of reporting forms specialists of CTF Consulting LLC. calculate CO_2 emission reductions achieved by project for that quarter, using calculation models that are the part of the determined PDD. The results of calculation are reported to the MMK.

CTF Consulting LLC. develops for OJSC “MMK” annual monitoring report under the quarterly reporting on CO_2 emission reductions, which is sent to Department for relations with state authorities and markets protection and Department of Economics of MMK. The Department of Economics has to compare the figures contained in the monitoring report of the consumption of raw materials and manufacture of products with Calculation of prime costs and confirm their compliance. Annual monitoring report is approved by Executive Director of MMK no later than February.

Table D.3.1 Responsible departments of MMK, reporting forms and monitoring parameters

#	Department, responsible	The name of the reporting form fixed in QMS	Monitoring parameters
1	BFP	Technical report of BFP	Consumption of dry skip metallurgical coke, agglomerate, natural gas, pig iron production
2	Technological department	Total electricity consumption by MMK	Electricity consumption

3	Central Laboratory of Control in structure of Scientific and Technological Center	Reporting form of chemical composition of metallurgical coke in By-product coke plant – monthly average	Carbon content in product
4	Gas Shop (Department of chief power engineer)	Technical quality passport of gas	Composition of natural gas for carbon content calculation

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

The developer of monitoring plan:

"CTF Consulting", LLC

Moscow, Baltchug street 7, Business-center "Baltchug Plaza", office 629;
Contact person: Konstantin Myachin, Carbon Project Manager
Ph: +7 495 984 59 51
Fax: +7 495 984 59 52
e-mail: konstantin.myachin@carbontradefinance.com

"CTF Consulting", LLC is not a project participant.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Project emissions in 2009 were calculated using the formulae in Section D.1.1.2, on the basis of actual annual data reported by MMK.

Consumption of materials and energy inputs in blast furnaces in 2010-2012 was estimated on the basis of specific consumption of dry skip metallurgical coke and natural gas per ton of pig iron, and on the basis of planned output of pig iron:

• for BF #4,6,9,10 on the basis of planned output of pig iron in 2010;

• for BF #2 on the basis of planned output of pig iron in 2011 because BLT charger was installed at BF #2 in March of 2010.

Specific consumption of dry skip metallurgical coke and natural gas in BFs #4,6,9 is taken from actual data reported by MMK in 2009, specific consumption of dry skip metallurgical coke and natural gas in BF #2 is taken from actual data of three months of 2010 in annualized terms (Table E.1.1.).

The resulting economy of coke consumption by blast furnace #10 is absent today. Specific consumption of dry skip metallurgical coke and natural gas in BF #10 is taken from actual data reported by MMK in 2009 and actual data of six months of 2010 in annualized terms using conservative assumption. For the period 2011-2012 the value of specific consumption of dry skip metallurgical coke and natural gas in BF #10 is taken as equal to baseline value (Table E.1.1.).

Table E.1.1. Specific consumption of dry skip metallurgical coke and natural gas in BFs #4,6,9,2,10 for the calculation the project emission in 2010-2012

The period of calculation for BFs	Specific consumption of dry skip metallurgical coke in 2009-2010, kg/t pig iron	Specific consumption of natural gas, m^3/t pig iron
BF #4 (2010-2012)	436.4 (the value of 2009)	112.4 (the value of 2009)
BF #6 (2010-2012)	438.9 (the value of 2009)	115.5 (the value of 2009)
BF #9 (2010-2012)	434.4 (the value of 2009)	108.3 (the value of 2009)
BF #2 (2010-2012)	432.5 (the value of 2010 annualized)	112.9 (the value of 2010 annualized)
BF #10 (2010)	437.3 (the value of 2010 annualized)	89.6 (the value of 2010 annualized)
BF #10 (2011-2012)	433.5 (baseline value)	86.1 (baseline value)

Table E.1.2. Actual production of pig iron by BF #4,6,9,10 in 2009, by BF #2 in 2010 and adjustment coefficients

BFs	Actual production of pig iron, t/year	Adjustment coefficients (derived according D.1.1.2.-3,

		D.1.1.2.-7, D.1.1.2.-11 and D.1.1.2.-15)
BF #4	1,229,894	K_1 = 0.990
BF #6	1,057,495	K_2 = 1.000
BF #9	1,611,638	K_3 = 1.000
BF #2	849,051	K_4 = 1.000
BF #10	1,588,956	K_5 = 1.000

Table E.1.3. Planned output of pig iron in 2010-2012 by BFs #4,6,9,10 and in 2011-2012 by BF#2; and maximum output under the baseline scenario

BFs	Planned output of pig iron, t/year	Maximum output of pig iron in the baseline scenario, t/year
BF #4	1,221,083	1,217,400
BF #6	1,179,891	1,110,700
BF #9	1,710,036	1,768,000
BF #2	1,053,322	1,182,901
BF #10	1,710,036	1,789,600

According to Equations D.1.1.2.-3 and D.1.1.2.-7, the output of pig iron in BF #4 and #6 during 2010-2012 is equal to maximum output under the baseline scenario. According to Equations D.1.1.2.-11 and D.1.1.2.-19 the output of pig iron in BF #9, 10 during 2010-2012 is equal to planned output. According to Equations D.1.1.2.-15 the output of pig iron in BF #2 during 2011-2012 is equal to planned output. All values in table E.1.3. above.

Projected reduced consumption of dry skip metallurgical coke and NG in 2010-2012 by BFs #4,6 is given similarly by the following equations:

$$\mathbf{M_{skip\ metallurgical\ coke\_BF\ 4\ reduced\ PJ} = SM_{skip\ metallurgical\ coke\_BF\ 4\ PJ} * P_{max\ pig\ iron\ BF\ 4\ BL} / 1000} \quad \textbf{(E.1.-1)}$$

Where:
$M_{skip\ metallurgical\_\ coke\ \_BF\ 4\ reduced\ PJ}$ – Projected reduced consumption of dry skip metallurgical coke in 2010-2012 by BF #4, tones
$SM_{skip\ metallurgical\ coke\ \_BF\ 4\ PJ}$ – Project specific consumption of dry skip metallurgical coke in BF #4, kg/t pig iron
$P_{max\ pig\ iron\ BF\ 4\ BL}$ – Maximum production of pig iron in BF #4 under the baseline scenario, tones

$$\mathbf{FC_{NG\_BF\ 4\ PJ} = SFC_{NG\_BF\ 4\ PJ} * P_{max\ pig\ iron\ BF\ 4\ BL} / 1000} \quad \textbf{(E.1.-3)}$$

Where:
$FC_{NG\_BF\ 4\ PJ}$ – Project consumption of NG in BF #4 in 2010-2012, th. m^3/year
$SFC_{NG\_BF\ 4\ PJ}$ – Specific consumption of NG in BF #4, m^3/t pig iron
$P_{max\ pig\ iron\ BF\ 4\ BL}$ – Maximum production of pig iron in BF #4 under the baseline scenario, tones

$$\mathbf{M_{skip\ metallurgical\ coke\_BF\ 6\ reduced\ PJ} = SM_{skip\ metallurgical\ coke\_BF\ 6\ PJ} * P_{max\ pig\ iron\ BF\ 6\ BL} / 1000} \quad \textbf{(E.1.-2)}$$

Where:

$M_{skip\ metallurgical\_ coke\ \_BF\ 6\ reduced\ PJ}$ – Projected reduced consumption of dry skip metallurgical coke in 2010-2012 by BF #6, tones
$SM_{skip\ metallurgical\ coke\ \_BF\ 6\ PJ}$ – Project specific consumption of dry skip metallurgical coke in BF #6, kg/t pig iron
$P_{max\ pig\ iron\ BF\ 6\ BL}$ – Maximum production of pig iron in BF #6 under the baseline scenario, tones

$$FC_{NG\_BF\ 6\ PJ} = SFC_{NG\_BF\ 6\ PJ} * P_{max\ pig\ iron\ BF\ 6\ BL} / 1000 \quad \textbf{(E.1.-4)}$$

Where:
$FC_{NG\_BF\ 6\ PJ}$ – Project consumption of NG in BF #6 in 2010-2012, th. m^3/year
$SFC_{NG\_BF\ 6\ PJ}$ – Specific consumption of NG in BF #6, m^3/t pig iron
$P_{max\ pig\ iron\ BF\ 6\ BL}$ – Maximum production of pig iron in BF #6 under the baseline scenario, tones

Projected reduced consumption of dry skip metallurgical coke and NG in 2010-2012 by BF #9,10 and in 2011-2012 by BF #2 is given similarly by the following equations:

$$M_{skip\ metallurgical\ coke\_BF\ 9\ reduced\ PJ} = SM_{skip\ metallurgical\ coke\_BF\ 9\ PJ} * P_{plan\ pig\ iron\ BF\ 9} / 1000 \quad \textbf{(E.1.-5)}$$

Where:
$M_{skip\ metallurgical\_ coke\ \_BF\ 9\ reduced\ PJ}$ – Projected reduced consumption of dry skip metallurgical coke in 2010-2012 by BF #9, tones
$SM_{skip\ metallurgical\ coke\ \_BF\ 9\ PJ}$ – Project specific consumption of dry skip metallurgical coke in BF #9, kg/t pig iron
$P_{plan\ pig\ iron\ BF\ 9}$ – Planned output of pig iron in BF #9 under the project, tones

$$FC_{NG\_BF\ 9\ PJ} = SFC_{NG\_BF\ 9\ PJ} * P_{plan\ pig\ iron\ BF\ 9} / 1000 \quad \textbf{(E.1.-6)}$$

Where:
$FC_{NG\_BF\ 9\ PJ}$ – Project consumption of NG in BF #9 in 2010-2012, th. m^3
$SFC_{NG\_BF\ 9\ PJ}$ – Specific consumption of NG in BF #9, m^3/t pig iron
$P_{plan\ pig\ iron\ BF\ 9}$ – Planned output of pig iron in BF #9 under the project, tones

$$M_{skip\ metallurgical\ coke\_BF\ 2\ reduced\ PJ} = SM_{skip\ metallurgical\ coke\_BF\ 2\ PJ} * P_{plan\ pig\ iron\ BF\ 2} / 1000 \quad \textbf{(E.1.-7)}$$

Where:
$M_{skip\ metallurgical\_ coke\ \_BF\ 2\ reduced\ PJ}$ – Projected reduced consumption of dry skip metallurgical coke in 2011-2012 by BF #2, tones
$SM_{skip\ metallurgical\ coke\ \_BF\ 2\ PJ}$ – Project specific consumption of dry skip metallurgical coke in BF #2, kg/t pig iron
$P_{plan\ pig\ iron\ BF\ 2}$ – Planned output of pig iron in BF #2 under the project, tones

$$FC_{NG\_BF\ 2\ PJ} = SFC_{NG\_BF\ 2\ PJ} * P_{plan\ pig\ iron\ BF\ 2} / 1000 \quad \textbf{(E.1.-8)}$$

Where:
$FC_{NG\_BF\ 2\ PJ}$ – Project consumption of NG in BF #2 in 2011-2012, th. m^3
$SFC_{NG\_BF\ 2\ PJ}$ – Specific consumption of NG in BF #2, m^3/t pig iron
$P_{plan\ pig\ iron\ BF\ 2}$ – Planned output of pig iron in BF #2 under the project, tones

$$M_{skip\ metallurgical\ coke\_BF\ 10\ reduced\ PJ} = SM_{skip\ metallurgical\ coke\_BF\ 10\ PJ} * P_{plan\ pig\ iron\ BF\ 10} / 1000 \quad \textbf{(E.1.-9)}$$

Where:
$M_{skip\ metallurgical\_\ coke\ \_BF\ 10\ reduced\ PJ}$ – Projected reduced consumption of dry skip metallurgical coke in 2010-2012 by BF #10, tones
$SM_{skip\ metallurgical\ coke\ \_BF\ 10\ PJ}$ – Project specific consumption of dry skip metallurgical coke in BF #10, kg/t pig iron
$P_{plan\ pig\ iron\ BF\ 10}$ – Planned output of pig iron in BF #10 under the project, tones

$$FC_{NG\_BF\ 10\ PJ} = SFC_{NG\_BF\ 10\ PJ} * P_{plan\ pig\ iron\ BF\ 10} / 1000 \quad \textbf{(E.1.-10)}$$

Where:
$FC_{NG\_BF\ 10\ PJ}$ – Project consumption of NG in BF #10 in 2010-2012, th. m^3
$SFC_{NG\_BF\ 10\ PJ}$ – Specific consumption of NG in BF #10, m^3/t pig iron
$P_{plan\ pig\ iron\ BF\ 10}$ – Planned output of pig iron in BF #10 under the project, tones

Project emissions from consumption of electricity by SCaSU at SP #2 and SP #3 for estimation in 2010-2012 are assumed to be equal the value of 2009 because in this year SCaSU at SP #2 and SP #3 had worked with the capacity to be approximately maximal.

Project emissions from consumption of electricity during production of pure nitrogen, which is used for cooling of BLT, were estimated for 2010 on the basis of actual data of consumption of pure nitrogen of six months of 2010 in annualized terms. Since the actual figure in 2009 was higher than projected for whole 2010, for conservative estimation the value of electricity consumption for pure nitrogen production in 2011-2012 is equal to the value of this parameter in 2009.

Table E.1.5. Project CO_2 emissions, th. tones per year

Parameter	2009	2010	2011	2012
Production in BPCP of the skip metallurgical coke consumed in BFP	2,305.361	2,741.219	2,859.330	2,859.330
Consumption of skip metallurgical coke in BFP	7,302.453	8,683.075	9,057.204	9,057.204
Consumption of NG in BFP	1,042.168	1,254.528	1,300.596	1,300.596
Electricity consumption	107.891	98.270	107.891	107.891
Total:	**10,757.873**	**12,777.093**	**13,325.021**	**13,325.021**

E.2. Estimated leakage:

There are several sources of project leakage emissions under the methodology applied:

1. Transportation of natural gas and transmission of electricity;
2. Operations of equipment, which is decommissioned in the result of project implementation. This equipment is considered beyond the project boundaries.

Production of pig iron increased in the result of project implementation, while consumption of coke, coke breeze, and natural gas decreased. Therefore, the quantities of transported raw materials and energy resources decreased relative to the baseline. Fugitive emissions during transmission of electricity are insignificant and not included, because the generation capacities (owned by MMK) and electricity consumption aggregates (i.e., SCaSU) are located closely enough on the project implementation site. This project does not involve any equipment, which could be considered the source of emission leakages. We conclude that this project does not require estimation of emission leakages in the monitoring plan.

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

Table E.3.1. The sum of E.1. and E.2., th. tons of CO_2 per year

Parameter	2009	2010	2011	2012
Production in BPCP of the skip metallurgical coke consumed in BFP	2,305.361	2,741.219	2,859.330	2,859.330
Consumption of skip metallurgical coke in BFP	7,302.453	8,683.075	9,057.204	9,057.204
Consumption of NG in BFP	1,042.168	1,254.528	1,300.596	1,300.596
Electricity consumption	107.891	98.270	107.891	107.891
Total:	**10,757.873**	**12,777.093**	**13,325.021**	**13,325.021**

E.4. Estimated baseline emissions:

Baseline CO_2 emissions were calculated by using the equations specified in Chapter D.1.1.4 on the basis of historical values of consumption of materials and fuels, and historical output.

The Table below specifies average values of these parameters, which were used for calculations of specific consumption of dry skip metallurgical coke and natural gas in the blast furnaces #4,6,9,2,10 before installation of the SCaSU and BLT chargers in 2004-2006.

Table E.4.1. Specific consumption of dry skip metallurgical coke and natural gas (historic data):

BFs	Specific consumption of dry skip metallurgical coke, kg/t pig iron	Specific consumption of natural gas, m^3/t pig iron
BF #4	476.0	101.9
BF #6	473.3	107.0
BF #9	448.2	95.5
BF #2	466.8	104.1
BF #10	433.5	86.1

Table E.4.2. Maximum output of pig iron under the baseline scenario:

BFs	The year of maximum output of pig iron	Maximum output of pig iron, tones
BF #4	1988	1,217,400
BF #6	1990	1,110,700
BF #9	1988	1,768,000
BF #2	average value of 2004-2006	1,182,901
BF #10	1987	1,789,600

Table E.4.3. Baseline CO_2 emissions, th. tones of CO_2 per year

Parameter	2009	2010	2011	2012
Production in BPCP of the skip metallurgical coke consumed in BFP	2,407.662	2,869.784	3,000.567	3,000.567

Consumption of skip metallurgical coke in BFP	7,626.502	9,090.317	9,504.586	9,504.586
Consumption of NG in BFP	958.191	1,150.571	1,203.590	1,203.590
Total:	**10,992.356**	**13,110.673**	**13,708.743**	**13,708.743**

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

We used Equation D.1.4.-1. to estimate total emission reductions (**1,335.508 tCO_2-eq.)** and average annual emission reductions (**333,877 tCO_2-eq.)**

During the credit period of 2013-2020, projected annual emission reductions will be equal to those in 2010-2012.

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

Table E.6-1 Project and baseline emissions, emission reductions during 2008-2012 crediting period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2008	0	0	0	0
2009	10,757,873	0	10,992,356	234,483
2010	12,777,093	0	13,110,673	333,580
2011	13,325,021	0	13,708,743	383,722
2012	13,325,021	0	13,708,743	383,722
Total (tonnes of CO_2 equivalent)	50,185,007	0	51,520,515	1,335,508

Table E.6-2: Project and baseline emissions, emission reductions during 2013-2020 crediting period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2013	13,325,021	0	13,708,743	383,722
2014	13,325,021	0	13,708,743	383,722
2015	13,325,021	0	13,708,743	383,722
2016	13,325,021	0	13,708,743	383,722
2017	13,325,021	0	13,708,743	383,722
2018	13,325,021	0	13,708,743	383,722
2019	13,325,021	0	13,708,743	383,722
2020	13,325,021	0	13,708,743	383,722
Total (tonnes of CO_2 equivalent)	106,600,167	0	109,669,944	3,069,777

Extension of the project crediting period is subject to approval of the Russian Federation as a Host party of the JI project.

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:

Article 32 of the Federal Law on environmental protection # 7-FZ provides that:

"Environmental impact assessment is conducted for economic and other projects, which may directly or indirectly influence the state of the environment, irrespective of ownership type of the subjects of economic and other activities."

There were two components in the course of project implementation:

1. Construction of sinter cooling and stabilization units at sintering plants #2 and #3.
2. Installation of BLT at BF #4,6,9,10,2.

On the whole a project implementation will result in reductions of negative environmental impacts.

The following environmental impacts were identified during EIA of the proposed project:

- Short-term environmental impacts of construction works;
- Air emissions from operations of technological equipment;
- Discharge of waste water from industrial and household uses;
- Generation of industrial and consumption waste in the result of industrial operations;
- Noise and vibrations in the result of industrial operations.

Air emissions from unloading of agglomerate from agglomeration machines of SP #2 and SP #3 to the plate conveyors of SCaSU are caught and treated in the existing air pollution treatment system. In particular, these emissions pass through the containment system and new electric filters (efficiency 99.9%). New electric filters also receive emissions from the aspirators installed at the agglomerate unloading stations. These aspirators catch emissions from unloading of agglomerate from the belt conveyors of SCaSU of SP #2 and #3 and transportation of cooled sinter from the ring coolers to the vibration grates; emissions from transportation of screened agglomerate to the railway cars, which carry this agglomerate to BFP; and emissions from the return breeze-and-sinter fines conveyor.

Air emissions from the hottest 30% sections of the ring coolers of SP #2 and #3 are caught by the containment system. Hot polluted air is pumped through the hood, which is installed over the coolers, passes through the heat exchanger, and escapes to the atmosphere through the stack. Air emissions from the remaining sections of the ring coolers, where the temperature is lower, do not pass through the covering.

The abovementioned emission sources release iron oxide, non-organic dust with SiO_2 content more than 70%, aluminum oxide, potassium oxide, magnesium oxide, phosphoric anhydride, zinc oxide, elemental sulfur, titanium dioxide, and Chromium III.

All machines and welding sets of the mechanical shop are equipped with local pumps with bag filters (efficiency 99.9%).

Installation of BLT reduces specific coke consumption due to more rational distribution of furnace charge across the furnace mouth, which reduces emissions of dust along the transportation tract.

Noise pollution mainly comes from technological and ventilation equipment. All sources of industrial noise are certified by the manufacturers. The level of sound pressure does not exceed the applicable hygienic standards for workplaces.

All industrial wastewater is pumped to the sludge tank 2 of the mining-and-processing works. Additional discharge of wastewater does not reduce the efficiency of wastewater treatment. The proposed project will not lead to deterioration of water quality in the surface water reservoirs.

Installation of SCaSU at SP #2 and #3 will not change operations of the main technological equipment of the sintering plants. The proposed project shall not generate any additional industrial waste at the sintering plants. BLT operation will generate several new kinds of waste in addition to the existing ones: used transmission and hydraulic oils, and waste ends. Waste disposal and storage is regulated by the waste disposal limits, issued for MMK by Chelyabinsk Regional Department of Technological and Environmental Surveillance of Rostechnadzor.

No transboundary effects are identified; moreover as a result of implementation of the project overall air pollution by OJSC “MMK” is reduced due to less coke demand. The proposed project includes implementation of several environmental protection measures to reduce the environmental impacts of the project.

All applicable requirements of environmental law were strictly observed during construction of sinter cooling and stabilization units at sintering plants #2 and #3 and installation of BLT at BF #4,6,9,10,2. Project implementation should:

- reduce air pollution;
- prevent pollution of surface and underground waters;
- prevent on-site pollution, provided that waste storage, disposal and utilization requirements are observed;
- keep noise pollution and vibrations within maximum permissible levels;

- not create any additional health risks and environmental risks in the region.

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:

The city-building Code of the Russian Federation RF No.190-FZ provides in Article 49, Paragraphs 1,4,5:

"Technical design documentation for capital construction projects is subject to state expertise. Specially designated Federal executive authority, or another agency under its jurisdiction carries out state expertise of project documentation. State expertise of project documentation establishes if the project meets the requirements of technical regulations, sanitary, epidemiological, environmental norms, the requirements in the area of protection of cultural heritage, fire safety, industrial, nuclear and radiation safety. State expertise of project documentation also establishes if the project conforms with the results of engineering survey."

Foliowing the abovementioned requirement, environmental impact assessment (EIA) was conducted for the two projects:

- Project. «OJSC MMK. Mining-and-processing works. Sintering plants 2 and 3. Sinter stabilization». (OJSC Magnitogorsk Gipromez, 2005).
- Project. «OJSC MMK. Blast furnace plant. Installation of BLC. Blast furnaces 1,2,4,6,7,9,10». (OJSC Magnitogorsk Gipromez, 2006).

These documents passed the State expertise prior to project implementation. The following approvals have been obtained:

- State Environmental Expertise Authority decision №167 of 29.04.2006 on the project «OJSC MMK. Mining-and-processing works. Sintering plants 2 and 3. Sinter stabilization». This decision was approved by the Order №369 of Chelyabink Regional Department for Environmental and Technological Surveillance of Federal Service for Environmental, Technological and Nuclear Surveillance (Rostechnadzor).
- State Environmental Expertise Authority decision №226 of 04.09.2006 on the project «OJSC MMK. Blast furnace plant. Installation of BLC. Blast furnaces 1,2,4,6,7,9,10». This decision was approved by the Order №529 of Chelyabink Regional Department for Environmental and Technological Surveillance of Federal Service for Environmental, Technological and Nuclear Surveillance (Rostechnadzor).

SECTION G. Stakeholders' comments

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

Federal Law on environmental protection #7-FZ defines the procedure of participation of citizens and public organizations in the public environmental expertise.

Public has been informed about the planned economic activities with the goal to identify public attitudes and take public opinion in account during environmental impact assessment process.

A central city newspaper “Magnitogorski Rabochi” published the announcements about the Projects «OJSC MMK. Mining-and-processing works. Sintering plants #2 and #3. Sinter stabilization» and «OJSC MMK. Blast furnace plant. Installation of BLC. Blast furnaces 1,2,4,6,7,9,10» correspondingly in issues 49 of 23.03.2005 and 122 of 08.07.2005.

These announcements contained the following information:

- Project name, goals and site;
- Legal name and address of project owner and its representative;
- Approximate dates of EIA procedure;
- Deadlines and formats of submission of public comments;
- When and where EIA documents can be retrieved.

No comments from the public were received within the deadlines indicated in these publications. Public hearings have not been organized, because the project site lies within the MMK territory and public did not express any interest in the planned activities.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

All the key elements of the baseline have been provided in Section B (including summary of key elements in tabular form in Section B.1.).

To avoid duplication, here the only additional historic values of parameters used as the baseline for operation of BFs #4,6,9,10,2 are provided. Data from technical reports of years 2004-2006 of blast furnace plant of MMK has been used.

Table 2.1. Historic values of parameters used as the baseline for operations of BFs #4,6,9,10,2.

BF #4

Data variable	Data unit	2004	2005	2006	Average
Consumption of dry skip metallurgical coke	t	467,127	481,929	494,987	481,348
Consumption of natural gas	th. m^3	91,976	112,044	105,031	103,017
Output of pig iron	t	981,017	1,016,214	1,036,288	1,011,173

Data variable	Data unit	2004	2005	2006	Average
Specific consumption of dry skip metallurgical coke in BF #4	kg/t pig iron	476.2	474.2	477.7	**476.0**
Specific consumption of natural gas in BF #4	m^3/t pig iron	93.8	110.3	101.4	**101.9**

BF #6

Data variable	Data unit	2004	2005	2006	Average
Consumption of dry skip metallurgical coke	t	525,944	509,819	510,683	515,482
Consumption of natural gas	th. m^3	116,533	120,303	112,678	116,505
Output of pig iron	t	1,091,403	1,084,449	1,091,825	1,089,226

Data variable	Data unit	2004	2005	2006	Average
Specific consumption of dry skip metallurgical coke in BF #6	kg/t pig iron	481.9	470.1	467.7	**473.3**
Specific consumption of natural gas in BF #6	m^3/t pig iron	106.8	110.9	103.2	**107.0**

BF #9

Data variable	Data unit	2004	2005	2006	Average
Consumption of dry skip metallurgical coke	t	689,555	663,674	653,722	668,984
Consumption of natural gas	th. m^3	139,996	136,569	150,976	142,514
Output of pig iron	t	1,489,320	1,463,355	1,524,717	1,492,464

Data variable	Data unit	2004	2005	2006	Average
Specific consumption of dry skip metallurgical coke in BF #9	kg/t pig iron	463.0	453.5	428.7	**448.2**
Specific consumption of natural gas in BF #9	m^3/t pig iron	94.0	93.3	99.0	**95.5**

BF #2

Data variable	Data unit	2004	2005	2006	Average
Consumption of dry skip metallurgical coke	t	555,966	520,676	579,952	552,198
Consumption of natural gas	th. m^3	134,594	116,614	118,292	123,167
Output of pig iron	t	1,178,916	1,114,945	1,254,842	1,182,901

Data variable	Data unit	2004	2005	2006	Average
Specific consumption of dry skip metallurgical coke in BF #2	kg/t pig iron	471.6	467.0	462.2	**466.8**
Specific consumption of natural gas in BF #2	m^3/t pig iron	114.2	104.6	94.3	**104.1**

BF #10

Data variable	Data unit	2004	2005	2006	Average
Consumption of dry skip metallurgical coke	t	629,824	697,289	656,330	661,148
Consumption of natural gas	th. m^3	123,952	134,144	135,877	131,324
Output of pig iron	t	1,430,555	1,599,548	1,545,081	1,525,061

Data variable	Data unit	2004	2005	2006	Average
Specific consumption of dry skip metallurgical coke in BF #10	kg/t pig iron	440.3	435.9	424.8	**433.5**
Specific consumption of natural gas in BF #10	m^3/t pig iron	86.6	83.9	87.9	**86.1**

Annex 3

MONITORING PLAN

All the key elements of the monitoring plan have been provided in Section D.

To avoid duplication, here the only additional description of the scheme of electricity supply for sinter cooling and stabilization units is provided.

Electric supply for sinter cooling and stabilization units

Sinter cooling and stabilization units were added to the existing production chains of hot agglomerate at SP #2 and SP #3. These additional units receive electricity from the reconstructed substations, which supply electricity only to them. Electric consumption of each SCaSU is metered individually and separately from the other industrial equipment.

The main equipment of SCaSU at SP 2 receives electricity from the two feeders of Substation 66G. This substation was reconstructed in 2006. Input (high) voltage of Substations 66G and 66B and the transformers 2x1600 kVA, feeding SCaSU at SP #2 and 3, is 6.3 kV. Output (low) voltage of the transformers 2x1600 kVA, feeding SCaSU at SP #2 and 3, is 0.4 kV.

The main equipment of SCaSU at SP #3 receives electricity from the two feeders of Substation 66B.

However, the 6.5 kV air-blast engines and smoke aspirator engines of both sintering plants receive electricity from Substation 66G.

All input feeders are equipped with active and reactive electricity meters. These meters are tested once every 5 or 6 years. The feeders of the transformers 2x1600 kVA at the substations 66G and 66B are equipped with the following meters:

- f66G-01 active electricity meter C6805V, accuracy rating 0.5;
- f66B-01 active electricity meter CA3U-I670M, accuracy rating 2.0;
- reactive electricity meter CR4U-I673M, accuracy rating 2.0;
- active electricity meter CA3U-I670D, accuracy rating 2.0.

The only piece of SCaSU equipment, which does not receive electricity from the reconstructed substations, is the heat pump station. This heat pump station receives 0.4 kV electricity from Substation 66A. This substation has not been reconstructed, because it is significant reserve of the electrical power of the Substation. The installed capacity of the heat pump station is 300 kWh, and heat pumps work only during heating season. Total electricity consumption of the heat pump station shall be measured on the basis of its installed capacity and maximum length of the heating season (6650 hours per year). In 2008, this heat pump station was not in operation.

Electricity consumption of SCaSU at SP #2 and SP #3 is metered daily; weekend readings are recorded on the following Monday, and holiday readings are recorded on the following work day. A standard reporting format is used. Each sintering plant has a "Journal of electricity consumption from the 1st day of the month", where daily consumption and cumulative sum are entered. Average daily electricity consumption of each sintering plant is calculated and reported to the mining-and-processing works, where the data are stored and then reported to CEST. CEST processes the data from the sintering plants and generates Electricity Consumption Report, which contains monthly data and cumulative averages, calculated each month. This date is then processed by Technological Department.

Annex 4

CALCULATION OF SPECIFIC CO_2 EMISSIONS PER TON OF DRY METALLURGICAL COKE PRODUCED IN BPCP

Calculation of specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP by carbon balance method is in line with Tier 3 approach described in Section 4.2.2 of Chapter 4 of "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC Guidelines 2006).

Production of metallurgical coke

$$PE_{metallurgical\_coke} = [(M_{coking\ coal\_PJ} * \%C_{coking\ coal\_PJ}) + (FC_{BFG\_CP\_PJ} * C_{BFG\_PJ}) + (FC_{COG\_CP\_PJ} * C_{COG\_PJ}) + (FC_{NG\_CP\_PJ} * C_{NG\_PJ}) - (P_{metallurgical\ coke\_PJ} * \%C_{metallurgical\ coke\_PJ}) - (P_{COG\_CP\_PJ} * C_{COG\_PJ}) - (P_{benzol\_PJ} * \%C_{benzol}) - (P_{coal\text{-}tar\_PJ} * \%C_{coal\text{-}tar})] * 44/12 \quad (4.\text{-}1)$$

Where:

$PE_{metallurgical\ coke}$ – Project emissions from production of metallurgical coke in BPCP, th. tons of CO_2
$M_{coking\ coal\_PJ}$ – Consumption of dry coal charge in BPCP, th. tons
$\%C_{coking\ coal\_PJ}$ – Carbon content in dry coal charge, % by mass
$FC_{BFG\_CP\_PJ}$ – Consumption of BFG in BPCP, million m^3
C_{BFG_PJ} – Carbon content in BFG, kg C/m^3
$FC_{COG\_CP\_PJ}$ – Consumption of COG in BPCP, million m^3
C_{COG_PJ} – Carbon content in COG, kg C/m^3
$FC_{NG\_CP\_PJ}$ – Consumption of NG in BPCP, million m^3
C_{NG_PJ} – Carbon content in NG, kg C/m^3
$P_{metallurgical\ coke\_PJ}$ – Production of dry metallurgical coke, th. tons
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in dry metallurgical coke, % by mass
$P_{COG\_CP\_PJ}$ – Output of COG in BPCP, million m^3
P_{benzol_PJ} - Production of crude benzol, th. tons
$\%C_{benzol}$ – Carbon content in dry benzol, % by mass
$P_{coal\text{-}tar\_PJ}$ – Output of dry coal tar, th. tons
$\%C_{coal\text{-}tar}$ – Carbon content in dry coal tar, % by mass

Specific CO_2 emissions per ton of produced metallurgical coke

$$SPE_{metallurgical\ coke} = PE_{metallurgical\ coke} / P_{metallurgical\ coke\_PJ} \quad (4.\text{-}2)$$

Where:

$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tCO_2/t
$PE_{metallurgical\_coke}$ – Project emissions from production of metallurgical coke in BPCP, th. tCO_2
$P_{metallurgical\ coke\_PJ}$ – Production of dry metallurgical coke, th. tons

Most parameters are monitored, while some of then are fixed ex-ante:

Table 4.1. Fixed parameters

№	Data variable and unit	Notation	Value
1.	Carbon content in crude benzol, % by weight	$\%C_{benzol}$	90.0
2.	Carbon content in coal tar (dry), % by weight	$\%C_{coal\text{-}tar}$	86.0

Table 4.2. Monitored parameters

№	Data variable and unit	Notation	Data source (MMK department)
1.	Consumption of dry coal charge in BPCP, th. tons	$M_{coking\ coal\_CP\_PJ}$	BPCP technical report (BPCP)
2.	Carbon content of dry coal charge, % by weight	$\%C_{coking\ coal\_CP\_PJ}$	Protocols of chemical analyzes in BPCP (CL)
3.	Consumption of BFG in BPCP, million m^3	$FC_{BFG\_CP\_PJ}$	Report “Gas balance by MMK departments” (CEST)
4.	Carbon content in BFG, kgC/m^3	C_{BFG_PJ}	Calculated on the basis of chemical composition of BFG (CEST)
5.	Consumption of COG in BPCP, million m^3	$FC_{COG\_CP\_PJ}$	Report “Gas balance by MMK departments” (CEST)
6.	Carbon content in COG, kgC/m^3	C_{COG_PJ}	Calculated on the basis of chemical composition of BFG (CEST)
7.	Consumption of NG in BPCP, million m^3	$FC_{NG\_CP\_PJ}$	Report “Gas balance by MMK departments” (CEST)
8.	Carbon content in NG, kgC/m^3	C_{NG_PJ}	Calculated on the basis of chemical composition of NG (Department of Chief Energy Expert)
9.	Production of dry metallurgical coke, thousand t	$P_{metallurgical\ coke\_PJ}$	BPCP technical report (BPCP)
10.	Carbon content in metallurgical coke, % by weight	$\%C_{metallurgical\ coke\_PJ}$	Protocols of chemical analyzes in BPCP (CL)
11.	Output of COG in BPCP, million m^3	$P_{COG\_CP\_PJ}$	Report “Gas balance by MMK departments” (CEST)
12.	Production of crude benzol, th. t	P_{benzol_PJ}	BPCP technical report (BPCP)
13.	Production of anhydrous coal tar (dry), th. t	$P_{coal\text{-}tar\_PJ}$	BPCP technical report (BPCP)

Annex 5

CALCULATION OF CO_2 EMISSION FACTOR FOR ELECTRICITY PRODUCED AT MMK

Calculation of CO_2 emission factor for electricity produced at MMK is based on fuel consumption (blast-furnace gas, coke oven gas, natural gas and energy coal) at own generation stations of MMK (CHPP, CPP, SABPP, turbine section of the steam plant, and gas recovery section of the steam plant).

CO_2 emission factor for electricity produced at MMK

$$EF_{own\ generation\_PJ} = PE_{total\ electricity\ generation} / (EC_{gross\_PJ} - EC_{import\_PJ}) \quad (5.-1)$$

Where:

$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced at MMK, t CO_2/MWh
$PE_{total\ electricity\ generation}$ – Total CO_2 emissions from electricity generation at MMK, th. tons of CO_2
EC_{gross_PJ} – Total electricity generation at MMK, GWh
EC_{import_PJ} – Electricity purchases from Unified Energy Systems of Urals grid, GWh

CO_2 emissions from electricity generation at MMK

$$PE_{total\ electricity\ generation} = PE_{combustion\ gases\_electricity} + PE_{combustion\ coal\_electricity} \quad (5.-2)$$

Where:

$PE_{total\ electricity\ generation}$ – CO_2 emissions from electricity generation at MMK, th. tons of CO_2/year
$PE_{combustion\ gases\_electricity}$ - CO_2 emissions from combustion of gases for electricity generation at MMK, th. tCO_2/year
$PE_{combustion\ coal\_electricity}$ - CO_2 emissions from combustion of power station coal for electricity generation at MMK, th. tCO_2/year

CO_2 emissions from combustion of gases for electricity generation at MMK

$$PE_{combustion\ gases\_electricity} = (FC_{BFG\_CPP\_PJ} * C_{BFG\_PJ} + FC_{NG\_CPP\_PJ} * C_{NG\_.PJ} + FC_{NG\_CHPP\_PJ} * C_{NG\_PJ} + FC_{BFG\_SABPP\_PJ} * C_{BFG\_PJ} + FC_{COG\_SABPP\_PJ} * C_{COG\_PJ} + FC_{NG\_SABPP\_PJ} * C_{NG\_PJ} + FC_{NG\_turbine\ section\ of\ SP\ \_PJ} * C_{NG\_PJ} + FC_{NG\_gas\ recovery\ unit\text{-}2\ of\ SP\ \_PJ} * C_{NG\_PJ})/100 * 44/12 \quad (5.-3)$$

Where:

$PE_{combustion\ gases\_electricity}$ - CO_2 emissions from combustion of gases for electricity generation at MMK, thousand tons of CO_2
$FC_{BFG\_CPP\_PJ}$ – Consumption of BFG in CPP, million m^3
$FC_{BFG\_SABPP\_PJ}$ – Consumption of BFG in SABPP, million m^3
$C_{BFG\_.PJ}$ – Carbon content in BFG, kg C/m^3
$FC_{COG\_SABPP\_PJ}$ – Consumption of COG in SABPP, million m^3
$C_{COG.PJ}$ – Carbon content in COG, kg C/m^3
$FC_{NG\_CPP\_PJ}$ – Consumption of NG in CPP, million m^3
$FC_{NG\_CHPP\_PJ}$ – Consumption of NG in CHPP, million m^3
$FC_{NG\_SABPP\_PJ}$ – Consumption of NG in SABPP, million m^3
$FC_{NG\_turbine\ section\ of\ SP\ \_PJ}$ – Consumption of NG in turbine section of Steam Plant, million m^3
$FC_{NG\_gas\ recovery\ unit\text{-}2\ of\ SP\ \_PJ}$ – Consumption of NG in gas recovery unit of Steam Plant, million m^3

$C_{NG\_.PJ}$ - Carbon content in NG, kg C/m^3

CO_2 emissions from combustion of power station coal for electricity generation at MMK

$$PE_{combustion\ coal\_electricity} = (FC_{energy\ coal\_CHPP\_PJ} * \%C_{energy\ coal})/100 * 44/12 \qquad (5.-4)$$

Where:
$PE_{combustion\ coal\_electricity}$ - CO_2 emissions from combustion of power station coal, thousand tons of CO_2
$FC_{energy\ coal\_CHPP\_PJ}$ – Consumption of power station coal by CHPP, thousand tons
$\%C_{energy\ coal}$ – Carbon content in power station coal, % by mass

While most parameters are monitored, some of them are fixed ex-ante:

Table 5.1. Fixed parameteres

№	Data variable and unit	Notation	Value
1.	Carbon content in energy coal, % by weight (IPCC Guidelines 2006)	$\%C_{energy\ coal}$	73

Table 5.2. Monitored parameters

№	Data variable and unit	Notation	Data source (MMK department)
1.	Consumption of BFG in CPP, million m^3	$FC_{BFG\_CPP\_PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
2.	Consumption of NG in CPP, million m^3	$FC_{NG\_CPP\_PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
3.	Consumption of NG in CHPP, million m^3	$FC_{NG\_CHPP\_PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
4.	Consumption of BFG in SABPP, million m^3	$FC_{BFG\_SABPP\_PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
5.	Consumption of COG in SABPP, million m^3	$FC_{COG\_SABPP\_PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
6.	Consumption of NG in SABPP, million m^3	$FC_{NG\_SABPP\_PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
7.	Consumption of NG in the turbine section of the Steam Plant, million m^3	$FC_{NG\_turbine\ section\ of\ SP\_PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
8.	Consumption of NG in the gas recovery unit of the Steam Plant, million m^3	$FC_{NG\_gas\ recovery\ unit-2\ of\ SP\ PJ}$	Report on fuel consumption by MMK power generation capacities (Technological Department)
9.	Consumption of power station	FC_{energy}	Report on fuel consumption by MMK

	coal in CHPP, th. t	coal_CHPP_PJ	power generation capacities (Technological Department)
10.	Total electricity consumption at MMK, GWh	EC_{gross_PJ}	Report on electricity consumption by MMK departments/Electricity consumption report (Technological Department)
11.	Electricity imported by MMK from Urals power grid, GWh	EC_{import_PJ}	Report “Analysis of consumption of energy resources at MMK” (Technological Department)

Annex 6

LIST OF ABBREVIATIONS

AIE	Accredited Independent Entity
BAU	Business as usual
BC	Bell charger
BF	Blast furnace
BFG	Blast furnace gas
BFP	Blast furnace plant
BLT	Bell-less top
BPCP	By-product coke plant
CEST	Center for Energy Saving Technologies
CHPP	Combined heat power plant
CIS	Commonwealth of Independent States
CL	Central Lab
CMP	Conference of the Parties serving as the Meeting of the Parties
COG	Coke oven gas
CPP	Central power plant
DBC	Double bell charger
EF	Emission factor
EIA	Environmental impact assessment
ERU	Emission reduction unit
ET	Emission trading
FC	Frequency converter
FEC	Federal Energy Commission
GDS	Gas-distributing station
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal rate of return
IT	Information technology
JI	Joint Implementation
KP	The Kyoto Protocol
LLC	Limited liability company
LoA	Letter of Approval
MED	Ministry of Economic Development
MMK	Magnitogorsk iron and steel works
MNR	Ministry of Natural Resources
MPDS	Maximum Permissible Discharge of Sewage document
MPE	Maximum Permissible Emissions
NG	Natural gas
NMC	Novolipetsk Metallurgical Combine
NPV	Net present value
NTMK	Nizhni Tagil Iron and Steel Works
OJSC	Open joint stock company
PDD	Project design documentation
PNPPW	Permissible Norm of Producing and Placement of Wastes document
QMS	Quality management system

SABPP	Steam-air blowing power plant
SCaSU	Sinter cooling and stabilization unit
SP	Sintering plant
TEE	Turbine expansion engine
UZTM	Uralmashzavod

Annex 7

Letter of Mr. V. F. Rashnikov, Director General of OJSC "MMK" to State Duma of the Russian Federation, dated 17.11.2004

Scanned copy of original is in Russian language and will be provided by request. The translation is provided below.

Open joint-stock company
"Magnitogorsk Iron and Steel Works" (OJSC «MMK»)

17.11.2004 № A-0181-09
On Ratification of the Kyoto Protocol
To: Mr. G. G. Lazarev
Deputy of State Duma of the Russian Federation

Dear Georgy Gennadievich,

The block of documents on ratification of the Kyoto Protocol has been passed on to the State Duma of the Russian Federation.

Despite ambiguity of the profits of ratification of the Kyoto Protocol for the Russian Federation, the process of implementation of its mechanisms has been fostered lately on different levels of legislative and executive authorities and among the subjects of energy market. As of today the following actions have been taken in the Russian Federation:

1. Russian Joint-Stock Company "Unified Energy Systems of Russia" (RAO EES) has established Energy Carbon Fund, which is responsible for GHG emission accounting, support and audit of emission reduction activities at RAO EES enterprises and its subsidiaries and performs several other functions.
2. In the framework of the Kyoto Protocol's implementation mechanisms, several joint projects are being implemented with participation of western partners:
   - The network of Climate Defense Centers was established in 2002 by the consortium of four firms: MVV (Germany), Tebodin (Holland), ADEM (France) and "Energy Agency East-West" (Russia), and with participation of 25 centers in East Europe and CIS countries.
   - More than 10 joint Russia-Sweden projects have been prepared for implementation in several regions of the Russian Federation for example, in Leningrad and Archangelsk regions). They will have to be officially approved as Kyoto Protocol projects, but the efficient procedures of project consideration and approval have not been developed so far.
   - Federal Energy Commission (FEC) and several regional level energy commissions have undertaken practical steps towards implementation of provisions of the Kyoto Protocol. In August of 2002, FEC allowed regional energy commissions to include the costs on establishment of investment stimulation funds by means of GHG emission reduction projects in electricity tariffs, and issued an official letter for regional energy commissions to inform them about this decision.

The Kyoto Protocol established joint implementation mechanism (JI), which can be used by OJSC «MMK» as the source of additional investments for implementation of energy saving projects.

The scheme of project implementation under JI mechanisms looks like this: a country which faces difficulties with meeting the Kyoto targets – national emission reduction obligations under the Protocol – offers co-financing ("carbon financing") for energy saving / energy efficiency projects which generate GHG emission reductions, particularly carbon dioxide, in some other country, where the cost of emission reduction is considerably lower. A certain number of Emission reduction units (ERU) generated by such projects is transferred to the country-investor to offset its national emission reduction obligations. JI project can be implemented by two legal entities after the governments of the two countries formally approved such project.

According to the estimates of western experts Russia and Ukraine are the biggest potential sellers of carbon credits (they can sell 300 and 150 mission tons of emission reduction units respectively). Chemical and ironwork industries are the major sectors of Ukrainian economy, which generate emission reductions. As of today Ukraine is the greatest player on the emission reduction market among all countries, which ratified the Kyoto Protocol. Ukraine is active proponent of international collaboration under the flexibility mechanisms of the Kyoto Protocol, prior to the ratification of this protocol by the Russian Federation. Ukraine has developed a program of implementation of 36 JI projects with total cost over 700 million dollars. Russian participation in the Kyoto Protocol would considerably lower ERU price and worsen the position of Ukraine.

OJSC «MMK» has prepared and approved "Long-term investment program of OJSC «MMK» for the period of 2004-2013". This program aims at technical modernization and retooling of technological processes and power installations. Implementation of this program would generate large quantities of GHG emission reductions. For example, installation of agglomerated cake stabilization unit in sintering plant would reduce CO_2 emissions by 331.400 tons per year, and reconstruction of blast furnaces No. 6, 10, 4 with installation of bell-less charging equipment ("BLT") would reduce CO_2 emissions by 99.800 tons per year. With 431.200 tons of total annual emission reductions and carbon price of 10 dollars per tons of CO_2 this would amount to $4.312 million (126 million Rubles) of proceeds from ERU sales. The price of $10 per ton of CO_2 has been used in pilot trades by foreign organizations and funds. Another example: construction of electric arc-furnace plant at OJSC «MMK» would bring additional 664.000 tons of annual CO_2 emission reductions, or $6.64 million (194 million Rubles) of income from carbon quota sales. But ERU sales would require emission monitoring and timely ratification of the Kyoto Protocol.

OJSC «MMK» has proposed the following pilot energy-saving projects under JI mechanism:

- Converter gas recovery;
- Installation of turbine expansion engine (TEE).

At this time all Russian ironworks with basic oxygen furnaces including OJSC «MMK» are thinking to invest in converter gas recovery. Currently this gas is released or flared at OJSC «MMK» are the rate of 80.000 m^3/hour. Each cubic meter of converter gas contains 2,000 Cal of energy, which simply heats up the atmosphere. OJSC «MMK» has developed and proposed two variants of converter gas recovery. The first variant is mixing with blast-furnace gas in special mixers and subsequent burning at the central power plant (CPP). The second variant is burning at local gas-piston power plants with capacity ~80 MW. Both variants include installation of three frequency converters (FC) at the turbochargers of the basic oxygen furnace plant, saving 9 MW of energy. The experience of OJSC «MMK» in implementation of such project can later be replicated by other ironworks.

Pressure differential at gas-distributing station (GDS) can be used as an alternative source of cheap and clean electric energy. Utilization of this source would require installation of TEE with 24 MW electricity generator in natural gas circuit, in parallel with GDS.

Implementation of these two energy-saving options would reduce CO_2 emissions by 491,100 tons per year, which is equivalent of $4.911 million income from ERU sales. Estimated proceeds from ERU sales shall cover about 20% of project implementation costs, provided that appropriate emission monitoring and certification procedures are in place.

After the enterprise obtains GHG emission inventory certificate, it is registered in National GHG emission registry and obtains a certain fraction of national GHG emission quota (according to its actual GHG emissions), thus becoming a full-fledged player at the emission trading (ET) market. Making use of this additional investment source increases attractiveness of an energy-saving project and reduces its payback period.

OJSC «MMK» has not monitored its CO_2 emissions yet, because Russian environmental law does not regulate emissions of this gas. CO_2 emission monitoring would require several technical and organizational activities. There are two institutions in Russia, which offer services of monitoring of industrial emissions: NII Atmosphere Institute in Saint Petersburg and Ural NII Ecologia Institute in Perm. Participation of foreign licensed emission monitoring firms would allow OJSC «MMK» to obtain international certificate of trader at international ET markets.

Thus we consider emission trading and joint implementation as principally new economic mechanisms of emission reduction. But to launch and fine-tune these mechanisms, several steps will have to be taken. Besides ratification of the Kyoto Protocol, these steps include prompt adoption of legislative acts and organizational decisions, allowing Russian enterprises to participate in mutually beneficial international cooperation.

V. F. Rashnikov,
Director General OJSC “MMK”

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