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

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Annexes

SECTION A. General description of the project

A.1. Title of the project:

Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works
Sectoral Scope: 9 (Metal Production)
Version: 1.5
January 31, 2011

A.2. Description of the project:

Open joint-stock company "Magnitogorsk Iron and Steel Works (MMK)" is the biggest enterprise of iron and steel industry in Russia. It is a full-cycle metallurgical complex, which begins with preparation of iron ore raw materials and ends up with advanced processing of rolled steel.

MMK includes the following producing departments:
- Agglomeration plants and sintering mix preparation plant
- By-product coke plant

Primary metal production facilities include:
- Blast-furnace plant
- Basic oxygen furnace plant
- Electric arc-furnace plant

Rolling plant includes:
- Sheet mill
- Finishing plant
- Steel bar plant

Power generation facilities (electricity, air blast, steam, etc.) include:
- Combined heat and power plant (CHPP)
- Central power plant (CPP)
- Steam-air blow power plant (SABPP)
- Steam plant (SP)

Auxiliary facilities include oxygen pumping plants, etc.

The proposed Joint Implementation project envisages a complex resource-saving effect from the transition to production of profiled steel in the electric arc furnaces and its teeming in the continuous casting machines (CCM) instead of production of the same steel and profiled billet in the open-hearth plant and blooming mill plant.

A steel production at MMK at the moment takes place in the Basic Oxygen Furnace Plant (BOFP – more than 60% of total volume) and in the Electric Arc-Furnace Plant (EAFP). BOFP was commissioned in 1990. Before proposed project implementation, steel production took place in Open-Hearth Furnace Plant (OHFP) instead of EAFP. BOFP historically specialized in production of slab steel billet while the OHFP specialized in production of profiled steel billet, until the latter was closed in 2006. This is why BOFP lies beyond the boundaries of this project.

Before project start, steel of profiled grades was mostly smelted in furnaces applying open-hearth process in Double-Bath Steelmaking Units (DBSU)[1] No. 29 and 32 and in the three conventional open-hearth furnaces, with subsequent teeming and production of steel billet in the blooming mill plant (BMP)[2] (blooming mill in conjunction with mills "630" and "530").

Above mentioned technology has been applied at MMK since 1960s without major changes, and was quite well-developed. About 75% of steel was produced from liquid pig-iron, which came from the Blast-Furnace Plant (BFP) of MMK. This is why the external risks associated with the procurement of scrap metal were quite low. The conventional open-hearth process is much more energy- and resource-intensive than modern technologies of steelmaking, because the steel hardened in casting moulds after teeming and then the hardened ingots were heated again by blast-furnace gas (BFG) or coke oven gas (COG) in the heating furnaces of the blooming mill plant. After the iron mould was heated up to the rolling temperature it was rolled at the blooming mill with subsequent edge trimming because during teeming the edges of the steel mould are pimpled. After rolling in the blooming mill the steel billet was transported to the section mills for rolling of steel profiles with required dimensions.

In the absence of the proposed JI project OJSC "MMK" would have continued production of profiled steel billet in double-bath steelmaking units No. 29 and 32, with subsequent production of steel shapes in the blooming mill plant. This would have required only a relatively small additional modernization: installation of ladle-furnace aggregates (LFA) for out-of-furnace steel processing, with the goal to improve quality and product mix of rolled steel. Conventional open-hearth furnaces could have been left, but the proposed project does not consider them in the baseline scenario, because the output of double-bath steelmaking units (1.2 million tons of steel per year each) was quite sufficient for full loading of new Danieli shape mills; and moreover, DBSUs are more efficient comparing to conventional open-hearth furnaces.

According to the project scenario MMK constructed a new electric arc-furnace plant in 2006, which replaced the open-hearth furnace plant after the required reconstruction. The arc-furnace production cycle includes the following units: two high-capacity electric arc furnaces (EAF-180) manufactured by Austrian company "Voest-Alpine AG" with output capacity of 2 million tons of liquid steel per year each, out-of-furnace steel processing aggregates, one slabbing continuous-casting machine (CCM #5) with capacity of 2 million tones/year of slab steel billet and two section continuous casting machines manufactured by Austrian company "VAI" with total capacity of 2 mln. tones/year of profiled steel billet. One DBSU was left to operate under partial load. Since the implementation of the proposed project MMK has not been using ingots teeming anymore because all liquid steel now comes through continuous casting.

The project boundary includes only production of the profiled steel billet which had been produced in the OHFP before project implementation. Therefore the augmentation of liquid steel production due to higher capacity of EAFs (4 mln. tones of liquid steel totally) and presence of one DBSU in hot reserve is not accounted in the ERUs calculation because the baseline technology had no technical capability to produce slab steel billet.
The production capacity for profiled steel billet is limited by technical performance of section CCMs (2 mln. tones of steel billet annually). That's why the potential production of profiled steel billet in the baseline scenario equals to the project scenario.

However to ensure the flexibility of the liquid steel production the steel for further section grades casting and slab grades casting is melted at MMK in both EAFs and one DBSU according to short-term workshop production plans. Thus the performance characteristics of whole EAFP is considered in the project but then the CO_2 emissions associated with production profiled steel billet are separated.

[1] http://slovari.yandex.ru/dict/bse/article/00021/95400.htm
[2] http://slovari.yandex.ru/dict/bse/article/00008/99800.htm

Electric steelmaking process in EAFP and further teeming in CCM is a resource-saving technology, which allows to save the carbon-containing materials and fuels – coking coal, coke, pig iron, natural gas compared to the conventional OHFP process with ingots teeming at the same output rate. After installation of EAF-180 the ratio of liquid pig iron to scrap metal has changed. Before reconstruction the share of pig iron in the load of the steel furnace was about 75%, while in 2007 it dropped down to 25% thus reducing the demand for production of pig iron, coke and related energy and resource demands. Besides that, a continuous casting produces less cuttings, than ingots teeming process.

Electric arc process requires more electricity and that is why electric arc furnaces are connected to the external grid only. External electricity is supplied by "Chelyabinsk Energy" – an affiliate of OJSC "Interregional distribution grid company of Urals", which is integrated into Unified Energy Systems of Urals. Electric arc furnaces are directly hooked up to the external power grid through a 220/35 kV electric power substation. All other industrial facilities (except LFA-3) are supplied with electricity from the closed-loop energy system of MMK, which has its own generating capacities (CHPP, CPP, SABPP, turbine section and heat recovery system of steam plant), and also receive energy from external power grid through several step-down substations.

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 (ERU) to be generated by the given JI project (implementation of EAF-CCM process). 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.

It should be admitted, that the proposed project (reconstruction of OHFP and transition to EAF-CCM process) was initially (in 2003) considered as a JI project and meets additionality criterion. The analysis of project barriers and project financing is presented in Section B.2 of this document.

As s result of project implementation total emission reductions in 2008-2012 are 7 500 735 tons of CO_2-eq.

A.3. Project participants:

Table 3.1 Project participants

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party A: (host) Russian Federation	OJSC "MMK"	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

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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.[3]

In 2008 OJSC "MMK" smelted 11,957,000 tons of steel and produced 11,522,000 tons of hot rolled metal. The output of commercial production of metals was 10,911,000 tons, which was 11% less than the record output, reached in 2007 (12,200,000 tons). The reduction in output was caused by overall recession in Russian metallurgy sector in 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 daughter company CTF Consulting Ltd. 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

A.4.1.1. Host Party(ies):

The Russian Federation

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%.

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

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.
Latitude: 53°27'33.55"N. Longitude: 59° 4'57.29"E.

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 1916 km by rail, and 2020 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 people (2009).[4] 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 involves implementation of electric arc-furnace and continuous casting process instead of open-hearth process of steelmaking. It consists of the following basic stages:

- Replacement of double-bath steelmaking units and conventional open-hearth furnaces by electric arc furnaces equipped by additional energy sources (gas-oxygen burners, oxygen tuyeres, tuyere injection of carbon-containing materials)

- Out-of-furnace steel processing in "ladle-furnace" aggregates (LFA) and steel refining aggregate (SRA), further reconstructed to LFA
- Casting of steel of profiled grades in section continuous casting machines (CCM) №1, 2, and casting of slab steel grades in the slabbing CCM (it is beyond the project boundaries). Continuous casting replaces ingots teeming and processing in the blooming mill plant.

MMK signed a procurement contract with Austrian company "Voest-Alpine AG" on delivery of electric arc furnaces and a contract with Austrian company "VAI" on delivery of two section continuous casting machines №1 and №2 as well as two ladle-furnace aggregates.

Table A.4.2-1 Schedule of project implementation and output of steel

Year	**Operating capacities, phase-out and commissioning dates**	**Output of steel, thousand tons**[5]
2003	Two DBSUs and three open hearth furnaces were in operation	1972.0
2004	Demounting : three open hearth furnaces Commissioning: LFA №1, SRA №1, two section CCMs	1461.1
2005	Demounting: one DBSU, chemicals preparation plant, blooming mill plant (BMP)	1318.9
2006	Commissioning: two electric arc furnaces (EAF) №1, 2, LFA №2 (reconstruction of SRA №1), one slabbing CCM	2206.3, including 1048.9 by DBSU
2008	Commissioning: LFA №3	3118.2, including 308.0 by DBSU. From that amount: 1673.0 of profiled steel. 1445.3 of slab steel

At this time (2009), MMK has installed in EAFP:

- Two alternative current electric arc furnaces with capacity 180 tons each (EAF-180), with maximum output 2.035 million of liquid steel per year. These furnaces are equipped with free-flowing ingredient conveyor;
- Double-bath steelmaking unit № 32, designed to operate under partial load (mainly for processing of generated metal waste and work during repairs of electric arc furnaces);
- Out-of-furnace steel processing units: three ladle-furnace aggregates (steel refining aggregate was further reconstructed to landle-furnace aggregate). Refined steel after LFA #1 and LFA #3 is casted at section CCM #1,2 (profiled steel). Refined steel after LFA #2 is casted at slabbing CCM #5;
- Section continuous casting machines №1, 2;
- Slabbing CCM №5 (it is beyond project boundaries).

Modern technology of electric steel processing used by MMK consists of two stages: preparation of intermediate product in electric arc furnace and further refining of this intermediate product in the ladle to produce final steel product in out-of-furnace aggregates.

[5] Data from official annual reports of Economics Department of OJSC "MMK".

Unlike open-hearth furnaces and DBSU, which use liquid pig iron as the main raw material, the electric arc furnaces are mainly consuming scrap metal as the input. These furnaces are capable to process the charge mixture with pig iron content lower than 40% (scrap metal content is between 60% and 100%).

Pig iron comes from blast furnace plant and fills mixers, where it is mixed with blocks of scrap metal coming from the drop-hammer plant. Two underground belt conveyors transport ferroalloys and free-flowing materials from reception department to EAFP transshipment unit.

Electric arc furnaces melt charge mixture, remove phosphates, carbon, and heat metal by electric heaters using fuel (natural gas) and oxygen.

The electric arc furnace is activated after loading of the charge mixture and scrap metal. At the same time the gas-oxygen burners are fired. After the wells appear in the charge mixture an operator begins continuous filling of liquid pig iron and feed of the carbonizing powder. After the first portion of scrap metal melts down, the second portion comes in. Intensive gaseous oxygen blowing provides additional energy through oxidization of carbon and impurities and through afterburning of carbon monoxide.

Blowing of carbon powder with lime additive allows to utilize “foam melt slag” technology when electric arcs are submerged in the slag and the furnace lining in the bottom section of the furnace is protected. Once the required temperature and content of carbon and phosphorus are reached, the liquid metal fills 175 ton casting ladle, while the iron-oxide slag is disposed of.

Out-of-furnace steel processing in the ladle and steel processing aggregates consists of deoxidation, alloy building, desulphuration, homogenizing and heating. Addition of deoxidizing agents and slag-making additives form high-basic slag without iron oxides and efficiently deoxidize metal.

Highly deoxidized slag, intensive mixing and inert atmosphere effectively remove sulfur. Blowing of inert gas through the ladle bottom plug help to initiate turbulent chemical reactions between metal and slag and remove non-metallic impurities. Blowing of inert gas also equalizes temperature and chemical composition in the ladle after addition of ferroalloys.

Processing of steel in LFA begins with immersion of electrodes in the ladle and blowing of inert gas (argon) through the bottom plug. Initial blowing homogenizes liquid metal in the ladle and equalizes the temperatures of metal and furnace lining. After equalization a sample is taken and temperature is measured. Then metal is heated by electric arc.

After chemical analysis of the sample the ferroalloys are added for correction of chemical composition of steel, and slag-making additives are added for correction of chemical composition of slag.

Continuous casting is performed by two shaping five-lane continuous casting machines № 1 and № 2, and one slabbing two-lane continuous casting machine № 5 (which is beyond the JI project boundaries). These plants are equipped with gas cutting machines.

The CCM performs two main functions:

- It casts steel
- It cuts steel shapes into lengths of cut.

Steel-teeming ladles and intermediary ladles are serviced for breaking-down and restoration of ladle lining, removal and installation of shuttles.

Implementation of the project is associated with reduction in specific consumption of the compressed air, oxygen, steam and water that is an energy efficient measure. However the accompanying corresponding reductions of CO_2 emissions due to the project implementation are hardly possible to estimate, because of the complexity of the enterprise. At the same time the consumption of nitrogen (pure and technical-grade) has increased, which has been taken in account. Commissioning of EAF-180 increased electricity consumption which has augmented the project emissions.

The consumption of agglomerate, limestone and lime has not been taken into account. The carbon content in agglomerate is average 0.04 % by mass, which is confirmed by technical report of BFP. The EAF consumes lime, which is preliminary calcined in furnace of limestone calcinations (CO_2 is emitted). Lime is used as an oxidant, together with oxides of silicon, manganese, carbon and iron form base ferruginous slag promotes removal of phosphorus from the metal.

The OHF in other turn consumes a limestone, it is calcined right in the furnace and result in forming of the lime and CO_2. The quantity of lime used in EAF and limestone in OHF is comparable because it is conditioned by chemical specifics of the steel production process, so the consumption of these raw materials has not been taken into account because it generally does no matter where CO2 is emitted as result of the calcination: in the furnace of limestone calcinations or in the open-hearth furnace.

A resource-saving effect of production of rolled metal from profiled steel billet and slab steel billet is beyond the scope of this project. The proposed project does not consider production of slab steel billet, because the baseline scenario did not consider its production in double-bath steelmaking units. This possibility emerged only after installation of very powerful electric arc furnaces EAF-180. The decision about installation of this particular type of electric arc furnaces was made in the spring of 2004, one year after the launch of reconstruction of plant.

The implementation of electric arc steelmaking process results in increase of the electricity consumption. Only in 2008 the electricity consumption grew by 440 GWh/year against the baseline (to produce the same quantities of profiled steel billet). Thus CO_2 emission reductions arise due to resource-saving and enhancement of efficiency of the use of secondary energy resources.

Therefore, the proposed JI project implements modern and more efficient technology of steelmaking and casting, reduces consumption of pig iron and carbon-containing fuels on preceding metallurgical conversion stages and reduces waste generation in comparison with the baseline.

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:

Technological modernization of a full-cycle ironworks results in considerable resource savings at several consecutive conversion stages of steel production (by-product coke plant, blast-furnace plant, steelmaking plant); it also helps to reduce energy intensity of profiled steel production, which both reduces emissions of greenhouse gas (CO_2).

The proposed project will have the following effects:

1. Reduction of energy input per unit of production, reduction of consumption of carbon-containing raw materials per ton of steel production. These effects are explained by reduction of the fraction of pig iron and respective increase of the fraction of scrap (approximately from 25% to 75%) in the charge mixture at the electric arc furnace plant;
2. Reduction of amount of metal waste: cutoff pieces and clippings – and consequent reduction of scrape steel consumption per ton of profiled steel billet. This effect is explained by transition from ingots teeming to continuous casting technology, which eliminate intermediate steps of the production processes: removal of saw ingots and blooming of ingots at the blooming mill plant (cutoff waste was up to 20% of total steel charge of the heating furnaces of BMP);

3. Reduction of specific energy consumption per ton of profiled steel billet due to the following technological changes: phasing-out of the chemicals preparation plant and blooming mill plant, where the steel ingots were heated up to the rolling temperature and bloomed to produce profiled steel billet. Since the need to burn coke oven gas and blast-furnace gas in the heating furnaces was eliminated, MMK can now utilize these valuable secondary energy resources in other departments with the greater efficiency.

Since MMK has the basic oxygen furnace plant, which is not involved in the proposed project, for correct monitoring of emission reductions the specific CO_2 emissions are calculated by carbon balance method for three metallurgical conversions:

- by-product coke plant (tons of CO_2 per ton of coke);
- blast-furnace plant (tons of CO_2 per ton of pig iron);
- electric arc furnace plant (tons of CO_2 per ton of profiled steel billet).

Using fixed coefficients of consumption of pig iron, scrap metal and steel per ton of profiled steel billet, we calculated additional production of steel, pig iron and coke, and additional consumption of blast furnace gas and coke oven gas in the blooming mill plant, which would have taken place in the baseline scenario.

Introduction of any legally binding GHG emission reduction requirements for enterprises is not expected in the Russian Federation in the near future. This is why GHG emission reductions due to implementation of industrial modernization projects are undertaken by private businesses upon consideration of projects' economic effectiveness, risks and barriers.

Section B.2 of this document will prove that MMK had enough economic incentives to continue steel production in the open-hearth furnaces (they are partly used even today) instead of undertaking a major technological modernization. When the decision about such modernization was taken, additional income from ERU sales via JI mechanism was seriously considered. The enterprise took necessary steps 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:	5 years
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	1 699 642
2009	654 663
2010	1 097 296
2011	2 024 567
2012	2 024 567
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	7 500 735
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	1 500 147

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	2 024 567
2014	2 024 567
2015	2 024 567
2016	2 024 567
2017	2 024 567
2018	2 024 567
2019	2 024 567
2020	2 024 567
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	16 196 536
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	2 024 567

A.5. Project approval by the Parties involved:

The project was approved in Russia (Host party) by the Order of the Russian Ministry of Economic Development #709 dated 30th of December 2010.

The approval of the second Party is pending and will be received before first issuance of ERUs.

SECTION B. Baseline

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

According to the Guidelines for users of the JI PDD form, Version 04 for description and justification of the baseline chosen the following step-wise approach was used:

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

Project developer applies JI specific approach for description and justification of the selected baseline (JI specific approach) in accordance with paragraph 9 (a) of the 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 were applied to describe the most plausible baseline scenario:

1. Selection of feasible alternatives, which could be a baseline scenario
2. Elimination of less likely alternatives, either technically or economically.

We described and analyzed the whole of alternatives and selected the most plausible one as a scenario of the baseline.

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

- Metallurgical sector reform policies and legislation;
- Economic situation in the metallurgical sector of Russia as well as resulting predicted demand;
- Technical specifics of the steel melting and casting for EAF and OHF/BMP technology
- Availability of capital (including investment barriers) specific for OJSC “MMK”;
- Local availability of technologies/techniques;
- Fuel prices and availability.

Step 2. Application of the approach chosen.

We considered 2003 as the base year during the selection of feasible future scenarios/alternatives of profiled steel billet production at MMK. The following alternatives have been considered:

1. Continuation of production of profiled steel in open-hearth plant with two DBSUs, ingots teeming and blooming in BMP without any further modernization.
2. Continuation of production of profiled steel in open-hearth plant with two DBSUs, installation of two LFAs, ingots teeming and blooming in BMP.
3. Continuation of production of profiled steel in open-hearth plant with two DBSUs, dismounting of the three conventional open-hearth furnaces and construction of continuous casting machines №1, 2, installation of two LFAs.
4. Multi-stage reconstruction of OHFP, and its conversion into electric arc furnace plant:
    a) Construction of two section CCMs №1, 2 with total output up to 2 million tons of steel billet per year, installation of two LFAs and dismounting of the three classic open-hearth furnaces;

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b) Construction of two electric arc furnaces with capacity 2.035 million of liquid steel per year each, and decommissioning of two DBSUs.

According to the Russian legislation all the listed alternatives do not face any prohibitive barriers. The only legal provision that potentially may limit the use of the open-hearth furnaces is a ban for exceeding of established levels of emissions of the harmful substances by OJSC "MMK". However during many years before OHFP was decommissioned OJSC "MMK" had been annually receiving the emission permit from local environmental authorities and production of 2 mln tones of profiled steel billet with use of the old technology was always acceptable from point of view of environmental impact.

Elimination of less likely alternatives, either technically or economically

1. Continuation of production of profiled steel in open-hearth plant with two DBSUs, ingots teeming and blooming in BMP, without any further modernization

This alternative means that profiled steel shall be produced by the same production facilities, which existed prior to 2003 without any modernization. OJSC "MMK" planned modernization of its section mills already in 2002. These plans finally led to installation of three new section mills manufactured by Danieli Company (Italy) in 2005. The improvements in production assortment generated more stringent requirements to steel quality.

To meet these new requirements, the technological chain of steel refining should include additional stages. Installation of ladle-furnace aggregate could meet these demands because it allows to produce steel with additional technical specifications: selected chemical composition, standards for nonmetallic inclusions, and the desired hardening characteristics[6]. Capability to meet these new demands increases the value and competitiveness of profiled steel of MMK both domestically and internationally.

These arguments render the alternative №1 unlikely and leave it out of further consideration.

2. Continuation of production of profiled steel in open-hearth plant with two DBSUs, installation of two LFAs, ingots teeming and blooming in BMP

Expansion of rolled steel production under this scenario would guarantee that MMK fully meets its prospective targets of profiled steel production. The full capacity of two DBSUs is 1.2 million tons of steel per year taking in account operational shutdowns and repairs. According to existed industrial expansion plans, MMK commissioned new section mill "450" and small section mill "370" in 2005, and new rod mill "170" in 2006. Installation of these new mills allowed to increase the output of rolled section steel 1.4 to 2 million tons, which corresponds to the capacity of blooming mill plant.

The strategy of development metallurgy industry in Russian Federation[7] defines the basic tendency of the development, among others:

- growth the production and consumption of steel products;
- improvement the quality characteristics of products and enhancement the range of products;

Installation of two LFAs allows to improve the quality characteristics of steel products. All requirements statutory by environmental protection legislation is satisfied in baseline scenario. There are no special requirements of environmental protection legislation or requirements of another regulatory agencies to reduce the emission of CO_2. All above-listed is showed that baseline scenario conforms to national policies and circumstances.

[6] http://www.eprussia.ru/epr/55/3589.htm
[7] http://www.minprom.gov.ru/activity/metal/strateg/2

This scenario of industrial development is the most plausible one, because it:

- allows to produce the required quantity of rolled metal and meet the most stringent quality standards (after installation of two LFAs) without large-scale and quite expensive capital reconstruction;
- does not require increase of external purchases of scrap metal;
- requires twenty times less investments (Euro 19.6 million baseline scenario) than the project scenario (Euro 152 million).

3. Continuation of production of profiled steel in open-hearth plant with two DBSUs, dismounting of the three conventional open-hearth furnaces and construction of section continuous casting machines №1, 2, installation of two LFAs.

Development of rolled steel production under this scenario would allow MMK to meet the target of 2 million tons of high-quality profiled steel billet per year, but the technological process chain in open-hearth plant would change fundamentally. Because of workshop space limitations, installation of two CCMs would require liquidation of three conventional open-hearth furnaces with capacity 800.000 tons/year of liquid steel each. This option would actually preclude potential ability of MMK to produce more steel in OHFP than the output of two DBSUs.

In the long run this alternative is unacceptable for MMK, because it limits industrial output and at the same time requires a costly and large-scale modernization, especially in the light of buoyant demand for steel on domestic and international markets, which existed at that time and the plans of industrial expansion. The industrial development in the subsequent years (after 2003) showed that installation of electric arc furnaces opened new prospects for growth of steel production.

It takes 2-3 hours to melt steel in double-bath steelmaking units, while it takes less than one hour to cast steel in CCM. This difference creates a serious technological problem, because the steel should be partly kept in constantly heated ladles. This would also mean more problems with internal workshop logistics and crane operation, as well as downturning the plant capacity.

This scheme was indeed implemented in OHFP between 2004 and 2006, but only as a temporal solution during the electric arc furnace construction stage. During this transition period the output of steel was greatly reduced. This scheme seems unlikely to be continued further in 2008-2012 and has to be rejected.

4. Multi-stage reconstruction of OHFP, and its conversion to electric arc furnace plant:
   a. Construction of two section CCM №1, 2 with total output up to 2 million tons of profiled steel billet per year, installation of two LFAs and dismounting of the three conventional open-hearth furnaces;
   b. Construction of two electric arc furnaces with capacity 175 tons, and decommissioning of two DBSUs.

In the Order №635 of 22.11.2002, the Director General of OJSC "MMK" sanctioned "reconstruction of open-hearth plant and organization of electric arc steelmaking process". According to this order a feasibility study was conducted and the described above modernization scenario was approved early in 2003. At that time, the management of MMK initiated process of procurement of industrial equipment and construction of section continuous casting machines №1, 2.

Reconstruction of continuous-running steel production process in open-hearth plant cannot be fulfilled in single stage without full shutdown of production for 1-2 years. This option was unacceptable for the enterprise. This is why the reconstruction was done in two steps.

According to the technological modernization project approved in 2003, the purpose of open hearth furnace plant reconstruction was to implement two electric arc furnaces and continuous casting machines, which coincides with the boundaries of the proposed JI project. Steel ladle capacity (175 tons) is the basic parameter, which determines all technological characteristics of a steelmaking plant. This volume value (175 t) defined the following sequence of reconstruction steps:

- reconstruction of DBSU № 29 and № 32, with corresponding reduction of their output to 1.100.000 t/y of steel each;
- procurement and installation of two section CCMs with capacity up to 1.080.000 tones/year of profiled steel billet, ladle-furnace aggregate and steel refining aggregate.

After construction and putting into operation of two 175-ton electric arc furnaces (№1 and №2) with output of 1.100.000 tones/year (each) both DBSUs should have been shut down.

Although the construction of two CCMs began in 2003, the second step of OHFP modernization project went through a preinvestment stage in 2004, and the final decision about construction of electric arc steelmaking complex was made in June of 2004 (order №440 of 22.06.2004). This complex included:

- Two EAFs with capacity up to 180 tons each. Each EAF can produce 2 million t/y of steel.
- One LFA (another LFA was installed earlier, together with CCM №1 and №2).
- Slab CCM №5 with capacity 2.2 million t/y of steel.
- Auxiliary equipment (lime burning furnace, cranes, electricity and water supply networks, etc.).

During the process of design of the EAF plant having as a ground the ladle capacity (175 tons) the project developers explored that the maximum output of each electric arc furnace with such capacity can be 2 million tones of liquid steel per year if the producer is Voest-Alpine AG. OJSC “MMK” signed with this company a procurement contract in March of 2004. The capacity of electric arc furnaces surpassed the capacity of two section CCMs, which were already under construction at that time. Therefore the management of MMK decided to construct additional slab CCM №5 in EAFP (the rest slab CCMs are installed in the basic oxygen furnace plant).

The proposed JI project does not include resource-saving effect of technological modernization of slab steel billet production because the decision about transition to CCM process and construction of EAFP was taken in the beginning of 2003, and the construction of slab CCM № 5 was a consequence of that decision.

During construction of EAF-2 one DBSU was liquidated, and the second DBSU has been working under partial load. This decision allowed MMK to meet its steel production targets during reconstruction period. Moreover this provided enough flexibility for MMK to react on changes in external prices for scrap metal and process its own waste (DBSU furnace charge may contain almost 100% of pig iron, while EAF charge can have not more than 40% of pig iron).

Conclusion and description of the chosen baseline scenario

The analysis of alternative options rendered only two alternatives as the most probable scenarios of development of open-hearth furnace plant of MMK in 2003:

<u>Alternative 1</u> (considered as the baseline scenario)

Continuation of production of profiled steel in open-hearth plant with two DBSUs, installation of two LFAs, ingots teeming and blooming in BMP.

Alternative 2 (considered as project scenario)

Multi-stage reconstruction of OHFP, and its conversion to electric arc furnace plant:

a) Construction of two section CCMs №1, 2 with total output up to 2 million tons of profiled steel per year, installation of two LFAs and dismounting of the three conventional open-hearth furnaces;

b) Construction of two electric arc furnaces with capacity 175 tons and decommissioning of two DBSUs.

Both Barrier and Investment analysis were applied to prove additionality of the proposed project (see detailed description in sub-section B.2.).

The selection of the baseline scenario as project baseline is in line with "Guidance on criteria for baseline setting and monitoring", version 02. Specifically:

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

Production of profiled steel in the open hearth furnace plant using two DBSUs, ingots teeming and further production of profiled steel billet in the blooming mill plant comprise all technological CO_2 emissions, associated with production of profiled steel billet. This baseline includes emission from by-product coke plant, blast-furnace plant, open-hearth furnace plant, and blooming mill plant. It also covers emissions associated with generation of electricity consumed by OHFP and BMP, either produced by own electricity-generating capacities of MMK: CHPP, CPP, SABPP, etc., or purchased from Unified Energy Systems of Urals power grid. It also includes emissions, associated with generation of air blast for production of the pig iron. All abovementioned emission sources are within the project boundaries.

To determine baseline CO_2 emissions, project developer partly used the approach described in IPCC Guidelines for National Greenhouse Gas Inventories (2006) Volume 3, Chapter 4.

Approach to define and calculate baseline emissions (Baseline emission calculation methodology)

The following principles were applied during baseline emission calculations:

1. Specific CO_2 emission from metallurgical conversion during production of one ton of blast-furnace coke and pig iron are annually estimated ex post; these emissions are the same in the project and baseline.
2. Specific CO_2 emission from metallurgical conversion during steel production in OHFP and during production of profiled steel billet in BMP are calculated by carbon balance method, based on historical data of consumption of carbon-containing materials and fuels for the existed baseline technologies of steelmaking, and actual carbon content in the natural gas, coke oven gas and blast furnace gas.
3. Based on historical consumption of pig iron, scrap metal and steel for production of one ton of profiled steel billet in OHFP-BMP process as well as on actual specific consumption of blast-furnace coke per ton of pig iron, applying above mentioned specific coefficients of CO_2 emissions, the general CO_2 emissions from metallurgical conversions during production of profiled steel billet in baseline are calculated. We assumed that output of profiled steel billet in baseline is the same as it is in the project.
4. Based on historical consumption of electricity in OHFP and BMP (they produced only profiled steel and billet) and actual CO_2 emission factors (EFs) from electricity production the baseline emissions from electricity consumption are calculated.

5. Applying the actual specific consumption of air blast per ton of pig iron and CO_2 emission factor from air blast generation as well as the demand for pig iron during production of profiled steel billet under the baseline scenario, the baseline emissions from air blast generation are calculated.
6. Finally the total CO_2 emissions associated with production of profiled steel billet in the baseline are calculated.

The information on consumption of raw materials, production inputs and energy resources, steel output; carbon content of production inputs and other data used for calculation of baseline emissions is monitored and stored by MMK during routine factory monitoring process for many years, and is well documented in the respective reports of the enterprise. This significantly reduces data uncertainty for baseline emission estimates.

It is necessary to note that according to the chosen baseline scenario (described beneath in B.2. section) two LFAs will be installed in OHFP. Those aggregates are equipped with electric-arc steel heating system and in conservativeness reason the additional electricity consumption that would have taken place, and respective CO_2 emissions during its production are not taken into account.

Key information and data used for selection of baseline

Data/Parameter	Annual average consumption of pig iron in OHFP ($M_{pig\ iron\ OHFP}$)
Data unit	Thousand tons
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	1,941.1
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average consumption of scrap metal in OHFP ($M_{scrap\ OHFP}$)
Data unit	Thousand tons
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	715.3
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average steel smelting in OHFP ($M_{steel\ OHFP}$)
Data unit	Thousand tons

Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	2,335.7
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average specific consumption of pig iron in OHFP per ton of steel ($SM_{pig\ iron\ OHFP}$)
Data unit	ton/ton
Description	Calculated on the basis of averaged over historical data presented in Annex 2
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data of consumption of pig iron and steel smelting archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	0.831
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average specific consumption of scrap metal in OHFP per ton of steel ($SM_{scrap\ OHFP}$)
Data unit	ton/ton
Description	Calculated on the basis of averaged over historical data presented in Annex 2
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data of consumption of pig iron and steel smelting archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	0.306
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average specific consumption of steel in OHFP per ton of profiled steel billet in BMP ($SC_{steel\ profiled\ steel\ BM}$)
Data unit	ton/ton
Description	Calculated on the basis of averaged over historical data presented in Annex 2
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data of consumption of pig iron and steel smelting archives of Economic Department (calculation of production costs)

Value of data applied (for ex ante calculation/ determinations)	1.151
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average production of profiled steel billet in BMP ($M_{profiled\ steel\ BM}$)
Data unit	Thousand tons
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	2,029.9
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average specific consumption of natural gas in OHFP ($M_{NG\ OHFP}$)
Data unit	m^3/t
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data on NG consumption in OHFP has been stored in CEST technical reports. Historical data on steel production is stored in archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	23.3
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average specific consumption of blast furnace gas in BMP (M_{BFG_BM})
Data unit	m^3/t
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data on BFG consumption in BMP has been stored in CEST technical reports. Historical data on steel production is stored in archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	267.1
Justification of the choice of data or	This parameter is determined according to the selected

description of measurement methods and procedures (to be) applied	approach of baseline emission calculations, as described above
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average consumption of blast furnace gas in BMP (C_{BFG_BM})
Data unit	mln. m^3
Description	Calculated on the basis of averaged over historical data presented in Annex 2
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data on BFG consumption in BMP has been stored in CEST technical reports.
Value of data applied (for ex ante calculation/ determinations)	542
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average specific consumption of coke oven gas in BMP (M_{COG_BM})
Data unit	m^3/t
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data on COG consumption in BMP has been stored in CEST technical reports. Historical data on steel production is stored in archives of Economic Department (calculation of production costs)
Value of data applied (for ex ante calculation/ determinations)	7.7
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Annual average consumption of coke oven gas in BMP (C_{COG_BM})
Data unit	Mln. m^3
Description	Calculated on the basis of averaged over historical data presented in Annex 2
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	Data on COG consumption in BMP has been stored in CEST technical reports.
Value of data applied (for ex ante calculation/ determinations)	16
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 implemented for fixed ex-ante parameter

Any comment	No additional comments

Data/Parameter	Annual average consumption of electricity in OHFP (EC_{OHFP})
Data unit	GWh
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	CEST technical reports.
Value of data applied (for ex ante calculation/ determinations)	16.2
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 implemented for fixed ex-ante parameter
Any comment	Under the conservative approach the additional electricity consumption that would have taken place in OHFP due to installation of 2 LFAs and respective CO_2 emissions during electricity production are not taken into account.

Data/Parameter	Annual average consumption of electricity in BMP ($EC_{\_BM}$)
Data unit	GWh
Description	Averaged over historical data (see Annex 2)
Time of determination/ monitoring	This parameter is fixed ex-ante
Source of data (to be) used	CEST technical reports.
Value of data applied (for ex ante calculation/ determinations)	83.8
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 implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Specific CO_2 emissions per ton of dry metallurgical coke production in BPCP ($SPE_{metallurgical\ coke}$)
Data unit	t CO_2/t
Description	This parameter is calculated by Eq. D.1.1.2-2
Time of determination/ monitoring	Quarterly/annually
Source of data (to be) used	Monitoring data of input and output flows during production of metallurgical coke in BPCP
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
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	See Chapter D.2
Any comment	No additional comments

Data/Parameter	Specific CO_2 emissions per ton of pig iron production ($SPE_{pig\ iron}$)
Data unit	tons of CO_2 per ton of pig iron
Description	This parameter is calculated by Eq. D.1.1.2-4

Time of determination/ monitoring	Quarterly/annually
Source of data (to be) used	Monitoring data of input and output flows during production of pig iron in BFP
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
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	See Chapter D.2
Any comment	No additional comments

Data/Parameter	Specific consumption of dry skip metallurgical coke per ton of pig iron produced in BFP ($SC_{skip\ metallurgical\ coke\ PJ}$)
Data unit	t/t
Description	This parameter is calculated by Eq. D.1.1.2-9
Time of determination/ monitoring	Quarterly/annually
Source of data (to be) used	Monitoring data of input and output flows during production of pig iron in BFP
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
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	See Chapter D.2
Any comment	No additional comments

Data/Parameter	Specific CO_2 emissions per ton of steel smelted in OHFP (SBE_{OHFP})
Data unit	t CO_2/t
Description	This parameter is calculated by Eq. D.1.1.4-2
Time of determination/ monitoring	Quarterly/annually
Source of data (to be) used	Calculation of this parameter is based on monitoring of carbon content in natural gas. The values of remaining parameters fixed ax-ante based on historical data
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
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. Carbon content in NG is calculated on the basis of chemical composition of natural gas, specified in shipment passport by gas supplier.
QA/QC procedures (to be) applied	See Chapter D.2
Any comment	No additional comments

Data/Parameter	Specific CO_2 emissions per ton of profiled steel billet produced in BMP (SBE_{BM})
Data unit	tons of CO_2 per ton of profiled steel
Description	This parameter is calculated by Eq. D.1.1.4-4
Time of determination/ monitoring	Quarterly/annually
Source of data (to be) used	Calculation of this parameter is based on monitoring of carbon contents in blast furnace gas and coke oven gas. The values of remaining parameters are fixed ax-ante based on

	historical data.
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
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. Carbon content in BFG and COG is calculated on the basis of their chemical composition, determined by CEST
QA/QC procedures (to be) applied	See Chapter D.2
Any comment	No additional comments

Data/Parameter	Specific consumption of air blast per ton of pig iron produced in BFP ($SC_{air\ blast\ generation}$)
Data unit	m^3/t
Description	This parameter is calculated by Eq. D.1.1.2-29
Time of determination/ monitoring	Quarterly/annually
Source of data (to be) used	Monitoring data of air blast generation by MMK and production of pig iron in BFP
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
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. Air blast generation is measured by air flow meters. The data are stored in CEST reports on electricity consumption
QA/QC procedures (to be) applied	See Chapter D.2
Any comment	No additional comments

Data/Parameter	CO_2 emissions factor for grid electricity purchased from Unified Energy System of Urals (EF_{grid})
Data unit	kg CO_2/MWh
Description	This parameter is needed to calculate CO_2 emissions from consumption of grid electricity
Time of determination/ monitoring	Fixed ex-ante
Source of data (to be) used	Report on GHG emission factors for Russian energy systems (2008)[8]. This report was prepared by Carbon Investments Ltd. by order of Carbon Trade & Finance SICAR S.A., and approved by Accredited Independent Entity (AIE) Bureau Veritas.
Value of data applied (for ex ante calculation/ determinations)	0.541
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The application of the coefficient 0.541 kg CO_2/MWh is conservative because this is higher than widely used ERUPT coefficient (0.504 kg CO_2/MWh in 2008, which is lowering up to 2012).
QA/QC procedures (to be) applied	See Chapter D.4.
Any comment	No additional comments

Data/Parameter	CO_2 emissions factor for electricity generated by MMK ($EF_{own\ generation\ PJ}$)

[8] The Report and its results are exclusively owned by "Carbon Trade & Finance SICAR S.A." and it can be used only after written permission of the owner. The relevant exacts from the Report are published in Annex 4.

Data unit	kg CO_2/MWh
Description	This parameter is required to calculate CO_2 emissions from consumption of own electricity. This parameter is calculated by Eq. D.1.1.2-22
Time of determination/ monitoring	Quarterly/annually
Source of data (to be) used	Monitoring data on fuel consumption by MMK generation capacities, density of gaseous fuel, total consumption of electricity by MMK, and purchases of grid electricity from Unified Energy System of Urals.
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is calculated in line with Guidelines on CO_2 emissions calculation from electricity consumption (CDM methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01)). Fuel consumption is metered by pressure drop flow meters. Gas fuel density is calculated on the basis of its component composition. Solid fuel is weighed. These data are needed to calculate CO_2 emissions from own electricity generation and total electricity supply from MMK own power stations, which is calculated as the difference between total electricity consumption and total purchases of grid electricity.
QA/QC procedures (to be) applied	See Chapter D.2
Any comment	No additional comments

Data/Parameter	Power transmission and distribution losses in Unified energy Systems of Urals grid (TDL)
Data unit	%
Description	This parameter is required to calculate CO_2 emissions from consumption of grid electricity
Time of determination/ monitoring	Annually
Source of data (to be) used	Annual Report of Inter-regional company for distribution of grid electricity of Urals published in the Internet[9]
Value of data applied (for ex ante calculation/ determinations)	This parameter is to be monitored
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is calculated in accordance with Guidelines on CO_2 emissions calculation from electricity consumption (CDM methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01)).
QA/QC procedures (to be) applied	See Chapter D.2
Any comment	No additional comments

The values of parameters listed below remain fixed in both baseline and project scenario.

Data/Parameter	Carbon content of crude benzol ($\%C_{benzol}$)
Data unit	% by mass
Description	Crude benzol is formed during purification and cooling of coke oven gas after the coking plant. It is a liquid mixture of

[9] http://www.mrsk-ural.ru/ru/460

	several aromatic hydrocarbons. The carbon content parameter is needed to calculate specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	Chemical formula of benzol
Value of data applied (for ex ante calculation/ determinations)	90.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	In accordance with analysis of chemical composition of crude benzol (was made by CL (BpCP Lab)) carbon content of crude benzol is 87.8%. As a conservative assumption, we use maximum value, with a certain margin (2%).
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Carbon content of coal tar ($\%C_{coal\ tar}$)
Data unit	% by mass
Description	Coal tar is formed during purification and cooling of coke oven gas after the coking plant. It is a heavy viscous liquid mixture of numerous aromatic and heterocyclic hydrocarbons. The carbon content parameter is needed to calculate specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	Chemical analysis of coal tar
Value of data applied (for ex ante calculation/ determinations)	86.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Form #BPCP-C296 of 26.06.2009, signed by Director of BPCP. Similar measurements in several preceding years showed the maximum value of 84%. As a conservative assumption, we use maximum value, with a certain margin (2%).
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Carbon content of pig iron ($\%C_{pig\ iron}$)
Data unit	% by mass
Description	This parameter is needed to calculate specific CO_2 emission per ton of pig iron
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	Chemical analysis of pig iron
Value of data applied (for ex ante calculation/ determinations)	4.7
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurements taken in 2002 and 2007 agreed in mean carbon content of pig iron, because this is an important technological indicator, which determines the end of blast furnace smelting. Final carbon content of pig iron is a technological standard.
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Carbon content of scrap metal ($\%C_{scrap}$)
Data unit	% by mass

Description	This parameter is needed to calculate specific CO_2 emission per ton of steel produced in OHFP
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	Average of measurements taken in 2002 and 2007. Scrap metal and steel have the same chemical composition.
Value of data applied (for ex ante calculation/ determinations)	0.18
Justification of the choice of data or description of measurement methods and procedures (to be) applied	As a conservative assumption, carbon content of steel is applied.
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Carbon content of steel ($\%C_{steel}$)
Data unit	% by mass
Description	This parameter is needed to calculate specific CO_2 emission per ton of steel smelted in OHFP and per ton of profiled steel billet produced in BMP.
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	Average of measurements taken in 2002 and 2007.
Value of data applied (for ex ante calculation/ determinations)	0.18
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurements taken in 2002 and 2007 agreed in mean carbon content of steel, because this is an important technological indicator, which determines its quality and may vary only within very narrow bounds. The mean carbon content of steel product mix, produced by the plant within one quarter or one year, is quite stable.
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Carbon content of energy coal ($\%C_{energy\ coal}$)
Data unit	% by mass
Description	This parameter is needed to calculate specific CO_2 emission from generation of own electricity at MMK. This coal is fired at CHPP
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	IPCC Guidelines for National Greenhouse Gas Inventories (2006) Volume 3, Chapter 4, Table 4.3
Value of data applied (for ex ante calculation/ determinations)	73.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Default value from IPCC Guidelines for National Greenhouse Gas Inventories (2006) Volume 3, Chapter 4, Table 4.3 is applied, because MMK does not measure carbon content of the energy coal
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Carbon content in carbon-containing powder ($\%C_{carbon\ powder\ EAFP}$)
Data unit	% by mass
Description	During oxidizing period of smelting carbon content in

	electric arc furnace is decrease and carbon-containing powder is added in the deoxidizing period of smelting for attainment of proper smelting steel quality. This parameter is needed to calculate specific CO_2 emission per ton of profiled steel billet produced in EAFP
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	In accordance with standard specification 1971-003-13303593-2006, which is confirmed by quality certification
Value of data applied (for ex ante calculation/ determinations)	95.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	In accordance with standard specification 1971-003-13303593-2006 carbon content in carbon-containing powder should be not less 95%.
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
Any comment	No additional comments

Data/Parameter	Carbon content in electrodes ($\%C_{electrodes\_EAFP}$)
Data unit	% by mass
Description	This parameter is needed to calculate specific CO_2 emission per ton of profiled steel billet produced in EAFP
Time of determination/ monitoring	Fixed ex-ante parameter
Source of data (to be) used	In accordance with standard specification 1911-109-052-2003, which is confirmed by quality certification.
Value of data applied (for ex ante calculation/ determinations)	99.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	In accordance with standard specification 1911-109-052-2003 carbon content in electrodes should be not less 99%.
QA/QC procedures (to be) applied	Not implemented for fixed ex-ante parameter
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. Indication and description of the approach applied.

Additionality of the proposed project shall be proved in accordance with requirement Annex I, item 2 (a) of "Guidance on criteria for baseline setting and monitoring" (version 02). This approach is applicable since the approved CDM methodology has not been used in the project context.

Justification of additionality has been done in several steps based on consideration of economic attractiveness of alternative technological options of commercial steel production.

Identification of alternatives to the project activity which could be a baseline scenario and evaluation of their conformity with relevant legislation

We considered 2003 as the base year during the selection of feasible alternatives of profiled steel billet production at MMK. The following alternatives have been considered:

1. Continuation of production of profiled steel in open-hearth plant with two DBSUs, ingots teeming and blooming in BMP without any further modernization.
2. Continuation of production of profiled steel in open-hearth plant with two DBSUs, installation of two LFAs, ingots teeming and blooming in BMP.
3. Continuation of production of profiled steel in open-hearth plant with two DBSUs, dismounting of the three conventional open-hearth furnaces and construction of continuous casting machines №1, 2, installation of two LFAs.
4. Multi-stage reconstruction of OHFP, and its conversion into electric arc furnace plant:
    a. Construction of two section CCMs №1, 2 with total output up to 2 million tons of steel billet per year, installation of two LFAs and dismounting of the three classic open-hearth furnaces;
    b. Construction of two electric arc furnaces with capacity 175 tons, and decommissioning of two DBSUs.

Step 2. Application of the approach chosen.

We detailed described and analyzed the whole of alternatives and selected only two alternatives as the most probable scenarios of development of open-hearth furnace plant of MMK (see B.1.):

Alternative 1 (considered as the baseline scenario)

Continuation of production of profiled steel in open-hearth plant with two DBSUs, installation of two LFAs, ingots teeming and blooming in BMP.

Alternative 2 (considered as project scenario)

Multi-stage reconstruction of OHFP, and its conversion to electric arc furnace plant:

a) Construction of two section CCMs №1, 2 with total output up to 2 million tons of profiled steel per year, installation of two LFAs and dismounting of the three conventional open-hearth furnaces;

b) Construction of two electric arc furnaces with capacity 175 tons and decommissioning of two DBSUs.

Step 3. Provision of additionality proofs.

Identification of significant barriers to project implementation

The proposed project cannot be considered as the baseline because of the economic barrier to project implementation, which could have precluded its approval by the management of MMK.

Economic barrier. Price and availability of scrap metal

Installation of electric arc furnaces requires additional external supplies of scrap metal, which means the emerging of additional risk of unplanned increase of prime cost of the profiled steel production.

Since 2006 project implementation would imply additional demand for scrap metal, which would have to be satisfied by external supplies. External prices for scrap metal are highly volatile and tend to react on market signals. For a full-cycle ironworks which produces its own pig iron the decision to save on scrap metal purchases seems quite logical. It would strive to reduce its dependency upon prices for raw materials.

Table B.2-1 Changes in annual average prices for ferrous scrap metal (grade 3A)[10]

[10] http://www.ruslom.ru/?page=analytics_19122006

Year	2002	2003	2004	2005	2006
Average annual price, Russian Rubles	1,652	2,644	3,663	3,844	4,584
% change with respect to previous year		60%	39%	5%	19%

In the beginning of 2009 the price for scrap metal surpassed the price of pig iron produced by MMK. Thus the EAFs were stopped for a few months and profiled steel was produced only at one DBSU. This situation may happen again in 2010 according to economic projections. This observation supports the abovementioned conclusion: EAF process depends upon external prices for scrap metal much more than traditional DBSU process.

Many market analysts projected that Russia would face shortage of scrap metal since 2006, additional increase in prices for this key raw material and loss of competitiveness on international electric steel markets.[11]

Thus implementation of the project scenario faces a significant barrier, which could have provided enough rationale for MMK management to choose the baseline scenario instead.

Investment analysis

The presented below investment analysis shows that the proposed project is not economically attractive for MMK without additional cash flows from ERUs sales.

The investment analysis is based on calculation of the profits from saving of energy and materials as the result of transition to steel melting in EAF and in DBSU, for comparison we consider melting 2 million tones of profiled steel in EAF. The analysis ends up with the comparison of prime costs of production of the profiled steel billet in the baseline and project scenarios. Baseline scenario assumes continuation of production of profiled steel in open-hearth plant with two DBSUs, installation of two LFAs, ingots teeming and blooming in BMP. All prices and costs in the investment analysis were valid (actual) for March 2004.

Since the investment analysis of March 2004 was elaborated for 2 EAFs with total capacity of 4 mln. tones of liquid steel/year, to make the economic comparison of the baseline and project scenario to be correct and associated with production of profiled steel billet only, the one EAF and respective equipment for slab steel production were deleted from the consideration. The project was implemented with use of own funds of JSC “MMK” and partly by use of credit funds. To avoid influence of the credit funds to cash flows distribution the investment analysis model has been amended with assumption that the project was implemented with own funds only.

In 2004 the management of MMK considered possibility to sell ERUs starting from 2009 at the sale price of $10 (Euro 8.5) per ton of CO_2 provided that the proposed technological modernization project would be approved as a JI project. The experts of MMK assessed the potential for ERU sales at that time and concluded that project implementation would generate 664,000 tons of CO_2-eq. of emission reductions per year. The income from ERU sales was estimated as 194 million Rubles per year (see Annex 6, the letter of Mr. V. F. Rashnikov, Director General of MMK, to State Duma of the Russian Federation, dated 17.11.2004).

[11] http://www.mair.ru/articles.phtml?id=28

Table B.2-2 Main parameters which were used in investment analysis

#	Parameter	The value of parameter
The cost of raw materials, energy resourses:		
1.	Pig iron (liquid), rub/ton	3 750
2.	Scrap metal, rub/ton	3 268
3.	Natural gas, rub/ths.m^3	981
4.	Electricity, rub/ths.kWh	1 055
Total project investments, ths. rub		2 667 672
Annual inflation, %		12.0
Rate of discount, %		8.0
Calculation horizon, year		12

Table B.2-3 summarizes the results of the investment analysis.[12]

Table B.2-3 Investment analysis of the proposed project scenario

Indicator	Internal rate of return (IRR), %	Net present value (NPV), thousand Rubles	Simple payback period, years	Discounted pay-back period, years	Minimum IRR needed for project approval by MMK management, %
Without ERU sales	6	- 239 912	9,7	> 12	8
With ERU sales	10	331 539	8,1	11,1	8

It may be seen from the table that the economical indexes of the proposed investment project without sales of ERUs were not attractive for the management of MMK. Possibility of ERUs sales made the project acceptable by the MMK management turning the project NPV from negative to positive and raising project IRR to the acceptable area of more than 8%.

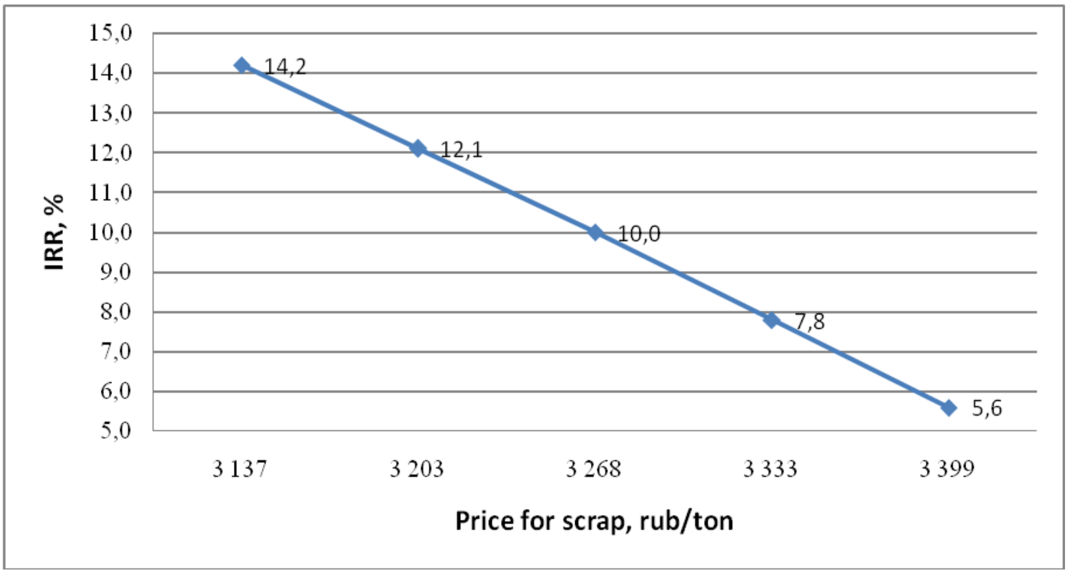
Despite the existence of the abovementioned barriers, the management of MMK approved the project “implementation of resource-saving technologies, by modernization of OHFP into EAFP, installation of two EAFs, two LFAs and section CCMs №1, 2”. This decision was supported because of initially embedded possibility to gain additional income from ERU sales starting from 2008-2009 under JI mechanism. This possibility improved economic indicators and hedged risks of the proposed project, in case of unfavorable prices for scrap metal. The additional income could be used for financing of purchases of scrap metal.
Therefore alternative № 1 (Continuation of production of profiled steel in open-hearth plant with two DBSUs, installation of two LFAs, ingots teeming and blooming in BMP) is the baseline scenario for calculation of project emission reductions.

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

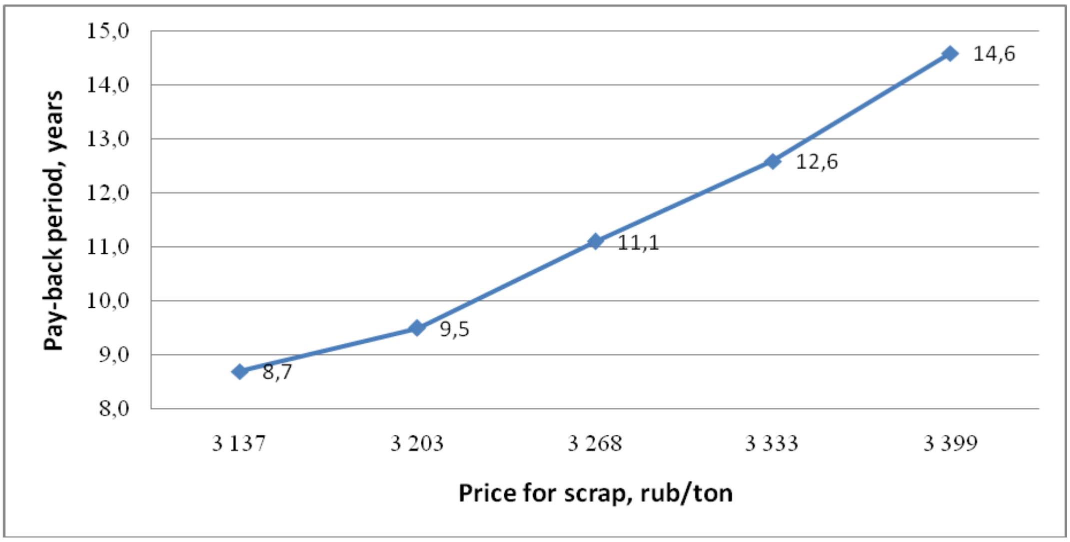
Sensitivity analysis

Sensitivity analysis is based on changing the price for ferrous scrap metal as a one of the main input parameter of investment analysis.
Even a slight changing the price of scrap in the range from –4% to +4% has a strong impact on the value of IRR and the payback period. The results of sensitivity analysis are summarized on Graphs B.2.1 and B.2.2.

Graph B.2.1 Sensitivity analysis: IRR response to variations of the price for scrap



Graph B.2.2 Sensitivity analysis: Response of investment project pay-back period to variations of the price for scrap



Sensitivity analysis showed that IRR and pay-back period are very sensitive to the changes in price for scrap. Increase in price for ferrous scrap metal even of 2% rendered the project unprofitable (IRR = 7.8, pay-back period = 12.6 years). So even small changes in the price for scrap may significantly worsen economic indicators of investment projects with low efficiency and no way for abrupt growth of the efficiency indicators is observed. This also confirms that above mentioned barrier of price and availability of scrap metal is robust.

Common practice analysis

For common practice analysis we consider metallurgical plants which had made the modernization of OHFP into EAFP in Ural region in 2004-2009.

JSC "Ural Steel"
An open joint-stock Company, Ural Steel is known as one of the largest companies in the Southern Urals region and one of the eighth leading metallurgical plants in Russia.

In 2007 the steel smelting and casting process was reconstructed. The share of electric steel was increased from 30% of the whole smelted steel in OHFP and EAFP to 49%. The PDD "Implementation of Resource-Saving Technologies at JSC "Ural Steel", Novotroitsk, Russia" was published in UNFCCC website in 2007[13].

JSC "Ashinskiy metallurgical works"
Ashinskiy metallurgical works is the average metallurgical enterprises of the Chelyabinsk region, it can be attributed to the category of major Russian producers and exporters of rolled metallurgical products.

Since 2007 the steel smelting and casting process has been reconstructed in several stages[14]:

- December of 2006 - the installation of LFA
- June of 2007 – the installation of CCM
- The second half of 2009 – the installation of EAF[15]

[13] http://ji.unfccc.int/JI_Projects/DB/X0QMHJ133AQSUN05EF99ER1KCASL35/PublicPDD/9C29T6T4CYURHWJD94N6SRBURJWOSX/view.html
[14] http://www.amet.ru/history.html

The PDD for the project has been announced but not published yet.

CJSC "ChTPZ Group"
CJSC "ChTPZ Group" is one of the largest Russian pipe-metallurgical holdings and it ranks second in the volume of pipe making in the Russian Federation.
The pipe division of ChTPZ group includes OJSC "Pervouralsky novotrubny works" ("PNTZ") and OJSC "Chelyabinsk Tube Rolling Plant" ("ChTPZ"). These enterprises manufacture a wide variety of pipe products.

The project realization was commenced in 2006. The start-up and commissioning of the Complex is assumed to be carried out in October 2010. The Electric Furnace Steel-smelting Complex will manufacture steel pipe billet by way of scrap metal remelting at "PNTZ". The Electric Furnace Steel-smelting Complex includes electric arc furnace for steel melting, ladle furnace, steel vacuum degassing unit for eliminating gases and non-metal inclusions from the steel and CCM for casting pipe billet. In the absence of the project pipe billet casting was organized at the open-hearth furnace shop of "ChTPZ" with the subsequent ingot casting. The PDD "Modernization of the "ChTPZ Group" steel-smelting operations, Russian Federation" was published in UNFCCC website in 2009[16].

The common practice analysis illustrated the large metallurgical plants of Urals region have already reconstructed steel smelting and casting from open-hearth furnace process to electric furnace process with implementation of continuous-casting technology. All them announced their projects as JI projects. And MMK is one of the first made a decision of reconstructed and realized it looking for additional cash flow from ERUs trade. The project was commenced in 2003, the start-up was carried out in 2004.

Resume

Implementation of the project activity faces significant barrier which is confirmed by sensitivity analysis. Investment analysis has shown that the project activity is not financially attractive without registration as JI. Common practice analysis has demonstrated that all the examples of the OHF to EAF modernization projects are claimed as JI project activity. Having all the mentioned the project is additional.

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

The project boundaries include:

- Metallurgical conversion stages: coking coal production in the by-product coke plant, blast-furnace plant, EAFP (or OHFP and BMP in the baseline scenario)
- Own power generation capacities of MMK: CHPP, CPP, SABPP, turbine section in the steam plant, gas recovery section in the steam plant
- Unified energy system of Urals.

[15] http://www.metalinfo.ru/ru/news/32503
[16] http://ji.unfccc.int/JI_Projects/DB/OWZAQ5Q1ZIDK4MKB12SHE4F9S13IUE/PublicPDD/D9XM64X54Q1JE4R41G01JV7RV016GY/view.html

Table B 3.1: Emission sources in the baseline and project

	Emission source	Gas	Included/not included	Comments
Baseline scenario	Metallurgical conversion stages: by-product coke plant, blast-furnace plant, open-hearth furnace plant and blooming mill plant	CO_2	Included	Use of carbon-containing materials (furnace charge, coking coal, pig iron, steel) and fuels (blast furnace gas, coke oven gas, natural gas)
	Own generation capacities of MMK: CHPP, CPP, SABPP, turbine section in the steam plant, gas recovery section in the steam plant	CO_2	Included	Electricity and air blast generation requires burning of blast furnace gas, coke oven gas, natural gas, and power station coal (only at CHPP)
	Unified energy system of Urals	CO_2	Included	MMK purchases grid electricity, which is generated by power plants from organic fuels
Project scenario	Metallurgical conversion stages: by-product coke plant, blast-furnace plant, electric arc furnace plant	CO_2	Included	Use of carbon-containing materials (furnace charge, coking coal, pig iron, steel) and fuels (blast furnace gas, coke oven gas, natural gas)
	Own generation capacities of OJSC “MMK”: CHPP, CPP, SABPP, turbine section in the steam plant, gas recovery section in the steam plant	CO_2	Included	Electricity and air blast generation requires burning of blast furnace gas, coke oven gas, natural gas, and power station coal (only at CHPP)
	Unified energy system of Urals	CO_2	Included	MMK purchases grid electricity, which is generated by power plants from organic fuels

Diagram B 3.1 Project boundaries. Project scenario

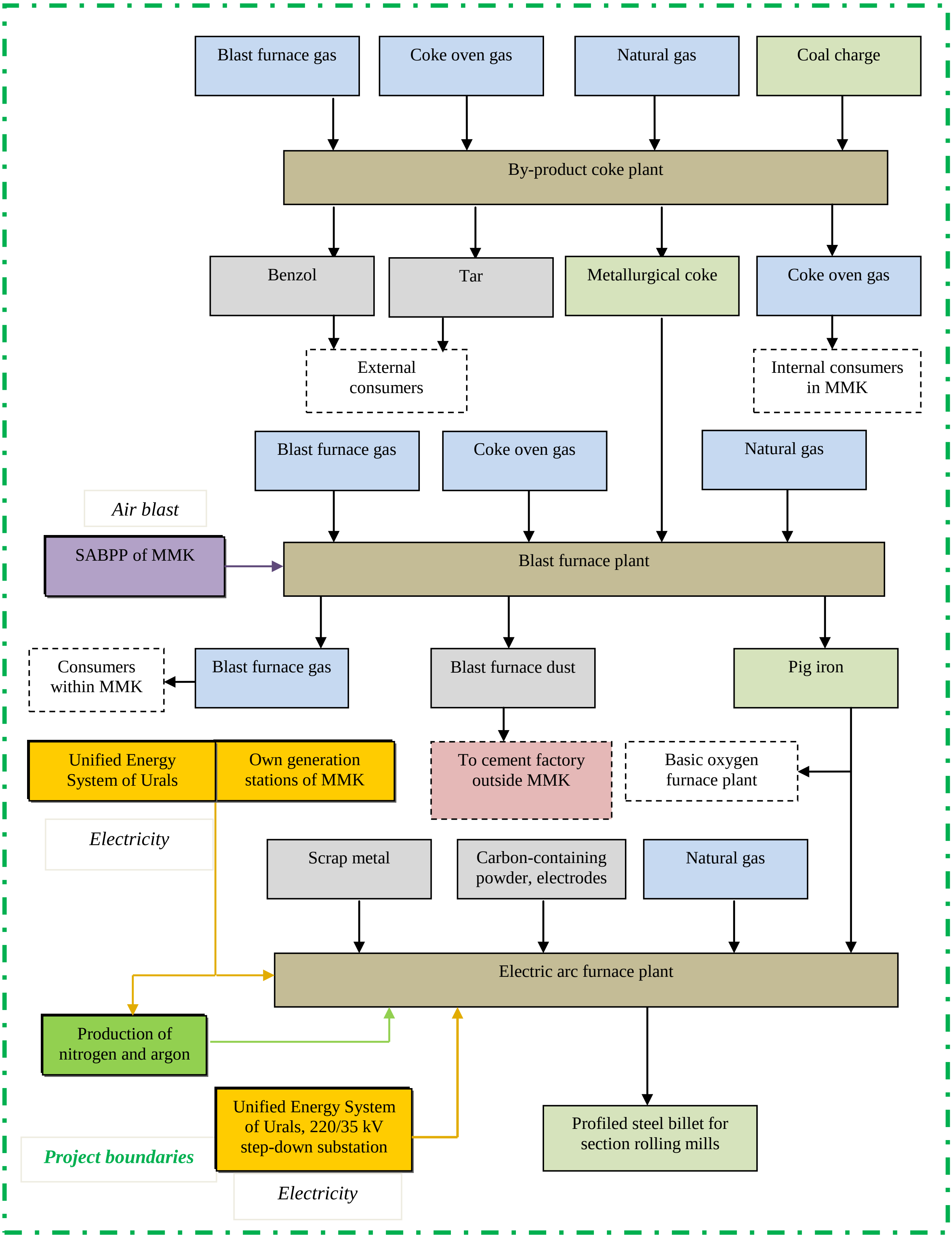
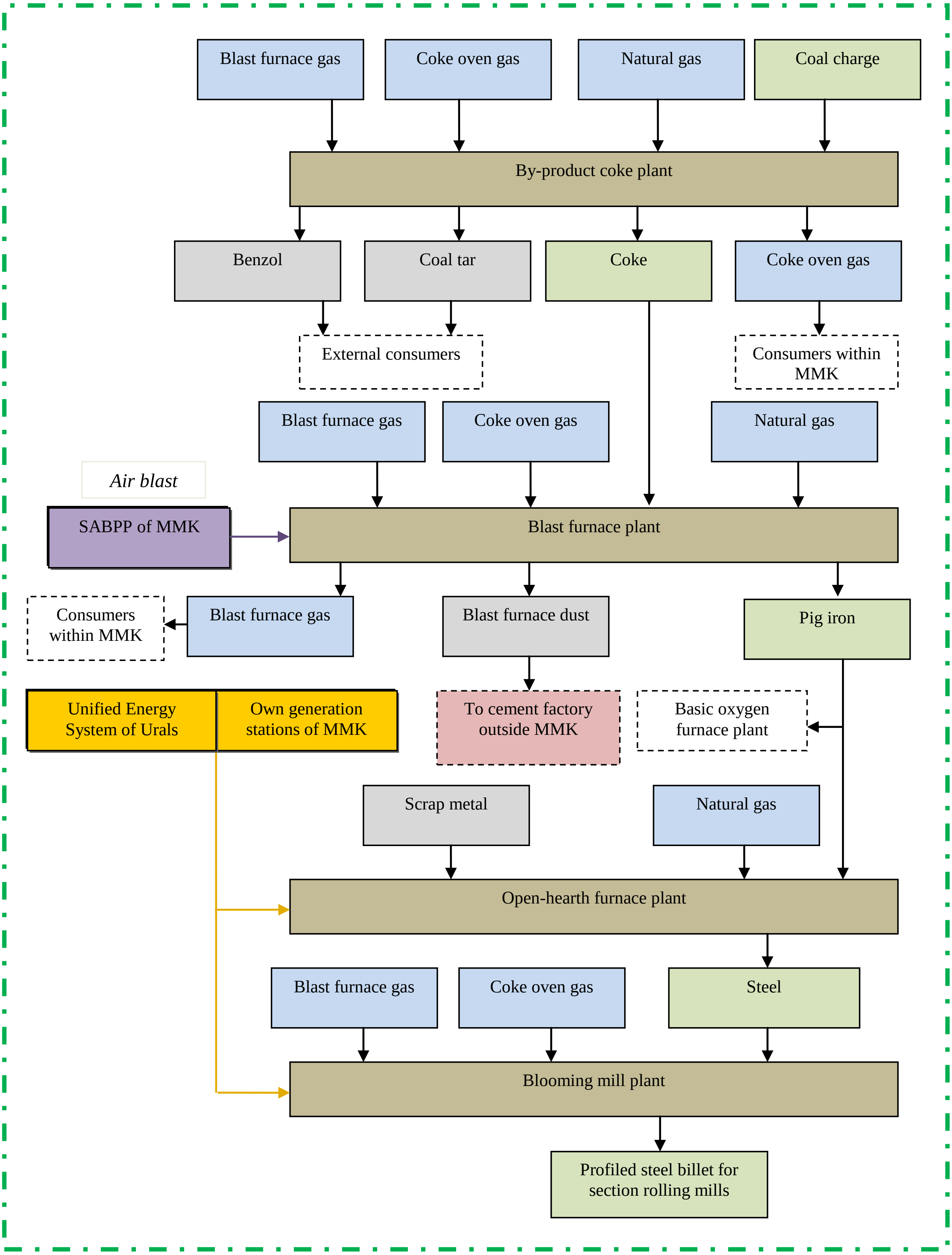


Diagram B 3.2 Project boundaries. Baseline scenario



Basic oxygen furnace plant	- 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: 15/09/2008

Baseline calculations were performed by:

“CTF Consulting Ltd.”
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 Ltd.” is not a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

June 2004

C.2. Expected operational lifetime of the project:

16 years/ 192 months between 2004 and 2020

C.3. Length of the crediting period:

5 years / 60 months from 01.01.2008 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:

Project developer applies JI specific approach for monitoring plan in accordance with paragraph 9 (a) of the "Guidance on criteria for baseline setting and monitoring" (Version 02), and other applicable JI guidelines. The monitoring plan is described throughout a section D in accordance with paragraph 30 of the Guidance on criteria for baseline setting and monitoring.

Calculation of CO_2 emissions 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). This approach was complemented with monitoring of CO_2 emission factor for generation of electricity at MMK own power plants, CO_2 emissions due to consumption of electricity in EAFP, CO_2 emissions from generation and consumption of air blast in blast furnace plant.

Since MMK is a full-cycle iron and steel works, the production of coke and pig iron meets apart from EAFP the demand of basic oxygen furnace plant, even though the latter lies outside the project boundaries. EAFP produces profiled steel billet and slab steel billet, the latter is outside the project boundaries. To calculate CO_2 emissions within the project boundaries the specific CO_2 emissions per ton of coke, pig iron and steel billet are defined. Then specific emissions are multiplied by the output of these products within the project boundaries.

To calculate project CO_2 emissions we estimated the following parameters:

1. CO_2 emission from metallurgical conversions within the project boundaries (using carbon balance method)
2. Specific CO_2 emission per ton of coke, pig iron and steel billet (profiled and slab all together).
3. Consumption of pig iron and scrap metal for production of one ton of steel billet and consumption of metallurgical coke per one ton of pig iron.
4. Project CO_2 emission from metallurgical conversions during production of profiled steel billet using defined specific values and coefficients
5. CO_2 emission coefficients during generation of electricity and air blast at MMK, and project emissions during consumption of electricity in EAFP and consumption of air blast in BFP required for production of the profiled steel billet.
6. Total project CO_2 emissions associated with production of profiled steel billet are summarized.

The production of metallurgical coke is accompanied by the formation of by-product - coke breeze. The coke batteries produce gross coke, which after quenching gross coke is sifted to coke breeze and metallurgical coke in BPCP, then metallurgical coke is transported to BFP. Coke breeze is transported to the sintering plant where it is used as fuel for sintering machines. Excess of coke breeze is sold to other companies, where the coke breeze is used as a special high-carbon fuel or as a component of the carbon-containing powder in metallurgy. As the coke breeze completely burned to CO_2 in the process of its use, these carbon dioxide emissions are attributable to the production of raw material for BFP – metallurgical coke, which is a major end product of the BPCP. Thus the integrated emission factor is calculated for the production of metallurgical coke. In BFP metallurgical coke is sifted once again with separation of additional coke breeze, which is formed during the transportation from BPCP to BFP. According the conservative approach this coke breeze has not been considered in the calculation of BFP and BPCP CO_2 emissions.

Formulae to describe this approach are provided in the sub-section D.1.1.2. Blast furnace dust and scrubber sludge are particular kinds of industrial waste generated during blast furnace process. They originate in the system of dry cleaning of blast furnace gas and contain significant amounts of carbon. These materials are transported to agglomeration plant and consumed during production of fluxed agglomerate. The carbon from blast furnace dust and scrubber sludge is fully released as CO_2. Therefore, these emissions are included in emissions during production of pig iron in blast furnace plant. A small fraction of blast furnace dust comes to the cement plant. By conservative approach this fraction is considered as leakage emission outside MMK and included in the corresponding chapter of monitoring plan.

The consumption of production inputs, raw materials, energy resources, and the output of commercial products are routinely monitored by MMK applying the system of factory monitoring and reporting. These parameters are measured in accordance with applicable standards and rules in the iron and steel industry of Russia as well as international standards (OJSC "MMK" is certified by ISO 9001 standard). All required parameters are available within the factory monitoring and reporting system implemented at MMK and thus associated procedure for monitoring of CO_2 emissions does not require any additional changes or improvements in the existing system.

The majority of carbon content parameters included in the monitoring plan are regularly determined by direct analyses in Central Lab of MMK or calculated on the basis of chemical composition of carbon-containing substances. The samples of blast furnace gas and coke oven gas are analyzed in CEST lab and the data on chemical composition of natural gas are taken from its technical passport issued and provided by the supplier.

Carbon content of materials and fuels listed in Table D.1-1 is either stable or standardized (e.g. in steel and pig iron) or may vary insignificantly, and therefore based on conservativeness principle the maximum value (with some excess) of carbon content in the benzol, tar, carbon-containing powder, etc was fixed ex-ante. We used the default value from IPCC Guidelines (2006) for carbon content in power station coal because MMK does not measure this parameter.

Table D.1-1 Carbon content of raw materials, fuels and produced substances fixed ex ante for the project and baseline

№	Parameter and measurement units	Notation	Value
1.	Carbon content in crude benzol, % by mass	$\%C_{benzol}$	90.0
2.	Carbon content in coal tar, % by mass	$\%C_{coal\text{-}tar}$	86.0
3.	Carbon content in pig iron, % by mass	$\%C_{pig\ iron}$	4.70

4.	Carbon content in scrap metal, % by mass	$\%C_{scrap}$	0.18
5.	Carbon content in carbon-containing powder[17], % by mass	$\%C_{carbon\ powder\_EAFP}$	95.0
6.	Carbon content in electrodes[18], % by mass	$\%C_{electrodes\_EAFP}$	99.0
7.	Carbon content in steel, % by mass	$\%C_{steel}$	0.18
8.	Carbon content in power station coal (IPCC Guidelines 2006), % by mass	$\%C_{energy\ coal}$	73

To estimate project emission reductions it is necessary to calculate the difference in baseline and project CO_2 emissions. Project implementation involves major changes in production assets: the equipment of open-hearth furnace plant is replaced, leaving in operation only one DBSA, and blooming mill plant is shut down. In these circumstances we use fixed specific coefficients, which characterize consumption of energy and materials in the baseline (Table D.1-2 and Annex 2).

The following parameters have been determined to calculate baseline CO_2 emissions:

1. Specific CO_2 emissions from metallurgical conversion during production of one ton of metallurgical coke and pig iron are the same in the project and baseline scenarios;
2. Specific CO_2 emissions from metallurgical conversion during steel smelting in OHFP and production of profiled steel billet in BMP are calculated by carbon balance based on historical consumption of carbon-containing materials and fuels, historical output of production under baseline technology, and actual carbon content of BFG, COG and NG;
3. CO_2 emission from metallurgical conversion during production of profiled steel billet in the baseline are calculated on the basis of historical consumption of pig iron and scrap metal per ton of profiled steel in OHFP-BMP process, actual specific consumption of metallurgical coke per ton of pig iron and actual output of profiled steel in the project;
4. CO_2 emissions from consumption of electricity in the baseline are calculated on the basis of historical electricity consumption in OHFP and BMP (they produced only profiled steel) and actual CO_2 emission factors from electricity consumption;
5. CO_2 emissions during generation of air blast were calculated using actual specific consumption of air blast per ton of pig iron, CO_2 emission factor for generation of air blast and demand for pig iron during production of profiled steel billet in the baseline;
6. Total CO_2 emissions associated with production of profiled steel billet in the baseline are summarized.

Formulae to describe this approach are provided in the sub-section D.1.1.4.

[17] In accordance with Russian standard specification 1971-003-13303593-2006, this is confirmed by quality certificate.
[18] In accordance with Russian standard specification 1911-109-052-2003, this is confirmed by quality certificate.

Table D.1-2 Historical averages of parameters, which characterize OHFP-BMP process

№	Parameter and measurement units	Notation	Value
1.	Annual average consumption of pig iron in OHFP, ths. Tons	$M_{pig\ iron\_OHFP}$	1941.1
2.	Annual average consumption of scrap metal in OHFP, ths. tons	M_{scrap_OHFP}	715.3
3.	Annual average smelting of steel in OHFP, ths. tons	P_{steel_OHFP}	2335.7
4.	Annual average specific consumption of pig iron in OHFP per ton of steel, ton per ton	$SM_{pig\ iron\_OHFP}$	0.831
5.	Annual average specific consumption of scrap metal in OHFP per ton of steel, ton per ton	SM_{scrap_OHFP}	0.306
6.	Annual average production of profiled steel billet in BMP, ths. tons	$P_{profiled\ steel\_BM}$	2029.9
7.	Annual average specific consumption of steel in OHFP per ton of profiled steel billet in BMP	$SC_{steel\_profiled\ steel\_BM}$	1.151
8.	Annual average specific consumption of natural gas in OHFP, m^3 per ton of steel	SC_{NG_OHFP}	23.3
9.	Annual average specific consumption of blast furnace gas in BMP, m^3 per ton of steel	SC_{BFG_BM}	267.1
10.	Annual average consumption of blast furnace gas in BMP, mln. m^3	C_{BFG_BM}	542
11.	Annual average specific consumption of coke oven gas in BMP, m^3 per ton of steel	SC_{COG_BM}	7.7
12.	Annual average consumption of coke oven gas in BMP, mln. m^3	C_{COG_BM}	16
13.	Annual average consumption of electricity in OHFP, GWh	EC_{OHFP}	16.2
14.	Annual average consumption of electricity in BMP, GWh	EC_{BM}	83.8

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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								
P-1	$\mathbf{M}_{coking\ coal\_CP\_PJ}$ Consumption of coal charge in BPCP (on dry mass)	BPCP	thousand tons	c	Daily	All	Electronic/ hard copy	Monthly technical report of BPCP. Annual data shall be confirmed by Economics Department
P-2	$\mathbf{\%C}_{coking\ coal\_CP\_PJ}$ Carbon content in dry coal charge	CL (BPCP Lab)	% by mass	m	2 times a day	All	Electronic/ hard copy	Each incoming batch of coal is analyzed. Monthly average value is used.
P-3	$\mathbf{FC}_{BFG\_CP\_PJ}$ Consumption of BFG in BPCP	CEST	million m^3	m	Continuously	All	Electronic	Report on balance of gas consumption in workshops
P-4	$\mathbf{C}_{BFG\_PJ}$ Carbon content in BFG	CEST	kg C/m^3	c	Monthly	All	Electronic	Calculated on the basis of component composition of blast furnace gas
P-5	$\mathbf{FC}_{COG\_CP\_PJ}$ Consumption of COG in BPCP	CEST	million m^3	m	Continuously	All	Electronic	Report on balance of gas consumption in

								workshops
P-6	**C** $_{COG\_PJ}$ Carbon content in COG	CEST	kg C/m^3	c	Monthly	All	Electronic	Calculated on the basis of component composition of coke oven gas
P-7	**FC** $_{NG\_CP\_PJ}$ Consumption of NG in BPCP	CEST	million m^3	m	Continuously	All	Electronic	Report on balance of gas consumption in workshops
P-8	**C** $_{NG\_PJ}$ Carbon content in NG	Chief power engineer department	kg C/m^3	c	Monthly	All	Electronic	Calculated on the basis of composition of natural gas, specified in the technical quality passport by the supplier
P-9	**P** $_{metallurgical\ coke\_PJ}$ Production of dry metallurgical coke	BPCP	thousand tons	c	Daily	All	Electronic/ hard copy	Monthly technical report of BPCP. Annual data shall be confirmed by Economics Department
P-10	**%C** $_{metallurgical\ coke\_PJ}$ Carbon content in dry metallurgical coke	CL (BPCP Lab)	% by mass	m	2 times a day	All	Electronic/ hard copy	Averaged over sample measurements
P-11	**P** $_{COG\_CP\_PJ}$ Output of COG	CEST	million m^3	m	Continuously	All	Electronic	Report on balance of gas

	in BPCP							consumption in workshops
P-12	**P** $_{benzol\_PJ}$ Production of crude benzol	BPCP	thousand tons	m/c	2 times a day	All	Electronic/ hard copy	Monthly technical report of BPCP. Annual data shall be confirmed by Economics Department
P-13	**P** $_{coal\text{-}tar\_PJ}$ Output of dry coal tar	BPCP	thousand tons	m/c	2 times a day	All	Electronic/ hard copy	Monthly technical report of BPCP. Annual data shall be confirmed by Economics Department
Production of pig iron								
P-14	**M** $_{skip\_metallurgical\ coke\_PJ}$ Consumption of skip metallurgical coke in BFP	BFP	thousand tons	m	Continuously	All	Electronic/ hard copy	Monthly technical report of BFP. Annual data shall be confirmed by Economics Department
P-15	**FC** $_{COG\_BF\_PJ}$ Consumption of COG in BFP	CEST	million m^3	m	Continuously	All	Electronic	Report on balance of gas consumption in workshops
P-16	**FC** $_{NG\_BF\_PJ}$ Consumption of NG in BFP	CEST	million m^3	m	Continuously	All	Electronic	Report on balance of gas consumption in workshops
P-17	**FC** $_{BFG\_BF\_PJ}$	CEST	million m^3	m	Continuously	All	Electronic	Report on

	Consumption of BFG in BFP							balance of gas consumption in workshops
P-18	**P** $_{pig\ iron\_BF\_PJ}$ Production of pig iron in BFP	BFP	thousand tons	m	Continuously	All	Electronic/ hard copy	Monthly technical report of BFP. Annual data shall be confirmed by Economics Department
P-19	**P** $_{BFG\_BF\_PJ}$ Output of BFG in BFP	CEST	million m^3	m	Continuously	All	Electronic	Report on balance of gas consumption in workshops
Production of steel billet in EAFP								
P-20	**M** $_{pig\ iron\_EAFP}$ Consumption of pig iron in EAFP	EAFP	thousand tons	m	Continuously	All	Electronic/ hard copy	Monthly technical report of EAFP. Annual data shall be confirmed by Economics Department
P-21	**M** $_{carbon\ powder\_EAFP}$ Consumption of carbon-containing powder in EAFP	EAFP	thousand tons	m	Monthly	All	Electronic/ hard copy	Monthly technical report of EAFP. Annual data shall be confirmed by Economics Department
P-22	**M** $_{scrap\_EAFP}$ Consumption of scrap metal in EAFP	EAFP	thousand tons	m	Monthly	All	Electronic/ hard copy	Monthly technical report of EAFP. Annual data shall be

								confirmed by Economics Department
P-23	**M** $_{electrodes\_EAFP}$ Consumption of electrodes in EAFP	EAFP	thousand tons	m	Monthly	All	Electronic/ hard copy	Monthly report of EAFP. Annual data shall be confirmed by Economics Department
P-24	**FC** $_{NG\_EAFP}$ Consumption of NG in EAFP	CEST	million m^3	m	Monthly	All	Electronic	Report on balance of gas consumption in workshops
P-25	**ΣP** $_{profiled\ \&\ slab\ steel\_EAFP}$ Total production of slab and profiled steel billet in EAFP	EAFP	thousand tons	e	Continuously	All	Electronic/ hard copy	Monthly technical report of EAFP. Annual data shall be confirmed by Economics Department
Consumption of electricity								
P-26	**P** $_{profiled\ steel\_EAFP}$ Output of profiled steel billet in EAFP	EAFP	thousand tons	e	Continuously	All	Electronic/ hard copy	Monthly technical report of EAFP. Annual data shall be confirmed by Economics Department
P-27	**TDL** Technological losses during transportation and distribution	Urals Inter-regional company for distribution of grid electricity	%	e	Annually	All	Electronic	Annual report of Urals Inter-regional company for distribution of

	of grid electricity in Unified Energy System of Urals							grid electricity posted in Internet
P-28	**EC** $_{grid\_sleel\_EAF}$ Consumption of grid electricity by EAF-180	Technological department	GW-h	m/c	Continuously	All	Electronic	Report on electricity utilization
P-29	∑**P** $_{steel\_EAF}$ Total smelting of steel in EAF-180	EAFP	thousand tons	e	Continuously	All	Electronic/ hard copy	Monthly technical report of EAFP. Annual data shall be confirmed by Economics Department
P-30	**EC** $_{EAFP}$ Total electricity consumption in EAFP	Technological department	GW-h	m/c	Continuously	All	Electronic	Report on electricity utilization
P-31	**EC** $_{gross\_PJ}$ Total electricity consumption by MMK	Technological department	GW-h	m/c	Continuously	All	Electronic	Report on electricity utilization
P-32	**EC** $_{import\_PJ}$ Electricity purchase from Unified Energy System of Urals grid	Technological department	GW-h	m/c	Continuously	All	Electronic	Report on analysis of consumption energy recourses in MMK
P-33	**SEC** $_{N2\_}$	Technological	MW-h/1000m^3	c	Monthly	All	Electronic	Report on

	Specific electricity consumption for nitrogen production at MMK	department						electricity utilization
P-34	**FC** $_{N2\_EAFP}$ Consumption of nitrogen in EAFP	Technological department	million m^3	m	Continuously	All	Electronic	Report on electricity utilization
P-35	**SEC** $_{pure\_N2}$ Specific electricity consumption for production of pure nitrogen at MMK	Technological department	MW-h/1000m^3	c	Monthly	All	Electronic	Report on electricity utilization
P-36	**FC** $_{pure\_N2\_EAFP}$ Consumption of pure nitrogen in EAFP	Technological department	million m^3	m	Continuously	All	Electronic	Report on electricity utilization
P-37	**SEC** $_{Ar}$ Specific electricity consumption for production of argon at MMK	Technological department	MW-h/1000m^3	c	Monthly	All	Electronic	Report on electricity utilization
P-38	**FC** $_{Ar\ EAFP}$ Consumption of argon in EAFP	Technological department	million m^3	m	Continuously	All	Electronic	Report on electricity utilization
Electricity generation								
P-39	**FC** $_{BFG\_CPP\_PJ}$ Consumption of	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by

	BFG in CPP							own power generating capacities
P-40	**FC** $_{NG\_CPP\_PJ}$ Consumption of NG in CPP	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-41	**FC** $_{NG\_CHPP\_PJ}$ Consumption of NG in CHPP	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-42	**FC** $_{BFG\_SABPP\_PJ}$ Consumption of BFG in SP	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-43	**FC** $_{COG\_SABPP\_PJ}$ Consumption of COG in SP	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-44	**FC** $_{NG\_SABPP\_PJ}$ Consumption of NG in SP	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-45	**FC** $_{NG\_turbine\ section\ of\ SP\ \_PJ}$ Consumption of NG in turbine section of SP	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-46	**FC** $_{NG\_gas\ recovery\ unit\text{-}2\ of\ SP\ \_PJ}$ Consumption of	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power

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	NG in recovery unit of SP							generating capacities
P-47	**FC** $_{energy\ coal\_CHPP\_PJ}$ Consumption of power station coal by CHPP	Technological department	thousand tons	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
Generation and consumption of air blast								
P-48	**OC** $_{air\ blast\ generation\_PJ}$ Generation of air blast at MMK	Technological department	million m^3	m	Continuously	All	Electronic	Report on electricity utilization
P-49	**FC** $_{BFG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ Consumption of BFG in SABPP for generation of air blast	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-50	**FC** $_{COG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ Consumption of COG in SABPP for generation of air blast	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities
P-51	**FC** $_{NG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ Consumption of NG in SABPP for generation of air blast	Technological department	million m^3	m	Continuously	All	Electronic/ hard copy	Report on fuel consumption by own power generating capacities

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

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CO_2 EMISSIONS FROM METALLURGICAL CONVERSIONS CALCULATED BY CARBON BALANCE METHOD

Production of metallurgical coke

$$PE_{metallurgical\_coke} = [(M_{coking\ coal\_PJ} * \%C_{coking\ coal\_PJ}) + (FC_{BFG\_CP\_PJ} * C_{BFG\_PJ}) + (FC_{COG\_CP\_PJ} * C_{COG\_PJ}) + (FC_{NG\_CP\_PJ} * C_{NG\_PJ}) - (P_{metallurgical\ coke\_PJ} * \%C_{metallurgical\ coke\_PJ}) - (P_{COG\_CP\_PJ} * C_{COG\_PJ}) - (P_{benzol\_PJ} * \%C_{benzol}) - (P_{coal\text{-}tar\_PJ} * \%C_{coal\text{-}tar})] * 44/12 \quad (D.1.1.2.\text{-}1)$$

Where:
$PE_{metallurgical\ coke}$ – Project emissions from production of metallurgical coke in BPCP, thousand tons of CO_2
$M_{coking\ coal\_PJ}$ – Consumption of dry coal charge in BPCP, thousand 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, thousand 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, thousand tons
$\%C_{benzol}$ – Carbon content in dry benzol, % by mass
$P_{coal\text{-}tar\_PJ}$ – Output of dry coal tar, thousand tons
$\%C_{coal\text{-}tar}$ – Carbon content in dry coal tar, % by mass

Specific CO_2 emissions per ton of produced metallurgical coke

$$SPE_{metallurgical\ coke} = PE_{metallurgical\ coke} / P_{metallurgical\ coke\_PJ} \quad (D.1.1.2.\text{-}2)$$

Where:
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, ton CO_2/ton
$PE_{metallurgical\_coke}$ – Project emissions from production of metallurgical coke in BPCP, thousand tons of CO_2

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$P_{metallurgical\ coke\_PJ}$ – Production of dry metallurgical coke, thousand tons

Production of pig iron

$$\mathbf{PE_{pig\_iron} = [(M_{skip\_metallurgical\ coke\_BF\_PJ} * \%C_{metallurgical\ coke\_PJ}) + (FC_{COG\_BF\_PJ} * C_{COG\_PJ}) + (FC_{NG\_BF\_PJ} * C_{NG\_PJ}) + (FC_{BFG\_BF\_PJ} * C_{BFG\_.PJ}) - (P_{pig\ iron\_BF\_PJ} * \%C_{pig\ iron}) - (P_{BFG\_BF\_PJ} * C_{BFG\_PJ})] * 44/12} \qquad \textbf{(D.1.1.2.-3)}$$

Where:
$PE_{pig\ iron}$ – Project emissions from production of pig iron in the blast furnace plant, thousand tons of CO_2
$M_{skip\_metallurgical\ coke\_BF\_PJ}$ – Consumption of skip metallurgical coke in BFP, thousand tons
$\%C_{metallurgical\ coke\_PJ}$ – Carbon content in dry metallurgical coke, % by mass
$FC_{COG\_BF\_PJ}$ – Consumption of COG in BFP, million m^3
C_{COG_PJ} – Carbon content in COG, kg C/m^3
$FC_{NG\_BF\_PJ}$ – Consumption of NG in BFP, million m^3
C_{NG_PJ} – Carbon content in NG, kg C/m^3
$P_{BFG\_BF\_PJ}$ – Output of BFG in BFP, million m^3
C_{BFG_PJ} – Carbon content in BFG, kg C/m^3
$P_{pig\ iron\_BF\_PJ}$ – Production of pig iron in BFP, thousand tons
$\%C_{pig\ iron}$ – Carbon content in pig iron, % by mass

Specific CO_2 emissions per ton of pig iron produced

$$\mathbf{SPE_{pig\ iron} = PE_{pig\_iron} / P_{pig\ iron\_BF\_PJ}} \qquad \textbf{(D.1.1.2.-4)}$$

Where:
$SPE_{pig\ iron}$ – Specific CO_2 emissions per ton of produced pig iron, ton CO_2/ton
$PE_{pig\ iron}$ – Project emissions from production of pig iron in the blast furnace plant, thousand tons of CO_2
$P_{pig\ iron\_BF\_PJ}$ – Production of pig iron in BFP, thousand tons

Production of profiled steel billet in EAFP

$$PE_{EAFP} = [(M_{pig\ iron\_EAFP} * \%C_{pig\ iron}) + (M_{carbon\ powder\_EAFP} * \%C_{carbon\ powder\_EAFP}) + (M_{scrap\_EAFP} * \%C_{scrap}) + (M_{electrodes\_EAFP} * \%C_{electrodes\_EAFP}) + (FC_{NG\_EAFP} * C_{NG\_PJ}) - (\sum P_{profiled\&slab\ steel\_EAFP} * \%C_{steel})] * 44/12 \quad (D.1.1.2.-5)$$

Where:

PE_{EAFP} – Project CO_2 emissions from production of profiled steel billet in EAFP, thousand tons of CO_2
$M_{pig\ iron\_EAFP}$ – Consumption of pig iron in EAFP, thousand tons
$\%C_{pig\ iron}$ – Carbon content in pig iron, % by mass
$M_{carbon\ powder\_EAFP}$ – Consumption of carbon-containing powder in EAFP, thousand tons
$\%C_{carbon\ powder\_EAFP}$ – Carbon content in carbon-containing powder, % by mass
M_{scrap_EAFP} – Consumption of scrap metal in EAFP, thousand tons
$\%C_{scrap}$ – Carbon content in scrap metal, % by mass
$M_{electrodes\_EAFP}$ – Consumption of electrodes in EAFP, thousand tons
$\%C_{electrodes\_EAFP}$ – Carbon content in electrodes, % by mass
FC_{NG_EAFP} – Consumption of NG in EAFP, million m^3
C_{NG_PJ} – Carbon content in NG, kg C/m^3
$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons
$\%C_{steel}$ – Carbon content in steel, % by mass

Specific CO_2 emissions per ton of profiled steel billet produced in EAFP

$$SPE_{EAFP} = PE_{EAFP} / \sum P_{profiled\&slab\ steel\_EAFP} \quad (D.1.1.2.-6)$$

Where:

SPE_{EAFP} – specific CO_2 emissions per ton of steel billet produced in EAFP, ton CO_2/ton
PE_{EAFP} – project CO_2 emissions from production of steel billet in EAFP, thousand tons of CO_2
$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons

COEFFICIENTS OF CONSUMPTION OF ENERGY AND MATERIALS FOR METALLURGICAL CONVERSIONS IN PROJECT

Consumption of pig iron per ton of steel billet produced in EAFP

$$SC_{pig\ iron\_EAFP} = M_{pig\ iron\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP} \quad (D.1.1.2.-7)$$

Where:
$SC_{pig\ iron\_\ EAFP}$ – Consumption of pig iron per ton of steel billet produced in EAFP, ton/ton
$M_{pig\ iron\_EAFP}$ – Consumption of pig iron in EAFP, thousand tons
$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons

Consumption of scrap metal per ton of steel billet produced in EAFP

$$SC_{scrap\_EAFP} = M_{scrap\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP} \qquad (D.1.1.2.-8)$$

Where:
SC_{scrap_EAFP} – Consumption of pig iron per ton of steel billet produced in EAFP, ton/ton
M_{scrap_EAFP} – Consumption of scrap metal in EAFP, thousand tons
$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons

Specific consumption of dry skip metallurgical coke per ton of produced pig iron

$$SC_{skip\_metallurgical\_coke\_PJ} = M_{skip\_metallurgical\ coke\_BF\_PJ} / P_{pig\ iron\_BF\_PJ} \qquad (D.1.1.2.-9)$$

Where:
$SC_{skip\_metallurgical\_coke\_PJ}$ – Specific consumption of dry skip metallurgical coke per ton of pig iron produced in BFP, ton/ton
$M_{skip\_metallurgical\ coke\_BF\_PJ}$ – Consumption of dry skip metallurgical coke in BFP, thousand tons
$P_{pig\ iron\_BF\_PJ}$ – Output of BFG in BFP, million m^3

PROJECT CO_2 EMISSIONS FROM METALLURGICAL CONVERSIONS ASSOCIATED WITH PRODUCTION OF PROFILED STEEL BILLET

Project CO_2 emissions from consumption of metallurgical coke for production of profiled steel billet

$$PE_{metallurgical\_coke\_profiled\_steel} = SC_{skip\_metallurgical\_coke\_PJ} * SC_{pig\ iron\_\ EAFP} * P_{profiled\ steel\_EAFP} * SPE_{metallurgical\ coke} \qquad (D.1.1.2.-10)$$

Where:
$PE_{metallurgical\_coke\_profiled\_steel}$ – Project CO_2 emissions from consumption of metallurgical coke for production of profiled steel billet, thousand tons of CO_2
$SC_{skip\_metallurgical\_coke\_PJ}$ – Specific consumption of dry skip metallurgical coke per ton of pig iron smelted in BFP, ton/ton

$SC_{pig\ iron\_\ EAFP}$ – Consumption of pig iron per ton of steel billet produced in EAFP, ton/ton
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tons CO_2/ton

Project CO_2 emissions from consumption of pig iron for production of profiled steel billet

$$PE_{pig\ iron\_profiled\_steel} = SC_{pig\ iron\_\ EAFP} * P_{profiled\ steel\_EAFP} * SPE_{pig\ iron} \quad (D.1.1.2.-11)$$

Where:
$PE_{pig\ iron\_\ profiled\_steel}$ – Project CO_2 emissions from consumption of pig iron for production of profiled steel billet, thousand tons of CO_2
$SC_{pig\ iron\_\ EAFP}$ – Consumption of pig iron per ton of steel billet produced in EAFP, ton/ton
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$SPE_{pig\ iron}$ – Specific CO_2 emissions per ton of produced pig iron, tons CO_2/ton

Project CO_2 emissions in EAFP from production of profiled steel billet

$$PE_{profiled\ steel\_\ EAFP} = P_{profiled\ steel\_\ EAFP} * SPE_{EAFP} \quad (D.1.1.2.-12)$$

Where:
$PE_{profiled\ steel\_\ EAFP}$ – Project CO_2 emissions in EAFP from production of profiled steel billet, thousand tons of CO_2
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
SPE_{EAFP} – Specific CO_2 emissions per ton of profiled steel billet produced in EAFP, tons CO_2/ton

CO_2 EMISSIONS FROM ELECTRICITY CONSUMPTION ASSOCIATED WITH PRODUCTION OF PROFILED STEEL BILLET IN EAFP

$$PE_{electricity\_profiled\_steel\_EAFP} = PE_{EC\_grid\_profiled\_steel\_EAF} + PE_{EC\_profiled\_steel\_other\ EAFP} + PE_{EC\_Ar\_N2\_profiled\_steel} \quad (D.1.1.2.-13)$$

Where:
$PE_{electricity\_profiled\_steel\_EAFP}$ – Total CO_2 emissions from electricity consumption associated with production of profiled steel billet in EAFP, thousand tons of CO_2
$PE_{EC\_grid\_profiled\_steel\_EAF}$ – CO_2 emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades in EAFP, thousand tons of CO_2

$PE_{EC\_profiled\_steel\_other\ EAFP}$ – CO_2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet, thousand tons of CO_2
$PE_{EC\_Ar\_N2\_profiled\_steel}$ - CO_2 emissions from consumption of electricity from corporate MMK grid for production of nitrogen, pure nitrogen, and argon needed for production of profiled steel billet in EAFP, thousand tons of CO_2

CO_2 emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades

$$PE_{EC\_grid\_profiled\_steel\_EAF} = SEC_{grid\_steel\_EAF} * P_{profiled\ steel\_EAFP} * \sum P_{steel\_EAF} / \sum P_{profiled\ \&slab\ steel\_EAFP} * EF_{grid} * (1+TDL) \quad (D.1.1.2.-14)$$

Where:
$PE_{EC\_grid\_profiled\_steel\_EAF}$ – CO_2 emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades, thousand tons of CO_2
$SEC_{grid\_steel\_EAF}$ – Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation per ton of all smelted steel, MWh/ton
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$\sum P_{steel\_EAF}$ – Total smelting of steel in EAF-180, thousand tons
$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons
EF_{grid} – CO_2 emission factor for grid electricity from Unified Energy Systems of Urals (EF_{grid} = 0.541 t CO_2/MW-h)
TDL – Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals, %[19]

Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades

$$SEC_{grid\_steel\_EAF} = EC_{grid\_steel\_EAF} / \sum P_{steel\_EAF} \quad (D.1.1.2.-15)$$

Where:
$SEC_{grid\_steel\_EAF}$ – Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation per ton of all smelted steel, MWh/t
$EC_{grid\_steel\_EAF}$ – Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation, GW-h
$\sum P_{steel\_EAF}$ – Total smelting of steel in EAF-180, thousand tons

[19] This value shall be taken from annual reports of Urals Inter-regional Company for Distribution of Grid Electricity posted in the Internet http://www.mrsk-ural.ru/ru/460

CO_2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet

$$PE_{EC\_profiled\_steel\_other\ EAFP} = (SEC_{steel\ refinement\ and\ casting\ EAFP} * P_{profiled\ steel\_EAFP} + SEC_{steel\_OHFP} * P_{profiled\ steel\_EAFP} * (\sum P_{profiled\&slab\ steel\_EAFP} - \sum P_{steel\_EAF}) / \sum P_{profiled\&slab\ steel\_EAFP})) * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL)) / (EC_{gross\_PJ} - EC_{grid\_steel\_EAF})) \quad (D.1.1.2.-16)$$

Where:

$PE_{EC\_other\ equipment\_EAFP\_PJ}$ – CO_2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet, thousand tons of CO_2

$SEC_{steel\ refinement\ and\ casting\ EAFP}$ – Specific consumption of electricity in EAFP for steel refining and casting, MWh/t

$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons

SEC_{steel_OHFP} – Specific consumption of electricity in OHFP, MWh/t (refer to Section D.1.1.4.)

$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons

$\sum P_{steel\_EAF}$ – Total smelting of steel in EAF-180, thousand tons

$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh

EC_{gross_PJ} – Total electricity consumption by MMK, GW-h

EC_{import_PJ} – Electricity purchases from Unified Energy Systems of Urals grid, GW-h

EF_{grid} – CO_2 emission factor for grid electricity from Unified Energy Systems of Urals (EF_{grid} = 0.541 t CO_2/MW-h)

$EC_{grid\_steel\_EAF}$ – Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation , GW-h

TDL – Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals, %

Specific electricity consumption in EAFP for steel refining and casting

$$SEC_{steel\ refinement\ and\ casting\ EAFP} = (EC_{EAFP} - EC_{grid\_steel\_EAF} - SEC_{steel\_OHFP} * (\sum P_{profiled\&slab\ steel\_EAFP} - \sum P_{steel\_EAF})) / \sum P_{profiled\&slab\ steel\_EAFP} \quad (D.1.1.2.-17)$$

Where:

$SEC_{steel\ refinement\ and\ casting\ EAFP}$ - Specific electricity consumption in EAFP for steel refining and casting, MWh/t

EC_{EAFP} – Total electricity consumption in EAFP, GW-h

$EC_{grid\_steel\_EAF}$ – Consumption of grid electricity by EAFP-180, via 220/35 kV step-down substation , GW-h

SEC_{steel_OHFP} – Specific electricity consumption in OHFP per ton of steel, MWh/t , (see Section D.1.1.4.)

$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons

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$\sum P_{steel\_EAF}$ – Total smelting of steel in EAFP-180, thousand tons

CO_2 emissions from consumption of electricity from corporate grid of MMK, for production of nitrogen, pure nitrogen and argon needed for production of profiled steel billet

$$PE_{EC\_Ar\_N2\_profiled\_steel} = (EC_{N2\_profiled\_steel} + EC_{pure\ N2\_profiled\_steel} + EC_{Ar\_profiled\_steel}) * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/(EC_{gross\_PJ} - EC_{grid\_steel\_EAF}) \quad \text{(D.1.1.2.-18)}$$

Where:
$PE_{EC\_Ar\_N2\_profiled\_steel}$ - CO_2 emissions from consumption of electricity from corporate grid of MMK, for production of nitrogen, pure nitrogen and argon needed for production of profiled steel billet, thousand tons of CO_2 per year
$EC_{N2\_profiled\_steel}$ - Electricity consumption for production of nitrogen, which is used during production of profiled steel billet in EAFP, GW-h
$EC_{pure\ N2\_profiled\_steel}$ - Electricity consumption for production of pure nitrogen, which is used during production of profiled steel billet in EAFP, GW-h
$EC_{Ar\_profiled\_steel}$ - Electricity consumption for production of argon, which is used during production of profiled steel billet in EAFP, GW-h
$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh
EF_{grid} – CO_2 emission factor for grid electricity from Unified Energy Systems of Urals (EF_{grid} = 0.541 t CO_2/MW-h)
EC_{import_PJ} – Electricity purchases from Unified Energy Systems of Urals grid, GW-h
TDL – Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals, %
EC_{gross_PJ} – Total electricity consumption by MMK, GW-h
$EC_{grid\_steel\_EAF}$ – Consumption of grid electricity by EAFP-180, via 220/35 kV step-down substation , GW-h

Electricity consumption for production of nitrogen, which is used during production of profiled steel billet in EAFP

$$EC_{N2\_profiled\_steel} = SEC_{N2\_PJ} * V_{N2\_EAFP} * P_{profiled\_steel\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP} \quad \text{(D.1.1.2.-19)}$$

Where:
SEC_{N2_PJ} – Specific electricity consumption for production of nitrogen at MMK, MWh/1000 m^3
V_{N2_EAFP} – Consumption of nitrogen in EAFP, million m^3
$P_{profiled\_steel\_EAFP}$ - Output of profiled steel billet in EAFP, thousand tons
$\sum P_{profiled\&slab\ steel\_EAFP}$ - Total production of slab and profiled steel billet in EAFP, thousand tons

Electricity consumption for production of pure nitrogen, which is used during production of profiled steel billet in EAFP

$EC_{pure\_N2\_profiled\_steel} = SEC_{pure\_N2\_PJ} * V_{pure\_N2\_EAFP} * P_{profiled\_steel\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP}$ **(D.1.1.2.-20)**

Where:
$SEC_{pure\_N2\_PJ}$ – Specific electricity consumption for production of pure nitrogen at MMK, MWh/1000 m^3
$V_{pure\_N2\_EAFP}$ – Consumption of pure nitrogen in EAFP, million m^3
$P_{profiled\_steel\_EAFP}$ - Output of profiled steel billet in EAFP, thousand tons
$\sum P_{profiled\&slab\ steel\_EAFP}$ - Total production of slab and profiled steel billet in EAFP, thousand tons

Electricity consumption for production of argon, which is used during production of profiled steel billet in EAFP

$EC_{Ar\_profiled\_steel} = SEC_{Ar\_PJ} * V_{Ar\_EAFP} * P_{profiled\_steel\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP}$ **(D.1.1.2.-21)**

Where:
SEC_{Ar_PJ} – Specific electricity consumption for production of argon at MMK, MWh/1000 m^3
V_{Ar_EAFP} – Consumption of argon in EAFP, million m^3
$P_{profiled\_steel\_EAFP}$ - Output of profiled steel billet in EAFP, thousand tons
$\sum P_{profiled\&slab\ steel\_EAFP}$ - Total production of slab and profiled steel billet in EAFP, thousand tons

<u>CO_2 emission factor for electricity produced at MMK</u>

$EF_{own\ generation\_PJ} = PE_{total\ electricity\ generation} / (EC_{gross\_PJ} - EC_{import\_PJ})$ **(D.1.1.2.-22)**

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, thousand tons of CO_2
EC_{gross_PJ} – Total electricity generation at MMK, GW-h
EC_{import_PJ} – Electricity purchases from Unified Energy Systems of Urals grid, GW-h

CO_2 emissions from electricity generation at MMK

$PE_{total\ electricity\ generation} = PE_{combustion\ gases\_electricity} + PE_{combustion\ coal\_electricity}$ **(D.1.1.2.-23)**

Where:

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

CO_2 emissions from combustion of gases for electricity generation at MMK

$$PE_{combustion\ gases\_electricity} = (FC_{BFG\_CPP\_PJ} * C_{BFG\_PJ} + FC_{NG\_CPP\_PJ} * C_{NG\_.PJ} + FC_{NG\_CHPP\_PJ} * C_{NG\_PJ} + FC_{BFG\_SABPP\_PJ} * C_{BFG\_PJ} + FC_{COG\_SABPP\_PJ} * C_{COG\_PJ} + FC_{NG\_SABPP\_PJ} * C_{NG\_PJ} + FC_{NG\_turbine\ section\ of\ SP\ \_PJ} * C_{NG\_PJ} + FC_{NG\_gas\ recovery\ unit-2\ of\ SP\ \_PJ} * C_{NG\_PJ})/100 * 44/12 \quad (D.1.1.2.-24)$$

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 SP, million m^3
$C_{BFG\_.PJ}$ – Carbon content in BFG, kg C/m^3
$FC_{COG\_SABPP\_PJ}$ – Consumption of COG in SP, 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 SP, million m^3
$FC_{NG\_turbine\ section\ of\ SP\ \_PJ}$ – Consumption of NG in turbine section of SP, million m^3
$FC_{NG\_gas\ recovery\ unit-2\ of\ SP\ \_PJ}$ – Consumption of NG in gas recovery unit of SP, 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

$$PE_{combustion\ coal\_electricity} = (FC_{energy\ coal\_CHPP\_PJ} * \%C_{energy\ coal})/100 * 44/12 \quad (D.1.1.2.-25)$$

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

CO_2 EMISSIONS FROM GENERATION OF AIR BLAST NEEDED FOR PRODUCTION OF PIG IRON USED FOR PRODUCTION OF PROFILED STEEL BILLET IN THE PROJECT

$$PE_{air\ blast\_for\_pig\_iron} = P_{profiled\ steel\_EAFP} * SC_{pig\ iron\_EAFP} * SC_{air\ blast\ generation} * EF_{air\ blast\ generation} \quad (D.1.1.2.-26)$$

Where:
$PE_{air\ blast\_for\_pig\_iron}$ – CO_2 emissions from generation of air blast for production of pig iron used for production of profiled steel billet, thousand tons of CO_2
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$SC_{pig\ iron\_EAFP}$ – Consumption of pig iron per ton of profiled steel billet produced in EAFP, ton/ton
$SC_{air\ blast\ generation}$ – Specific consumption of air blast in BFP per ton of pig iron, thousand m^3/ton
$EF_{air\ blast\ generation}$ – CO_2 emission factor for air blast generation, t CO_2/thousand m^3

$$EF_{air\ blast\ generation\_} = PE_{air\ blast\ generation} / OC_{air\ blast\ generation\_PJ} \quad (D.1.1.2.-27)$$

Where:
$EF_{air\ blast\ generation\_PJ}$ – CO_2 emission factor for air blast generation, t CO_2/thousand m^3
$PE_{air\ blast\ generation}$ – CO_2 emissions from combustion of fuel for generation of air blast, thousand t CO_2
$OC_{air\ blast\ generation\_PJ}$ – generation of air blast at MMK, million m^3

$$PE_{air\ blast\ generation} = (FC_{BFG\_SABPP\_\ air\ blast\ generation\ \_PJ} * C_{BFG\_PJ} + FC_{COG\_SABPP\_\ air\ blast\ generation\ \_PJ} * C_{COG\_PJ} + FC_{NG\_SABPP\_\ air\ blast\ generation\_PJ} * C_{NG\_PJ})/100 * 44/12 \quad (D.1.1.2.-28)$$

Where:
$PE_{air\ blast\ generation}$ – CO_2 emissions from combustion of fuel for generation of air blast, thousand t CO_2
$FC_{BFG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ –Consumption of BFG in SABPP for generation of air blast, million m^3
C_{BFG_PJ} – Carbon content in BFG, kg C/m^3
$FC_{COG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ – Consumption of COG in SABPP for generation of air blast, million m^3
C_{COG_PJ} – Carbon content in COG, kg C/m^3
$FC_{NG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ – Consumption of NG in SABPP for generation of air blast, million m^3
C_{NG_PJ} - Carbon content in NG, kg C/m^3

Specific consumption of air blast per ton of pig iron produced

$$SC_{air\ blast\ generation\_PJ} = P_{air\ blast\ generation} / P_{pig\ iron\_BF\_PJ} \quad \text{(D.1.1.2.-29)}$$

Where:

$SC_{air\ blast\ generation\_PJ}$ – Specific consumption of air blast in BFP per ton of produced pig iron, thousand m^3/ton
$P_{air\ blast\ generation}$ – Generation of air blast at MMK, m^3 of air blast
$P_{pig\ iron\_BF\_PJ}$ – Production of pig iron in BFP, thousand tons

TOTAL PROJECT EMISSIONS FROM PRODUCTION OF PROFILED STEEL BILLET

$$PE = PE_{metallurgical\ coke\_profiled\_steel} + PE_{pig\ iron\_\ profiled\_steel} + PE_{profiled\ steel\_\ EAFP} + PE_{electricity\_profiled\_steel\_EAFP} + PE_{air\ blast\_for\_pig\_iron} \quad \text{(D.1.1.2.-30)}$$

Where:

PE – Total project CO_2 emissions from production of profiled steel billet, thousand tons of CO_2
$PE_{metallurgical\_coke\_profiled\_steel}$ – CO_2 emissions from consumption of metallurgical coke for production of profiled steel billet, thousand tons of CO_2
$PE_{pig\ iron\_\ profiled\_steel}$ – CO_2 emissions from consumption of pig iron for production of profiled steel billet, thousand tons of CO_2
$PE_{profiled\ steel\_\ EAFP}$ – CO_2 emissions in EAFP from production of profiled steel billet, thousand tons of CO_2
$PE_{electricity\_profiled\_steel\_EAFP}$ – CO_2 emissions from consumption of electricity for production of profiled steel billet in EAFP, thousand tons of CO_2
$PE_{air\ blast\_for\_pig\_iron}$ – CO_2 emissions from consumption of air blast for production of pig iron for production of profiled steel billet, thousand tons of 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-4	**C** $_{BFG\_PJ}$ Carbon content in BFG	CEST	kg C/m^3	c	Monthly	All	Electronic	Calculated on the basis of component composition of blast furnace gas
P-6	**C** $_{COG\_PJ}$ Carbon content in COG	CEST	kg C/m^3	c	Monthly	All	Electronic	Calculated on the basis of component composition of coke oven gas
P-8	**C** $_{NG\_PJ}$ Carbon content in NG	Chief power engineer department	kg C/m^3	c	Monthly	All	Electronic	Calculated on the basis of component composition of natural gas specified in the technical passport by the supplier
P-26	**P** $_{profiled\ steel\_\ EAFP}$ Output of profiled steel billet in EAFP	EAFP	thousand tons	e	Continuously	All	Electronic/ hard copy	Monthly technical report of EAFP. Annual data shall be confirmed by Economics Department
P-27	**TDL** Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals	Urals Inter-regional company for distribution of grid electricity	%	e	Annually	All	Electronic	Annual report of Urals Inter-regional company for distribution of grid electricity posted in Internet

P-28	**EC** $_{grid\_sleel\_EAF}$ Consumption of grid electricity by EAF-180	CEST	GW-h	m/c	Continuously	All	Electronic	Report on electricity utilization
P-31	**EC** $_{gross\_PJ}$ Total electricity consumption by MMK	CEST	GW-h	m/c	Continuously	All	Electronic	Report on electricity utilization
P-32	**EC** $_{import\_PJ}$ Electricity purchases from Unified Energy System of Urals grid	CEST	GW-h	m/c	Continuously	All	Electronic	Report on electricity utilization

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

CO_2 EMISSIONS FROM METALLURGICAL CONVERSION (STEEL SMELTING IN OHFP AND PRODUCTION OF PROFILED STEEL BILLET IN BMP) CALCULATED BY CARBON BALANCE METHOD

Steel smelting in Open-Hearth Furnace Plant (OHFP)

$$BE_{OHFP} = [(M_{pig\ iron\_OHFP} * \%C_{pig\ iron}) + (M_{scrap\_OHFP} * \%C_{scrap}) + (SC_{NG\_OHFP} * P_{steel\_OHFP} * C_{NG\_PJ}) - (P_{steel\_OHFP} * \%C_{steel})] * 44/12 \quad (D.1.1.4.-1)$$

Where:

BE_{OHFP} – CO_2 emissions from steel smelting in OHFP, thousand tons of CO_2

$M_{pig\ iron\_OHFP}$ – Annual average consumption of pig iron in OHFP, thousand tons

$\%C_{pig\ iron}$ – Carbon content in pig iron, % by mass

M_{scrap_OHFP} – Annual average consumption of scrap metal in OHFP, thousand tons

$\%C_{scrap}$ – Carbon content in scrap, % by mass

SC_{NG_OHFP} – Annual average consumption of NG in OHFP, million m^3

C_{NG_PJ} – Carbon content in NG, kg C/m^3
P_{steel_OHFP} – Annual average smelting of steel in OHFP, thousand tons
$\%C_{steel}$ – Carbon content in steel, % by mass

Specific CO_2 emissions per ton of steel smelted in OHFP

$$SBE_{OHFP} = BE_{OHFP} / P_{steel\_OHFP} \quad \textbf{(D.1.1.4.-2)}$$

Where:
SBE_{OHFP} – Specific CO_2 emissions per ton of steel smelted in OHFP, t CO_2/t
BE_{OHFP} – CO_2 emissions from steel smelting in OHFP, thousand tons of CO_2
P_{steel_OHFP} – Annual average smelting of steel in OHFP, thousand tons

Production of profiled steel billet in the Blooming Mill Plant (BMP)

$$BE_{BM} = [(M_{steel\_BM} * \%C_{steel}) + (SC_{BFG\_BM} * P_{profiled\ steel\_BM} * C_{BFG\_PJ}) + (SC_{COG\_BM} * P_{profiled\ steel\_BM} * C_{COG\_PJ}) - (P_{profiled\ steel\_BM} * \%C_{steel})] * 44/12 \quad \textbf{(D.1.1.4.-3)}$$

Where:
BE_{BM} – CO_2 emissions from production of profiled steel billet in BMP, thousand tons of CO_2
M_{steel_BM} – Annual average consumption of steel in BMP, thousand tons
$\%C_{steel}$ – Carbon content in steel, % by mass
SC_{BFG_BM} – Annual average consumption of BFG in BMP, million m^3
C_{BFG_PJ} – Carbon content in BFG, kg C/m^3
SC_{COG_BM} – Annual average consumption of COG in BMP, million m^3
C_{COG_PJ} – Carbon content in COG, kg C/m^3
$P_{profiled\ steel\_BM}$ – Annual average production of profiled steel billet in BMP, thousand tons

Specific CO_2 emissions per ton of profiled steel billet produced in BMP

$$SBE_{BM} = BE_{BM} / P_{profiled\ steel\_BM} \quad \textbf{(D.1.1.4.-4)}$$

Where:

SBE_{BM} – Specific CO_2 emissions per ton of profiled steel billet produced in BMP, t CO_2/t
BE_{BM} – CO_2 emissions from production of profiled steel billet in BMP, thousand tons of CO_2
$P_{profiled\ steel\_BM}$ – Annual average production of profiled steel billet in BMP, thousand tons

COEFFICIENTS OF CONSUMPTION OF ENERGY AND MATERIALS FOR METALLURGICAL CONVERSIONS IN THE BASELINE

Consumption of pig iron per ton of smelted steel in the baseline

$$SC_{pig\ iron\_OHFP} = M_{pig\ iron\_OHFP} / P_{steel\_OHFP} \quad \text{(D.1.1.4.-5)}$$

Where:
$SC_{pig\ iron\_OHFP}$ – Consumption of pig iron per ton of steel smelted in OHFP, ton/ton
$M_{pig\ iron\_OHFP}$ – Consumption of pig iron in OHFP, thousand tons
P_{steel_OHFP} – Annual average output of steel in OHFP, thousand tons

Consumption of scrap metal per ton of smelted steel in the baseline

$$SC_{scrap\_OHFP} = M_{scrap\_OHFP} / P_{steel\_OHFP} \quad \text{(D.1.1.4.-6)}$$

Where:
SC_{scrap_OHFP} – Consumption of scrap metal per ton of steel smelted in OHFP, ton/ton
M_{scrap_OHFP} – Annual average consumption of scrap metal in OHFP, thousand tons
P_{steel_OHFP} – Annual average output of steel in OHFP, thousand tons

Consumption of steel per ton of profiled steel billet produced in BMP

$$SC_{steel\_profiled\_steel\_BM} = M_{steel\_BM} / P_{profiled\ steel\_BM} \quad \text{(D.1.1.4.-7)}$$

Where:
$SC_{steel\_profiled\_steel\_BM}$ – Consumption of steel per ton of profiled steel billet produced in BMP, t/t
M_{steel_BM} – Annual average consumption of steel in BMP, thousand tons
$P_{profiled\ steel\_BM}$ – Annual average output of profiled steel billet in BMP, thousand tons

CO_2 emissions from consumption of metallurgical coke for production of profiled steel billet in the baseline

$$BE_{metallurgical\ coke\_profiled\_steel} = SC_{skip\_metallurgical\_coke\_PJ} * SC_{pig\ iron\_OHFP} * P_{profiled\ steel\_EAFP} * SC_{steel\_profiled\_steel\_BM} * SPE_{metallurgical\_coke} \quad (D.1.1.4.-8)$$

Where:
$BE_{metallurgical\ coke\_profiled\_steel}$ – CO_2 emissions from consumption of metallurgical coke in BFP for production of profiled steel billet in the baseline, thousand tons of CO_2
$SC_{skip\_metallurgical\_coke\_PJ}$ – Specific consumption of dry skip metallurgical coke per ton of pig iron smelted in BFP, t/t
$SC_{pig\ iron\_OHFP}$ – Consumption of pig iron per ton of steel billet produced in OHFP, t/t
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$SC_{steel\_profiled\_steel\_BM}$ – Consumption of steel per ton of profiled steel billet produced in BMP, t/t
$SPE_{metallurgical\_coke}$ – Specific CO_2 emissions per ton of dry metallurgical coke produced in BPCP, tons CO_2/ton

CO_2 emissions from consumption of pig iron in the baseline

$$BE_{pig\ iron\_profiled\_steel} = SC_{pig\ iron\_OHFP} * P_{profiled\ steel\_EAFP} * SC_{steel\_profiled\_steel\_BM} * SPE_{pig\ iron} \quad (D.1.1.4.-9)$$

Where:
$BE_{pig\ iron\_profiled\_steel}$ – CO_2 emissions from consumption of pig iron in OHFP, thousand tons of CO_2
$SC_{pig\ iron\_OHFP}$ – Consumption of pig iron per ton of steel smelted in OHFP, t/t
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$SC_{steel\_profiled\_steel\_BM}$ – Consumption of steel per ton of profiled steel billet produced in BMP, t/t
$SPE_{pig\ iron}$ – Specific CO_2 emissions per ton of produced pig iron, tons CO_2/ton

CO_2 emissions from steel smelting in OHFP

$$BE_{steel\_OHFP} = SC_{steel\_profiled\_steel\_BM} * P_{profiled\ steel\_EAFP} * SBE_{OHFP} \quad (D.1.1.4.-10)$$

Where:
$BE_{steel\_\ OHFP}$ – CO_2 emissions from steel smelting in OHFP, thousand tons of CO_2
$SC_{steel\_profiled\_steel\_BM}$ – Consumption of steel per ton of profiled steel billet produced in BMP, t/t
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons

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SBE_{OHFP} – Specific CO_2 emissions per ton of steel produced in OHFP, tons CO_2/ton

CO_2 emissions from production of profiled steel billet in BMP

$$BE_{profiled\ steel\_BM} = SBE_{BM} * P_{profiled\ steel\_EAFP} \quad (D.1.1.4.\text{-}11)$$

Where:
$BE_{profiled\ steel\_BM}$ – CO_2 emissions from production of profiled steel billet in BMP, thousand tons of CO_2
SBE_{BM} – Specific CO_2 emissions per ton of production of profiled steel billet in BMP, tons CO_2/ton
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons

CO_2 EMISSIONS FROM ELECTRICITY CONSUMPTION IN THE BASELINE

CO_2 emissions from electricity consumption in OHFP

$$BE_{electricity\_OHFP} = SEC_{steel\_OHFP} * P_{profiled\ steel\_\ EAFP} * SC_{steel\_profiled\_steel\_BM} *((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/(EC_{gross\_PJ} - EC_{grid\_steel\_EAF}) \quad (D.1.1.4.\text{-}12)$$

Where:
$BE_{electricity\_OHFP}$ – CO_2 emissions from electricity consumption in OHFP, thousand tons of CO_2
SEC_{steel_OHFP} – Specific consumption of electricity in OHFP per ton of smelted steel, MWh/t
$P_{profiled\ steel\_\ EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$SC_{steel\_profiled\_steel\_BM}$ – Consumption of steel per ton of profiled steel billet produced in BMP, t/t
$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh (See Chapter D.1.1.2)
EF_{grid} – CO_2 emission factor for grid electricity from Unified Energy Systems of Urals (EF_{grid} = 0.541 t CO_2/MW-h)
EC_{gross_PJ} – Total electricity consumption by MMK, GW-h
EC_{import_PJ} – Electricity purchases from Unified Energy Systems of Urals grid, GW-h
$EC_{grid\_steel\_EAF}$ – Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation, GW-h
TDL – Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals, % [20]

[20] This value shall be taken from annual reports of Urals Inter-regional Company for Distribution of Grid Electricity posted in the Internet

$$\mathbf{SEC_{steel\_OHFP} = EC_{OHFP} / P_{steel\_OHFP}} \quad \mathbf{(D.1.1.4.-13)}$$

Where:
SEC_{steel_OHFP} – Specific consumption of electricity in OHFP per ton of smelted steel, MWh/t
EC_{OHFP} – Annual average consumption of electricity in OHFP, GW-h
P_{steel_OHFP} – Annual average output of steel in OHFP, thousand tons

CO_2 emissions from consumption of electricity in BMP

$$\mathbf{BE_{electricity\_BM} = SEC_{profiled\ steel\_BM\_} * P_{profiled\ steel\_\ EAFP} * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/(EC_{gross\_PJ} - EC_{grid\_steel\_EAF})} \quad \mathbf{(D.1.1.4.-14)}$$

Where:
$BE_{electricity\_BM}$ – CO_2 emissions from consumption of electricity in BMP, thousand tons of CO_2
$SEC_{profiled\ steel\_BM}$ – Specific consumption of electricity in BMP per ton of profiled steel billet, MW-h/t
$P_{profiled\ steel\_\ EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh (See Chapter D.1.1.2)
EF_{grid} – CO_2 emission factor for grid electricity from Unified Energy Systems of Urals (EF_{grid} = 0.541 t CO_2/MW-h)
EC_{gross_PJ} – Total electricity consumption by MMK, GW-h
EC_{import_PJ} – Electricity purchases from Unified Energy Systems of Urals grid, GW-h
$EC_{grid\_steel\_EAF}$ – Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation , GW-h
TDL – Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals, %

$$\mathbf{SEC_{profiled\ steel\_BM} = EC_{BM} / P_{profiled\_steel\_BM}} \quad \mathbf{(D.1.1.4.-15)}$$

Where:
$SEC_{profiled\ steel\_BM}$ – Specific consumption of electricity in BMP per ton of profiled steel billet, MWh/t
EC_{BM} – Annual average consumption of electricity in BMP, GW-h
$P_{profiled\_steel\_BM}$ – Output of profiled steel billet in BMP, thousand tons

Total CO_2 emissions from electricity consumption

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$$BE_{total\ electricity\ consumption} = BE_{electricity\ OHFP} + BE_{electricity\ BM} \quad (D.1.1.4.-16)$$

Where:

$BE_{total\ electricity\ consumption}$ – Total CO_2 emissions from electricity consumption, under the baseline scenario, thousand tons of CO_2
$BE_{electricity\_OHFP}$ – CO_2 emissions from electricity consumption in OHFP, thousand tons of CO_2
$BE_{electricity\_BM}$ – CO_2 emissions from electricity consumption in BMP, thousand tons of CO_2

CO_2 EMISSIONS FROM GENERATION OF AIR BLAST FOR PRODUCTION OF PIG IRON USED FOR PRODUCTION OF PROFILLED STEEL BILLET IN THE BASELINE

$$BE_{air\ blast\_for\_pig\_iron} = SC_{air\ blast\ generation\_PJ} * SC_{pig\ iron\_OHFP} * P_{profiled\ steel\_EAFP} * SC_{steel\_profiled\_steel\_BM} * EF_{air\ blast\ generation\_PJ} \quad (D.1.1.4.-17)$$

Where:

$BE_{air\ blast\_for\_pig\_iron}$ - CO_2 emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the project, thousand tons of CO_2
$SC_{air\ blast\ generation\_PJ}$ – Specific consumption of air blast in BFP per ton of pig iron, thousand m^3/t
$SC_{pig\ iron\_\ OHFP}$ – Consumption of pig iron per ton of steel produced in OHFP, ton/ton
$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$SC_{steel\_profiled\_steel\_BM}$ – Consumption of steel per ton of profiled steel billet produced in BMP, ton/ton
$EF_{air\ blast\ generation\_PJ}$ – CO_2 emission factor for air blast generation, t CO_2/thousand m^3

TOTAL CO_2 EMISSIONS IN THE BASELINE

$$BE = BE_{metallurgical\ coke\_profiled\_steel} + BE_{pig\ iron\_profiled\_steel} + BE_{steel\_OHFP} + BE_{profiled\ steel\_BM} + BE_{total\ electricity\ consumption} + BE_{air\ blast\_for\_pig\_iron} \quad (D.1.1.4.-18)$$

Where:

BE – Total CO_2 emissions in the baseline, thousand tons of CO_2
$BE_{metallurgical\ coke\_profiled\_steel}$ – CO_2 emissions from consumption of metallurgical coke in BFP for production of profiled steel billet in the baseline, thousand tons of CO_2
$BE_{pig\ iron\_profiled\_steel}$ – CO_2 emissions from consumption of pig iron in BFP in the baseline, thousand tons of CO_2
$BE_{steel\_\ OHFP}$ – CO_2 emissions from steel smelting in OHFP, thousand tons of CO_2
$BE_{profiled\ steel\_BM}$ – CO_2 emissions from production of profiled steel billet in BMP, thousand tons of CO_2

$BE_{total\ electricity\ consumption}$ – Total CO_2 emissions from electricity consumption in the baseline, thousand tons of CO_2
$BE_{air\ blast\_for\_pig\_iron}$ – CO_2 emissions from generation of air blast in the baseline, thousand tons of 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 leakage as the result of:

1. Transportation of raw materials and products as result of the project implementation;
2. Transportation of natural gas and electricity;
3. Operations of decommissioned equipment beyond the project boundaries.

The volume of production of profiled steel billet in EAFP as the result of the project implementation will not exceed the same under the baseline scenario. This assumption is based on the analysis of market situation and capacity of equipment. The volumes of transportation of scrap metal, which is needed for EAF operation shall increase greatly but the demand for pig iron and raw materials for its production shall decrease. Thus the volumes of transported materials shall be the same in the project and baseline scenarios. Moreover the resource-saving effect of the proposed project shall bring a reduction in transportation needs regarding raw materials and energy resources (natural gas). The losses during transmission of electricity are accounted for in the monitoring plan.

The permanent equipment of the former open-hearth furnace plant and blooming mill plant was dismantled and disposed of excluding one DBSU, which is included in the project. Therefore there will be no leakages under this category.

For the preparation of scrap to be used in EAFP the equipment in scrap metal shop consumes electricity. The specific electricity consumption by scrap metal shop in the baseline is 26.14 kW-h (2002), the specific electricity consumption in the project is 13.69 kW-h (2009). Thereby such source of indirect emission as electricity consumption in scrap metal shop is not considered under conservative approach.

A certain fraction of blast furnace dust formed in the BFP is transported to the cement factory outside MMK. This fraction and its carbon content are included in the monitoring plan. CO_2 emissions during utilization of this dust at the cement factory are considered as leakages.

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
Utilization of blast furnace dust outside MMK								
P-52	**$M_{dust\ utilization\ \_PJ}$** Supply of blast furnace dust to the cement factory outside MMK	BFP	Thousand tons	m	Each batch	All	electronic/ paper	Monthly technical report produced by BFP. Annual data shall be verified in Economics Department
P-53	**$\%C_{dust\ \_BF\_PJ}$** Carbon content in blast furnace dust	Chemical lab of IMP and LDW	% by mass	m	Monthly	All	electronic/ paper	Arithmetic mean of measurement results

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

Utilization of blast furnace dust at the cement factory **outside MMK**

$$LE_y = M_{dust\ utilization\_PJ} * \%\ C_{dust\_BF\_PJ} * 44/12 \qquad (D.1.3.2.-1)$$

Where:
LE_y – CO_2 emissions from utilization of blast furnace dust at the cement factory outside MMK, thousand tons of CO_2
$M_{dust\ utilization\ \_PJ}$ - supply of blast furnace dust at the cement factory outside MMK, thousand tons
$\%C_{dust\_.BF\_PJ}$ – carbon content in blast furnace dust, % by mass

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:

$$ER_y = BE_y - PE_y - LE_y \qquad (D.1.4.-1)$$

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
LE_y – CO_2 emissions from utilization of blast furnace dust at the cement factory outside MMK, thousand tons of CO_2

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 the Federal Law on environmental protection # 7-FZ OJSC “MMK” has the approved Maximum Permissible Emissions (MPE) document. This document was approved by Chelyabinsk Regional Department of Technological and Environmental Surveillance of

Rostechnadzor the decision №1855 of 30.12.2008. This decision is valid for one year. Under this decision the harmful emission permit №1855 was issued. This permit quantified environmental impacts of MMK.

Air emissions were estimated by OJSC "Magnitogorsk GIPROMEZ" in accordance with Russian "Guidelines for calculation of industrial emissions of air pollutants" (OND-86)[21]. 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 Ekaterinburg (2008). This report was approved according to the established procedure.

MMK Laboratory for Control of Air Quality 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.

In accordance with referred above Federal Law OJSC "MMK" has 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.

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 $M_{coking\ coal\_CP\_PJ}$	Low	Consumption of coal charge is calculated based on gross coke production. The production of gross coke is calculated as a sum of weighed amounts of metallurgical coke and coke breeze after quenching and sifting of every shipment of the gross coke from the coke batteries. The methodology of calculation is approved by chief engineer of JCS "MMK" based on widely used in Russian metallurgical branch "Instruction on rationing of the raw materials for coke and by-product coke production, developed by Ministry of ferrous metallurgy of URRS, 1969". The cross check is made based on data of coke charge funnel scales for every loading into coke batteries.

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

		Actual weight is converted into dry mass, using coal charge humidity data. Coal charge humidity is measured by the Central Laboratory of Control.
P-9 $P_{metallurgical\ coke\_PJ}$	Low	The metallurgical coke is a coke after quenching and initial sifting when the coke breeze is separated. The metallurgical coke is transported from BPCP to BFP by railcar or by conveyor where to be measured. The railcars are weighted before and after loading of coke in BFP at the railway scales of Vkhodnaya, Ugolnaya, Domennaya stations owned by MMK and by the difference of the weight of each full and empty railcar the amount of incoming metallurgical coke is calculated. The amount of incoming metallurgical coke transported by the conveyor is weighted by funnel scales. Then the data of metallurgical coke supply to BFP and shipment out of MMK (weighted by the same way) are put into corporate information system of MMK and used in BPCP for their reporting in metallurgical coke production.
P-12 P_{benzol_PJ}	Low	The volume of benzol production is measured by balance method: the amount of crude benzol in storage is measured by fluid level gauge twice a day, and the amount of benzol supplied to the consumers is measured in tanks by fluid level gauge.
P-13 $P_{coal\text{-}tar\_PJ}$	Low	Distillation of coal-tar resin in the recovery plant gives commercial products: oil gas tar pitch, anthracene fraction, absorption oil, naphthalene, phenol, claroline. Quantity of distillation products is measured in tanks by fluid level gauge during shipment. The quantity of coal-tar resin is calculated as the sum of all distillation fractions.
P-18 $P_{pig\ iron\_BF\_PJ}$	Low	Pig iron is weighted at the BFP weighing station.
P-14 $M_{skip\_metallurgical\ coke\_\ PJ}$	Low	Before loading into the blast furnace the skip metallurgical coke is weighted in the weighting funnels with strain sensor VDD6-0.5, then moisture content is measured and dry weight of coke is calculated in the technological department.
P-52 $M_{dust\ utilization\_PJ}$	Low	The amount of blast furnace dust shipped to the cement factory outside MMK is measured in the number of freight cars, which are periodically weighed to determine their mean weight.
P-20 $M_{pig\ iron\_EAFP}$	Low	The mass of pig iron in the ladles is determined by weighting at railway scales of Zavodskaya railway station, when the pig iron leaves BFP and transported to EAFP. Cold pig iron is transported from BPF to the EAFP furnace-charging yard, where it is weighed at the commercial scales.
P-21 $M_{carbon\ powder\_EAFP}$	Low	Carbon-containing powder is weighed at the EAFP scales before it enters EAFP.
P-22 M_{scrap_EAFP}	Low	Scrap metal comes to DBSU in pan cars. The pans of scrap metal weighed at the technological scales of EAFP furnace charging yard. Some scrap metal comes to EAFP in grout pans, which are weighed at the entrance weighing station of the furnace-charging yard.
P-23 $M_{electrodes\_EAFP}$	Low	All replaced electrodes are counted. Their weight is indicated in technical passport issued by the supplier.
P-25 $\Sigma P_{profiled\ \&\ slab\ steel\_EAFP}$ P-26 $P_{profiled\ steel\_\ EAFP}$ P-29 $\sum P_{steel\ EAF}$	Low	The amount of steel produced in EAFP is calculated on the basis of theoretical mass of profiled billet. The mass of clipping and waste is estimated on the basis of geometry of billet.
P-47 $FC_{energy\ coal\_CHPP\_PJ}$	Low	The incoming power station coal is weighed at the scales.

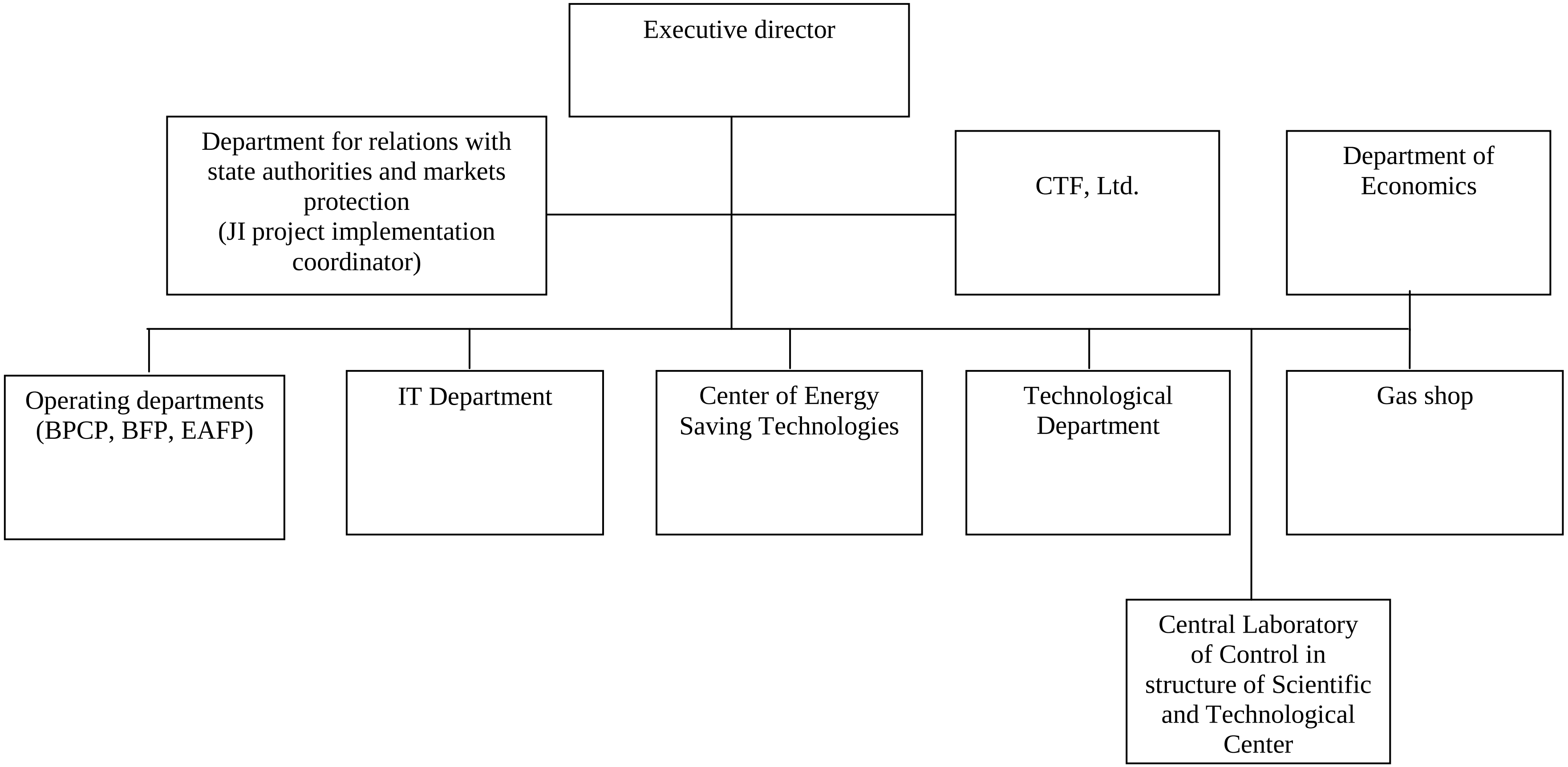
P-2 %C $_{coking\ coal\_CP\_PJ}$ P-10 %C $_{metallurgical\ coke\_PJ}$	Low	Carbon content in coal charge, metallurgical coke is measured by carbon analyzer LECO SC144DR in BPCP lab.
P-4 C $_{BFG\_.PJ}$ P-6 C $_{COG\_PJ}$	Low	CEST laboratory measures component composition of BFG and COG by VTI-2 gas analyzer under state standard GOST 5439-76. Carbon content is then estimated on the basis of that measured composition of gases.
P-53 %C $_{dust\_.BF\_PJ}$	Low	Carbon content in blast furnace dust is measured in the chemical lab of IMP and LDW located in Agapovka village by express carbon analyzer AN-7529.
P -8 C $_{NG\_PJ}$	Low	Component composition of NG is specified in technical passport by the supplier. Carbon content is then estimated on the basis of that measured composition of gas.
P-3 FC $_{BFG\_CP\_PJ}$ P-5 FC $_{COG\_CP\_PJ}$ P-7 FC $_{NG\_CP\_PJ}$ P-11 P $_{COG\_CP\_PJ}$ P-15 FC $_{COG\_BF\_PJ}$ P-17 FC $_{BFG\_BF\_PJ}$ P-19 P $_{BFG\_BF\_PJ}$ P-24 FC $_{NG\_EAFP}$ P-39 FC $_{BFG\_CPP\_PJ}$ P-42 FC $_{BFG\_SABPP\_PJ}$ P-43 FC $_{COG\_SABPP\_PJ}$ P-49 FC $_{BFG\_SABPP\_\ air\ blast\ generation\ \ PJ}$	Low	Pressure differential flow meters Metran-100-DD-1411, Metran-22-DD-1420 and Sapphire-22-DD-2410 measure flows of COG, BFG and NG. Then the consumption of these gases is calculated by SPG-762 calculator.
P-16 FC $_{NG\_BF\_PJ}$ P-40 FC $_{NG\_CPP\_PJ}$ P-41 FC $_{NG\_CHPP\_PJ}$ P-44 FC $_{NG\_SABPP\_PJ}$ P-45 FC $_{NG\_turbine\ section\ of\ SP\ \_PJ}$ P-46 FC $_{NG\_gas\ recovery\ unit\text{-}2\ of\ SP\ \_PJ}$ P-50 FC $_{COG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ P-51 FC $_{NG\_SABPP\_\ air\ blast\ generation\ \ PJ}$	Low	Pressure differential flow meters Yokogava Eja110a measure flows of NG in BFP, CHPP, CPP, SABPP and the turbine section of the steam plant. Then the consumption of natural gas is calculated by SPG-762 calculator.
P-27 TDL	Low	Specified in Annual report of Urals Inter-regional Power Distribution Company.
P-28 EC $_{grid\_sleel\_EAF}$ P-30 EF $_{EAFP}$	Low	See Annex 3.

P-31 EC_{gross_PJ} P-32 EC_{import_PJ}		
P-33 SEC_{N2} P-35 SEC_{pure_N2} P-37 SEC_{Ar}	Low	CEST experts calculate these parameters on the basis of electricity consumption and amount of gas formed in BOFP.
P-34 FC_{N2_EAFP} P-36 $FC_{pure\_N2\_EAFP}$ P-38 FC_{Ar_EAFP}	Low	Consumption of nitrogen, pure nitrogen and argon is measured by gas flow meters.
P-48 $OC_{air\ blast\ generation\_PJ}$	Low	Production of air blast at SABPP turbine is measured by air flow meter.

The calibration of measuring equipment is provided by calibration laboratory owned by OJSC "MMK". The verification of measuring instruments is done by contracted Federal state agency "Center of standardization, metrology and certification of Magnitogorsk". The schedule of calibration and verification is approved by Chief metrologist of MMK. All related information is collected in the Collection of calibration and verification schedules of the measuring equipment of MMK departments per each year.

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



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

All reports are allocated on the server every month.
Keeping of all secondary reporting forms related to the monitoring of JI project (period from 1 January 2008 to December 31, 2012) shall be done until January 1, 2015. The Department for relations with state authorities and markets protection (JI project implementation coordinator) controls the completeness and timing the of the reporting data allocation and monitor the changes in the reporting forms or procedures of monitoring.

Every quarter all the relevant data is transferred to CTF Consulting Ltd. Within 10 working days after receipt of the complete set of reporting forms the specialists of CTF Consulting Ltd. 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 Ltd. develops for JSC “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 within 5 working days 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, 10 of the year following the reporting period.

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	By-product coke plant	Technical report of BPCP	Consumption of raw materials, production
2	Blast-furnace plant	Technical report of BFP	Consumption of raw materials, production,

			waste
3	Electric arc-furnace plant	Technical report of EAFP	Consumption of raw materials, production
4	Electric arc-furnace plant	Reporting form of actual consumption of carbon-containing powder and electrodes, which is prepared and approved in EAFP –monthly value	Consumption of raw materials
5	Technological department	Report on electricity utilization	Electricity consumption
6	Technological department	Report on analysis of consumption energy recourses in MMK	Electricity purchase
7	Technological department	Report on fuel consumption by own power generating capacities	Electricity generation
8	Central Laboratory of Control in structure of Scientific and Technological Center	Reporting form of chemical consumption of coal charge in BPCP – average monthly value	Carbon content in raw material
9	Central Laboratory of Control in structure of Scientific and Technological Center	Reporting form of chemical consumption of metallurgical coke in BPCP – average monthly value	Carbon content in product
10	Central Laboratory of Control in structure of Scientific and Technological Center	Reporting form of chemical consumption of blast furnace dust in BFP – average monthly value	Carbon content in waste
11	Center of Energy Saving Technologies	Report on balance of blast furnace gas consumption in workshops	Gas consumption and gas production
12	Center of Energy Saving Technologies	Report on balance of coke over gas consumption in workshops	Gas consumption and gas production
13	Center of Energy Saving Technologies	Report on balance of natural gas consumption in workshops	Gas consumption and gas production

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14	Center of Energy Saving Technologies	Report on the distribution of products of oxygen pumping plant supplied to consumer by pipeline	Gas consumption in EAFP
15	Center of Energy Saving Technologies	Reporting QMS form of chemical consumption of coke over gas – average monthly value	Carbon content in gas
16	Center of Energy Saving Technologies	Reporting QMS form of chemical consumption of blast furnace gas – average monthly value	Carbon content in gas
17	Gas shop	Technical quality passport of gas	Carbon content in gas

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

The developer of monitoring plan:

“CTF Consulting Ltd.”

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 Ltd.” is not a project participant.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Project emissions for 2008 were calculated using the formulae in Section D.1.1.2, on the basis of actual annual data reported by OJSC "MMK".

To estimate project emissions for 2009-2012 project developer applied specific emission factors (CO_2 emissions per ton of produced metallurgical coke and pig iron) calculated for 2008, because no significant technological changes are expected in BPCP and BFP during this period (especially since the majority of investment projects were suspended in autumn of 2008).

At the end of 2008 OJSC "MMK" has been forced to shut down some of the coke-oven batteries due to decrease of the pig iron production caused by global economic recession. While planning of the amounts of pig iron and steel to be produced in 2009 the forecasted crisis conditions and economic situation in Russia and worldwide were taken into account. However in spring of 2009 the demand for OJSC "MMK" production has risen and need in output of pig iron and steel has augmented.

Due to the specifics of design and continuous production process at the coke-oven batteries, the quick start-up or shut down of coke batteries is impossible, because the large scale rehabilitation work shall be done, which takes several months. Therefore in 2 and 3 quarters of 2009 OJSC "MMK" purchased a part of required metallurgical coke from other coke producers but in 4 quarter BPCP fully supplied BFP with metallurgical coke.

In future, following the restoration process at own coke-oven batteries, the purchase of off-site coke will be canceled. It is proposed to keep the value of specific CO_2 emissions per ton of produced metallurgical coke the same for own produced and purchase coke since other producers of coke have not lesser carbon intensity during its production. The values of emission factors are reported in the Table below.

Table E.1.1 Specific emission factors in metallurgical conversion stages (BPCP and BFP) in 2008

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific CO_2 emission per ton of produced metallurgical coke, t CO_2/t	$SPE_{metallurgical\_coke}$	D.1.1.2.-2	0.967
2.	Specific CO_2 emission per ton of produced pig iron, t CO_2/t	$SPE_{blast\ furnace\ plant}$	D.1.1.2.-6	0.841

Coefficients of consumption of pig iron and coke during metallurgical conversion for production of profiled steel billet were calculated by equations D.1.1.2-9, 10 on the basis of reported by MMK plans for industrial expansion in 2009-2012. We also used projected outputs of profiled and slab steel billet, total smelting of steel in EAF-180, consumption of pig iron and scrap metal in EAFP.

Table E.1.2 Plans for industrial expansion in 2009-2012

№	Parameter and measurement units	2009	2010	2011	2012
1.	Production of profiled steel billet in EAFP, thousand tones	1095,0	1613,0	2015,0	2015,0

2.	Profiled and slab steel production in EAF plant (EAFs and Double-Basin OHF), thousand tones	1306,0	2321,0	3816,0	3816,0
3.	Steel melting at EAFs, thousand tones	352	1094	3340	3340
4.	Pig iron consumption in EAF plant, thousand tones	863	1366	1281	1281
5.	Scrap consumption in EAF plant, thousand tones	595	1279	2916	2916

Since the 2009 and 2010 will be characterized by high prices for scrap metal the volume of steel smelting in DBSU will increase and the share of pig iron in furnace charge shall prevail. For correct estimation of emissions in 2009-2012 the following equation was used:

$$\mathbf{PE_{profiled\ steel\_EAFP} = P_{profiled\ steel\_EAFP} * SPE_{EAFP} * \sum P_{steel\_EAF} / \sum P_{profiled\ \&slab\ steel\_EAFP} + P_{profiled\ steel\_EAFP} * SBE_{OHFP} * (\sum P_{profiled\ \&slab\ steel\_EAFP} - \sum P_{steel\_EAF}) / \sum P_{profiled\ \&slab\ steel\_EAFP}} \quad \mathbf{(E.1.-1)}$$

Where:

$PE_{profiled\ steel\_EAFP}$ - CO_2 emissions during production of profiled steel billet in EAFP, thousand tons of CO_2 per year

$P_{profiled\ steel\_EAFP}$ – output of profiled steel billet in EAFP, thousand tons

SPE_{EAFP} – specific CO_2 emissions per ton of profiled steel billet produced in EAFP, t CO_2/t

$\sum P_{steel\_EAF}$ – total smelting of steel in EAF-180, thousand tons

$\sum P_{profiled\&slab\ steel\_EAFP}$ – total production of profiled and slab steel billet in EAFP, thousand tons

SBE_{OHFP} – specific CO_2 emissions per ton of steel smelted in OHFP, t CO_2/t

To estimate emissions from steel smelting in DBSU in 2009 and 2010 the specific CO_2 emission factor for open-hearth plant was used. Before installation of EAFs DBSU was utilized in OHFP under full load. This specific emission factor was already used to estimate baseline emissions.

Table E.1.3 Specific CO_2 emission factors during metallurgical conversion: actual values for EAFP in 2008, historical averages for OHFP

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific CO_2 emission per ton of profiled steel billet produced in EAFP, t CO_2/t	SPE_{EAFP}	D.1.1.2.-8	0.105
2.	Specific CO_2 emission per ton of steel produced in OHFP, t CO_2/t	SBE_{OHFP}	D.1.1.4.-2	0.175

Total CO_2 emissions from consumption of electricity during production of profiled steel billet in EAFP were estimated by Equation D.1.1.2-13:

$$\mathbf{PE_{electricity\_profiled\_steel\_EAFP} = PE_{EC\_grid\_profiled\_steel\_EAF} + PE_{EC\_profiled\_steel\_other\ EAFP} + PE_{EC\_Ar\_N2\_profiled\_steel}} \quad \mathbf{(D.1.1.2.-13)}$$

Where:

$PE_{electricity\_profiled\_steel\_EAFP}$ – total CO_2 emissions from electricity consumption during production of profiled steel billet in EAFP, thousand tons of CO_2 per year

$PE_{EC\_grid\_profiled\_steel\_EAF}$ – CO_2 emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during production of profiled steel billet in EAFP, thousand tons of CO_2 per year

$PE_{EC\_ profiled\_steel\_other\ EAFP}$ – CO_2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet, thousand tons of CO_2 per year

$PE_{EC\_Ar\_N2\_profiled\_steel}$ - CO_2 emissions from consumption of electricity from corporate MMK grid for production of nitrogen, pure nitrogen, and argon during production of profiled steel billet in EAFP, thousand tons of CO_2 per year

CO_2 emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation per ton of all smelted steel were calculated by Equation D.1.1.2-14. To estimated emissions in 2009-2012 the specific consumption of grid electricity by EAF-180 per ton of all smelted steel was assumed to be the same as in 2008. CO_2 emission factor during consumption of electricity from Unified Energy Systems of Urals grid is fixed ex-ante (Annex 4):

Table E.1.4 Specific consumption of electricity by EAF-180 in 2008 and CO_2 emission factor for consumption of grid electricity

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation per ton of all steel smelted in EAF, MWh/t	$SEC_{grid\_steel\_EAF}$	D.1.1.2.-15	0.294
2.	CO_2 emission factor for grid electricity, kg CO_2/MWh	EF_{grid}	D.1.1.2.-14	0.541
3.	Technological losses during transmission and distribution of grid electricity in Unified Energy Systems of Urals, %	TDL	D.1.1.2.-14	7.36%

CO_2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet were estimated by another equation. Under conservative approach we assumed that all electricity consumed by other equipment of EAFP was generated by MMK own capacities, because there were no credible estimates of electricity imports from the grid. In other words we did not calculate average weighed CO_2 emission factor for electricity in MMK corporate grid. Instead the CO_2 emission factor for electricity generated by MMK own capacities in 2008 is considered to be the same for 2009-2012.

Because considerable amount of steel is smelted in DBSU we estimated electricity consumption separately for this process on the basis of historical average annual electricity consumption per ton of steel in OHFP (the same coefficient was used for baseline emissions estimation).

CO_2 emissions during steel refining and casting in EAFP for the years 2009-2009 were estimated on the basis of actual specific coefficient of electricity consumption defined for 2008. The following equation was used:

$$\mathbf{PE_{EC\_profiled\_steel\_other\ EAFP} = (SEC_{steel\ refinement\ and\ casting\ EAFP} * P_{profiled\ steel\_EAFP} + SEC_{steel\_OHFP} *}$$

$$\mathbf{P_{profiled\ steel\_EAFP} * (\sum P_{profiled\&slab\ steel\_EAFP} - \sum P_{steel\_EAF})) / \sum P_{profiled\&slab\ steel\_EAFP}) * EF_{own\ generation\_PJ}} \quad \textbf{(E.1.-2)}$$

Where:

$PE_{EC\_other\ equipment\_EAFP\_PJ}$ – CO_2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet, thousand tons of CO_2

$SEC_{steel\ refinement\ and\ casting\ EAFP}$ - Specific consumption of electricity in EAFP for steel refining and teeming, MWh/t

SEC_{steel_OHFP} – Specific consumption of electricity in OHFP, MWh/t (refer to Section D.1.1.4.)

$P_{profiled\ steel\_EAFP}$ –Output of profiled steel billet in EAFP, thousand tons

$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons

$\sum P_{steel\_EAF}$ – Total smelting of steel in EAF-180, thousand tons

$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh

Table E.1.5 Specific electricity consumption coefficients and CO_2 emission factors during generation of this electricity

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific consumption of electricity in EAFP for steel refining and teeming, MWh/t	$SEC_{steel\ refinement\ and\ casting\ EAFP}$	D.1.1.2.-19	0.055
2.	Specific consumption of electricity in OHFP, MWh/t	SEC_{steel_OHFP}	D.1.1.4.-13	0.007
3.	CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh	$EF_{own\ generation\_PJ}$	D.1.1.2.-24	0.838

CO_2 emissions from consumption of electricity from corporate MMK grid for production of nitrogen, pure nitrogen, and argon during production of profiled steel billet in EAFP were estimated for 2009-2012 applying specific emission factors defined for 2008. Although DBSU process does not consume pure nitrogen and argon, the increase in the share of DBSU smelting was not considered under conservative approach. The following equation (just like the previous one E.1.-2) uses the following conservative assumption: all electricity, consumed during production of nitrogen, pure nitrogen, and argon was generated by MMK own capacities.

$$\mathbf{PE_{EC\_Ar\_N2\_profiled\_steel} = (EC_{N2\_profiled\_steel} + EC_{pure\ N2\_profiled\_steel} + EC_{Ar\_profiled\_steel}) * EF_{own\ generation\_PJ}} \quad \textbf{(E.1.-3)}$$

Where:

$PE_{EC\_Ar\_N2\_profiled\_steel}$ - CO_2 emissions from consumption of electricity from corporate MMK grid for production of nitrogen, pure nitrogen, and argon during production of profiled steel billet in EAFP, thousand tons of CO_2 per year

$EC_{N2\_profiled\_steel}$ - Consumption of electricity for production of nitrogen used for production of profiled steel billet in EAFP, GW-h

$EC_{pure\ N2\_profiled\_steel}$ - Consumption of electricity for production of pure nitrogen used for production of profiled steel billet in EAFP, GW-h
$EC_{Ar\_profiled\_steel}$ - Consumption of electricity for production of argon used for production of profiled steel billet in EAFP, GW-h
$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh

Table E.1.6 Specific electricity consumption for production of nitrogen, pure nitrogen, and argon

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific electricity consumption for production of nitrogen at MMK, MWh/1000 m^3	SEC_{N2_PJ}	CEST data for 2008	0.213
2.	Specific electricity consumption for production of pure nitrogen at MMK, MWh/1000 m^3	$SEC_{pure\_N2\_PJ}$	CEST data for 2008	0.826
3.	Specific electricity consumption for production of argon at MWh/1000 m^3	SEC_{Ar_PJ}	CEST data for 2008	0.055

To estimate project emissions for 2009-2012 from air blast generation for production of pig iron which is needed to produce profiled steel billet we used CO_2 emission factor for air blast generation in 2008. The value is provided below in the table.

Table E.1.7 CO_2 emission factor for air blast generation

№	Parameter and measurement units	Notation	Formula №	Value
1.	CO_2 emission factor for air blast generation, t CO_2/1000 m^3	$EF_{air\ blast\ generation}$	D.1.1.2.-27	0.053

Table E.1.8: Project CO_2 emissions, tons CO_2/year

Parameter	2008	2009	2010	2011	2012
Project emissions of metallurgical shops (BPCP, BFP, EAFP)					
Output of pig iron for production of profiled steel billet	433 207	576 835	756 797	539 244	539 244
Output of coke for production of corresponding amount of pig iron (see above)	247 374	329 390	432 153	307 924	307 924
Production of profiled steel billet	173 781	175 369	233 246	209 300	209 300
Project emissions of electricity consumption in EAFs, other technological equipment in the EAFP, oxygen pumping plants					

Electricity consumption by EAFs	257 503	50 404	129 845	301 205	301 205
Electricity consumption for production of consumed nitrogen, pure nitrogen, argon	3 465	2 384	3 511	4 386	4 386
Electricity consumption by other technonological equipment (including double-basin OHF) in the EAF plant	73 079	54 246	78 038	92 815	92 815
Project emission of Steam-air blowing power plant					
Consumption of air blast for production of corresponding amount of pig iron (see above)	72 428	96 441	126 532	90 157	90 157
Total:	**1 260 837**	**1 285 069**	**1 760 122**	**1 545 031**	**1 545 031**

E.2. Estimated leakage:

Under conservative approach the amount of blast furnace dust to be shipped to the cement plant annually in 2009-2012 is assumed to be the same as in 2008.

Table E.2.1: CO_2 emissions from leakages, tons CO_2/year

Parameter	2008	2009	2010	2011	2012
Utilization of blast furnace dust at the cement plant outside MMK	164	164	164	164	164

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

Table E.3.1: The sum of E.1. and E.2, tons CO_2/year

Parameter	2008	2009	2010	2011	2012
Project emissions of metallurgical shops (BPCP, BFP, EAFP)					
Output of pig iron for production of profiled steel billet	433 207	576 835	756 797	539 244	539 244
Output of coke for production of corresponding amount of pig iron (see above)	247 374	329 390	432 153	307 924	307 924
Production of profiled steel billet	173 781	175 369	233 246	209 300	209 300
Project emissions of electricity consumption in EAFs, other technological equipment in the EAFP, oxygen pumping plants					
Electricity consumption by EAFs	257 503	50 404	129 845	301 205	301 205
Electricity consumption for production of consumed nitrogen, pure nitrogen, argon	3 465	2 384	3 511	4 386	4 386
Electricity consumption by other technonological equipment (including double-basin OHF) in the EAF plant	73 079	54 246	78 038	92 815	92 815
Project emission of Steam-air blowing power plant					
Consumption of air blast for	72 428	96 441	126 532	90 157	90 157

production of corresponding amount of pig iron (see above)					
CO_2 emissions from leakages					
Utilization of blast furnace dust at the cement plant outside MMK	164	164	164	164	164
Total:	**1 261 001**	**1 285 233**	**1 760 286**	**1 545 195**	**1 545 195**

E.4. Estimated baseline emissions:

CO_2 emissions from metallurgical conversion during smelting of steel in OHFP and production of profiled steel billet in BMP were calculated by carbon balance method under baseline conditions, using the Equations specified in Chapter D.1.1.4 on the basis of average historical values of parameters, which characterize OHFP-BMP process (Table D.1-2).

To estimate baseline emissions in 2009-2012, project developers used specific emission factors (CO_2 emissions per ton of steel smelted in OHFP and CO_2 emissions per ton of profiled steel billet produced in BMP) calculated for 2008. These emission factors are reported in the Table below.

Table E.4.1. Specific CO_2 emissions for OHFP and BMP

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific CO_2 emissions per ton of steel smelted in OHFP, t CO_2/t	SBE_{OHFP}	D.1.1.4.-2	0.175
2.	Specific CO_2 emissions per ton of profiled steel billet produced in BMP, t CO_2/t	SBE_{BM}	D.1.1.4.-4	0.198

Since the baseline parameters are fixed ex-ante (see Chapter B.1 and Annex 2), annual consumption of materials during metallurgical conversion in the baseline in 2009-2012 is the same as in 2008. These values are reported in the Table below:

Table E.4.2. Consumption of materials during metallurgical conversion in the baseline

№	Parameter and measurement units	Notation	Formula №	Value
1.	Consumption of pig iron per ton of steel smelted in OHFP, t/t	$SC_{pig\ iron\_OHFP}$	D.1.1.4.-5	0.831
2.	Consumption of scrap metal per ton of steel smelted in OHFP, t/t	SC_{scrap_OHFP}	D.1.1.4.-6	0.306
3.	Consumption of steel per ton of profiled steel billet produced in BMP, t/t	$SC_{steel\_profiled\_steel\_BM}$	D.1.1.4.-7	1.151

Total CO_2 emissions from consumption of electricity under the baseline scenario were calculated by Equations D.1.1.4-16:

$BE_{electricity\_profiled\_steel\_OHFP+BM} = BE_{electricity\_OHFP} + BE_{electricity\_BM}$ (D.1.1.4.-16)

Where:
$BE_{total\ electricity\ consumption}$ – total CO_2 emissions from electricity consumption under the baseline scenario, thousand tons of CO_2 per year
$BE_{electricity\ consumption\_OHF}$ – total CO_2 emissions from electricity consumption in OHFP, thousand tons of CO_2 per year
$BE_{electricity\ consumption\_blooming\ mill}$ – total CO_2 emissions from electricity consumption in BMP, thousand tons of CO_2 per year

CO_2 emissions from electricity consumption in OHFP and BMP were estimated on the basis of projected output of profiled steel billet in EAFP in 2009-2012 as reported by MMK.

CO_2 emissions from electricity consumption in OHFP were estimated somewhat differently than described in Section D fir this source of emissions. Under conservative approach we assumed that all electricity consumed in OHFP and BMP was generated by MMK own capacities, because there was no credible estimates of electricity imports from the grid. In other words we did not calculate average weighed CO_2 emission factor for electricity in MMK corporate grid. Instead the CO_2 emission factor for electricity generated by MMK own capacities in 2008 is considered to be the same for 2009-2012.

$BE_{electricity\_OHFP} = SEC_{steel\_OHFP} * P_{profiled\ steel\_\ EAFP} * SC_{steel\_profiled\_steel\_BM} * EF_{own\ generation\_PJ}$ (E.4.-1)

Where:
$BE_{electricity\_OHFP}$ – CO_2 emissions from consumption of electricity in OHFP, thousand tons of CO_2 per year
SEC_{steel_OHFP} – Specific electricity consumption per ton of steel in OHFP, MWh/t.
$P_{profiled\ steel\_\ EAFP}$ – output of profiled steel billet in EAFP, thousand tons
$SC_{steel\_profiled\_steel\_BM}$ – Specific consumption of steel per ton of profiled steel billet, produced in BMP, t/t (see Table E 4.2.)
$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh

Specific electricity consumption in OHFP per ton of steel is the same in 2008 and 2009-2012 because the baseline parameters are fixed ex-ante (see Section B.1 and Annex 2). CO_2 emission factor for electricity generated by MMK own capacities in 2008 is considered to be the same for 2009-2012. This parameter is equal for the project and the baseline.

Table E.4.3. Specific electricity consumption in OHFP and CO_2 emission factors during generation of electricity by own capacities at MMK

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific consumption of electricity in OHFP, MWh/t	SEC_{steel_OHFP}	D.1.1.4.-13	0.007
2.	CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh	$EF_{own\ generation\_PJ}$	D.1.1.2.-22	0.838

Under conservative approach we assumed that all electricity, consumed in BMP, was generated by MMK own capacities.

$$BE_{electricity\_BM} = SEC_{profiled\ steel\_BM\_} * P_{profiled\ steel\_\ EAFP} * EF_{own\ generation\_PJ} \quad (E.4.-2)$$

Where:
$BE_{electricity\_BM}$ – CO_2 emissions from consumption of electricity in BMP, thousand tons of CO_2 per year
$SEC_{profiled\ steel\_BM}$ – Specific electricity consumption per ton of profiled steel billet in BMP, MWh/t
$P_{profiled\ steel\_\ EAFP}$ – Output of profiled steel billet in EAFP, thousand tons
$EF_{own\ generation\_PJ}$ – CO_2 emission factor for electricity produced by own generating capacities of MMK, t CO_2/MWh

Specific electricity consumption in BMP per ton of profiled steel billet is the same in 2008 and 2009-2012, because the baseline parameters are fixed ex-ante (see Table below).

Table E.4.4. Specific electricity consumption in BMP

№	Parameter and measurement units	Notation	Formula №	Value
1.	Specific consumption of electricity per ton of profiled steel billet in BMP, MWh/t	$SEC_{profiled\ steel\_BM}$	D.1.1.4.-15	0.041

To estimate baseline emissions during 2009-2012 from air blast generation for production of pig iron, which is needed to produce profiled steel billet, we used CO_2 emission factor for air blast generation in 2008, see Table below

Table E.4.5 CO_2 emission factor for air blast generation

№	Parameter and measurement units	Notation	Formula №	Value
1.	CO_2 emission factor for air blast generation, tCO_2/1,000 m^3	$EF_{air\ blast\ generation}$	D.1.1.2.-27	0.053

Table E.4.6 Baseline CO_2 emissions, tons CO_2/year

Parameter	2008	2009	2010	2011	2012
Baseline emissions of metallurgical shops (BPCP, BFP, OHFP, BMP)					
Output of pig iron for production of profiled steel billet (same as in project)	1 275 399	834 743	1 229 626	1 536 079	1 536 079
Output of coke for production of corresponding amount of pig iron (see above)	728 290	476 663	702 152	877 146	877 146
Steel smelting in OHFP	348 283	227 950	335 784	419 469	419 469
Production of steel billet in BMP	330 630	216 396	318 764	398 208	398 208
Baseline emissions of electricity consumption of OHFP, BMP					
Consumption of electricity during	64 806	44 583	65 673	82 041	82 041

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process of profiled steel billet production in OHFP and BMP					
Baseline emissions of Stream-air blowing power plant					
Consumption of air blast for production of corresponding amount of pig iron (see above)	213 235	139 561	205 583	256 820	256 820
Total:	**2 960 643**	**1 939 896**	**2 857 582**	**3 569 763**	**3 569 763**

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

Equation D.1.4.-1 at page 59 in Section D.1.4 is used to estimate emission reductions as the result of project implementation. Total emission reductions in 2008-2012 are **7 500 735 tons of CO_2-eq**. Annual average emission reductions are **1 500 147 tons of CO_2-eq**.

For crediting period of 2013-2020 the emission reductions are considered to be the same as in 2011-2012.

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	1 260 837	164	2 960 643	1 699 642
2009	1 285 069	164	1 939 896	654 663
2010	1 760 122	164	2 857 582	1 097 296
2011	1 545 031	164	3 569 763	2 024 567
2012	1 545 031	164	3 569 763	2 024 567
Total (tonnes of CO_2 equivalent)	7 396 090	820	14 897 645	7 500 735

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	1 545 031	164	3 569 763	2 024 567
2014	1 545 031	164	3 569 763	2 024 567
2015	1 545 031	164	3 569 763	2 024 567
2016	1 545 031	164	3 569 763	2 024 567
2017	1 545 031	164	3 569 763	2 024 567
2018	1 545 031	164	3 569 763	2 024 567
2019	1 545 031	164	3 569 763	2 024 567
2020	1 545 031	164	3 569 763	2 024 567
Total (tonnes of CO_2 equivalent)	12 360 248	1312	28 558 104	16 196 536

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

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 prescribes 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 stages in the course of project implementation:

1. Installation of continuous casting machine (CCM) and phase-out of teeming. Installation of ladle-furnace aggregate (LFA)
2. Replacement of double-bath steelmaking units (DBSU) by electric arc furnace (EAF) and installation of additional LFA.

The first stage (commissioning of CCM and LFA) was completed in 2004. The second stage (commissioning of electric arc furnaces) was completed in 2006.

Because of two-stage project implementation process the environmental impact assessment (EIA) was also done in two stages: two separate EIAs have been performed and corresponding documents prepared:

- EIA document "Reconstruction of open-hearth furnace plant at MMK" prepared by OJSC Magnitogorsk GIPROMEZ in 2004
- EIA document "Reconstruction of open-hearth furnace process at MMK. Electric arc furnace plant complex" prepared by OJSC Magnitogorsk GIPROMEZ in 2005

These documents were submitted to State expertise prior to project implementation.

In general project implementation will result in considerable reductions of negative environmental impacts because resource-saving technologies of steel smelting and casting shall be implemented. Project implementation will bring about considerable reductions of harmful emissions.

Reconstruction of open-hearth furnace plant at MMK will have the following environmental impacts:

- Air emissions from technological equipment
- Increased consumption of industrial water, additional discharge of polluted waters into existing waste water treatment facilities
- Generation of industrial and consumption waste in the course of project implementation.

The main sources of air pollution include:

- Steel smelting facilities (LFA-1, LFA-2, two free-flowing ingredient conveyors, EAF-1, EAF-2, ladle stopper drying area, drying of teeming and intermediary ladles, welding areas).
- Terminal points of free-flowing ingredient conveyor and ferroalloy conveyor, where these materials are reloaded
- Preparation of equipment - welding tables, machining stations
- Continuous cutting department - torch cutting, secondary cooling of CCM №1, 2, 5, teeming area, two furnaces for heating of external channels, welding areas
- Oil dispenser - oil reservoirs, road tank car, water boiler

- Servicing station - welding table, welding areas, DBSU №32 (hot standby)

Sixteen air pollutants are emitted during EAF process: nitrous oxide, nitrous dioxide, carbon oxide, sulphur dioxide, ferrous oxide, potassium oxide, non-organic dust, manganese and its compounds, magnesium oxide, phosphorus oxide, chromium III, zinc oxide, aluminum oxide, elemental sulfur, nickel oxide.

In the result of project implementation, the maximum permissible ground-level concentrations (MPC) will be exceeded for the following air pollutants: nitrous dioxide, carbon oxide, the sum of nitrous dioxide and sulfur dioxide. This is explained by high background concentrations of these pollutants. Gas purification measures shall be implemented to reduce air emissions.

Project implementation will also increase noise pollution. The main sourses of noise are:

- Electric arc at LFA;
- Ventilation equipment;
- Central conditioners

Several measures are planned to reduce noise and vibrations: installation of ventilation equipment in special insulated rooms, installation of fans on antivibration mounts, installation of continuously serviced mufflers in ventilation rooms, installation of sound-proof panels on central conditioners, installation of flexible inserts on fans to reduce vibrations.

These measures will reduce noise pollution outside the plant building below the applicable environmental standard. Residential areas shall not be affected by the sources of noise pollution.

Project implementation will have impacts on surface waters. To reduce water pollution a closed-loop water supply system with chemical treatment will be implemented for cooling of CCM №1, 2 and LFA. Polluted waste waters after secondary cooling shall pass through the pumping station and be discharged into the existing wastewater treatment plant (WWTP). After WWTP, treated waters are diverted into OHFP closed-loop water supply system, and sludge is pumped to the vacuum-filtering station, where it is dried up and shipped to IMP agglomeration plant. WWTP efficiency is 99.1%.

Project implementation will be associated with changes in the volumes of generation of the following types of waste: scrubber sludge from purification of technological gas, bulk steel scrap, mercury lamps, abrasive dust, calcines and remnants of steel electrodes, waste abrasive disks, waste circuit-breaker oil, aspiration dust, mixed fiber waste, waste industrial oils and rags.

The existing environmental load in the west bank district of Magnitogorsk is quite intense. Several industrial enterprises are the sources of environmental impacts in this area: MMK, Magnitogorsk metalware and metallurgical plant, Magnitogorsk metallurgical machine-building plant, etc.

The technical solutions under the proposed project will reduce its environmental impacts and have the following effects:

- Compliance with environmental requirements, reduction of emissions of air pollutants
- Prevention of pollution of water basins above the applicable environmental standards
- Compliance with noise and vibration standards
- Prevention of pollution of territory, surface and ground waters, provided that the requirements for industrial waste storage, disposal and utilization are met.

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 №.190-FZ prescribes 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."

In the light of abovementioned requirement, environmental impact assessment (EIA) was done in two stages:

- EIA document "Reconstruction of open-hearth furnace plant at MMK", prepared by OJSC Magnitogorsk GIPROMEZ in 2004
- EIA document "Reconstruction of open-hearth furnace process at MMK. Electric arc furnace plant complex", prepared by OJSC Magnitogorsk GIPROMEZ in 2005.

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

- The decision №394 of State Environmental Expertise Authority on EIA document "Reconstruction of open-hearth furnace plant at MMK" of 05.07.2004. This decision was approved by the Order №658 of Chelyabinsk Regional Department for Environmental Resources and Environmental Protection of MNR.
- The decision №130 of State Environmental Expertise Authority on EIA document "Reconstruction of open-hearth furnace process at MMK. Electric arc furnace plant complex" of 30.05.2006. This decision was approved by the Order №303 of Chelyabinsk Regional Department for Environmental and Technological Surveillance of Rostechnadzor.

SECTION G. Stakeholders' comments

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

Federal Law on environmental protection No.7-FZ defined the procedure of participation of citizens and public organizations in the public environmental expertise.

Public stakeholders 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 "Magnitogorskij Rabochij" published an announcement about the first stage of reconstruction of MMK open-hearth furnace plant on 27.01.2004. Similar announcement about the second stage of the project was published there on 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 on 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

Table 2.1: Historical values of parameters of OHFP-BMP process at MMK (2000-2002)

Parameter	Units	2000	2001	2002	Average
Consumption of pig iron in the open-hearth furnace plant	ton	1 992 150.0	1 983 212.5	1 847 881.3	1 941 081.3
Consumption of scrap metal in the open-hearth furnace plant	ton	747 523.7	780 198.4	618 235.4	715 319.2
Smelting of steel in the open-hearth furnace plant	ton	2 412 898.0	2 427 829.0	2 166 251.0	2 335 659.3
Production of profiled steel billet in the blooming mill plant	ton	2 160 005.8	2 084 851.9	1 844 845.1	2 029 900.9
Specific consumption of natural gas in OHFP	m^3/ton of steel	26.5	20.7	22.7	23.3
Specific consumption of blast furnace gas in BMP	m^3/ton of profiled steel	276.0	277.1	248.3	267.1
Specific consumption of coke oven gas in BMP	m^3/ton of profiled steel	7.4	8.3	7.3	7.7
Annual consumption of electricity in OHFP	GW-h	16.51	16.13	16.06	16.2
Annual consumption of electricity in BMP	GW-h	85.51	86.81	79.13	83.8

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 industrial site of OJSC "MMK" and information about accounting of the electricity consumption in EAFP is provided.

Scheme of electricity supply at MMK

Electricity is supplied to OJSC "MMK" from own generating capacities (CHPP, CPP, SABPP, SP) and the external grids (OJSC "Chelyabinsk Energy", Unified Energy Systems of Urals), under the contract with Magnitogorsk Energy Company Ltd. (MEC). External grid electricity is supplied by 11 high-voltage lines 220 kV, 110 kV from Smelovskaya-500 substation, Magnitogorskaya-500 substation and Troiyskaya GRES to head-end step-down substations № 30, 60, 77, 86 and 90. Thus total electricity consumption of MMK is the sum of electricity output by own capacities and electricity purchased from MEC.

All high-voltage power lines can work two-way, including the connecting lines between MMK substations and external power plants (isolated generating plants). Electricity can be transmitted to and from MMK. All head-end substations (30, 60, 77, 86, 90) and isolated generating plants are interconnected into two 110 kV semicircles. This feature guarantees secure and stable electricity supply of MMK.

Consumption of purchased electricity at MMK and its daughter companies is calculated by the following algorithm specified in the power supply contract:

The volume of electricity purchased by MMK from MEC during each credit period (usually one month) is calculated as the difference between W1 and W2, where:

W1 is total consumption of electricity by MMK indicated by meters installed at the substations of high-voltage power lines (29 substations).

W2 is the sum of the following expenses:

- Electricity consumption by main consumers as determined by Automated system for electricity monitoring (ASKUE), this information is reported by MEC;
- Electricity consumption by consumers, which have installed meters at substations of MMK and substations rented by MEC (List №4 is reported by MMK);
- Electricity consumption by other consumers (List №5 is reported by MEC).

Electricity consumption is metered in most cases. For those industrial consumers, which do not have technical capability to install electric meters the electricity consumption is determined on the basis of installed capacity and operation time.

"Alpha A1A, A2A" lead-in meters with accuracy class 0.2; 0.5 are installed at the boundaries of energy balance ownership of 22 kV, 110 kV voltage systems.

Electricity production is metered by “PSCH-4AP” meters with accuracy class 0.5. Electricity supply is metered by “SA4U-I670” meters with accuracy class 2, “CE 680” meters with accuracy class 0.5, “SET-4TM” meters with accuracy class 0.5, “PSCH-4 AR” meters with accuracy class 2.5, “SO” meters with accuracy class 2.5, and “Mercury” meters with accuracy class 0.5.

Accounting for electricity consumption at EAFP

Accounting for electricity consumption at EAFP is conducted individually for voltages 220 kV, 110 kV, 10 kV, and 0.4 kV on daily basis (for operative analysis) and monthly. Automated monitoring is implemented on 220kV, 110 kV and 10 kV meters. Electric arc furnaces are powered by 35 kV from substation №77 (this substation is directly connected to the external grid of UES Urals). Electricity consumption by LFA-1 and LFA-2 is metered at the lead-in feeders which receive electricity from 110 kV CHPP. Electricity consumption is metered at substation №81 (CJSC “MRK”) connected to these lines.

Accounting for electricity consumption of EAFs is conducted by data of lead-in feeders meters installed at substation №77 with separation of losses in power lines and transformers and separation of electricity consumption by LFA-3 equipped with own meter.

Substations №8, 71 and 95 belong to Electricity network and substations department of MMK. Electricity consumption is metered by the meters installed at the power lines, which connect this network with EAFP excluding third party consumers.

Electricity consumption is recorded daily in the balance sheets, which are delivered to CEST on the 1st day of each month.

Table 3.1 Types of meters installed in EAFP and their accuracy class

Substation № and voltage	Voltage	Meter type	Accuracy class
50	10 kV	SA3U-I670M; D CA4U-I672M MA4U-I672 CO-2	2.0 2.5
8	10 kV	CET4t-02-2м CA3U-I670D; I672 CO-1; CO-2; 2M; Co-I446	0.5 2.0 2.5
95	10 kV	CE 680B CA3U-I670D; CA4U-510; CA4U-I672M	0.5 2.0
CHPP	110 kV	PSCH-4AP.05.2; CET-4TM.03.1	0.5
51	10 kV	CE 6805B; PSCH-4AP.05.2 CA4U-510; CA3U-I670M;	0.5 2.0
71	10 kV	CA3U-I670M; CA4U-I672	2.0
4-b	10 kV	CE 6805B; CE 6805	0.5
4-d	10 kV	CE 6805B CA 4U-I672M	0.5 2.0
PS 4-a	10 kV	CE 6805B; PSCH-4AP.05.2	0.5
77	**35 kV**	**LFA № 3**	

		CE 6805B; PSCH-4TM.05	0.5
		EAF-180	
		CE 6805B; PSCH-4TM.05	0.5

Annex 4

CO_2 EMISSION FACTORS FOR GRID ELECTRICITY

Emission factors (EFs) for grid electricity generation by Ural Regional Energy system of the Russian Federation were developed under the “Guidelines for calculation of emission factors for energy systems” (EB-35, October 2007) by Carbon Investments Ltd. Co., Moscow (contact person is Mikhail Rogankov). This work was commissioned by Carbon Trade & Finance SICAR S.A. These EFs should be used by JI project initiators and independent organizations involved in preparation of PDD for JI projects. The same EFs will be used in PIN documents, in research and development activities, and for other purposes.

The EFs study has been a subject for verification performed by Bureau Veritas Certification Holding SAS in October-November 2008. The official approval for the EFs used in this PDD was received by 10.11.2008. We give beneath the extracts from the study.

The application of the coefficient 0.541 kg CO_2/MWh is conservative because this is higher than widely used ERUPT coefficient (0.504 kg CO_2/MWh in 2008, which is lowering up to 2012). Moreover the electric arc furnaces of OJSC “MMK” that are the direct user of grid electricity were started in mid 2006. Thus the generation of electricity for these furnaces is counted for half of 2006 and whole 2007 in the operating margin of the UES Urals grid.

CO_2 emission factors were estimated for the situations when grid electricity is substituted by electricity generated at the existing power stations (“operating margin” - OM), by newly constructed plants (“built margin” - BM) or their combination (“combined margin” - CM). These three categories refer to the power plants, which may be influenced by the JI project.

The following sources of information were used to calculate EF_{OM}:
- Official information of Federal Statistical Service (Rosstat),
- Information published by Russian Open Joint-Stock Company “Integrated Power Systems of Russia” (RES),
- Information published by OJSC “System Operator of RES”,
- Data of regional energy dispatching departments,
- Data of energy companies reported in annual statistical reports No.6-TP.

The following sources of information were used to calculate EF_{BM}:
- Official annual reports of RES and regional energy companies which listed recently commissioned power plants,
- “General scheme of location of power plants until 2020”, approved by the Government of the Russian Federation (Decision No. 215 of 22.02.2008),
- Investment programs of regional energy companies.

The electric power industry of Russian Federation comprises 319 thermal power plants (TPPs), 61 hydro power stations (HPSs) and 9 nuclear power stations (NPSs) (data of 2006 from JSC UES of Russia) related to the «electric power sector» and some block-units being shops of industrial enterprises (mainly, of metallurgical plants) and some municipal electric power stations. The capacity of municipal power plants constitutes an insignificant part in the power balance of the country. The power stations are unified by transmission lines in 60 provincial electricity systems (PESs), while these systems have in its turn the electric connections with the neighbor ones (excluding some isolated provincial systems). Provincial electricity systems (PESs) are unified in 7 regional systems (RESs), which have the connections between themselves through backbone and interconnection networks. All together these power plants, transmission lines, distribution networks and power systems constitute the national energy system (UES of Russia).

Thermal and hydro plants of electric power industry appertain to 6 generating companies of the wholesale electricity market (OGCs), 14 territorial generating companies (TGCs), JSC “Irkutskenergo”, JSC “Novosibirskenergo”, “JSC “Tatenergo”, JSC “Bashkirenergo”, provincial power companies of isolated territories, hydrogenerating OGC (JSC “RusHydro”), nuclear plants belong to the State concern «RosEnergoAtom». The backbone (main) networks are in the maintenance of JSC «Federal Network Company of UES», distribution networks in the maintenance of more than 50 distributional companies.

For decades the national Unified Energy System is functioning as a centralized, 3 level dispatched system “from top to the bottom” and strict discipline of all of the participants to provide reliable, safe and optimal power supply in the country. Along with this “command” system wholesale power market which was launched in Russia several years ago is functioning. The structure of UES and subordination of its component entities are presented in Figure 3-1.

Figure 3-1. Structure of UES and dispatch management.

UES The dispatch management is carried out by JSC “SO UES”						
RES of Center	RES of North-West	RES of Mid- Volga	RES of South	RES of the Urals	RES of Siberia	RES of East
The dispatch management is carried out by the corresponding branch of JSC “SO UES” (SO ODU)						
16 PESs	7 PESs	8 PESs	6 PESs	8 PESs	8 PESs	3 PESs + 4 isolated ones
The dispatch management is carried out by the corresponding branch of JSC “SO UES” (SO RDU)						

JSC «System Operator of Unified Energy System» (JSC «SO UES») was launched in June 2002 (as the successor of the former Central Dispatch Operator of UES acting as a department of JSC “UES of Russia”). It is the superior body of operative-dispatching management in electric power industry. JSC «SO UES» was first created as 100%-affilated company of JSC "UES of Russia". 64 branches (7 branches – SO ODU and 57 branches – SO RDU) are functioning as a part of JSC “SO UES”. From July 2008 JSC «SO UES» is transformed in 100%-state company (owned by the Government of Russia).

JSC «SO UES» is continuously forming operational tasks and regimes of RESs and some large-scale power plants of federal significance and define optimal power transmission between RESs. “SO ODU” branches provide fulfillment of those tasks on a regional level and form tasks, regimes of PESs and transmission between them. “SO RDU” branches fulfill those tasks and dispatch the loads of related power plants.

Such a structure of power systems in Russia and regimes of their operation as referred to the choice of the project electricity system which must meet the condition of being dispatched “without significant transmission constraints” mean the following. Large and mid-scale JI project activity will physically cause changes in transmission, especially in small and mid-scale provincial power systems though these impulses may be smoothed down by the dispatch general policy and decisions. But obviously the larger the system is the lower the probability of constraints (e.g. for RESs the probability of transmission constraints from even large-scale JI projects activity will be minimal while for small and mid-scale PESs for each JI project this must be the subject of discussions with the corresponding system operator).

RESs “Center”, “North-West”, “South”, “Siberia” and “East” coincide with the Federal districts of the Russian Federation (okrugs). 4 PESs “Udmurt”, “Perm”, “Kirov” and “Orenburg” are referred to RES

"Urals" while the 4 corresponding subjects of Russia are component parts of the Volga Federal District. As for the PESs they coincide with the corresponding subjects of the Russian Federation; some of them with one or two provinces of the Russian Federation.

PESs vary a great deal by their capacities, lack or redundancy of capacities, import/export rates, shares of thermal, hydro and nuclear capacities, fuel mix, degree of interrelations. For instance, PES "Kurgan" (in the Urals) comprises only one TPP 480 MW, some transmission lines and distribution network while in Moscow PES the capacity of power plants constitutes 15 560 MW. Thus developing EFs for PESs will need taking into consideration peculiarities of each system while RESs are more or less universal for this task.

United energy system of Urals (RES Urals) includes Yamalo-Nenetsky Autonomous District, Sverdlov, Chelyabinsk, Perm, Orenburg, Tumen, Kirov and Kurgan regions, Udmurtia and Bashkortostan. RES Urals has more than 106,000 km of power lines (about ¼ of Russian high-voltage power lines), with voltages 500 – 110 kV. This grid unites 111 power plants, with total installed capacity over 42,000 MW, or 21% of total installed capacity of the Russian Federation. Annual electricity generation is over 210 billion kWh, or 25% of total electricity generation in the Russian Federation. About 55% of this electricity is consumed by industrial consumers, which is 30% of electricity consumption by industrial consumers in the Russian Federation. RES Urals is situated in the center of the country, between RES of Siberia, Central European Part, Middle Volga and Kazakhstan.

The following equation was used to calculate the operating margin (OM) emission factor:

$EF_{grid,OMsimple,y} = b_{weight,\ y} \times EF_{CO2,weight}$ (4.1.)

where
$EF_{grid,OMsimple,y}$ - simple emission factor EF_{OM} in the year ***y*** (tons of CO_2 per MWh)
$b_{weight,\ y}$ – unit consumption of fuel per 1 kWh of net electricity generation, averaged for the whole RES (t.c.e. per MWh);
$EF_{CO2,weight}$ – weighted average emission factor for the fuel mix (tons of CO_2 per t.c.e.).

It should be noted that in Russian Federation historically for measurement of thermal energy produced or consumed the non SI values are used, i.e. tonne of equivalent fuel (1 t.c.e*0.0293076=1 TJ). Every Russian power plant is legally obliged to submit production information (6-TP report form) to Federal Statistical Service (Rosstat) which is then aggregate each individual report to unit consumption of fuel per 1 kWh of net electricity generation, averaged for the whole RES. The same aggregation for scale of RES is done for consumed fuel share in the mix and electricity generation. Thus, to avoid extensive work the developer decided to use aggregated data which already includes info about each power plant.

The data for calculation of $EF_{grid,OMsimple,y}$ were taken from Rosstat reports. The regional shares of various fuels ***a*** were calculated using the regional-level fuel consumption data (reported by Rosstat in t.c.e).
Table 4.1. IPCC default emission factors for stationary combustion in the energy industries

Fuel	Default emission factor in tCO_2/TJ	Default emission factor in tCO_2/t c.e. (converted from tCO_2/TJ)
Sub-bituminous coal	96.1	2.775
Lignite (brown coal)	101.0	2.962
Residual fuel oil (mazut)	77.4	2.270
Natural gas	56.1	1.645

Source: 2006 IPCC Guidelines for National GHG Inventories

Table 4.2 The results of calculation of EF_{OM}

RES Urals			
$b_{.weight}$ (t c.e./MWh)	0.3414	0.3325	0.3226
$EF_{CO2,average}$ (tCO_2/t c.e.)	1.8732	1.9387	1.880
$EF_{grid,OMsimple,y}$ (tCO_2/MWh)	0.6395	0.6446	0.6064
Net generation by TPPs (thous. MWh)	124564.2	149426.2	138016.6
3 years average electricity weighted EF_{OM} (tCO_2/MWh)	**0.630**		

Then we identified the set of new power plants to be included in "BM" category.

The main principle stated by the Tool is that the cohort should reasonably "reflect the power plants that would likely be built in the absence of the project activity" (*quoted from the Tool*) which means that the BM capacity is a virtual one (though the most probable) and the cohort is assembled just to determine the parameters of such a capacity to calculate GHG emissions.

The sample group of power units used to calculate the BM consists of either:

(a) The set of 5 power units that have been built most recently (in 10 years period), or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Capacity additions from retrofits of power plants should not be included in the calculations of $EF_{grid,BM,y}$. In case it is impossible to fulfill conditions (a) and (b) the Tool recommends to increase the 10 year period for the new capacities so that 5 new plants (a) or 20% additions (b) are available.
In terms of vintage of data, projects participants can choose between one of the following 2 options:
Option 1.
For the first crediting period, calculate the BM emission factor ex-ante based on the most recent information on units already built for the sample group ***m*** at the time of PDD submission for determination. This option does not require monitoring of the EF.
Option 2.
For the first crediting period, the BM emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if this information is not available, including those units built up to the latest year for which information is available.

Power plants with higher capacities should be included in the cohort of 5 plants/units.

The Tool states that if this approach does not reasonably reflect the power plants that would likely be built in the absence of the project activity, project participants are encouraged to propose an alternative.

From mid '90s Russia was recovering after a long and deep economic crisis, construction of new power capacities were very rare and in some RESs one or two new capacities are lacking for the cohort of 5 plants. In this case we increased the 10 years period to 15 years as recommended by the Tool. If this didn't work we had to include a new plant(s)/unit(s) which are under construction.

Table 4.3. RES Urals. Power plants/units commissioned from 1993

Power plant/unit	Year of commissioning	Capacity, MW	Technology	Fuel
Commissioned in 1996-2008				
Nizhne-Vartovsk TPP, unit # 2	2003	800	New steam unit	Gas

Nizhne-Vartovsk TPP, unit # 1	1993	800	New steam unit	Gas
Tchaikovsky CHP	2007	50	Additional steam turbine	Gas
Kizelovsk TPP-3	2005	26	Additional steam turbine	Coal/ gas
Kizelovsk TPP-3	2006	26	Additional steam turbine	Coal/ gas
Berezniky CHP-2	2005	30	Additional steam turbine	Coal/ gas
Berezniky CHP-2	2003	12	Additional steam turbine	Coal/ gas
Tumen CHP-1	2003	190	CC GT	Gas
Cheliabinsk CHP-3 (unit No.2)	2006	180	New steam unit	Gas
Cheliabinsk CHP-3 (unit No.1)	1996	180	New steam unit	Gas
Total		Less than 20% of RES's capacity		

Small-scale (12-30 MW) steam turbines that have been commissioned at Tchaikovsky CHP, Kizelovsky and Bereznikovsky CHP plants can't be related to the "new" capacities, because these projects are either direct or delayed substitution of obsolete turbines, while capacity additions from retrofits are not recommended by the Tool for calculating the build margin EF. They are not included in the group of 5 units. The cohort of 5 plants comprises:

- 2 x 800 MW steam unit
- 190 MW CC GT unit that has been commissioned;
- 2 steam units by 180 MW

The BM emission factor is the generated-weighted average emission factor of all power units ***m*** during the year y calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_5 EG_y} \qquad (6)$$

Where:
$EF_{grid,BM,y}$ = BM emission factor in year ***y*** (tCO_2/MWh)
$EG_{m,y}$ = net quantity of electricity generated and delivered to the grid by power unit ***m*** in year ***y***
$\sum_5 EG_y$ = net quantity of electricity generated and delivered to the grid by the cohort of 5 units in year ***y***
$EF_{EL,m,y}$ = CO_2 emission factor of power unit ***m*** in year ***y*** (tCO_2/MWh)
m = power units included in the BM
y = year for which power generation data is available.

The method of calculation of $EF_{EL,m,y}$ here is the same as for EF_{OM} described under Step 3, i.e. by using specific fuel consumption per 1 kWh of energy output b_m (kg c.e./kWh).

$$EF_{EL,m,y} = EF_{CO2fuel} \times b_{m,y}$$

Where

$EF_{CO2fuel}$ – fuel emission factor (fuel type weighted) in tCO_2/MJ or tCO_2/t c.e; the IPCC factors for main types of fuel values are presented in Table 4-4.
b_m – specific fuel consumption by unit ***m*** (MJ/MWh or t c.e./MWh)

b_m is accepted according either to the operational reports, or from the projects' designs or from the standards established by the "Concept of Technical Policy of JSC UES" (2005) for new equipment.

The results of EF_{BM} calculation for RESs are presented in Table 4-16.

Table 4.4. Calculation of $EF_{grid,BM}$ for RES "Urals"

Description	Natural gas-fired 800 MW steam unit*	Natural gas-fired 800 MW steam unit*	Natural gas-fired CC GT 190 MW unit **	Natural gas-fired steam unit 180 MW **	Natural gas-fired steam unit 180 MW**
Electric capacity, MW	800	800	190	180	180
Capacity utilization, %***			52	52	52
Annual net generation of electricity, MWh	5817000	5817000	865488	819936	819936
Specific fuel consumption, b_m (kg c.e./kWh)	0.3045	0.3045	0.2399	0.330	0.330
The same in MJ/MWh	$8.931x\ 10^3$	$8.931x\ 10^3$	$7.0363x10^3$	$9.679\ x\ 10^3$	$9.679x10^3$
Fuel	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Fuel emission factor, $EF_{CO2fuel}$ (tCO_2/MJ)	$0.0561.10^{-3}$	$0.0561.10^{-3}$	$0.0561.10^{-3}$	$0.0561.10^{-3}$	$0.0561.10^{-3}$
Results of calculations					
$EF_{EL,m,}$ (tCO_2/MWh)	0.501	0.501	0.3947	0.5430	0.5430
Average weighted EF_{gridBM}, tCO_2/MWh	**0.501**				

* based on the reported data of operational Nijne-Vartovsk TPP with 2 x 800 MW units
** based on the reported data of analogs
*** assumed based on the 2007 figure from Rosstat of 52 % for TPPs; for high capacity and TPPs of condensed type assumed as 60 %

The $EF_{grid,CM,y}$ is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM},$$

Where:

$EF_{grid,OM,y}$ – OM emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$ - BM emission factor in year *y* (tCO_2/MWh)
w_{OM} – weighting of OM emission factor (equals 0.5 for the first crediting period as recommended by the Tool);
w_{BM} - weighting of OM emission factor.

Table 4.5. Final EF_{CM} values for the case of increase of power delivery to the grid or/and increase of electricity consumption from the grid.

Regional power system	Amendment of EF_{CM} (taking	EF_{CM}

	into account uncertainty)	**(tCO_2/MWh)**
"Urals"	0.566 - 4.4%	0.541

Annex 5

LIST OF ABBREVIATIONS

BFG	Blast-furnace gas
BFP	Blast-furnace plant
BMP	Blooming mill plant
BOFP	Basic oxygen furnace plant
BPCP	By-product coke plant
CCM	Continuous casting machine
CEST	Center for Energy Saving Technologies
CHPP	Combined heat power plant
CL	Central lab
COG	Coke oven gas
CPP	Central power plant
DBSU	Double-bath steelmaking unit
EAF	Electric arc furnace
EAFP	Electric arc-furnace plant
EF	Emission factor
EIA	Environmental impact assessment
ERU	Emission reduction unit
ET	Emission trading
FC	Frequency converter
GDS	Gas distributing station
GHG	Greenhouse gas
IMP and LDW	Integrated mining-and-processing, limestone and dolomite works
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
KP	The Kyoto Protocol
LFA	Ladle-furnace aggregate
MEC	Magnitogorsk Energy Company
MED	Ministry of Economic Development
MMK	Magnitogorsk iron and steel works
MNR	Ministry of Natural Resources
MPC	Maximum permissible concentration
MPE	Maximum permissible emissions
OHFP	Open-hearth furnace plant
SABPP	Steam-air blowing power plant
SP	Steam plant
SRA	Steel refining aggregate
TEE	Turbine expansion engine
WWTP	Waste water treatment plant

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

Annex 6

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. Here is a translation.

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 agglomeration 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 ("BZU") 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.

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