| JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM<br>Version 01 - in effect as of: 15 June 2006 |
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| SECTION A. General description of the project |
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| A.1. Title of the project: |
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Production of continuously casted slab steel billet by arc-furnace technique at OJSC MMK

Sectoral Scope: 9 (Metal Production)

Version: 1.2

February 1, 2011

| A.2. Description of the project: |
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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.

The aim of the proposed project is to reduce overall environmental impact including $CO_2$ emissions as a result of implementation of new resource-saving technology of slab steel billet production at OJSC MMK which is performed by arc-furnace technique with further continuous casting.

**Situation existed before project realization**

Before project implementation the slab steel billet has not been produced by arc-furnace technique at OJSC MMK. Historically the production of slab steel grades was assigned to oxygen-converter plant (OCP) of MMK started in 1990-1999 and equipped with five continuous casting machines (CCM). Section steel grades were produced at open-hearth furnace plant.

**Project scenario**

In 2005-2006 MMK has realized a large project of steel smelting facilities reconstruction. In 2006 the new electric arc furnace plant (EAFP) replaced open-hearth furnace plant that was revamped. The EAFP 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, ladle furnace steel processing aggregates, one slab 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. Thereby EAFP produces both section and slab steel billet.

The project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works" was arranged as Joint Implementation project[1] and passed a determination and verification by Bureau Veritas, however in the project boundary the only section steel billet production was included as previously this function was performed by open-hearth furnace plant and blooming mill plant, i.e. steel billet was made at the own industrial site area.

The proposed project takes into account the greenhouse gas emissions associated with production of slab steel billet in EAFP of MMK.

Double-strand slab CCM #5 was commissioned in July 2006 together with other facilities of electric arc furnace plant complex. The contract for CCM delivery was signed in August 2004 with "Uralmash Machine-Building Corporation" company.

**Baseline scenario**

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[1] http://ji.unfccc.int/JI_Projects/DB/3YOHME3FSIKG8602M8WN9D60QNIQT7/PublicPDD/YAGHLX0KYONQ CEVWW7EHHU3EW75Z32/view.html

In the absence of the proposed JI project the production of slab steel billet would be carried out at the existing metallurgical plants of Russia (including the oxygen-converter shop of MMK) or newly introduced capacities (during the crediting period). Output of slab steel billet in EAFP of MMK is limited by the technical capacity of the slab CCM #5 - 2 million tons of steel billet annually. Output of slab steel billet is equivalent in the project and in the baseline.

Various metallurgical enterprises of the Russian Federation use different production technologies: at the beginning of 2010 the most common method of steelmaking - smelting in oxygen converters, the share of this technology accounted for 67% of the total smelting, steel melted in electric arc steel furnaces is 25% and 8% is steel produced by different versions of the open-hearth process: the pig-and-ore process, the scrap process and the production in double-bath steelmaking units. $CO_2$ emissions from production of one ton of steel by steel mills of Russia exceeds $CO_2$ emissions from production of one ton of steel billet in EAFP of MMK[2], because open-hearth and oxygen-converter method of production are more resource-and carbon intensive in comparison with the arc-furnace process due to use of mostly pig iron as a raw material (except open-hearth scrap process).

Actually before the ratification of the Kyoto Protocol by the Russian Federation in 2004 OJSC "MMK" had seriously considered the possibility to raise income via sale of emission reduction units (ERUs) to be generated by the given JI project (Annex 7). For this purpose a top-management of MMK established a JI project implementation working group, which was meeting on monthly basis, identifying potential project scenarios and estimating the expected emission reductions. This working group actively communicated with governmental authorities: Ministry of Economic Development of the Russian Federation (MED), Ministry of Natural Resources (MNR), State Duma. Various pertinent issues were discussed: clarification of the provisions of the KP with regard to the proposed project, GHG emission inventory, JI project registration procedures. As a result of project implementation, total emission reductions in 2008-2012 were estimated as 1,842,992 tons of $CO_2$-eq.

| A.3. | **Project participants:** |
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Table 3.1. Project participants

| Party involved | Legal entity project participant (as applicable) | Please indicate if the Party involved wishes to be |
|---|---|---|
| | | |

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[2] Technological cycle of production of any metallurgical works includes production of steel billet, as a commodity that can be stored and transported. Steel billet is further used in rolled metal shops at the same metallurgical works or transferred to other works for further processing, but as a rule – both together. The conversion of the liquid steel into steel billet is performed in two ways:

1. through the continuous casting at CCM
2. liquid steel is casted first into the moulds with further recovery and heating of ingots, and their treatment into a standard billet at the blooming-slabbing mill.

Both operations lead to metal losses, in the first case they are insignificant, in second - losses reach 10 percent or more (formation of clipping during the extraction of the ingots, metal loss during heating before the blooming slabbing mill, etc.)

A number of metallurgical works involved in the calculation of baseline emissions cast all or part of the steel by the second method, and therefore spend more resources and fuel for the steel billet production, however this is not included in the calculation of baseline emissions in the PDD.

Therefore as the specific $CO_2$ emission per tonne of the steel (baseline) is lower than specific $CO_2$ emission per tonne of the steel billet (project) the equalization of the steel and steel billet is acceptable and conservative.

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

**OJSC "Magnitogorsk iron and steel works (MMK)"** is the largest steelmaking enterprise in the Russian Federation. Its share in the sales of metal production on domestic market is about 20%. This company is a large full cycle metallurgy plant, which begins with preparation of iron ore raw materials and ends up with advanced processing of ferrous metals. This company currently produces the largest mix of metal products among all ironworks of the Russian Federation and CIS countries. Considerable part of its products is exported to different countries.[3]

In 2009 OJSC "MMK" smelted 9,618,000 tons of steel and produced 8,764,000 tons of hot rolled metal.

The record output of commercial production, reached in 2007 was 12,200,000 tons. The reduction in output was caused by overall recession in Russian metallurgy sector as the result of economic crisis.

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

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

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

| **A.4.    Technical description of the <u>project</u>:** |

| **A.4.1.   Location of the <u>project</u>:** |

Urals Federal District, Chelyabinsk Region, Magnitogorsk city.

| **A.4.1.1.   <u>Host Party(ies)</u>:** |

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.

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

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

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



Chelyabinsk Region

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

Magnitogorsk city. Industrial site of OJSC "MMK". Latitude: $53^0\,26^/\,35.65^{//}$ Longitude: $59^0\,05^/\,19.93^{//}$ (resource of the geographical coordinates – Google Earth)[4].

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

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

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

The city occupies the territory of 376 km$^2$, it stretches by 27 km in north-south direction and by 20 km in east-west direction. The absolute elevation is 310 m above sea level. The population of Magnitogorsk is 409,400 inhabitants (2009).[5] MMK is located on the left bank of river Ural, and occupies a large plot of land. Legal address of the company is: Chelyabinsk Region, Magnitogorsk, Kirova Street, 93.

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

The considered Joint Implementation project proposes additional output of 2 million tones of slab steel billet produced at OJSC MMK with most efficient technology – by arc-furnace technique with further continuous casting.

The contract for slab CCM # 5 delivery was signed with company "Uralmash Machine-Building Corporation". The contract for delivery of two section CCMs #1 and #2 was signed with Austrian

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[4] http://www.google.com/intl/ru/earth/index.html

company "VAI". The contract for delivery of two electric arc furnaces was signed with Austrian company "Voest-Alpine AG".

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

| Year | Operating capacities, phase-out and commissioning dates | Total output of steel by open-hearth/electric arc furnace plant, thousand tons[6] |
|---|---|---|
| 2003 | Two DBSUs and three classic open hearth furnaces were in operation | 1,972.0 |
| 2004 | Demounting : three classic open hearth furnaces<br>Commissioning: LFA #1, two section CCMs #1, 2<br>In operation: two DBSUs | 1,461.1 |
| 2005 | Demounting: one DBSU, chemicals preparation plant, blooming mill plant (BMP)<br>In operation: DBSU #32, LFA #1, section CCMs #1, 2 | 1,318.9 |
| **2006** | Commissioning: **two electric arc furnaces (EAF) #1, 2, LFA #2 (reconstruction of SRA #1), one slab CCM #5**<br>In operation: DBSU #32, LFA #1, section CCMs #1, 2 | 2206.3, including 1048.9 by DBSU |
| 2008 | Commissioning: LFA #3<br>In operation: EAF #1, 2, DBSU #32,  slab CCM #5, section CCMs #1, 2, LFA #1, LFA #2 | 3,118.2, including 308.0 by DBSU.<br>From that amount:<br>1,673.0 of profiled steel.<br>1,445.3 of slab steel |

At this time, MMK has installed in complex 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 each. 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 slab CCM #5;

- Section continuous casting machines №1, 2;

- Slab CCM №5.

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.

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

Unlike open-hearth furnaces and oxygen steel-making converters, 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. 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.

The ability to produce slab steel billet has arisen due to the installation of heavy-duty EAF-180, and decision on the choice of the type and capacity of electric arc furnace was taken in the spring of 2004, a year after the start of the reconstruction of open-hearth furnace plant.

The introduction of electric arc furnace steel smelting technology leads to an increase in electricity consumption that is taken into account when calculating $CO_2$ emissions from the production of steel billet in EAF MMK.

Through the project there was introduced a modern and efficient technology of smelting and casting of slab steel.

> **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:**

Smelting of slab steel by arc-furnace technique followed by casting at continuous casting machine to date in Russia is most advanced technology that promote resource saving, which is achieved by a large percentage of steel scrap in the charge of smelting furnaces in comparison with other methods of steel production (see Table. A.4.3-1). In the converter and pig-and-ore open-hearth steel production technique the pig iron, which production is associated with significant emissions of $CO_2$, prevails in furnace charge. Scrap open-hearth process uses scrap metal as a main raw material but for furnace heating the significant amount of natural gas is used and therefore this process is more resource and carbon intensive.

Table A.4.3-1. Share of pig iron and scrap metal in the furnace charge for different steel production techniques in Russia [7]

| № | Steel production technique | Pig iron | Metal scrap |
|---|---|---|---|
| 1. | Electric arc-furnace | 37% | 62% |
| 2. | Oxygen-converter | 75% | 24% |
| 3. | Open-hearth furnace: | | |
| 3.1. | Double-bath steelmaking unit | 76% | 22% |
| 3.2. | Pig-and-ore process* | 73% | 25% |
| 3.3. | Scrap process* | 23% | 75% |

*For pig-and-ore process and scrap process the significant volumes of natural gas are used and as well as mazut on some plants.

Therefore project implementation reduces $CO_2$ emissions associated with production of the slab steel billet by the Russian metallurgical industry because specific $CO_2$ emission factor for steel billet produced in EAFP of MMK is lesser than the integrated $CO_2$ emission factor for steel production at the Russian metallurgical works that produce slab steel billet and accordingly smelt steel for that.

Thereby as a commodity with a practically unlimited distribution area the steel (and products further made of that) smelted in EAFP of MMK would contribute to displacing of the steel smelted in Russia by more carbon intensive technologies. This is especially actual in the conditions of the thin market after collapse of the demand on the back of global economic crisis at the end of 2008. Production of steel billets from liquid steel is accompanied by additional emissions that are conservatively not taken into account under calculation of baseline emissions. So the comparison of $CO_2$ emissions from production of one ton of steel by Russian metallurgical works and one ton of slab steel billet produced in the EAFP of MMK is correct.

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.

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[7] Data from quarterly report "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC for I quarter 2010.

As a result of project implementation, total emission reductions in 2008-2012 were estimated as 1,842,992 tons of $CO_2$-eq.

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

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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 | 465 214 |
| 2009 | 0 |
| 2010 | 189 483 |
| 2011 | 500 297 |
| 2012 | 687 999 |
| Total estimated emission reductions over the crediting period (tonnes of $CO_2$ equivalent) | 1 842 992 |
| Annual average of estimated emission reductions over the crediting period (tonnes of $CO_2$ equivalent) | 368 598 |

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 | 687 999 |
| 2014 | 687 999 |
| 2015 | 687 999 |
| 2016 | 687 999 |
| 2017 | 687 999 |
| 2018 | 687 999 |
| 2019 | 687 999 |
| 2020 | 687 999 |
| Total estimated emission reductions over the crediting period (tonnes of $CO_2$ equivalent) | 5 503 990 |
| Annual average of estimated emission reductions over the crediting period (tonnes of $CO_2$ equivalent) | 687 999 |

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**A.5. Project approval by the Parties involved:**

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

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## SECTION B.   Baseline

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

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

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

Project developer uses JI specific approach for description and justification of the selected baseline. This is based on the requirements of Paragraph 9(a) of JI Guidance on criteria for baseline setting and monitoring, Version 02.

*A baseline was identified by listing and describing plausible future scenarios on the basis of conservative assumptions and selecting the most plausible one.*

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

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

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

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

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

- Sectoral reform policies and legislation in steel industry.

Ministry of Industry of the Russian Federation set the following goals of development of steel industry: "to meet the growing demand of the domestic, CIS (Commonwealth of Independent States) and international markets for steel products; to meet the requirements of metal-processing industries in terms of quality and quantity in the whole range of metal products; to accelerate innovative development and modernization of steel industry, to increase its economic efficiency, environmental safety, energy-savings and resource-savings, competitiveness, import substitution and raw material security"[8].

This project is in line with the mentioned goals however they do not impose any obligations for the company owner of the metallurgical plant.

- Economic situation in Russian steel industry and predicted demand.

According to the Strategy of development of the metallurgical industry of Russia until 2020 approved by Order of Ministry of Industry and Trade of Russia by March 18, 2009 № 150:

In the period 2009-2010 the domestic demand will decline. Revival of demand from the major steel consuming sectors and the beginning of disaffiliation with crisis is not expected to happen before 2010, according to the prediction. The restoration of capacity of the domestic market to the pre-crisis level (basic) in 2007 will occur in 2012-2014[9].

- Technological aspects of slab steel billets production.

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[8] http://www.minpromtorg.gov.ru/ministry/strategic/sectoral/2

[9] http://www.minpromtorg.gov.ru/ministry/strategic/sectoral/2

Technological aspects of slab steel billets production are described in Section A.4.2. Also there are technical parameters of main technological equipment. The description of the equipment used for the production of slab steel at the major Russian metallurgical works is presented below in Section B.1.

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

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

- Local availability of technology/techniques and equipment.

A producer of EAF-180 Voest-Alpine AG has been working in Russian market since 1999[10]. This is a reliable business partner with excellent credentials.

The company-supplier of slab CCM #5 is "Uralmash Machine-Building Corporation" that is the leading heavy machine building company in Russia, manufacturing equipment for metallurgy, mining, oil and gas industry, etc. The corporation's customers include many major corporations: Metalloinvest, EvrazHolding, MMK, Severstal, UMMC, Norilsk Nickel, Eurocement-group, Arcelor Mittal, Visakhapatnam Steel Plant, Severny GOK, Kazhrom and other companies from the CIS, China. India, Pakistan, Bulgaria, Romania, etc[11]. URALMASH machine-building corporation features complete production cycle, including engineering departments and metallurgical, welding, machine assembly and toolmaker shops[12].

Technological processes of steel production in open-hearth furnace, electric arc furnace and converter are very well known and used at the metallurgical works of Russia.

- Price and availability of fuel.

By implementing of the project the slab steel billet is produced by more resource-saving technology than the existing methods of production in the Russian metallurgical plants, which allows to use less fuel but increases the electricity consumption. For the production of slab steel billets natural gas, electricity and coke is used at the metallurgical works. All fuels are produced in Russia and available to metallurgical works.

**Step 2. Application of the approach chosen**

Selection of likely baseline scenario is based on an assessment of the alternatives for production of the additional volume of slab steel billet, which could potentially take place. Such options include the following alternatives:

1. Production of slab steel billet at the existing metallurgical works or newly introduced capacities (during the crediting period) in Russia other than EAFP of MMK;

2. Reconstruction of the open-hearth plant of MMK into EAFP and production of continuously casted slab steel billet in it (project without registration as JI).

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

*Elimination of unlikely alternatives (either technically or economically)*

**1. Production of slab steel billet at the existing metallurgical works or newly introduced capacities (during the crediting period) in Russia other than EAFP of MMK**

For identification of the baseline scenario we used data from annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron

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

[11] http://www.uralmash.ru/rus/about/information/about.htm

[12] http://www.uralmash.ru/rus/about/enterprise/uralmash-engineering/uralmash-mo/uralmash-mo.htm

at ferrous metallurgy works", "Corporation CHERMET", LLC (See Annex 2 for full list of the metallurgical enterprises and information on them). All metallurgical enterprises that participate in the study produce slab steel billet. The annual reports "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC of 2008-2009 and the 1-st quarter report of 2010 will be provided to AIE on request during the determination process.

Of the 16 plants (see Annex 2) five are located in the Ural Federal District: OJSC «MMK», OJSC «NTMK», OJSC "Ural Steel", OJSC "ChMK", «Metzavod Kamasteel», LLC. Four of them, i.e. excluding «Metzavod Kamasteel», LLC are steel giants with annual output more than 3 million tones.

Location of Russian enterprises of ferrous metallurgy depends primarily on the proximity to iron ore and other minerals fields. Thus for example steel mills that produce pig iron and steel are situated in areas where there are deposits of iron ore and also taking into account the security of electricity, natural gas and water. Ural metallurgical base is part of the three major resource bases along with Central and Siberian metallurgical base[13].

Slab steel billet produced by metallurgical plants is used to manufacture hot-rolled flat-rolled coils and sheets[14]. World consumption of rolled metal in 2006 increased compared with 2005 by 7.6%. Consumption of metal in the Russian market grew by 13% to about 33 million tons in 2006. The most intensively developing industries consuming slab steel billet as raw material are: the pipe industry, machinery, construction industry and manufacturing.

Therefore regardless of the location of the plant, manufactured products are supplied both into domestic and foreign market respectively which is due to developed infrastructure of rail and marine transport. As examples are: Cherepovets Steel Mill, which supplies its products to the Volga Pipe Plant, the Chelyabinsk Pipe Rolling Plant, AvtoVAZ, UAZ, GAZ. Evraz Group SA is a major supplier of slabs in the world market, the company "Mechel" sells its products in more than 30 regions of Russia.

Described above confirms that as a relevant geographic area for alternative scenario of the project activity all the Russian Federation can be used, not just the Chelyabinsk region where MMK is located or Ural Federal District.

The major share of the steel output in Russia is occupied by 7 integrated steelworks according to the statistical data of "Corporation CHERMET", LLC:

1. OJSC "Cherepovets Steel Mill" as part of OJSC "Severstal"

2. OJSC "MMK" (oxygen-converter shop);

3. OJSC "Novolipetsk Steel";

4. OJSC "West Siberian Iron and Steel Plant";

5. OJSC "Nizhny Tagil Iron and Steel Plant";

6. OJSC "Chelyabinsk Metallurgical Plant"

7. OJSC "Ural Steel".

Let us consider plans (**in the historical context**) for production of steel that existed at Russian metallurgical works producing slab billet during the implementation of EAFP project at MMK, and actual output at different periods in order to understand how likely the additional production there of 2 million tonnes of slab steel.

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[13] http://www.metaprom.ru/pub501.html

[14] Annual report of OJSC "MMK" for 2006.

It is important to understand that part of the plans were not realized or delayed due to strong impact of global economic recession started in 2008. Its influence is expected to be perceived until 2014[15]. The main directions of development of Russian metallurgical industry were increase of the share of continuously casted steel, development of the oxygen-convertor technique of steel smelting that bases on the traditional resource chain iron ore – pig iron – steel, replacement of the open hearth furnaces with electric arc technique. The last activity is arranged mostly with help of JI component (see section B.2. for further information).

OJSC "Cherepovets Steel Mill" as part of OJSC "Severstal"

"JSC Severstal has been realizing the investment program until 2012 aimed to change the structure of the product mix toward higher products, in particular, high-quality sheet steel, including coated steel.

The main facilities for casting of the converter steel undergo a complete renovation scheduled to be completed in 2007 - this year the Cherepovets Steel Mill expects to complete the reconstruction of oxygen-converter shop. So in February the repair of continuous casting machine #1 is scheduled. Third and fourth CCMs are waiting for 2007. As for the second and fifth CCM – they are currently being put into operation after reconstruction. A whole complex of modernization of converter shop facility will increase productivity, reduce maintenance and operating costs, improve the quality of the slabs, improve environmental performance"[16].

According to the annual report of JSC Severstal in 2006 the completion of modernization of the last two of six steel continuous casting machines at the Cherepovets Metallurgical Plant would increase the annual volume of steel produced by 1 million tons[17].

Total production capacity of Cherepovets Steel Mill is about 12 million tons of steel per year.

OJSC "Novolipetsk Steel" (NLMK)

NLMK produces the wide range of quality steel products of various sizes. The main products are: pig iron, steel semi-finished products (slabs), hot-rolled, cold rolled, electrical steel (dynamo and transformer) as well as rolled zinc, and polymeric coatings.

NLMK in 2006 produced 3,463 tons of slab steel billet, which is 260 thousand tons (8,1%) more compared with 2005.

According to the annual report of the plant during the 2006 NLMK has been active in upgrading and improving the productivity of existing facilities. In September 2006 NLMK's adopted guidelines of the program "The strategy of balanced growth in 2007 to 2011". The main objectives of the Company during this period was to increase the smelting of molten steel by 40% to 12,4 million tons and production of flat products by 90%, which is achieved by augmentation of production volumes, as well as through the purchase of steel mill facilities in major markets sales of NLMK. This objective is also included in the Strategy of development of metallurgical industry of the Russian Federation until 2015, approved by Order № 177 of Russian Ministry of Industry and Energy on May 29, 2007.

In the first phase of the Technical Upgrading Program for oxygen-converter shops there was built a new continuous casting machine # 4 with capacity of 2 million tons of cast slabs per year, and two additional installation of metal refining in the oxygen-converter shop # 1, and in converter shop #2 was commissioned installation of desulfurization of pig iron in ladle. In the second phase of the Technical Upgrading Program it is planned to reconstruct two existing blast furnaces and the construct a new blast furnace # 7. In the oxygen converter plants it will be the reconstruction of gas-escape paths of existing converters, as well as four machines for continuous casting and construction of a new converter.

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[15] http://www.minpromtorg.gov.ru/ministry/strategic/sectoral/2

[16] http://metal4u.ru/articles/by_id/94

[17] http://www.rts.ru/ru/listing/emidocs.html?iss=CHMF

OJSC "West Siberian Iron and Steel Plant" (Zapsib)

"Management of EvrazHolding, experts of Zapsib and a number of design organizations developed and has been implementing a strategic modernization program. Priority for Zapsib is a complete transition of steelmaking technology for continuous casting of steel"[18].

In the second oxygen-converter shop, in addition to already existing eight-strand section CCM with capacity of 1 million 300 thousand tons of continuously casted steel billet per year it will be built a slab CCM with capacity of up to 2,4 million tons of slab billet per year. Ladle treatment of steel will be implemented through a unique two-position ladle furnace with capacity of 320 tons. Since February 2004 the construction of these two complexes is underway. In the first oxygen-converter shop it will be built three six-strand CCMs with annual capacity of 1 - 1,2 million tons of cast billets each as well as one one-position and one two-position ladle-furnaces with a capacity of 140 tons.

This extensive program is designed for extremely tight deadline – by the end of 2006 all steel of Zapsib will be casted through the CCM. With the completion of the project plant will be able to diversify the production of steel billet from section to slab steel and enlarge the structure of production and number of steel grades. Of the process chain will be withdrawn blooming mill, mold shop and shop for compositions preparation".

OJSC "Nizhny Tagil Iron and Steel Plant" (NTMK)

NTMK in 2007 produced 1596,872 ths. tones of slab steel billet which is 2,8% more than in 2006.

Currently all steel is casted at NTMK by continuous process. In July 2004 NTMK commissioned continuous casting machine # 4. Between 1995 and 2004 the company has launched four such machines in the converter shop. To obtain high-quality metal Evraz has introduced a modern system of its preparation for the casting: the plant installed three ladle furnaces, two vacuum degassers, equipment for desulphurization[19].

Company has developed and implemented modernization program under which in 2006-2007 the reconstruction of blast furnace # 5 and the fifth of coke oven battery were performed[20].

The integrated steelworks has been realizing the large project of reconstruction of oxygen-converter shop.

Over the past three years 3 of 4 converters have been reconstructed. In autumn 2010 it is planned to complete reconstruction of the 4-th converter, which was delayed for a year and a half. The decision to postpone this reconstruction was not due to the crisis, and, above all, the fact that after the decommission of the open-hearth furnace plant the capacity of existing converters was seriously increased and, consequently, it became clear that the bottleneck is not the converters but casting machines and it was decided to reconstruct the CCM #3. This will increase the capacity of the oxygen-converter plant up to 4,5 million tons of steel per year[21].

OJSC "Chelyabinsk Metallurgical Plant" (ChMK)

"According to the annual report of the metallurgical works for 2006 the completion of phase I of construction of CCM # 4 will allow to expand the range of products and solve the problem of providing Beloretsk Metallurgical Complex with high-quality billet with section of 150 and 180 mm in full of its need and improve the performance of the machine. As part of a program to increase steel output at

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[18] http://www.zsmk.ru/showpress.jsp?iid=53

[19] http://www.ntmk.ru/ru/press/press_release.php?rel_id=1437&month_=2&year=2010

[20] http://www.uralinform.ru/armnews/news66688.html

[21] http://www.metaldaily.ru/news/news34571.html

oxygen-converter plant up to 4 million tons per year it is planned in 2007 to build in a shop additionally 2 units of high-temperature heating of ladles and one installation of metal refining[22].

Proposals and feasibility studies has been prepared and the execution of design and preparatory work is initiated in order to clarify the prospects of plant development for the period 2007-2009. There are plans in particular: in 2008 to reconstruct the converter # 1, and implement a CCM # 4 (2nd stage)".

OJSC "MMK" (oxygen-converter shop)

Oxygen-converter shop of JSC "MMK" consists of three converters with capacity of 370 tonnes and designed output of 3.35 million tons per year each, equipment for secondary treatment and finishing of steel, as well as four continuous casting machines (since 2009 – five CCMs). In 2006 the 100 millionth ton of converter steel has been melted since launch of the shop in 1990[23].

Table B.1-1. The dynamics of the converter steel production at JSC "MMK"

|  | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|
| Steel production, ths. tones | 7,915 | 8,843 | 9,503 | 9,820 | 10,066 | 10,249 | 10,077 | 8,838 | 8,218 |

As can be seen from Table B.1-1. the maximum output of converter steel was reached in 2006, and this value is slightly higher than (200 ths. tons) designed performance of converters which was determined by increased market demand.

Practice shows that the converter shop of three 400 tons converters can provide annual production of 10 million tons[24]. Taking into account the fact that the EAFs and the CCM # 5 was launched in 2006 and designed capacity of EAFP in slab steel billet output was expected in 2008 it made possible to unload the converter shop (see data table. B.1-1.)

OJSC "Ural Steel"

As a result of implementation of the Programme of Technical Development at JSC "Ural Steel", which reflects the priorities of technological development it will be achieved the growth of steel production in EAF shop from 750 to 2,000 thousand tons per year, and increase of continuous casting of steel in the EAF shop from 350 to 2,000 thousand tons per year, as well as growth in output of plate rolling mill 2800 to 1.2 million tons in 2009[25].

As a perspective area of technological development of JSC "Ural Steel" is necessary to note the investment project "Construction of the oxygen-furnace shop" currently being prepared. This investment project will include reconstruction of the open-hearth furnace, which results in replacement of open-hearth furnaces and double-bath steelmaking units by oxygen converters, and the technology of casting steel into molds will be replaced by continuous casting. In addition, a technology for ladle treatment of steel in ladle furnace and vacuum degassing will be implemented.

Annual production of steel in the oxygen-converter shop will be 3.0 – 3.5 million tons of casted billet, including 2.0 – 2.5 million tons of slabs and 1 million tons of section billet.

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[22] http://www.mechel.ru/investors/enclosure/chmk/index.wbp

[23] http://www.mmk.ru/rus/shareholders/year_reports/index.wbp

[24] http://ukrsteel.org/uas/node/104

[25] http://www.metallinvest.ru/rus/factorys/metallyrgiceskii-divizion/yral_skaa-stal_/raskritie-informacii/godovie-otceti/

The strategy of development of metallurgical industry of the Russian Federation until 2015, approved by Order of Russian Ministry of Industry and Energy on May 29, 2007 № 177 declared an increase in steel production to 5 million tons per year in 2008-2010.

**Conclusion:**

This analysis of production plans of the largest metallurgical enterprises in Russia shows that all investment programs envisaged an augmentation of the output of slab steel billet, which was determined by market demand. In 2006 in Russia there was an increase in demand for steel and steel products, which led to price growth by 4,7% [26].

Therefore we can confidently assert that the steel mills of the Russian Federation (on example of a 7-top) could produce additionally 2 million tons of slab steel billet in the absence of EAFP project at MMK.

According to the data of "Corporation CHERMET", LLC in 2006 in Russia 63% of the steel was smelted in converters, 21 % in the electric arc furnaces and 16 % in open-hearth furnaces.

This option is the most likely scenario for the baseline, because there is enough production capacity to produce 2 million slab of steel billet with required quality.

2. **Reconstruction of the open-hearth plant of MMK into EAFP and production of continuously casted slab steel billet in it (project without registration as JI).**

This alternative was realized at JSC "MMK" in 2006.

Construction of the EAFP complex allowed to replace the double-bath steelmaking units and classic open-hearth furnaces, and to give up from casting into molds followed by treatment at the blooming mill plant. The capacity of EAFP allowed to produce both section and slab steel billet. Maximum performance of one EAF-180 is 2 million tons per year, in addition to two EAFs one double-bath steelmaking unit # 32 was left in operation under partial load (for recycling of metallurgical wastes and for operation during repair of arc furnaces). Reconstruction on this scale made possible to install two section CCMs # 1 and 2, and one slab CCM # 5 (capacity of section CCMs and slab CCM are 2 million tons of steel billet per year, i.e. 4 million tones in total).

This alternative is not financially attractive for MMK and requires significant additional investment. Barrier and investment analysis have been presented to prove the additionality in section B.2.

**Conclusion and description of the chosen baseline scenario**

Based on analysis made above the most likely baseline alternative has been identified:

***Production of slab steel billet at the existing metallurgical works or newly introduced capacities (during the crediting period) in Russia other than EAFP of MMK***

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*

The identified baseline comprises $CO_2$ emissions associated with steel smelting at the metallurgical enterprises of Russia with capacity for production of the slab steel billet.

"Corporation GHERMET", LLC was established in 1991 during the dissolution of the Ministry of Metallurgy of the USSR. In accordance with governmental regulation the task of the Corporation is coordination of the work of all Russian works of ferrous metallurgy. Thereby annually report "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous

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[26] http://www.rts.ru/ru/listing/emidocs.html?iss=CHMF

metallurgy works" includes production factors of all Russian metallurgical works of ferrous metallurgy. Total steel output of metallurgical works, which is under the project boundary, is 52,474.5 thousand tons in 2008 and 48,538.1 thousand tons in 2009 (on the basis of Corporation CHERMET data). Total steel output of all Russian metallurgical works is 68,510 thousand tons in 2008 and 60,011 thousand tons in 2009 (data of the International Iron and Steel Institute). So we can conclude that all metallurgical works with capacity for production of slab steel billet (about 80% of all metallurgical works) are under the project boundary.

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

Baseline $CO_2$ emissions are calculated as follows:

1. The number of metallurgical works of Russia with capacity for production of slab steel billet is identified according to data of annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC  and information from public sources in the Internet (web sites of metallurgical works to insure that slab steel billet is produced);

2. General $CO_2$ emission factor for steel production is calculated for each metallurgical works of this group of metallurgical enterprises of Russia. General $CO_2$ emission factor for steel production characterizes the carbon intensity of steel production at the metallurgical works. The basis of calculation is statistic data of "Corporation CHERMET", LLC. The calculation is provided for the steel smelting at the whole enterprise without separation of slab steel production, because of such detailing is not provided in statistic data;

3. General $CO_2$ emission factor for steel production is calculated based on the share of each technique of steel production (converter, arc-furnace, pig-and-ore process, steel production in DBSU, scrap process) in the whole volume of steel output at the metallurgical works. In turn for each used technique the specific $CO_2$ emissions from production of one ton of steel are calculated separately based on statistic data of specific consumption of relevant carbon-bearing raw materials and energy source (consumption of pig iron, natural gas, electrodes, electricity, oxygen) and fixed ex-ante $CO_2$ emissions factors for them;

4. Integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet is calculated based on general $CO_2$ emission factor for steel production at each metallurgical works defined in point 3 and the share of each metallurgical works with capacity for production of slab steel billet in the whole volume of steel output by this group metallurgical works of Russia.

5. Taking into account output of slab steel billet in EAFP of MMK and integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet, the baseline emissions $CO_2$ from slab steel production at the metallurgical works of Russia are calculated.

Explaining of scheme for calculation of the integrated emission factor of $CO_2$ emissions from steel production at the Russian metallurgical works with capacity for production of slab steel billet is shown in Diagram D.1-1. Formulae to describe this approach are provided in the sub-section D.1.1.4.

When defining the integrated $CO_2$ emission factor for steel production at the Russian metallurgical works we take into account data on the specific consumption of primary carbon-bearing raw materials and energy-sources on the existing steel works during the reporting period. During the project crediting period new steel plants that produce slab steel billets can be put in operation or increase of the capacity of existing ones may take place. These changes will be considered through the regular monitoring of the baseline $CO_2$ emissions on the basis of annual report (also released quarterly) report of "Corporation CHERMET", LLC. If statistic data of Corporation CHERMET are not available, the value of integrated $CO_2$ emission factor for steel production at the Russian metallurgical works will be ex-ante in line with

conservative assumptions (the value of 2008 – 1.103 tons $CO_2$/ton steel). This situation is unlikely because MMK is one of the founders of Corporation CHERMET.

The statistic report of "Corporation CHERMET", LLC includes all metallurgical works of Russia (producing slab steel, profiled steel, pipes and special steel).

Specialized pipe mills and special steel works cannot be considered as the part of the baseline scenario (pipe mills smelt steel for own needs and special steel grades are made for different purpose than slab ones) and they were excluded from the list.

The metallurgical works with capacity for production of the profiled steel billet only were excluded from the list.

The remaining metallurgical works which form the final list used for baseline $CO_2$ emission calculation produce either slab steel or slab and profiled steel simultaneously. For them a general $CO_2$ emission factor for steel production is calculated without differentiation for slab and profiled steel grades production.

In this list there are three metallurgical works in Russia which total production is higher that 50% of the whole volume (54-56% depending of the year[27]):

• Oxygen-converter shop of MMK (EAFP of MMK is excluded as it is a project site);

• Novolipetsk Steel Mill;

• Cherepovets Steel Mill

Two of these "giants", i.e. Oxygen-converter shop of MMK and Novolipetsk Steel Mill produce only slab steel therefore this category of product prevails for these plants.

The share of oxygen-converter method of steel smelting for these plants is following:

- Oxygen-converter shop of MMK – 100%,

-  Novolipetsk Steel Mill – 100%

- Cherepovets Steel Mill – 85% (data of 2010).

Therefore it may be definitely assumed that oxygen-convertor method dominates in slab steel production in Russia as other large metallurgical works producing slab steel billet also use the oxygen-converter technology as a main one.

However since PDD developer considers in the list of metallurgical works all the enterprises with capacity to produce slab steel billet, such approach reduce integrated $CO_2$ emission factor for steel production at the Russian metallurgical works due to use of mostly arc-furnace technology at the smaller works these days.

Therefore it is more conservative not to differentiate the $CO_2$ emissions at the each plant for slab steel and profiled steel separately i.e. follow approach proposed in the PDD as for production of slab steel only the $CO_2$ emission in the baseline would be higher.

**Key information and data used to establish the baseline**

| Data/parameter | $P_{slab\ steel\ EAFP\ MMK}$ |
|---|---|
| Data unit | Tones |
| Description | Output of slab steel billet in EAFP. The same in the project and in the baseline. |
| Time of determination/ monitoring | Continuously |
| Source of data (to be) used | Monthly technical report of EAFP |

[27] Report "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC

| | |
|---|---|
| Value of data applied (for ex ante calculation/ determinations) | This parameter is 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 Section D.2. |
| Any comment | No additional comments |

| | |
|---|---|
| **Data/parameter** | $EF_{integrated\_Russian\ metallurgical\ plants}$ |
| Data unit | t $CO_2$/t steel |
| Description | Integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is calculated based on monitored data |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The value is calculated on the basis of general $CO_2$ emission factor for steel production at the metallurgical works n and share of each metallurgical works with capacity for production of slab steel billet in the whole volume of steel output by this group metallurgical works of Russia. Parameter is necessary for calculation baseline $CO_2$ emissions from steel production at the metallurgical works of Russia |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| | |
|---|---|
| **Data/parameter** | $\omega_n$ |
| Data unit | Nondimensional |
| Description | Share of each metallurgical works with capacity for production of slab steel billet in the whole volume of steel output by this group metallurgical works of Russia |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The value is calculated for each metallurgical works that has facilities for slab steel billet production on the basis of total value of steel output. Parameter is necessary for calculation integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet. |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| **Data/parameter** | $\omega_{EAF\_n}$ |
|---|---|
| Data unit | Nondimensional |
| Description | Share of arc-furnace technique of steel production in the whole volume of steel output at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is calculated based on monitored data. |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The value is calculated for each metallurgical works that has facilities for slab steel billet production on the basis of value of steel production by arc-furnace technique. Parameter is necessary for calculation general $CO_2$ emission factor for steel output at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| **Data/parameter** | $\omega_{converter\_n}$ |
|---|---|
| Data unit | Nondimensional |
| Description | Share of converter technique of steel production in the whole volume of steel output at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is calculated based on monitored data |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The value is calculated for each metallurgical works that has facilities for slab steel billet production on the basis of value of steel output by converter technique. Parameter is necessary for calculation general $CO_2$ emission factor for steel production at the metallurgical works n |
| QA/QC procedures (to be) | See Section D.2. |

| applied | |
|---|---|
| Any comment | No additional comments |

| **Data/parameter** | $\omega_{\text{pig-and-ore process\_n}}$ |
|---|---|
| Data unit | Nondimensional |
| Description | Share of pig-and-ore technique of steel production in the whole volume of steel output at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is calculated based on monitored data |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The value is calculated for each metallurgical works that has facilities for slab steel billet production on the basis of value of steel output by pig-and-ore technique. Parameter is necessary for calculation general $CO_2$ emission factor for steel production at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| **Data/parameter** | $\omega_{\text{DBSU\_n}}$ |
|---|---|
| Data unit | Nondimensional |
| Description | Share of steel production in DBSU in the whole volume of steel output at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is calculated based on monitored data |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The value is calculated for each metallurgical works that has facilities for slab steel billet production on the basis of value of steel output in DBSU. Parameter is necessary for calculation general $CO_2$ emission factor for steel production at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| **Data/parameter** | $\omega_{\text{scrap process\_n}}$ |
|---|---|
| Data unit | Nondimensional |
| Description | Share of scrap technique of steel production in the whole |

| | volume of steel output at the metallurgical works n |
|---|---|
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is calculated based on monitored data |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The value is calculated for each metallurgical works that has facilities for slab steel billet production on the basis of value of steel output by scrap technique. Parameter is necessary for calculation general $CO_2$ emission factor for steel production at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{iron\ EAF\_n}$ |
|---|---|
| Data unit | t/t |
| Description | Specific consumption of pig iron per ton of steel produced by arc-furnace technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from production of pig iron per ton of steel produced by arc-furnace technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{NG\ EAF\_n}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific consumption of NG per ton of steel produced by arc-furnace technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |

| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| --- | --- |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of NG per ton of steel produced by arc-furnace technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{electrodes\_n}$ |
| --- | --- |
| Data unit | t/t |
| Description | Specific consumption of electrodes per ton of steel produced by arc-furnace technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of electrodes per ton of steel produced by arc-furnace technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{oxygen\ EAF\_n}$ |
| --- | --- |
| Data unit | $m^3/t$ |
| Description | Specific consumption of oxygen per ton of steel produced by arc-furnace technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by arc-furnace technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |

| Any comment | No additional comments |
|---|---|

| Data/parameter | SM $_{electricity\ EAF\_n}$ |
|---|---|
| Data unit | MWh/t |
| Description | Specific consumption of electricity per ton of steel produced by arc-furnace technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of electricity per ton of steel produced by arc-furnace technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | All electric arc furnaces are powered by external grid of UES of region, where metallurgical works n is situated |

| Data/parameter | SM $_{iron\ converter\_n}$ |
|---|---|
| Data unit | t/t |
| Description | Specific consumption of pig iron per ton of steel produced by converter technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from production of pig iron per ton of steel produced by converter technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | SM $_{NG\ converter\_n}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific consumption of NG per ton of steel produced by converter technique at the metallurgical works n |
| Time of | Annually/ received quarterly |

| determination/ monitoring | |
|---|---|
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of NG per ton of steel produced by converter technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{\text{oxygen converter\_n}}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific consumption of oxygen per ton of steel produced by converter technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by converter technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{\text{iron pig-and-ore process\_n}}$ |
|---|---|
| Data unit | t/t |
| Description | Specific consumption of pig iron per ton of steel produced by pig-and-ore technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from production of pig iron per ton of steel produced by pig-and-ore technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| **Data/parameter** | $SM_{\text{NG pig-and-ore process\_n}}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific consumption of NG per ton of steel produced by pig-and-ore technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of NG per ton of steel produced by pig-and-ore technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| **Data/parameter** | $SM_{\text{oxygen pig-and-ore process\_n}}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific consumption of oxygen per ton of steel produced by pig-and-ore technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by pig-and-ore technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | SM $_{\text{iron DBSU\_n}}$ |
|---|---|
| Data unit | t/t |
| Description | Specific consumption of pig iron per ton of steel produced in DBSU at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from production of pig iron per ton of steel produced in DBSU at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | SM $_{\text{NG DBSU\_n}}$ |
|---|---|
| Data unit | $m^3$/t |
| Description | Specific consumption of NG per ton of steel produced in DBSU at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of NG per ton of steel produced in DBSU at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | SM $_{\text{oxygen DBSU\_n}}$ |
|---|---|
| Data unit | $m^3$/t |
| Description | Specific consumption of oxygen per ton of steel produced in DBSU at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of |

| | |
|---|---|
| | pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of oxygen per ton of steel produced in DBSU at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{iron\ scrap\ process\_n}$ |
|---|---|
| Data unit | t/t |
| Description | Specific consumption of pig iron per ton of steel produced by scrap technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from production of pig iron per ton of steel produced by scrap technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $SM_{NG\ scrap\ process\_n}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific consumption of NG per ton of steel produced by scrap technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of NG per ton of steel produced by scrap technique at the metallurgical works n |

| QA/QC procedures (to be) applied | See Section D.2. |
|---|---|
| Any comment | No additional comments |

| Data/parameter | $SM_{oxygen\ scrap\ process\_n}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific consumption of oxygen per ton of steel produced by scrap technique at the metallurgical works n |
| Time of determination/ monitoring | Annually/ received quarterly |
| Source of data (to be) used | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |
| Value of data applied (for ex ante calculation/ determinations) | This parameter is monitored |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by scrap technique at the metallurgical works n |
| QA/QC procedures (to be) applied | See Section D.2. |
| Any comment | No additional comments |

| Data/parameter | $EF_{iron}$ |
|---|---|
| Data unit | $t\ CO_2/t$ |
| Description | $CO_2$ emission factor for iron production |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | IPCC Guidelines 2006, Volume 3, Chapter 4, table 4.1. |
| Value of data applied (for ex ante calculation/ determinations) | 1.35 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from production of pig iron per ton of steel produced by different technique at the each metallurgical works n |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | No additional comments |

| Data/parameter | $EF_{NG}$ |
|---|---|
| Data unit | $tCO_2/1,000\ m^3$ |
| Description | $CO_2$ emission factor for NG combustion |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Calculated on the base of data of $CO_2$ EF for NG combustion – 56,100 kg/TJ (IPCC Guidelines 2006, volume 2, Chapter 1, Introduction, table 1.4), data of net calorific value of NG – 48.0 TJ/Gg (IPCC Guidelines 2006, volume |

| | |
|---|---|
| | 2, Chapter 1, Introduction, table 1.2) and density of NG under normal conditions. Since the composition of NG is variable in different regions, we standardize this value at 0.7 $kg/m^3$ (confirmed by data of OJSC "Ashinsky metallurgical works"). |
| Value of data applied (for ex ante calculation/ determinations) | 1.88 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of NG per ton of steel produced by different technique at the each metallurgical works n |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | No additional comments |

| | |
|---|---|
| **Data/parameter** | $EF_{electrodes}$ |
| Data unit | $tCO_2/t$ |
| Description | $CO_2$ emission factor for electrodes consumption |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Calculated on the base of data of carbon content in EAF carbon electrodes (IPCC Guidelines 2006, volume 3, Chapter 4, table 4.3.). Carbon content 0.82 is multiplied by 44/12 |
| Value of data applied (for ex ante calculation/ determinations) | 3.007 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of electrodes per ton of steel produced by different technique at the each metallurgical works n |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | No additional comments |

| | |
|---|---|
| **Data/parameter** | $EC_{oxygen}$ |
| Data unit | $MWh/1,000\ m^3$ |
| Description | Electricity consumption for oxygen production |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Public data of suppliers of air separation units for metallurgical works. Lowest value |
| Value of data applied (for ex ante calculation/ determinations) | 0.83 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Parameter is necessary for calculation of specific $CO_2$ emissions from consumption of electricity per ton of steel produced by arc-furnace technique at the metallurgical works n |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | No additional comments |

| Data/parameter | EF $_{grid\_Centre}$ |
|---|---|
| Data unit | t $CO_2$/MWh |
| Description | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Center |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Report on GHG emission factors for Russian energy systems (2008)[28]. 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) | 0.511 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Application of the value of the grid emission factor is conservative because its calculation process takes into account uncertainties caused by the following parameters of a power plant: <ul><li>fuel consumption of power plants;</li><li>net calorific values of fuel of different types;</li><li>fuel emission factors;</li><li>net electricity generation.</li></ul> See Annex 4 for more details. |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | Parameter is necessary for calculation of $CO_2$ emissions from consumption of electricity from the grid. Fugitive emissions during transportation of electricity are not included in the baseline for reasons of conservativeness approach. |

| Data/parameter | EF $_{grid\_Northwest}$ |
|---|---|
| Data unit | t $CO_2$/MWh |
| Description | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Northwest |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Report on GHG emission factors for Russian energy systems (2008). 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) | 0.548 |

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[28] 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.

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Application of the value of the grid emission factor is conservative because its calculation process takes into account uncertainties caused by the following parameters of a power plant:<br>• fuel consumption of power plants;<br>• net calorific values of fuel of different types;<br>• fuel emission factors;<br>• net electricity generation.<br>See Annex 4 for more details. |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | Parameter is necessary for calculation of $CO_2$ emissions from consumption of electricity from the grid. Fugitive emissions during transportation of electricity are not included in the baseline for reasons of conservativeness approach. |

| Data/parameter | $EF_{grid\_Middle\ Volga}$ |
|---|---|
| Data unit | t $CO_2$/MWh |
| Description | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Middle Volga |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Report on GHG emission factors for Russian energy systems (2008). 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) | 0.506 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Application of the value of the grid emission factor is conservative because its calculation process takes into account uncertainties caused by the following parameters of a power plant:<br>• fuel consumption of power plants;<br>• net calorific values of fuel of different types;<br>• fuel emission factors;<br>• net electricity generation.<br>See Annex 4 for more details. |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | Parameter is necessary for calculation of $CO_2$ emissions from consumption of electricity from the grid. Fugitive emissions during transportation of electricity are not included in the baseline for reasons of conservativeness approach. |

| Data/parameter | $EF_{grid\_Ural}$ |
|---|---|
| Data unit | t $CO_2$/MWh |
| Description | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Urals |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Report on GHG emission factors for Russian energy systems (2008). 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 | Application of the value of the grid emission factor is conservative because its calculation process takes into account uncertainties caused by the following parameters of a power plant:<br>• fuel consumption of power plants;<br>• net calorific values of fuel of different types;<br>• fuel emission factors;<br>• net electricity generation.<br>See Annex 4 for more details. |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | Parameter is necessary for calculation of $CO_2$ emissions from consumption of electricity from the grid. Fugitive emissions during transportation of electricity are not included in the baseline for reasons of conservativeness approach. |

| Data/parameter | $EF_{grid\_South}$ |
|---|---|
| Data unit | t $CO_2$/MWh |
| Description | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of South |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Report on GHG emission factors for Russian energy systems (2008). 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) | 0.500 |
| Justification of the choice of data or description of measurement methods and | Application of the value of the grid emission factor is conservative because its calculation process takes into account uncertainties caused by the following parameters of |

| procedures (to be) applied | a power plant: |
|---|---|
| | • fuel consumption of power plants; |
| | • net calorific values of fuel of different types; |
| | • fuel emission factors; |
| | • net electricity generation. |
| | See Annex 4 for more details. |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | Parameter is necessary for calculation of $CO_2$ emissions from consumption of electricity from the grid. Fugitive emissions during transportation of electricity are not included in the baseline for reasons of conservativeness approach. |

| Data/parameter | $EF_{grid\_Siberia}$ |
|---|---|
| Data unit | t $CO_2$/MWh |
| Description | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Siberia |
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Report on GHG emission factors for Russian energy systems (2008). 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) | 0.894 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Application of the value of the grid emission factor is conservative because its calculation process takes into account uncertainties caused by the following parameters of a power plant: |
| | • fuel consumption of power plants; |
| | • net calorific values of fuel of different types; |
| | • fuel emission factors; |
| | • net electricity generation. |
| | See Annex 4 for more details. |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | Parameter is necessary for calculation of $CO_2$ emissions from consumption of electricity from the grid. Fugitive emissions during transportation of electricity are not included in the baseline for reasons of conservativeness approach. |

| Data/parameter | $EF_{grid\_East}$ |
|---|---|
| Data unit | t $CO_2$/MWh |

| Description | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of East |
|---|---|
| Time of determination/ monitoring | Fixed ex-ante parameter |
| Source of data (to be) used | Report on GHG emission factors for Russian energy systems (2008). 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) | 0.823 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Application of the value of the grid emission factor is conservative because its calculation process takes into account uncertainties caused by the following parameters of a power plant: <br>• fuel consumption of power plants; <br>• net calorific values of fuel of different types; <br>• fuel emission factors; <br>• net electricity generation. <br>See Annex 4 for more details. |
| QA/QC procedures (to be) applied | Not implemented for fixed ex-ante parameter |
| Any comment | Parameter is necessary for calculation of $CO_2$ emissions from consumption of electricity from the grid. Fugitive emissions during transportation of electricity are not included in the baseline for reasons of conservativeness approach. |

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

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

**Step 1. Identification and description of the approach applied**

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

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

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

**Step 2. Application of the approach chosen**

Detailed description and analysis of likely alternatives has been provided in Section B.1:

Alternative 1 (proposed baseline scenario)

Production of slab steel billet at the existing metallurgical works or newly introduced capacities (during the crediting period) in Russia other than EAFP of MMK.

<u>Alternative 2</u> (proposed project scenario without registration as JI).

Reconstruction of the open-hearth plant of MMK into EAFP and production of continuously casted slab steel billet in it.

### Step 3. Provision of additionality proofs

*Identification of significant barriers to project implementation*

<u>*Economic barrier. Price and availability of scrap metal*</u>

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 slab 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)[29]

| 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% |

Actually at the time of decision making about investing into the project, this situation could have been taken into account. Proposed: The project owner (MMK) when deciding about investing into the proposed project activity in 2004 faced the risk of scrap metal price volatility based on previously observed price fluctuations (see the Table B.2-1). At the time of PDD development, it should be noted, that concerns of MMK have been actually proven (please also refer to Table B.2-1 years 2005-2006), and finally 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 slab steel was produced only at one DBSU. This situation was continued in the beginning of 2010 according to economic conditions in the country.

The technologies most dependent on external market prices for scrap are the arc-furnace technique of steel production and scrap process (see Table A.4.3-1).

The largest integrated steel mills are part of holdings, which include their own raw material base, and use mostly their own pig iron for steel production.

According to materials of "Corporation CHERMET", LLC of 2010 and the International Iron and Steel Institute of 2005 in Russia was dominated a converter steel production technique (see Figure B.2.1) and a main raw material for that is an iron (the consumption of scrap about 20%).

Therefore increasing the price of scrap is not a significant barrier to the production of slab steel billet on the existing metallurgical plants in Russia, while it makes sense for operation of the EAFP of MMK.

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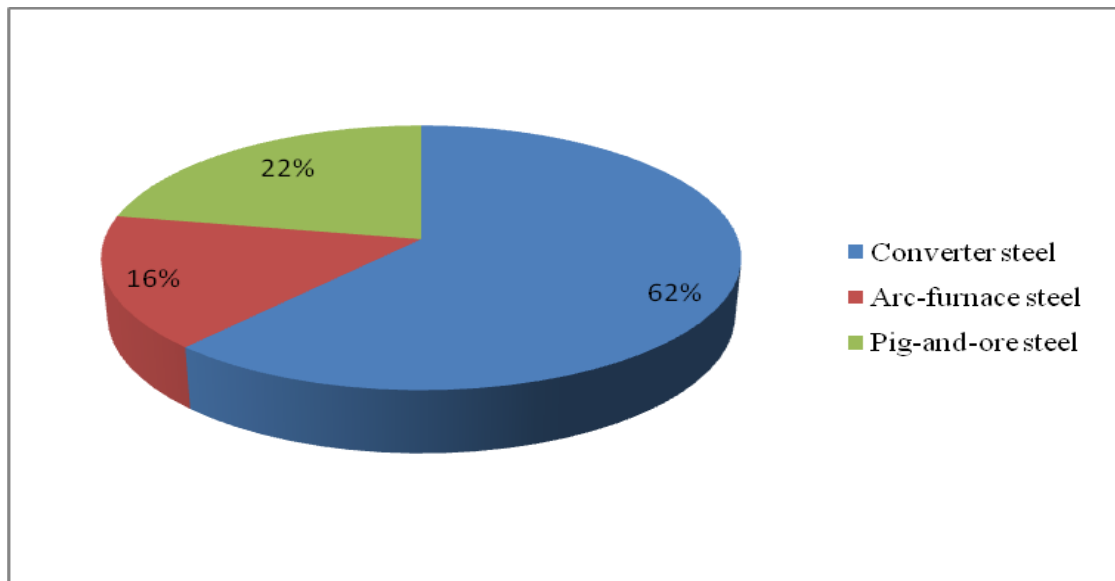
[29] http://www.ruslom.ru/?page=analytics_19122006

Figure B.2-1: Proportion of different ways of steel production in Russia in 2005 (all steel works)
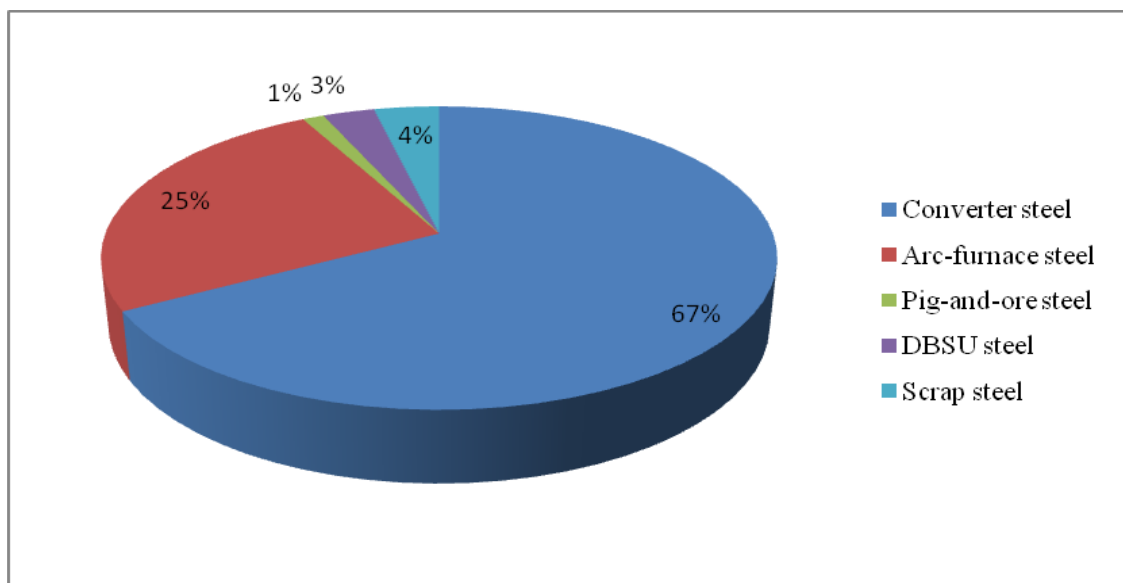


Figure B.2-2: Proportion of different ways of steel production in Russia in 2010 (all steel works)

Numerous studies and projections noted that in 2006 Russia would experience shortage of scrap, resulting in an additional surge in prices on this key raw material and lowering the competitiveness of Russian electrometallurgy[30].

Thus we can conclude that implementation of the project scenario faces a significant barrier, which would be sufficient to press MMK to avoid the project on construction of EAFP complex with CCM # 5 and do not carry out the expensive reconstruction of the open-hearth furnace plant. At the same time the production of the slab steel billet on the existing metallurgical plants in Russia do not face a significant barrier.

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[30] http://metal4u.ru/articles/by_id/34

**Barrier analysis confirms that there is an alternative that is not prevented from realization by the barrier (the change in the price and availability of scrap) and this is a baseline, not a project scenario**

*Investment analysis*

The presented below investment analysis shows that the proposed project is not economically attractive for MMK.

Investment analysis includes the production of profiled and slab steel billet by EAFP complex. Capital expenditures include installation of: EAF-180 - 2 units, ladle-furnace - 1 unit, continuous casting machine #5 and auxiliary equipment. Originally EAFP complex has been focused on the production of profiled steel billet, which is explained by the fact that historically at MMK open-hearth plant produced profiled steel while slab steel was smelted in oxygen-converter plant. But in the process of elaboration of specific design options and equipment set of the EAF plant it was determined to be technically possible to install in it two electric arc furnaces with capacity of 2 million tons of steel a year each, which provided a loading of section CCMs being constructed at that time (started up in mid-2004) and offered a potential for the production of slab steel billet. Therefore it was decided to include into EAFP complex two powerful EAF-180 and slab CCM. At the same time a construction of separate slab steel billet production complex without reconstruction of open-hearth furnace plant and replacement of technology for profiled steel billet production had no practical sense for MMK.

Based on that and since the main part of the equipment of EAFP (except slab CCM) is used for production of both slab and profiled steel billet and therefore the capital expenditures are common the specialists of OJSC "MMK" had developed a joint investment analysis model. However the method for profits calculations for each type of steel billet in this model is different:

- for profiled steel billet production the profit is based on calculation of effect from saving of energy and materials as the result of transition into steel smelting in EAFs instead of DBSUs (for details see PDD for the JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works"[31]),

- for slab steel billet production and profit is based on calculation of revenue from sale of 2 million tones of slab steel billet (as MMK might alternatively purchase a steel billet for further rolling in the market) minus costs of its production in EAFP.

All prices and costs in the investment analysis were valid (actual) for March 2004.

Table B.2-2. Main parameters which were used in investment analysis[32]

| # | 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 |

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

[32] The values of main parameters have been confirmed at the stage of determination by AIE and will be submitted to JISC as required after approval by the Parties involved.

| | |
|---|---|
| Total project investments, ths. rub | 7,643,188 |
| Annual inflation, % | 12.0 |
| Rate of discount, % | 8.0 |
| Calculation horizon, year | 12 |
| Price for slab steel billet, rubles / ton | 5,274 |

The results of investment analysis are summarized in Table B.2.3[33]

Table B.2-3. The results of 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 | 2 | - 2,571,473 | 11.9 | > 12 | 8 |

**According to the results of investment analysis the economic indicators of the project are not attractive for management of OJSC "MMK"**

*Sensitivity analysis*

Sensitivity analysis is based on the change in capital costs, prices for scrap and the price of slab steel billet. The results of sensitivity analysis are shown in Table B.2-4

Capital expedenture of the project is 7,121,582 thousand rubles.

The price of scrap is 3,268 rubles / ton.

Price for slab steel billet is 5,274 rubles / ton.

Table B.2-4: The results of sensitivity analysis

| % of variations | IRR, % | Simple payback period, years | NPV, thousand Rubles |
|---|---|---|---|
| *Variations of capital expenditure* | | | |
| -10% | 3 | 11.3 | - 1,910,272 |
| +10% | - | 12.5 | - 3 232 673 |
| *Variations of scrap price* | | | |
| +10% | - | - | - 8 128 164 |
| -10% | 12.0 | 7.4 | 1 738 290 |
| *Variations of slab billet price* | | | |
| +10% | 14.0 | 7.0 | 2 447 926 |
| -10% | - | - | - 9 096 030 |

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[33] These results were obtained with use of calculation models used by specialists of JSC "MMK" for assessment of efficiency of the investment projects.

The project is effective and financially sustainable, if at all possible scenarios of its development project economic indicators remain positive[34].

**The sensitivity analysis confirms that the project is not financially attractive as in some cases the NPV is negative.**

*Common practice analysis*

Arc-furnace method of steel production is not a common technology in Russia.

According to the data of "Corporation CHERMET", LLC and the International Iron and Steel Institute (data for 2005) the production of steel in the converters was a dominant technology in the metallurgical industry in Russia and retains as of today.

Table B.2-5. The degree of prevalence of different technique of steel production in Russia, %

| Technique of steel production | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 [35] |
|---|---|---|---|---|---|---|
| Converter steel | 61.60 | 60.18 | 58.03 | 57.73 | 64.76 | 66.92 |
| Arc-furnace steel | 16.30 | 21.75 | 26.46 | 28.21 | 26.70 | 25.36 |
| Pig-and-ore process | 22.10 | 7.70 | 6.04 | 5.08 | 1.46 | 1.20 |
| Steel produced in DBSU | | 4.93 | 4.04 | 3.42 | 3.73 | 2.89 |
| Scrap process | | 5.40 | 5.40 | 5.57 | 3.35 | 3.63 |

The main direction of modernization of smelting complexes in the investment programs of the largest metallurgical plants (described in section B) was transition from casting into molds to continuous casting of steel (NTMK, Zapsib), or reconstruction of existing facilities for continuous casting (CherMk), or installing a new continuous casting machines for empowerment of converter production (NLMK, Zapsib, ChMK).

Projects of EAF construction realized as the Joint Implementation projects, for example, are following:

- Production modernisation at JSC Amurmetal, Komsomolsk-on-Amur, Khabarovsk Krai, Russian Federation[36] (the end of modernization is 1st quarter 2010).

- Finger Shaft Furnace construction at OJSC Severstal, Cherepovets, Vologda region, Russian Federation[37] (the end of modernization is 4th quarter 2005)

- Reconstruction of the steelmaking at JSC Ashinskiy Metallurgical Works (AMW), Asha, Russian Federation (Track I project)[38] (the end of modernization – mid 2010).

- Implementation of Resource-Saving Technologies at JSC "Ural Steel", Novotroitsk, Russia[39] (the end of modernization is 2007).

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[34] Guideline of efficiency assessment of the investment projects approved by Ministry of Economy, Ministry of Finance and Rosstroy of Russia by June 21, 1999 #VK 477. P. 10.5.

[35] Data of first quarter of 2010 "Corporation CHERMET", LLC

[36]http://ji.unfccc.int/JI_Projects/DB/UVNZRJEB5WZQ7N9UR9YINGKVG1QXM0/PublicPDD/QL4F4O8TJVW1IVEFPUFEJRK9FRF0TM/view.html

[37]

http://ji.unfccc.int/JI_Projects/DB/8I872FVHWG8K8RLIZJACLSZ6BTNGBY/PublicPDD/PN256LQ338FL76TV44O0GM7AINZP13/view.html

[38] http://www.bureau-veritas.ru/wps/wcm/connect/bv_ru/local/home/news/news-ghg-pdd_ashinskiy_metallurgical_works?presentationtemplate=bv_master/news_full_story_presentation

Therefore projects realized as Joint Implementation (in accordance with Article 6 of the Kyoto protocol) are excluded from the common practice analysis.

**Thus projects of construction of the electric arc furnaces implemented at the Russian metallurgical enterprises, without the involvement of Joint Implementation is not a common practice in Russia. The project implemented at MMK in 2006 was one of the first of its kind and the above arguments including barrier and investment analysis shows that this project is additional.**

| B.3. | Description of how the definition of the <u>project boundary</u> is applied to the <u>project</u>: |
|---|---|

The project boundaries include:

- Metallurgical conversion stages of MMK: coking coal production in the by-product coke plant, blast-furnace plant, EAFP

- Own power generation capacities of MMK: CHPP, CPP, SABPP, turbine section in the steam plant, gas recovery section in the steam plant

- Unified Energy Systems of the Russian Federation: Center, North West, South, Middle Volga, Urals, Siberia, East.

- Existing metallurgical works or newly introduced capacities (during the crediting period) in Russia

Project boundaries comprise metallurgical enterprises with facilities for production of the slab steel billet. Information on existing plants included in the calculation of baseline $CO_2$ emissions for 2008-2010 has been presented in Appendix 2. Project boundaries as well include capacities that would be built during the crediting period.

Table B.3-1: Emission sources in the baseline and in the project

| | Emission source | Gas | Included/not included | Comments |
|---|---|---|---|---|
| Baseline | Metallurgical conversion stages of the Russian metallurgical works with capacity for production of slab steel billet (including oxygen-converter shop of MMK) | $CO_2$ | Included | In accordance with conservative approach only the following variables (specific consumption per ton of steel) have been sorted out from reports of  "Corporation CHERMET", LLC, for baseline $CO_2$ emissions calculation: <br><br> - pig iron; <br><br> - natural gas; <br><br> - graphite electrodes; <br><br> - oxygen; <br><br> - electricity. <br><br> The values of emissions factor of these variables are fixed over the crediting period (see Section B and D). <br><br> $CO_2$ emissions associated with use of lime |

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[39]http://ji.unfccc.int/JI_Projects/DB/X0QMHJ133AQSUN05EF99ER1KCASL35/PublicPDD/9C29T6T4CYURH WJD94N6SRBURJWOSX/view.html

| | | | | |
|---|---|---|---|---|
| | | | | and limestone are assumed to be zero both for the baseline and in the project[40]. |
| | Unified Energy Systems of the Russian Federation | $CO_2$ | Included | Use of the fossil fuel by power plants of 7 Unified Energy Systems for electricity production, which is supplied to metallurgical enterprise (Annex 4). For the baseline calculation only electricity for steel smelting in EAFs and electricity for oxygen production is taken into account. This approach is conservative because electric arc furnace smelts semiproduct, which is than refined in the ladle-furnace aggregate.

Besides electric arc furnaces use nitrogen and argon that is not accounted in the baseline unlike in the project. |
| Project | Metallurgical conversion stages: by- | $CO_2$ | Included | Use of carbon-containing materials (furnace charge, coking coal, pig iron, steel) and fuels |

[40] Lime and limestone are used to form the slag of the required composition and consistency. Slag provides the occurrence of oxidation reactions, the removal of harmful admixtures (particularly sulphur) and metal heating. Slag composition is regulated by addition of limestone during the period of charging and addition of lime during ore boil in the open-hearth furnace. For the purpose of formation the basic slag, binding phosphorus lime is added in the converter in the beginning of the blowdown. Blowing of carbon powder with lime additive allows to utilize "foam melt slag" technology after the melting of charge at EAF-180 MMK.

Lime (CaO) is produced from limestone ($CaCO_3$) by preliminary calcining in the special furnace where $CO_2$ molecules are emitted.

Time of steel smelting is different for each technology:

- 8-10 hours in the open-hearth furnace

- around 2.5 hours in DBSU;

- 45 minutes in converter;

- 46-56 minutes in electric arc furnace.

Therefore open-hearth furnaces and DBSUs consume mainly limestone while converter and electric arc furnaces mostly consume lime.

According to data of conference of the 60 years anniversary of the oxygen converter process (2006) (http://www.d-s-r.ru/texts/Kolpakov%20S.V..pdf) the consumption of the lime in converter is generally 0.050-0.060 kg/kg steel. According to MMK historical data the consumption of the limestone in open-hearth furnace is 0.067 kg/kg steel (2002) and the consumption of the lime in EAFP is 0.047 kg/kg steel (2007).

The share of steel production in baseline (data "Corporation CHERMET", LLC for 3 quarters 2010) is following:

- 80% of steel is smelted in oxygen converters

- 15% of steel in electric arc furnaces,

and 5% in open-hearth furnaces/DBSUs

Therefore it is evident that in the baseline the consumption of lime/limestone would be slightly higher and thus the exclusion the consumption of lime / limestone is acceptable and conservative.

| product coke plant, blast-furnace plant, complex of electric arc furnace plant | | | (blast furnace gas, coke oven gas, natural gas) for slab steel production. |
|---|---|---|---|
| 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). Consumption of electricity is considered for all operations in EAFP, not only the electric arc furnace activity. |
| Unified Energy System of Urals | $CO_2$ | Included | Usage organic fuel by power plants for electricity production, which is supplied to MMK |

**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: 18/11/2010

Baseline calculations were performed by:

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

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

**SECTION C.   Duration of the project / crediting period**

**C.1.    Starting date of the project:**

June 7, 2004

**C.2.    Expected operational lifetime of the project:**

Operation lifetime of the project is 12 years/ 144 months between 2004 and 2016

**C.3.    Length of the crediting period:**

5 years 0 months / 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. And additionally the length of the crediting period will be 8 years 0 months / 96 months.

| SECTION D.　Monitoring plan |
| --- |

| D.1.　　Description of monitoring plan chosen: |
| --- |

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

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

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

MMK is a metallurgical complex in which the production of coke and pig iron meets not only needs of the EAFP, but the oxygen-converter plant. Besides slab steel billet and profiled steel billet are produced in EAFP (production of profiled steel is not included under the project boundary, and considered in the JI Project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works". This PDD had been determined by independent expertise (determination) by Bureau Veritas[41]). In order to limit the calculation of $CO_2$ emissions within the project activity, specific $CO_2$ emissions per ton of coke and per ton of pig iron, steel and billet are calculated and then they are multiplied by the part of production, which relates to the project.

Project $CO_2$ emissions are calculated as follows:

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 combined).
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 slab steel billet using defined specific values and coefficients
5.  $CO_2$ emission coefficients associated with generation of electricity and air blast at MMK, and project emissions from 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 slab steel billet are summarized.

Formulae to describe this approach are provided in the sub-section D.1.1.2.

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

The production of metallurgical coke is accompanied by the formation of by-product - coke breeze. The coke batteries in BPCP (By product coke plant) produce gross coke, which after quenching is sifted to coke breeze and metallurgical coke, 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.

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. $CO_2$ emissions during utilization of this dust at the cement factory are considered as leakages and fully accounted in the monitoring plan of the JI Project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works". This PDD had been determined by independent expertise (determination) by Bureau Veritas[42]. To avoid double counting, $CO_2$ emissions during utilization of this dust at the cement factory are not calculated in this project.

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 Russian Federation 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.

Baseline $CO_2$ emissions are calculated as follows:

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

1. The number of metallurgical works of Russia with capacity for production of slab steel billet is identified according to data of annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC and information from public sources in the Internet (web sites of metallurgical works to insure that slab steel billet is produced);

2. General $CO_2$ emission factor for steel production is calculated for each metallurgical works of this group of metallurgical enterprises of Russia. General $CO_2$ emission factor for steel production characterizes the carbon intensity of steel production at the metallurgical works. The basis of calculation is statistic data of "Corporation CHERMET", LLC. The calculation is provided for the steel smelting at the whole enterprise without separation of slab steel production, because of such detailing is not provided in statistic data;

3. General $CO_2$ emission factor for steel production is calculated based on the share of each technique of steel production (converter, arc-furnace, pig-and-ore process, steel production in DBSU, scrap process) in the whole volume of steel output at the metallurgical works. In turn for each used technique the specific $CO_2$ emissions from production of one ton of steel are calculated separately based on statistic data of specific consumption of relevant carbon-bearing raw materials and energy source (consumption of pig iron, natural gas, electrodes, electricity, oxygen) and fixed ex-ante $CO_2$ emissions factors for them;

4. Integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet is calculated based on general $CO_2$ emission factor for steel production at each metallurgical works defined in point 3 and the share of each metallurgical works with capacity for production of slab steel billet in the whole volume of steel output by this group metallurgical works of Russia.

5. Taking into account output of slab steel billet in EAFP of MMK and integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet, the baseline emissions $CO_2$ from slab steel production at the metallurgical works of Russia are calculated.

Explaining scheme for calculation of the integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet is shown in Diagram D.1-1. Formulae to describe this approach are provided in the sub-section D.1.1.4.

For estimation of the integrated $CO_2$ emission factor the data on the specific consumption of primary carbon-bearing raw materials, fuel and energy on the existing metallurgical works during the crediting period are taken into account. During the crediting period of the project new metallurgical works, which produce slab steel billets can be introduced in operation, or capacity of existing ones can be increased. These changes will be considered through the regular monitoring of baseline $CO_2$ emissions on the basis of annual report (also released quarterly) reports of "Corporation CHERMET", LLC.

Diagram D.1-1. The scheme of calculation of integrated emission factor of $CO_2$ emissions from steel production at the Russian metallurgical works with capacity for production of slab steel billet
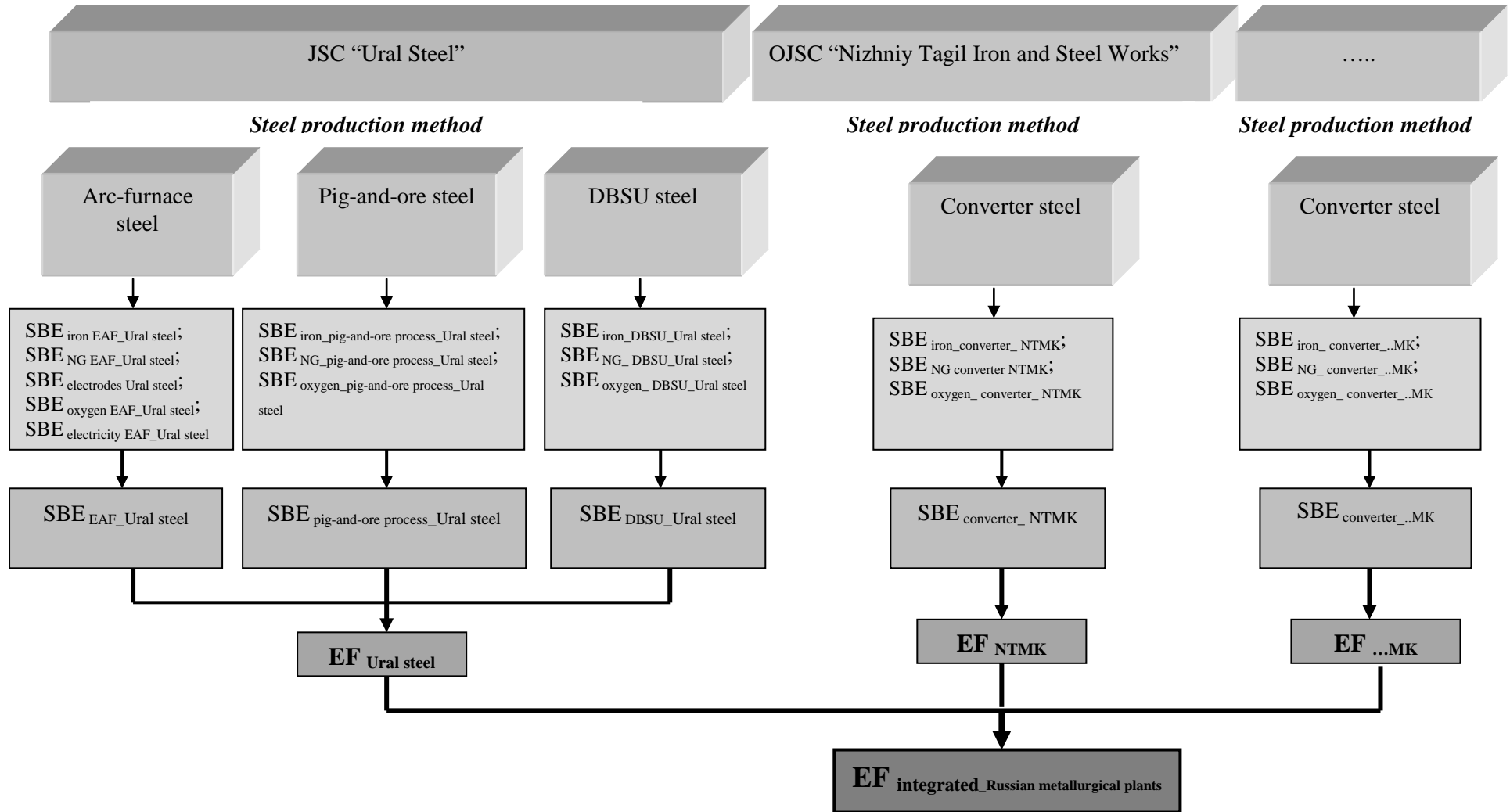
**Step 2. Application of the approach chosen**

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

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

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

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

In the project context the application is following:

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

Table D.1-1. Data and parameters, which remain fixed over the crediting period, and are available at the determination stage

| № | Parameter and measurement units | Notation | Value | Data source |
|---|---|---|---|---|
| 1. | Carbon content in crude benzol, % by mass | $\%C_{benzol}$ | 90.0 | In accordance with results of analysis of CL (BpCP Lab) these parameters are 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. (Such approach was used in the JI Project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works". This PDD had been determined by independent expertise (determination) by Bureau Veritas[43]). |
| 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 | Carbon content in scrap of ferrous metal is equal to |

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

| 5. | Carbon content in steel, % by mass | $\%C_{steel}$ | 0.18 | the carbon content in steel. EAF-180 consume scrap of ferrous metal, DBSU consume waste of steel production, carbon content of which is even smaller than in the scrap of ferrous metal. Typical carbon content in scrap consumed in EAFP is 0.18 %. |
|----|-----|-----|-----|-----|
| 6. | Carbon content in carbon-containing powder, % by mass | $\%C_{carbon\ powder\_EAFP}$ | 95.0 | In accordance with Russian standard specification 1971-003-13303593-2006, this is confirmed by quality certificate. |
| 7. | Carbon content in electrodes, % by mass | $\%C_{electrodes\_EAFP}$ | 99.0 | In accordance with Russian standard specification 1911-109-052-2003, this is confirmed by quality certificate. |
| 8. | Carbon content in power station coal, % by mass | $\%C_{energy\ coal}$ | 73 | "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC Guidelines 2006), Chapter 4, table 4.3. Use the value of coking coal as the most conservative. |
| 9. | $CO_2$ emission factor for iron production, t $CO_2$/t pig iron | $EF_{iron}$ | 1.35 | IPCC Guidelines 2006, Chapter 4, table 4.1. |
| 10. | $CO_2$ emission factor for NG combustion, t $CO_2$/ 1,000 $m^3$ | $EF_{NG}$ | 1.88 | Calculated on the base of data of $CO_2$ EF for NG combustion – 56,100 kg/TJ (IPCC Guidelines 2006, volume 2, Chapter 1, Introduction, table 1.4), data of net calorific value of NG – 48.0 TJ/Gg (IPCC Guidelines 2006, volume 2, Chapter 1, Introduction, table 1.2) and density of NG under normal conditions. Since the composition of NG is variable in different regions, we standardize this value at 0.7 kg/$m^3$ (confirmed by data of OJSC "Ashinsky metallurgical works"). |
| 11. | $CO_2$ emission factor for electrodes consumption, t $CO_2$/t electrodes | $EF_{electrodes}$ | 3.007 | Calculated on the base of data of carbon content in electrodes (IPCC Guidelines 2006, Chapter 4, table 4.3.). Carbon content 0.82 is multiplied by 44/12. |
| 12. | Electricity consumption for oxygen production, | $SEC_{oxygen}$ | 0.83 | The main producers and suppliers of air separation |

| | | | | |
|---|---|---|---|---|
| | MWh/ 1,000 m$^3$ | | | units for metallurgical works are JSC "Cryogenmash" (cryogenic plant) and "Energotechprom", LLC (absorption and membrane plants). Air separation units of JSC "Cryogenmash" are installed at MMK, NTMK, NKMK, Seversteel, Zapsib[44]. Electricity consumption for oxygen production for units KAr-30 is 0.83 MWh/ 1,000 m$^3$.[45] Electricity consumption for oxygen production for units K-0.25 is 1.2 MWh/ 1,000 m$^3$.[46] So taking account the conservativeness approach we use the lowest value of this parameter – 0.83 MWh/1,000 m$^3$. |
| 13. | Specific electricity consumption for nitrogen production at MMK, MWh/1.000 m$^3$ (since August 2010) | SEC $_{N2\_PJ}$ | 0.150 | Nitrogen compressors which provide EAFP with nitrogen were switched to another current feeder in July 2010. As a result it has become impossible to separate the amount of electricity spent for compression of nitrogen. The value of specific electricity consumption for nitrogen production has been fixed at MMK since August 2010. |
| 14. | Specific electricity consumption for production of pure nitrogen at MMK, MWh/1.000 m$^3$ | SEC $_{pure\_N2\_PJ}$ | 0.826 | The value of these parameters is fixed at MMK, the analysis of electricity consumption reporting by MMK for 2008-2012 shows that these values remain unchanged. |
| 15. | Specific electricity consumption for production of argon at MMK | SEC $_{Ar\_PJ}$ | 0.055 | |

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

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

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[44] http://www.cryogenmash.ru/

[45] http://www.arcelormittal.com.ua/index.php?id=126&p=224

[46] http://www.compressed-air.ru/odessa/ustanovka-k-025.html

| № | Parameter and measurement units | Notation | Value | Data source |
|---|---|---|---|---|
| 1. | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Center, t $CO_2$/MWh | EF $_{grid\_Centre}$ | 0,511 | Report on GHG emission factors for Russian energy systems (2008)[47]. 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 in October-November 2008. Official approval was received November, 10 2008. See additionally Annex 4. |
| 2. | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Northwest, t $CO_2$/MWh | EF $_{grid\_Northwest}$ | 0,548 | |
| 3. | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Middle Volga, t $CO_2$/MWh | EF $_{grid\_Middle\ Volga}$ | 0,506 | |
| 4. | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Urals, t $CO_2$/MWh | EF $_{grid\_Ural}$ | 0,541 | |
| 5. | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of South, t $CO_2$/MWh | EF $_{grid\_South}$ | 0,50 | |
| 6. | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of Siberia, t $CO_2$/MWh | EF $_{grid\_Siberia}$ | 0,894 | |
| 7. | $CO_2$ emissions factor for grid electricity produced by Unified Energy System of East, t $CO_2$/MWh | EF $_{grid\_East}$ | 0,823 | |

*Data and parameters that are monitored throughout the crediting period*

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

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[47] 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.

| | **D.1.1.  Option 1 – <u>Monitoring</u> of the emissions in the <u>project</u> scenario and the <u>baseline</u> scenario:** |
|---|---|

| **D.1.1.1.  Data to be collected in order to monitor emissions from the <u>project</u>, 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 | $M_{coking\ coal\_PJ}$ 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 | $\%C_{coking\ coal\_PJ}$ 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 | $FC_{BFG\_CP\_PJ}$ Consumption of BFG in BPCP | CEST | million m$^3$ | m | Continuously | All | Electronic | Report on balance of gas consumption in workshops |
| P-4 | $C_{BFG\_PJ}$ 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 | $FC_{COG\_CP\_PJ}$ Consumption of | CEST | million m$^3$ | m | Continuously | All | Electronic | Report on balance of gas |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | COG in BPCP | | | | | | | 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 | $P_{COG\_CP\_PJ}$ | CEST | million m$^3$ | m | Continuously | All | Electronic | Report on |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Output of COG in BPCP | | | | | | | balance of gas 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 | $M_{skip\_metallurgical\_coke\_BF\_PJ}$ 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 |

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| P-17 | $FC_{BFG\_BF\_PJ}$ Consumption of BFG in BFP | CEST | million m$^3$ | m | Continuously | All | Electronic | Report on 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 | e | 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 | $\Sigma P_{profiled \& slab\ steel\_EAFP}$ 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 | $P_{slab\ steel\_EAFP}$ Output of slab 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 | 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 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | in Unified Energy System of Urals | | | | | | | posted in Internet |
| P-28 | $EC_{grid\_sleel\_EAF}$ Consumption of grid electricity by EAF-180 | Technological department | GWh | m/c | Continuously | All | Electronic | Report on electricity utilization |
| P-29 | $\sum P_{steel\_EAF}$ 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 | GWh | m/c | Continuously | All | Electronic | Report on electricity utilization |
| P-31 | $EC_{gross\_PJ}$ Total electricity consumption by MMK | Technological department | GWh | 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 | GWh | m/c | Continuously | All | Electronic | Report on analysis of consumption energy recourses in MMK |
| P-33 | $V_{N2\_EAFP}$ Consumption of | CEST | million m$^3$ | m | Continuously | All | Electronic | Report on distribution of |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | nitrogen in EAFP | | | | | | | | oxygen-compressor shop products delivered to consumers by pipeline |
| P-34 | $V_{pure\_N2\_EAFP}$ Consumption of pure nitrogen in EAFP | CEST | million m$^3$ | m | Continuously | All | Electronic | | Report on distribution of oxygen-compressor shop products delivered to consumers by pipeline |
| P-35 | $V_{Ar\_EAFP}$ Consumption of argon in EAFP | CEST | million m$^3$ | m | Continuously | All | Electronic | | Report on distribution of oxygen-compressor shop products delivered to consumers by pipeline |
| P-36 | $V_{O2\ EAFP}$ Consumption of oxygen in EAFP | CEST | million m$^3$ | m | Continuously | All | Electronic | | Report on distribution of oxygen-compressor shop products delivered to consumers by pipeline |
| P-37 | $P_{O2\ OCS\ \#1}$ Output of oxygen by oxygen-compressor shop | Technological department | thousand m$^3$ | m | Continuously | All | Electronic | | Report on electricity utilization |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (OCS) #1 | | | | | | | |
| P-38 | $P_{O2\ OCS\ \#2}$ Output of oxygen by oxygen-compressor shop (OCS) #2 | Technological department | thousand m$^3$ | m | Continuously | All | Electronic | Report on electricity utilization |
| P-39 | $SEC_{O2\ OCS\ \#1}$ Specific electricity consumption for production of oxygen in OCS #1 | Technological department | MWh/1,000m$^3$ | c | Monthly | All | Electronic | Report on electricity utilization |
| P-40 | $SEC_{O2\ OCS\ \#2}$ Specific electricity consumption for production of oxygen in OCS #2 | Technological department | MWh/1,000m$^3$ | c | Monthly | All | Electronic | Report on electricity utilization |
| *Electricity generation* | | | | | | | | |
| P-41 | $FC_{BFG\_CPP\_PJ}$ Consumption of BFG in CPP (Central power plant) | Technological department | million m$^3$ | m | Continuously | All | Electronic/ hard copy | Report on fuel consumption by own power generating capacities |
| P-42 | $FC_{NG\_CPP\_PJ}$ 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-43 | $FC_{NG\_CHPP\_PJ}$ | Technological | million m$^3$ | m | Continuously | All | Electronic/ hard | Report on fuel |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Consumption of NG in CHPP (combined heat and power plant) | department | | | | | | copy | consumption by own power generating capacities |
| P-44 | **FC** $_{\text{BFG\_SABPP\_PJ}}$ Consumption of BFG in SABPP (steam-air blowing power plant) | Technological department | million m$^3$ | m | Continuously | All | Electronic/ hard copy | Report on fuel consumption by own power generating capacities |
| P-45 | **FC** $_{\text{COG\_SABPP\_PJ}}$ Consumption of COG in SABPP | Technological department | million m$^3$ | m | Continuously | All | Electronic/ hard copy | Report on fuel consumption by own power generating capacities |
| P-46 | **FC** $_{\text{NG\_SABPP\_PJ}}$ Consumption of NG in SABPP | Technological department | million m$^3$ | m | Continuously | All | Electronic/ hard copy | Report on fuel consumption by own power generating capacities |
| P-47 | **FC** $_{\text{NG\_turbine section of SP \_PJ}}$ Consumption of NG in turbine section of SP (steam plant) | Technological department | million m$^3$ | m | Continuously | All | Electronic/ hard copy | Report on fuel consumption by own power generating capacities |
| P-48 | **FC** $_{\text{NG\_gas recovery unit-2 of SP \_PJ}}$ Consumption of NG in recovery unit of SP | Technological department | million m$^3$ | m | Continuously | All | Electronic/ hard copy | Report on fuel consumption by own power generating capacities |
| P-49 | **FC** $_{\text{energy coal\_CHPP\_PJ}}$ | Technological department | thousand tons | m | Continuously | All | Electronic/ hard copy | Report on fuel consumption by |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Consumption of power station coal by CHPP | | | | | | | | own power generating capacities |
| *Generation and consumption of air blast* | | | | | | | | | |
| P-50 | **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-51 | **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-52 | **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-53 | **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):**

**CO$_2$ EMISSIONS FROM METALLURGICAL CONVERSIONS CALCULATED BY CARBON BALANCE METHOD**

**Production of metallurgical coke**

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

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 CO₂ emissions per ton of produced metallurgical coke*

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

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 $CO_2$

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

**Production of pig iron**

$$PE_{pig\_iron} = [(M_{skip\_metallurgical\ coke\_BF\_PJ} * \%C_{metallurgical\ coke\_PJ}) + (FC_{COG\_BF\_PJ} * C_{COG\_PJ}) + (FC_{NG\_BF\_PJ} * C_{NG\_PJ}) + (FC_{BFG\_BF\_PJ} * C_{BFG\_PJ}) - (P_{pig\ iron\_BF\_PJ} * \%C_{pig\ iron}) - (P_{BFG\_BF\_PJ} * C_{BFG\_PJ})] * 44/12$$
**(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*

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

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 slab steel billet in EAFP**

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

Where:

$PE_{EAFP}$ – Project $CO_2$ emissions from production of slab 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 total production of slab and profiled steel billet in EAFP*

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

Where:

$SPE_{EAFP}$ – specific $CO_2$ emissions per ton of total production of slab and profiled steel billet 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**

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

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**

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

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**

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

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 SLAB STEEL BILLET**

**Project CO$_2$ emissions from consumption of metallurgical coke for production of slab steel billet**

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

Where:

$PE_{metallurgical\_coke\_slab\_steel}$ – Project $CO_2$ emissions from consumption of metallurgical coke for production of slab 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

$P_{slab\ steel\_EAFP}$ – Output of slab 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 slab steel billet**

$$PE_{pig\ iron\_slab\_steel} = SC_{pig\ iron\_EAFP} * P_{slab\ steel\_EAFP} * SPE_{pig\ iron} \qquad \text{(D.1.1.2.-11)}$$

Where:

$PE_{pig\ iron\_slab\_steel}$ – Project $CO_2$ emissions from consumption of pig iron for production of slab 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

$P_{slab\ steel\_EAFP}$ – Output of slab 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 slab steel billet**

$$PE_{slab\ steel\_EAFP} = P_{slab\ steel\_EAFP} * SPE_{EAFP} \qquad \text{(D.1.1.2.-12)}$$

Where:

$PE_{slab\ steel\_EAFP}$ – Project $CO_2$ emissions in EAFP from production of slab steel billet, thousand tons of $CO_2$

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

$SPE_{EAFP}$ – Specific $CO_2$ emissions per ton of slab steel billet produced in EAFP, tons $CO_2$/ton

**$CO_2$ EMISSIONS FROM ELECTRICITY CONSUMPTION ASSOCIATED WITH PRODUCTION OF SLAB STEEL BILLET IN EAFP**

$$PE_{electricity\_slab\_steel\_EAFP} = PE_{EC\_grid\_slab\_steel\_EAF} + PE_{EC\_slab\_steel\_other\ EAFP} + PE_{EC\_Ar\_N2\_slab\_steel} + PE_{EC\_O2\_slab\_steel} \quad \text{(D.1.1.2.-13)}$$

Where:

$PE_{electricity\_slab\_steel\_EAFP}$ – Total $CO_2$ emissions from electricity consumption associated with production of slab steel billet in EAFP, thousand tons of $CO_2$

$PE_{EC\_grid\_slab\_steel\_EAF}$ – $CO_2$ emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of slab steel grades in EAFP, thousand tons of $CO_2$

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

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

$PE_{EC\_O2\_slab\_steel}$ - $CO_2$ emissions from consumption of electricity from corporate grid of MMK, for production of oxygen needed for production of slab steel billet, 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 slab steel grades**

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

Where:

$PE_{EC\_grid\_slab\_steel\_EAF}$ – $CO_2$ emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of slab 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

$P_{slab\ steel\_EAFP}$ – Output of slab 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, %[48]

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

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[48] 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

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

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, GWh

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

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

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

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 slab 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

$P_{slab\ steel\_EAFP}$ − Output of slab steel billet in EAFP, thousand tons

$SEC_{steel\_OHFP}$ − Specific consumption of electricity in OHFP, MWh/t (the value of open-hearth furnace plant MMK is 0.007 MWh/t, calculated based on fix-ante parameters: annual average consumption of electricity in OHFP, GW-h (historical data of 2000-2002) and annual average output of steel in OHFP, thousand tons (historical data of 2000-2002))

$\sum P_{profiled\&slab\ steel\_EAFP}$ − 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, please also refer to the equation D.1.1.2-25

$EC_{gross\_PJ}$ − Total electricity consumption by MMK, GWh

$EC_{import\_PJ}$ − Electricity purchases from Unified Energy Systems of Urals grid, GWh

$EF_{grid}$ − $CO_2$ 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 , GWh

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**

$$\text{SEC}_{\text{steel refinement and casting EAFP}} = (\text{EC}_{\text{EAFP}} - \text{EC}_{\text{grid\_steel\_EAF}} - \text{SEC}_{\text{steel\_OHFP}} * (\sum \text{P}_{\text{profiled\&slab steel\_EAFP}} - \sum \text{P}_{\text{steel\_EAF}})) / \sum \text{P}_{\text{profiled\&slab steel\_EAFP}} \quad \text{(D.1.1.2.-17)}$$

Where:

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

$\text{EC}_{\text{EAFP}}$ – Total electricity consumption in EAFP, GWh

$\text{EC}_{\text{grid\_steel\_EAF}}$ – Consumption of grid electricity by EAFP-180, via 220/35 kV step-down substation , GWh

$\text{SEC}_{\text{steel\_OHFP}}$ – Specific electricity consumption in OHFP per ton of steel, MWh/t (the value of open-hearth furnace plant MMK is 0.007 MWh/t, calculated based on fix-ante parameters: annual average consumption of electricity in OHFP, GW-h (historical data of 2000-2002) and annual average output of steel in OHFP, thousand tons (historical data of 2000-2002))

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

$\sum \text{P}_{\text{steel\_EAF}}$ – 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 slab steel billet**

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

Where:

$\text{PE}_{\text{EC\_Ar\_N2\_slab\_steel}}$ - $CO_2$ emissions from consumption of electricity from corporate grid of MMK, for production of nitrogen, pure nitrogen and argon needed for production of slab steel billet, thousand tons of $CO_2$ per year

$\text{EC}_{\text{N2\_slab\_steel}}$ - Electricity consumption for production of nitrogen, which is used during production of slab steel billet in EAFP, GWh

$\text{EC}_{\text{pure N2\_slab\_steel}}$ - Electricity consumption for production of pure nitrogen, which is used during production of slab steel billet in EAFP, GWh

$\text{EC}_{\text{Ar\_slab\_steel}}$ - Electricity consumption for production of argon, which is used during production of slab steel billet in EAFP, GWh

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

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

$\text{EC}_{\text{import\_PJ}}$ – Electricity purchases from Unified Energy Systems of Urals grid, GWh

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

$EC_{gross\_PJ}$ – Total electricity consumption by MMK, GWh

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

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

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

Where:

$SEC_{N2\_PJ}$ – Specific electricity consumption for production of nitrogen at MMK, MWh/1,000 m$^3$ (this parameter has been fixed ex-ante since August 2010, before that it was monitored)

$V_{N2\_EAFP}$ – Consumption of nitrogen in EAFP, million m$^3$

$P_{slab\_steel\_EAFP}$ - Output of slab 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 slab steel billet in EAFP**

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

Where:

$SEC_{pure\_N2\_PJ}$ – Specific electricity consumption for production of pure nitrogen at MMK, MWh/1,000 m$^3$ (this parameter is fixed ex-ante)

$V_{pure\_N2\_EAFP}$ – Consumption of pure nitrogen in EAFP, million m$^3$

$P_{slab\_steel\_EAFP}$ - Output of slab 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 slab steel billet in EAFP**

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

Where:

$SEC_{Ar\_PJ}$ – Specific electricity consumption for production of argon at MMK, MWh/1,000 m$^3$ (this parameter is fixed ex-ante)

$V_{Ar\_EAFP}$ – Consumption of argon in EAFP, million m$^3$

$P_{slab\_steel\_EAFP}$ - Output of slab steel billet in EAFP, thousand tons

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

**$CO_2$ emissions from consumption of electricity from corporate grid of MMK for production of oxygen needed for production of slab steel billet in EAFP**

$$PE_{EC\_O2\_slab\_steel} = EC_{O2\_slab\_steel} * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/(EC_{gross\_PJ} - EC_{grid\_steel\_EAF}) \qquad (D.1.1.2.-22)$$

Where:

$PE_{EC\_O2\_slab\_steel}$ - $CO_2$ emissions from consumption of electricity from corporate grid of MMK for production of oxygen needed for production of slab steel billet, thousand tons of $CO_2$

$EC_{O2\_slab\_steel}$ - Electricity consumption for production of oxygen, which is used during production of slab steel billet in EAFP, GWh

$EF_{own\ generation\_PJ}$ – $CO_2$ 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, GWh

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

$EC_{gross\_PJ}$ – Total electricity consumption by MMK, GWh

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

**Electricity consumption for production of oxygen, which is used during production of slab steel billet in EAFP**

$$EC_{O2\_slab\_steel} = SEC_{O2\_PJ} * V_{O2\_EAFP} * P_{slab\_steel\_EAFP}/\_\sum P_{profiled\&slab\ steel\_EAFP} \qquad (D.1.1.2.-23)$$

Where:

$EC_{O2\_slab\_steel}$ - Electricity consumption for production of oxygen, which is used during production of slab steel billet in EAFP, GWh

$SEC_{O2\_PJ}$ – Specific electricity consumption for production of oxygen at MMK, MWh/1,000 m$^3$

$V_{O2\_EAFP}$ – Consumption of oxygen in EAFP, million m$^3$/ t steel

$P_{slab\_steel\_EAFP}$ - Output of slab steel billet in EAFP, thousand tons

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

**Specific electricity consumption for production of oxygen at MMK**

$$SEC_{O2\_PJ} = ((P_{O2\,OCS\,\#1} * SEC_{O2\,OCS\,\#1}) + (P_{O2\,OCS\,\#2} * SEC_{O2\,OCS\,\#2}))/(P_{O2\,OCS\,\#1} + P_{O2\,OCS\,\#2}) \quad \text{(D.1.1.2.-24)}$$

Where:

$SEC_{O2\_PJ}$ – Specific electricity consumption for production of oxygen at MMK, MWh/1,000 m$^3$

$P_{O2\,OCS\,\#1}$ - Output of oxygen by oxygen-compressor shop #1, thousand m$^3$

$SEC_{O2\,OCS\#1}$ - Specific electricity consumption for production of oxygen in oxygen-compressor shop #1, MWh/1,000m$^3$

$P_{O2\,OCS\,\#2}$ - Output of oxygen by oxygen-compressor shop #2, thousand m$^3$

$SEC_{O2\,OCS\,\#2}$ - Specific electricity consumption for production of oxygen in oxygen-compressor shop #2, MWh/1,000m$^3$

## $CO_2$ emission factor for electricity produced at MMK

$$EF_{own\,generation\_PJ} = PE_{total\,electricity\,generation} / (EC_{gross\_PJ} - EC_{import\_PJ}) \quad \text{(D.1.1.2.-25)}$$

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 consumption at MMK, GWh

$EC_{import\_PJ}$ – Electricity purchases from Unified Energy Systems of Urals grid, GWh

**$CO_2$ emissions from electricity generation at MMK**

$$PE_{total\,electricity\,generation} = PE_{combustion\,gases\_electricity} + PE_{combustion\,coal\_electricity} \quad \text{(D.1.1.2.-26)}$$

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 $CO_2$ per year.

PE $_{\text{combustion coal\_electricity}}$ - $CO_2$ 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 $_{\text{combustion gases\_electricity}}$ = (FC $_{\text{BFG\_CPP\_PJ}}$ * C $_{\text{BFG\_PJ}}$ + FC $_{\text{NG\_CPP\_PJ}}$ * C $_{\text{NG\_.PJ}}$ + FC $_{\text{NG\_CHPP\_PJ}}$ * C $_{\text{NG\_PJ}}$ + FC $_{\text{BFG\_SABPP\_PJ}}$ * C $_{\text{BFG\_PJ}}$ + FC $_{\text{COG\_SABPP\_PJ}}$ * C $_{\text{COG\_PJ}}$ + FC $_{\text{NG\_SABPP\_PJ}}$ * C $_{\text{NG\_PJ}}$ + FC $_{\text{NG\_turbine section of SP \_PJ}}$ * C $_{\text{NG\_PJ}}$ + FC $_{\text{NG\_gas recovery unit-2 of SP \_PJ}}$ * C $_{\text{NG\_PJ}}$)/100 * 44/12 **(D.1.1.2.-27)**

Where:

PE $_{\text{combustion gases\_electricity}}$ - $CO_2$ emissions from combustion of gases for electricity generation at MMK, thousand tons of $CO_2$

FC $_{\text{BFG\_CPP\_PJ}}$ – Consumption of BFG in CPP, million m$^3$

FC $_{\text{BFG\_SABPP\_PJ}}$ – Consumption of BFG in SABPP (steam-air blowing power plant), million m$^3$

C $_{\text{BFG\_PJ}}$ – Carbon content in BFG, kg C/m$^3$

FC $_{\text{COG\_SABPP\_PJ}}$ – Consumption of COG in SABPP (steam-air blowing power plant), million m$^3$

C $_{\text{COG.PJ}}$ – Carbon content in COG, kg C/m$^3$

FC $_{\text{NG\_CPP\_PJ}}$ – Consumption of NG in CPP (central power plant), million m$^3$

FC $_{\text{NG\_CHPP\_PJ}}$ – Consumption of NG in CHPP (combined heat and power plant), million m$^3$

FC $_{\text{NG\_SABPP\_PJ}}$ – Consumption of NG in SP (steam plant), million m$^3$

FC $_{\text{NG\_turbine section of SP \_PJ}}$ – Consumption of NG in turbine section of SP, million m$^3$

FC $_{\text{NG\_gas recovery unit-2 of SP \_PJ}}$ – Consumption of NG in gas recovery unit of SP, million m$^3$

C $_{\text{NG\_PJ}}$ - Carbon content in NG, kg C/m$^3$

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

PE $_{\text{combustion coal\_electricity}}$ = (FC $_{\text{energy coal\_CHPP\_PJ}}$ * %C $_{\text{energy coal}}$)/100 * 44/12 **(D.1.1.2.-28)**

Where:

PE $_{\text{combustion coal\_electricity}}$ - $CO_2$ emissions from combustion of power station coal, thousand tons of $CO_2$

FC $_{\text{energy coal\_CHPP\_PJ}}$ – Consumption of power station coal by CHPP, thousand tons

%C $_{\text{energy coal}}$ – Carbon content in power station coal, % by mass

**CO₂ EMISSIONS FROM GENERATION OF AIR BLAST NEEDED FOR PRODUCTION OF PIG IRON USED FOR PRODUCTION OF SLAB STEEL BILLET IN THE PROJECT**

$$PE_{\text{air blast\_for\_pig\_iron}} = P_{\text{slab steel\_EAFP}} * SC_{\text{pig iron\_EAFP}} * SC_{\text{air blast generation}} * EF_{\text{air blast generation}} \qquad \text{(D.1.1.2.-29)}$$

Where:

$PE_{\text{air blast\_for\_pig\_iron}}$ – $CO_2$ emissions from generation of air blast for production of pig iron used for production of slab steel billet, thousand tons of $CO_2$

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

$SC_{\text{pig iron\_EAFP}}$ – Consumption of pig iron per ton of slab steel billet produced in EAFP, ton/ton

$SC_{\text{air blast generation}}$ – Specific consumption of air blast in BFP per ton of pig iron, thousand $m^3$/ton

$EF_{\text{air blast generation}}$ – $CO_2$ emission factor for air blast generation, t $CO_2$/thousand $m^3$

$$EF_{\text{air blast generation\_}} = PE_{\text{air blast generation}} / OC_{\text{air blast generation\_PJ}} \qquad \text{(D.1.1.2.-30)}$$

Where:

$EF_{\text{air blast generation\_PJ}}$ – $CO_2$ emission factor for air blast generation, t $CO_2$/thousand $m^3$

$PE_{\text{air blast generation}}$ – $CO_2$ emissions from combustion of fuel for generation of air blast, thousand t $CO_2$

$OC_{\text{air blast generation\_PJ}}$ – generation of air blast at MMK, million $m^3$

$$PE_{\text{air blast generation}} = (FC_{\text{BFG\_SABPP\_ air blast generation \_PJ}} * C_{\text{BFG\_PJ}} + FC_{\text{COG\_SABPP\_ air blast generation \_PJ}} * C_{\text{COG\_PJ}} + FC_{\text{NG\_SABPP\_ air blast generation\_PJ}} * C_{\text{NG\_PJ}})/100 * 44/12 \qquad \text{(D.1.1.2.-31)}$$

Where:

$PE_{\text{air blast generation}}$ – $CO_2$ emissions from combustion of fuel for generation of air blast, thousand t $CO_2$

$FC_{\text{BFG\_SABPP\_ air blast generation \_PJ}}$ – Consumption of BFG in SABPP for generation of air blast, million $m^3$

$C_{\text{BFG\_PJ}}$ – Carbon content in BFG, kg C/$m^3$

$FC_{\text{COG\_SABPP\_ air blast generation \_PJ}}$ – Consumption of COG in SABPP for generation of air blast, million $m^3$

$C_{\text{COG\_PJ}}$ – Carbon content in COG, kg C/$m^3$

$FC_{\text{NG\_SABPP\_ air blast generation \_PJ}}$ – Consumption of NG in SABPP for generation of air blast, million $m^3$

$C_{\text{NG\_PJ}}$ - Carbon content in NG, kg C/$m^3$

**Specific consumption of air blast per ton of pig iron produced**

$$SC_{\text{air blast generation\_PJ}} = OC_{\text{air blast generation\_PJ}} / P_{\text{pig iron\_BF\_PJ}} \tag{D.1.1.2.-32}$$

Where:

$SC_{\text{air blast generation\_PJ}}$ – Specific consumption of air blast in BFP per ton of produced pig iron, thousand $m^3$/ton

$OC_{\text{air blast generation\_PJ}}$ – generation of air blast at MMK, million $m^3$

$P_{\text{pig iron\_BF\_PJ}}$ – Production of pig iron in BFP, thousand tons

**TOTAL PROJECT EMISSIONS FROM PRODUCTION OF SLAB STEEL BILLET**

$$PE = PE_{\text{metallurgical coke\_slab\_steel}} + PE_{\text{pig iron\_ slab\_steel}} + PE_{\text{slab steel\_ EAFP}} + PE_{\text{electricity\_slab\_steel\_EAFP}} + PE_{\text{air blast\_for\_pig\_iron}} \tag{D.1.1.2.-33}$$

Where:

$PE$ – Total project $CO_2$ emissions from production of slab steel billet, thousand tons of $CO_2$

$PE_{\text{metallurgical\_coke\_slab\_steel}}$ – $CO_2$ emissions from consumption of metallurgical coke for production of slab steel billet, thousand tons of $CO_2$

$PE_{\text{pig iron\_ slab\_steel}}$ – $CO_2$ emissions from consumption of pig iron for production of slab steel billet, thousand tons of $CO_2$

$PE_{\text{slab steel\_ EAFP}}$ – $CO_2$ emissions in EAFP from production of slab steel billet, thousand tons of $CO_2$

$PE_{\text{electricity\_slab\_steel\_EAFP}}$ – $CO_2$ emissions from consumption of electricity for production of slab steel billet in EAFP, thousand tons of $CO_2$

$PE_{\text{air blast\_for\_pig\_iron}}$ – $CO_2$ emissions from consumption of air blast for production of pig iron for production of slab steel billet, thousand tons of $CO_2$

| D.1.1.3. Relevant data necessary for determining the <u>baseline</u> 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-26 | $P_{slab\ steel\_EAFP}$ Output of slab 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 |
|---|---|---|---|---|---|---|---|---|
| B-1 | $\omega_n$ Share of each metallurgical works with capacity for production of slab steel billet in the whole volume of steel output by this group metallurgical works of Russia | CTF Consulting | Nondimensional | c | Annually/ received quarterly | All | Electronic | This parameter is calculated based on annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC |

| B-2 | $\omega_{EAF\_n}$ Share of arc-furnace technique of steel production in the whole volume of steel output at the metallurgical works n | CTF Consulting | Nondimensional | c | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
|---|---|---|---|---|---|---|---|---|
| B-3 | $\omega_{converter\_n}$ Share of converter technique of steel production in the whole volume of steel output at the metallurgical works n | CTF Consulting | Nondimensional | c | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-4 | $\omega_{pig\text{-}and\text{-}ore\ process\_n}$ Share of pig-and-ore technique of steel production in the whole volume of steel output at the metallurgical works n | CTF Consulting | Nondimensional | c | Annually/ received quarterly | All | Electronic | Same as above (B-1) |

| B-5 | $\omega_{DBSU\_n}$ Share of steel production in DBSU in the whole volume of steel output at the metallurgical works n | CTF Consulting | Nondimensional | c | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
|---|---|---|---|---|---|---|---|---|
| B-6 | $\omega_{scrap\ process\_n}$ Share of scrap technique of steel production in the whole volume of steel output at the metallurgical works n | CTF Consulting | Nondimensional | c | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-7 | $SM_{iron\ EAF\_n}$ Specific consumption of pig iron per ton of steel produced by arc-furnace technique at the metallurgical works n | "Corporation CHERMET", LLC | t/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |

| B-8 | $SM_{NG\ EAF\ \_n}$ Specific consumption of NG per ton of steel produced by arc-furnace technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
|---|---|---|---|---|---|---|---|---|
| B-9 | $SM_{electrodes\ EAF\ \_n}$ Specific consumption of electrodes per ton of steel produced by arc-furnace technique at the metallurgical works n | "Corporation CHERMET", LLC | t/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-10 | $SM_{oxygen\ EAF\ \_n}$ Specific consumption of oxygen per ton of steel produced by arc-furnace technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |

| B-11 | **SM** electricity EAF _n Specific consumption of electricity per ton of steel produced by arc-furnace technique at the metallurgical works n | "Corporation CHERMET", LLC | MWh/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
|---|---|---|---|---|---|---|---|---|
| B-12 | **SM** iron converter_n Specific consumption of pig iron per ton of steel produced by converter technique at the metallurgical works n | "Corporation CHERMET", LLC | t/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-13 | **SM** NG converter_n Specific consumption of NG per ton of steel produced by converter technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3$/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B-14 | **SM** $_{oxygen\ converter\_n}$ Specific consumption of oxygen per ton of steel produced by converter technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-15 | **SM** $_{iron\ pig-and-ore\ process\_n}$ Specific consumption of pig iron per ton of steel produced by pig-and-ore technique at the metallurgical works n | "Corporation CHERMET", LLC | t/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-16 | **SM** $_{NG\ pig-and-ore\ process\_n}$ Specific consumption of NG per ton of steel produced by pig-and-ore technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |

| B-17 | $SM_{oxygen\ pig\text{-}and\text{-}ore\ process\_n}$ Specific consumption of oxygen per ton of steel produced by pig-and-ore technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
|------|------|------|------|------|------|------|------|------|
| B-18 | $SM_{iron\ DBSU\_n}$ Specific consumption of pig iron per ton of steel produced in DBSU at the metallurgical works n | "Corporation CHERMET", LLC | t/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-19 | $SM_{NG\ DBSU\_n}$ Specific consumption of NG per ton of steel produced in DBSU at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |

| B-20 | $SM_{oxygen\ DBSU\_n}$ Specific consumption of oxygen per ton of steel produced in DBSU at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
|---|---|---|---|---|---|---|---|---|
| B-21 | $SM_{iron\ scrap\ process\_n}$ Specific consumption of pig iron per ton of steel produced by scrap technique at the metallurgical works n | "Corporation CHERMET", LLC | t/t | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
| B-22 | $SM_{NG\ scrap\ process\_n}$ Specific consumption of NG per ton of steel produced by scrap technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |

| B-23 | **SM** $_{oxygen\ scrap\ process\_n}$ Specific consumption of oxygen per ton of steel produced by scrap technique at the metallurgical works n | "Corporation CHERMET", LLC | $m^3/t$ | e | Annually/ received quarterly | All | Electronic | Same as above (B-1) |
|------|------|------|------|------|------|------|------|------|

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

**BASELINE $CO_2$ EMISSIONS FROM PRODUCTION OF SLAB STEEL BILLET**

$$\textbf{BE} = \textbf{P}_{slab\ steel\_EAFP\_MMK} * \textbf{EF}_{integrated\_Russian\ metallurgical\ plants} \qquad \textbf{(D.1.1.4.-1)}$$

Where:

BE – baseline $CO_2$ emissions from steel production at the metallurgical works of Russia, thousand tones $CO_2$

$P_{slab\ steel\_EAFP\_MMK}$ – output of slab steel billet in EAFP MMK, tones

$EF_{integrated\_Russian\ metallurgical\ plants}$ – integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet, t $CO_2$/t steel

*Integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet*

$$\textbf{EF}_{integrated\_Russian\ metallurgical\ plants} = \sum \textbf{EF}_n * \boldsymbol{\omega}_n \qquad \textbf{(D.1.1.4.-2)}$$

Where:

$EF_{integrated\_Russian\ metallurgical\ plants}$ – integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet, t $CO_2$/t steel

$EF_n$ - general $CO_2$ emission factor for steel production at the metallurgical works n, t $CO_2$/t steel

$\omega_n$ - share of each metallurgical works with capacity for production of slab steel billet in the whole volume of steel output by this group metallurgical works of Russia, nondimensional

The number of metallurgical works of Russia with capacity for production of slab steel billet is identified according to data of annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC and information from public sources of the Internet.

*General $CO_2$ emission factor for steel production at the metallurgical works n*

$$EF_n = SBE_{EAF\_n} * \omega_{EAF\_n} + SBE_{converter\_n} * \omega_{converter\_n} + SBE_{pig\text{-}and\text{-}ore\ process\_n} * \omega_{pig\text{-}and\text{-}ore\ process\_n} + SBE_{DBSU\_n} * \omega_{DBSU\_n} + SBE_{scrap\ process\_n} * \omega_{scrap\ process\_n}$$

**(D.1.1.4.-3)**

Where:

$EF_n$ - general $CO_2$ emission factor for steel production at the metallurgical works n, t $CO_2$/t steel

$SBE_{EAF\_n}$ – specific $CO_2$ emissions from production of one ton of steel by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$\omega_{EAF\_n}$ – share of arc-furnace technique of steel production in the whole volume of steel output at the metallurgical works n, nondimensional

$SBE_{converter\_n}$ – specific $CO_2$ emissions from production of one ton of steel by converter technique at the metallurgical works n, t $CO_2$/ t steel

$\omega_{converter\_n}$ – share of converter technique of steel production in the whole volume of steel output at the metallurgical works n, nondimensional

$SBE_{pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from production of one ton of steel by pig-and-ore technique at the metallurgical works n, t $CO_2$/ t steel

$\omega_{pig\text{-}and\text{-}ore\ process\_n}$ – share of pig-and-ore technique of steel production in the whole volume of steel output at the metallurgical works n, nondimensional

$SBE_{DBSU\_n}$ – specific $CO_2$ emissions from production of one ton of steel in DBSU at the metallurgical works n, t $CO_2$/ t steel

$\omega_{DBSU\_n}$ – share of steel production in DBSU in the whole volume of steel output at the metallurgical works n, nondimensional

$SBE_{scrap\ process\_n}$ – specific $CO_2$ emissions from production of one ton of steel by scrap technique at the metallurgical works n, t $CO_2$/ t steel

$\omega_{scrap\ process\_n}$ – share of scrap technique of steel production in the whole volume of steel output at the metallurgical works n, nondimensional

*Specific $CO_2$ emissions from production of one ton of steel by arc-furnace technique at the metallurgical works n*

$$SBE_{EAF\_n} = SBE_{iron\_EAF\_n} + SBE_{NG\_EAF\_n} + SBE_{electrodes\_EAF\_n} + SBE_{oxygen\ EAF\_n} + SBE_{electricity\ EAF\_n}$$

**(D.1.1.4.-4)**

Where:

$SBE_{EAF\_n}$ – specific $CO_2$ emissions from production of one ton of steel by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{iron\_EAF\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{NG\_EAF\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{electrodes\_EAF\_n}$ – specific $CO_2$ emissions from consumption of electrodes per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{oxygen\ EAF\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{electricity\ EAF\_n}$ – specific $CO_2$ emissions from consumption of electricity per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$$SBE_{iron\_EAF\_n} = SM_{iron\ EAF\_n} * EF_{iron} \qquad \text{(D.1.1.4.-5)}$$

Where:

$SBE_{iron\_EAF\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel
$SM_{iron\ EAF\_n}$ – specific consumption of pig iron per ton of steel produced by arc-furnace technique at the metallurgical works n, t pig iron/ t steel
$EF_{iron}$ – $CO_2$ emission factor for iron production, t $CO_2$/t pig iron (**1.35** see table D.1.1.)

$$SBE_{NG\_EAF\_n} = SM_{NG\ EAF\_n} /1,000* EF_{NG} \qquad \text{(D.1.1.4.-6)}$$

Where:

$SBE_{NG\_EAF\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel
$SM_{NG\ EAF\_n}$ – specific consumption of NG per ton of steel produced by arc-furnace technique at the metallurgical works n, $m^3$/ t steel
$EF_{NG}$ – $CO_2$ emission factor for NG combustion, t $CO_2$/ 1,000 $m^3$ (**1.88** see table D.1.1.)

$$SBE_{electrodes\_EAF\_n} = SM_{electrodes\ EAF\_n} * EF_{electrodes} \qquad \text{(D.1.1.4.-7)}$$

Where:

$SBE_{electrodes\_EAF\_n}$ – specific $CO_2$ emissions from consumption of electrodes per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SM_{electrodes\ EAF\_n}$ – specific consumption of electrodes per ton of steel produced by arc-furnace technique at the metallurgical works n, t electrodes / t steel

$EF_{electrodes}$ – $CO_2$ emission factor for electrodes consumption, t $CO_2$/t electrodes (**3.007** see table D.1.1.)

$$SBE_{oxygen\ EAF\_n} = SM_{oxygen\ EAF\_n} /1,000 * EC_{oxygen} * EF_{grid\_region} \qquad \text{(D.1.1.4.-8)}$$

Where:

$SBE_{oxygen\ EAF\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SM_{oxygen\ EAF\_n}$ – specific consumption of oxygen per ton of steel produced by arc-furnace technique at the metallurgical works n, $m^3$ / t steel

$EC_{oxygen}$ – electricity consumption for oxygen production, MWh/ 1,000 $m^3$ (**0.83 MWh/1,000** $m^3$ see table D.1.1.)

$EF_{grid\_region}$ – $CO_2$ emissions factor for grid electricity produced by Unified Energy System of region, where metallurgical works n is situated, t $CO_2$ /MWh (the value of emission factors is in table D.1.1.)

$$SBE_{electricity\ EAF\_n} = SM_{electricity\ EAF\_n} * EF_{grid\_region} \qquad \text{(D.1.1.4.-9)}$$

Where:

$SBE_{electricity\ EAF\_n}$ – specific $CO_2$ emissions from consumption of electricity per ton of steel produced by arc-furnace technique at the metallurgical works n, t $CO_2$/ t steel

$SM_{electricity\ EAF\_n}$ – specific consumption of electricity per ton of steel produced by arc-furnace technique at the metallurgical works n, MWh/ t steel

$EF_{grid\_region}$ – $CO_2$ emissions factor for grid electricity produced by Unified Energy System of region, where metallurgical works n is situated, t $CO_2$ /MWh (the value of emission factors is in table D.1.1.)

*Specific $CO_2$ emissions from production of one ton of steel by converter technique at the metallurgical works n*

$$SBE_{converter\_n} = SBE_{iron\ converter\_n} + SBE_{NG\ converter\_n} + SBE_{oxygen\ converter\_n} \qquad \text{(D.1.1.4.-10)}$$

Where:

SBE $_{converter\_n}$ – specific $CO_2$ emissions from production of one ton of steel by converter technique at the metallurgical works n, t $CO_2$/ t steel

SBE $_{iron\ converter\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by converter technique at the metallurgical works n, t $CO_2$/ t steel

SBE $_{NG\ converter\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by converter technique at the metallurgical works n, t $CO_2$/ t steel

SBE $_{oxygen\ converter\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by converter technique at the metallurgical works n, t $CO_2$/ t steel

$$\textbf{SBE}_{\textbf{iron converter\_n}} = \textbf{SM}_{\textbf{iron converter\_n}} * \textbf{EF}_{\textbf{iron}} \qquad \textbf{(D.1.1.4.-11)}$$

Where:

SBE $_{iron\ converter\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by converter technique at the metallurgical works n, t $CO_2$/ t steel
SM $_{iron\ converter\_n}$ - specific consumption of pig iron per ton of steel produced by converter technique at the metallurgical works n, t pig iron/ t steel
EF $_{iron}$ – $CO_2$ emission factor for iron production, t $CO_2$/t pig iron (**1.35** see table D.1.1.)

$$\textbf{SBE}_{\textbf{NG converter\_n}} = \textbf{SM}_{\textbf{NG converter\_n}} /\textbf{1,000} * \textbf{EF}_{\textbf{NG}} \qquad \textbf{(D.1.1.4.-12)}$$

Where:

SBE $_{NG\ converter\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by converter technique at the metallurgical works n, t $CO_2$/ t steel
SM $_{NG\ converter\_n}$ – specific consumption of NG per ton of steel produced by converter technique at the metallurgical works n, $m^3$/ t steel
EF $_{NG}$ – $CO_2$ emission factor for NG combustion, t $CO_2$/ 1,000 $m^3$ (**1.88** see table D.1.1.)

$$\textbf{SBE}_{\textbf{oxygen converter\_n}} = \textbf{SM}_{\textbf{oxygen converter\_n}} /\textbf{1,000} * \textbf{EC}_{\textbf{oxygen}} * \textbf{EF}_{\textbf{grid\_region}} \qquad \textbf{(D.1.1.4.-13)}$$

Where:

SBE $_{oxygen\ converter\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by converter technique at the metallurgical works n, t $CO_2$/ t steel

$SM_{oxygen\ converter\_n}$ – specific consumption of oxygen per ton of steel produced by converter technique at the metallurgical works n, $m^3$/ t steel

$EC_{oxygen}$ – electricity consumption for oxygen production, MWh/ 1,000 $m^3$ (**0.83,** see table D.1.1.)

$EF_{grid\_region}$ – $CO_2$ emissions factor for grid electricity produced by Unified Energy System of region, where metallurgical works n is situated, t $CO_2$/MWh (the value of emission factors is in table D.1.1.)

*Specific $CO_2$ emissions from production of one ton of steel by pig-and-ore technique at the metallurgical works n*

$$SBE_{pig\text{-}and\text{-}ore\ process\_n} = SBE_{iron\ pig\text{-}and\text{-}ore\ process\_n} + SBE_{NG\ pig\text{-}and\text{-}ore\ process\_n} + SBE_{oxygen\ pig\text{-}and\text{-}ore\ process\_n} \qquad \textbf{(D.1.1.4.-14)}$$

Where:

$SBE_{pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from production of one ton of steel by pig-and-ore technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{iron\ pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by pig-and-ore technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{NG\ pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by pig-and-ore technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{oxygen\ pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by pig-and-ore technique at the metallurgical works n, t $CO_2$/ t steel

$$SBE_{iron\ pig\text{-}and\text{-}ore\ process\_n} = SM_{iron\ pig\text{-}and\text{-}ore\ process\_n} * EF_{iron} \qquad \textbf{(D.1.1.4.-15)}$$

Where:

$SBE_{iron\ pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by pig-and-ore technique at the metallurgical works n, t $CO_2$/ t steel

$SM_{iron\ pig\text{-}and\text{-}ore\ process\_n}$ – specific consumption of pig iron per ton of steel produced by pig-and-ore technique at the metallurgical works n, t pig iron/ t steel

$EF_{iron}$ – $CO_2$ emission factor for iron production, t $CO_2$/t pig iron (**1.35** see table D.1.1.)

$$SBE_{NG\ pig\text{-}and\text{-}ore\ process\_n} = SM_{NG\ pig\text{-}and\text{-}ore\ process\_n} /1,000 * EF_{NG} \qquad \textbf{(D.1.1.4.-16)}$$

Where:

$SBE_{NG\ pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by pig-and-ore technique at the metallurgical works n, t $CO_2/$ t steel

$SM_{NG\ pig\text{-}and\text{-}ore\ process\_n}$ – specific consumption of NG per ton of steel produced by pig-and-ore technique at the metallurgical works n, $m^3/$ t steel

$EF_{NG}$ – $CO_2$ emission factor for NG combustion, t $CO_2/$ 1,000 $m^3$ (**1.88** see table D.1.1.)

$$SBE_{oxygen\ pig\text{-}and\text{-}ore\ process\_n} = SM_{oxygen\ pig\text{-}and\text{-}ore\ process\_n} /1{,}000 * EC_{oxygen} * EF_{grid\_region} \qquad \text{(D.1.1.4.-17)}$$

Where:

$SBE_{oxygen\ pig\text{-}and\text{-}ore\ process\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by pig-and-ore technique at the metallurgical works n, t $CO_2/$ t steel

$SM_{oxygen\ pig\text{-}and\text{-}ore\ process\_n}$ – specific consumption of oxygen per ton of steel produced by pig-and-ore technique at the metallurgical works n, $m^3/$ t steel

$EC_{oxygen}$ – electricity consumption for oxygen production, MWh/ 1,000 $m^3$ (**0.83** see table D.1.1.)

$EF_{grid\_region}$ – $CO_2$ emissions factor for grid electricity produced by Unified Energy System of region, where metallurgical works n is situated, t $CO_2$ /MWh (the value of emission factors is in table D.1.1.)

*Specific $CO_2$ emissions from production of one ton of steel in DBSU at the metallurgical works n*

$$SBE_{DBSU\_n} = SBE_{iron\ DBSU\_n} + SBE_{NG\ DBSU\_n} + SBE_{oxygen\ DBSU\_n} \qquad \text{(D.1.1.4.-18)}$$

Where:

$SBE_{DBSU\_n}$ – specific $CO_2$ emissions from production of one ton of steel in DBSU at the metallurgical works n, t $CO_2/$ t steel

$SBE_{iron\ DBSU\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced in DBSU at the metallurgical works n, t $CO_2/$ t steel

$SBE_{NG\ DBSU\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced in DBSU at the metallurgical works n, t $CO_2/$ t steel

$SBE_{oxygen\ DBSU\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced in DBSU at the metallurgical works n, t $CO_2/$ t steel

$$SBE_{iron\ DBSU\_n} = SM_{iron\ DBSU\_n} * EF_{iron} \qquad \text{(D.1.1.4.-19)}$$

Where:

$SBE_{iron\ DBSU\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced in DBSU at the metallurgical works n, t $CO_2$/ t steel

$SM_{iron\ DBSU\_n}$ – specific consumption of pig iron per ton of steel produced in DBSU at the metallurgical works n, t pig iron/ t steel

$EF_{iron}$ – $CO_2$ emission factor for iron production, t $CO_2$/t pig iron (**1.35** see table D.1.1.)

$$SBE_{NG\ DBSU\_n} = SM_{NG\ DBSU\_n} / 1,000 * EF_{NG} \tag{D.1.1.4.-20}$$

Where:

$SBE_{NG\ DBSU\_n}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced in DBSU at the metallurgical works n, t $CO_2$/ t steel

$SM_{NG\ DBSU\_n}$ – specific consumption of NG per ton of steel produced in DBSU at the metallurgical works n, $m^3$/ t steel

$EF_{NG}$ – $CO_2$ emission factor for NG combustion, t $CO_2$/ 1,000 $m^3$ (**1.879** see table D.1.1.)

$$SBE_{oxygen\ DBSU\_n} = SM_{oxygen\ DBSU\_n} / 1,000 * EC_{oxygen} * EF_{grid\_region} \tag{D.1.1.4.-21}$$

Where:

$SBE_{oxygen\ DBSU\_n}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced in DBSU at the metallurgical works n, t $CO_2$/ t steel

$SM_{oxygen\ DBSU\_n}$ – specific consumption of oxygen per ton of steel produced in DBSU at the metallurgical works n, $m^3$/ t steel

$EC_{oxygen}$ – electricity consumption for oxygen production, MWh/ 1,000 $m^3$ (**0.83** see table D.1.1.)

$EF_{grid\_region}$ – $CO_2$ emissions factor for grid electricity produced by Unified Energy System of region, where metallurgical works is situated n, t $CO_2$ /MWh (the value of emission factors is in table D.1.1.)

*Specific $CO_2$ emissions from production of one ton of steel by scrap technique at the metallurgical works n*

$$SBE_{scrap\ process\_n} = SBE_{iron\ scrap\ process\_n} + SBE_{NG\ scrap\ process\_n} + SBE_{oxygen\ scrap\ process\_n} \tag{D.1.1.4.-22}$$

Where:

$SBE_{scrap\ process\_n}$ – specific $CO_2$ emissions from production of one ton of steel by scrap technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{iron\ scrap\ process\_n}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by scrap technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{\text{NG scrap process\_n}}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by scrap technique at the metallurgical works n, t $CO_2$/ t steel

$SBE_{\text{oxygen scrap process\_n}}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by scrap technique at the metallurgical works n, t $CO_2$/ t steel

$$SBE_{\text{iron scrap process\_n}} = SM_{\text{iron scrap process\_n}} * EF_{\text{iron}} \qquad \text{(D.1.1.4.-23)}$$

Where:

$SBE_{\text{iron scrap process\_n}}$ – specific $CO_2$ emissions from production of pig iron per ton of steel produced by scrap technique at the metallurgical works n, t $CO_2$/ t steel
$SM_{\text{iron scrap process\_n}}$ – specific consumption of pig iron per ton of steel produced by scrap technique at the metallurgical works n, t pig iron/ t steel
$EF_{\text{iron}}$ – $CO_2$ emission factor for iron production, t $CO_2$/t pig iron (**1.35** see table D.1.1.)

$$SBE_{\text{NG scrap process\_n}} = SM_{\text{NG scrap process\_n}} /1,000 * EF_{\text{NG}} \qquad \text{(D.1.1.4.-24)}$$

Where:

$SBE_{\text{NG scrap process\_n}}$ – specific $CO_2$ emissions from consumption of NG per ton of steel produced by scrap technique at the metallurgical works n, t $CO_2$/ t steel
$SM_{\text{NG scrap process\_n}}$ – specific consumption of NG per ton of steel produced by scrap technique at the metallurgical works n, $m^3$/ t steel
$EF_{\text{NG}}$ – $CO_2$ emission factor for NG combustion, t $CO_2$/ 1,000 $m^3$ (**1.88** see table D.1.1.)

$$SBE_{\text{oxygen scrap process\_n}} = SM_{\text{oxygen scrap process\_n}} /1,000 * EC_{\text{oxygen}} * EF_{\text{grid\_region}} \qquad \text{(D.1.1.4.-25)}$$

Where:

$SBE_{\text{oxygen scrap process\_n}}$ – specific $CO_2$ emissions from consumption of oxygen per ton of steel produced by scrap technique at the metallurgical works n, t $CO_2$/ t steel
$SM_{\text{oxygen scrap process\_n}}$ – specific consumption of oxygen per ton of steel produced by scrap technique at the metallurgical works n, $m^3$/ t steel
$EC_{\text{oxygen}}$ – electricity consumption for oxygen production, MWh/ 1,000 $m^3$ (**0.83** see table D.1.1.)
$EF_{\text{grid\_region}}$ – $CO_2$ emissions factor for grid electricity produced by Unified Energy System of region, where metallurgical works n is situated, t $CO_2$ /MWh (the value of emission factors is in table D.1.1.)

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

| **D.1.2.1.   Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
| | | | | | | | | |
| | | | | | | | | |

Not applicable

| **D.1.2.2.   Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO$_2$ equivalent):** |
|---|

Not applicable

| **D.1.3.   Treatment of leakage in the monitoring plan:** |
|---|

The proposed project may have technological leakage effects in the result of:

1.  Transportation of raw materials and products as the result of project implementation;

2.  Transportation of natural gas and electricity;

3.  Use of carbon-containing wastes.

The consumption of carbon-bearing raw materials in the production of slab steel billet by arc-furnace technique at MMK is smaller than in the production of slab steel billet by the most popular technique in Russia – converter technique (the consumption of pig iron in EAFP is 37%, in converter – 75%). Therefore leakage in the production of slab steel billet in the baseline would be more than in the project and they are not included for reasons of conservativeness approach.

A certain fraction of blast furnace dust formed in the BFP is transported to the cement factory outside MMK. CO$_2$ emissions during utilization of this dust at the cement factory are considered as leakages in the monitoring plan of the JI Project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel

Works". This PDD had been determined by independent expertise (determination) by Bureau Veritas[49]. To avoid double counting, $CO_2$ emissions during utilization of this dust at the cement factory are not calculated in this project.

| D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
| | | | | | | | | |
| | | | | | | | | |

Not applicable

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

See section D.1.3.

| 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:

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

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

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

$PE_y$ – Project emissions in the period y, t $CO_2$-eq

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

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

For confirmation of MPE the air emissions were estimated by OJSC "Magnitogorsk GIPROMEZ" in accordance with Russian "Guidelines for calculation of industrial emissions of air pollutants" (OND-86)[50]. These estimations were based on OJSC "MMK" Emission Inventory and Emission Sources Report done by Federal State Unitary Enterprise "All-Russian Institute for Carbon Chemistry" in Yekaterinburg (2008). This report was approved according to the established procedure.

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

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

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

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

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

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

| D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored: | | |
|---|---|---|
| Data *(Indicate table and ID number)* | Uncertainty level of data (high/medium/low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
| Table D.1.1.1. P-1 $M_{coking\ coal\_CP\_PJ}$ | Low | Consumption of coal charge is calculated based on gross coke production. The production of gross coke is calculated as a sum of weighted 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. 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 it is 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 $P_{coal-tar\_PJ}$ | 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 based on actual number of burned candles of electrodes (utilized fully without remains) and their weight, which is indicated in technical passport issued by the supplier. |
| P-25 $\Sigma$P $_{profiled\ \&\ slab\ steel\_EAFP}$ <br> P-26 P $_{slab\ steel\_\ EAFP}$ <br> 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-49 FC $_{energy\ coal\_CHPP\_PJ}$ | Low | The incoming power station coal is weighed at the scales. |
| P-2 %C $_{coking\ coal\_CP\_PJ}$ <br> 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 $_{BFG\_.PJ}$ <br> 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 $_{BFG\_CP\_PJ}$ <br> P-5 FC $_{COG\_CP\_PJ}$ <br> P-7 FC $_{NG\_CP\_PJ}$ <br> P-11 P $_{COG\_CP\_PJ}$ <br> P-15 FC $_{COG\_BF\_PJ}$ <br> P-17 FC $_{BFG\_BF\_PJ}$ <br> P-19 P $_{BFG\_BF\_PJ}$ <br> P-24 FC $_{NG\_EAFP}$ <br> P-41 FC $_{BFG\_CPP\_PJ}$ <br> P-44 FC $_{BFG\_SABPP\_PJ}$ <br> P-45 FC $_{COG\_SABPP\_PJ}$ <br> P-51 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. |

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| | | |
|---|---|---|
| P-16 FC $_{NG\_BF\_PJ}$<br>P-42 FC $_{NG\_CPP\_PJ}$<br>P-43 FC $_{NG\_CHPP\_PJ}$<br>P-46 FC $_{NG\_SABPP\_PJ}$<br>P-47 FC $_{NG\_turbine\ section\ of\ SP\ \_PJ}$<br>P-48 FC $_{NG\_gas\ recovery\ unit\text{-}2\ of\ SP\ \_PJ}$<br>P-52 FC $_{COG\_SABPP\_\ air\ blast\ generation\ \_PJ}$<br>P-53 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 $_{grid\_sleel\_EAF}$<br>P-30 EF $_{EAFP}$<br>P-31 EC $_{gross\_PJ}$<br>P-32 EC $_{import\_PJ}$ | Low | See Annex 3. |
| P-39 SEC $_{O2\ OCS\#1}$<br>P-40 SEC $_{O2\ OCS\#2}$ | Low | CEST experts calculate these parameters on the basis of electricity consumption and amount of gas formed in OCS. |
| P-33 V $_{N2\_EAFP}$<br>P-34 V $_{pure\_N2\_EAFP}$<br>P-35 V $_{Ar\ \_EAFP}$<br>P-36 V $_{O2\ EAFP}$<br>P-37 P $_{O2\ OCS\ \#1}$<br>P-38 P $_{O2\ OCS\ \#2}$ | Low | Consumption of nitrogen, pure nitrogen, argon and oxygen is measured by gas flow meters. |
| P-50 OC $_{air\ blast\ generation\_PJ}$ | Low | Production of air blast at SABPP turbine is measured by air flow meter. |
| B-1 $\omega_n$<br>B-2 $\omega_{EAF\_n}$<br>B-3 $\omega_{converter\_n}$<br>B-4 $\omega_{pig\text{-}and\text{-}ore\ process\_n}$<br>B-5 $\omega_{DBSU\_n}$<br>B-6 $\omega_{scrap\ process\_n}$ | Low | These parameters are calculated based on data of annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC. Founders of Corporation are enterprises and associations of ferrous metallurgy. In accordance with Governmental regulation "Corporation CHERMET", LLC shall coordinate the work of all Russian enterprises of ferrous metallurgy. Therefore, these reports and their derivatives are reliable and have a low level of uncertainty. |

| | | |
|---|---|---|
| B-7 $SM_{iron\ EAF\_n}$<br>B-8 $SM_{NG\ EAF\_n}$<br>B-9 $SM_{electrodes\_n}$<br>B-10 $SM_{oxygen\ EAF\_n}$<br>B-11 $SM_{electricity\ EAF\_n}$<br>B-12 $SM_{iron\ converter\_n}$<br>B-13 $SM_{NG\ converter\_n}$<br>B-14 $SM_{oxygen\ converter\_n}$<br>B-15 $SM_{iron\ pig\text{-}and\text{-}ore\ process\_n}$ | Low | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC. Founders of Corporation are enterprises and associations of ferrous metallurgy. In accordance with Governmental regulation "Corporation CHERMET", LLC shall coordinate the work of all Russian enterprises of ferrous metallurgy. Therefore, these reports and their derivatives are reliable and have a low level of uncertainty. |
| B-16 $SM_{NG\ pig\text{-}and\text{-}ore\ process\_n}$<br>B-17 $SM_{oxygen\ pig\text{-}and\text{-}ore\ process\_n}$<br>B-18 $SM_{iron\ DBSU\_n}$<br>B-19 $SM_{NG\ DBSU\_n}$<br>B-20 $SM_{oxygen\ DBSU\_n}$<br>B-21 $SM_{iron\ scrap\ process\_n}$<br>B-22 $SM_{NG\ scrap\ process\_n}$<br>B-23 $SM_{oxygen\ scrap\ process\_n}$ | Low | Annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC. Founders of Corporation are enterprises and associations of ferrous metallurgy. In accordance with Governmental regulation "Corporation CHERMET", LLC shall coordinate the work of all Russian enterprises of ferrous metallurgy. Therefore, these reports and their derivatives are reliable and have a low level of uncertainty. |

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

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

Diagram D.3.1: Management structure of monitoring process
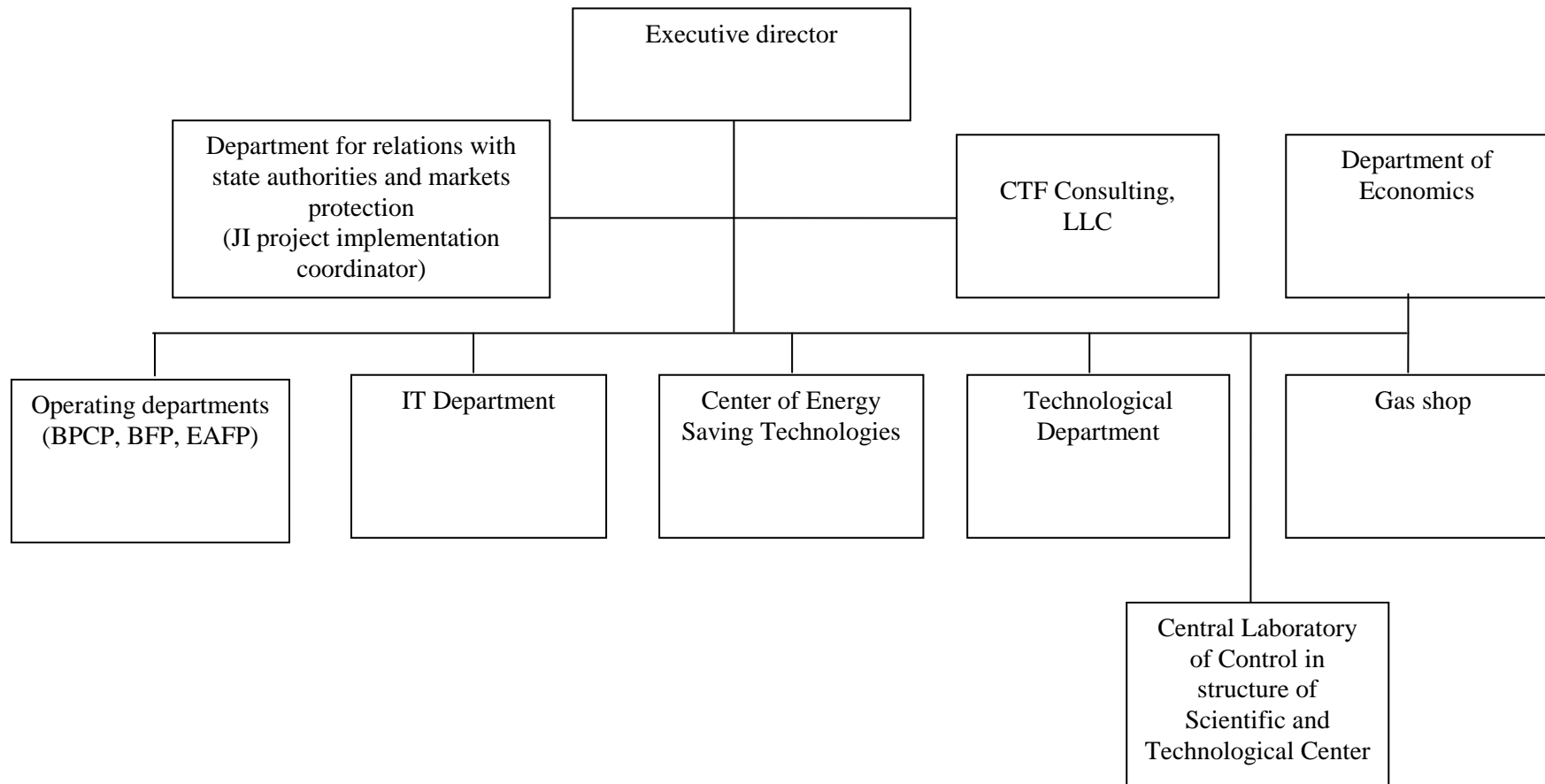
**Organization of monitoring process**

Approved internal procedure PD MMK 3-SSGO-01-2010 "Monitoring of GHGs emission reduction units generated by the JI projects" are in operation at MMK. This document defines the procedure of regular monitoring of GHGs emission reduction units generated by the following JI projects:

1.  Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works

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

As far as monitoring parameters of current project and JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works" are practically identical, so this procedure PD MMK 3-SSGO-01-2010 can be used for the monitoring of GHGs emission reduction units generated by the JI project "Production of continuously casted slab steel billet by arc-furnace technique at OJSC MMK". However this procedure will be updated taking into account monitoring parameters which are characteristic of current project.

Following order is described according to the procedure.

The MMK's structural departments which have a function of processing of 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 of the reporting data allocation and monitors the changes in the reporting forms or procedures of monitoring.

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

CTF Consulting, LLC. develops for JSC "MMK" annual monitoring report under the monthly 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, 15 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 by EAF-180, other equipment of EAFP and electricity consumption for production of nitrogen, pure nitrogen, argon and oxygen needed for production of slab steel billet |
| 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 |
| 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 |
| 18 | Department for relations with state authorities and markets protection | Annual report (also released quarterly) "Analysis of the expenditure of materials and process | Specific consumption of raw materials and electricity for |

| | | fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC | production of steel at the metallurgical works and volumes of steel production |
|---|---|---|---|

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

The developer of monitoring plan:

"CTF Consulting", LLC

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

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

## SECTION E.   Estimation of greenhouse gas emission reductions

### E.1.      Estimated project emissions:

*Project emissions in 2008-2009*

Project emissions for 2008-2009 were calculated using the formulae in Section D.1.1.2, on the basis of actual annual data reported by OJSC "MMK". Initial data for the calculation of project emissions are taken from the same reporting documents and forms that were used for monitoring report of GHGs emission reduction for JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works". Monitoring report had been verified by independent expertise (determination) of Bureau Veritas. Positive opinion has been issued by 19.10.2010.

The global financial crisis that started in late 2008 led to the emergence of global problems in the economy, one of which was the instability of demand of the steel consuming industries. Annual production of steel at MMK in 2009 was 9.618 million tons (compared to 11.957 million tons in 2008), and commercial products – 8.764 million tons (10.911 million tons in 2008).

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 and slab steel was produced only at one DBSU. That is why emission reduction is absent for 2009.

$CO_2$ emissions from consumption of electricity from corporate grid of MMK for production of oxygen needed for production of slab steel billet were calculated by the same as formula D.1.1.2.-22:

$$PE_{EC\_O2\_slab\_steel} = EC_{O2\_slab\_steel} * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/(EC_{gross\_PJ} - EC_{grid\_steel\_EAF}) \quad (E.1.-1)$$

Where:

$PE_{EC\_O2\_slab\_steel}$ - $CO_2$ emissions from consumption of electricity from corporate grid of MMK for production of oxygen needed for production of slab steel billet, thousand tons of $CO_2$

$EC_{O2\_slab\_steel}$ - Electricity consumption for production of oxygen, which is used during production of slab steel billet in EAFP, GWh

$EF_{own\ generation\_PJ}$ – $CO_2$ 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, GWh

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

$EC_{gross\_PJ}$ – Total electricity consumption by MMK, GWh

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

Electricity consumption for production of oxygen, which is used during production of slab steel billet in EAFP is calculated on basis of specific consumption of oxygen in EAFP ($SV_{O2\_EAFP}$). The sources of data for calculation of $SV_{O2\_EAFP}$ is the annual report (also released quarterly) report "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC.

$$EC_{O2\_slab\_steel} = SEC_{O2\_PJ} * SV_{O2\_EAFP} * P_{slab\_steel\_EAFP} \quad (E.1.-2)$$

Where:

EC $_{O2\_slab\_steel}$ - Electricity consumption for production of oxygen, which is used during production of slab steel billet in EAFP, GWh

SEC $_{O2\_PJ}$ – Specific electricity consumption for production of oxygen at MMK, MWh/1,000 m$^3$ (calculated in accordance with formula **D.1.1.2.-24** in Section D)

SV$_{O2\_EAFP}$ – Specific consumption of oxygen in EAFP, ths. m$^3$/ t steel

P $_{slab\_steel\_EAFP}$ - Output of slab steel billet in EAFP, thousand tons

**Specific consumption of oxygen in EAFP**

$$SV_{O2\_EAFP} = ((P_{\text{slab steel\_EAF-180}} * SV_{O2\,EAF}) + (P_{\text{slab steel\_DBSU}} * SV_{O2\,DBSU}))/1,000/(P_{\text{slab steel\_EAF-180}} + P_{\text{slab steel\_DBSU}}) \quad \text{(E.1.-3)}$$

Where:

SV$_{O2\_EAFP}$ – Specific consumption of oxygen in EAFP, ths. m$^3$/ t steel

P $_{slab\ steel\_EAF-180}$ – Smelting of slab steel grades by EAF-180 in EAFP, tons (the data of technical report of EAFP), tons

P $_{slab\ steel\_DBSU}$ – Smelting of slab steel grades by DBSU in EAFP, tons

SV $_{O2\ EAF}$ – Specific consumption of oxygen by EAF-180 in EAFP (the data of "Corporation CHERMET", LLC, m$^3$/t

SV $_{O2\ DBSU}$ – Specific consumption of oxygen by DBSU in EAFP (the data of "Corporation CHERMET", LLC), m$^3$/t

*Project emissions in 2010-2012*

For the calculation of project emissions for 2010-2012 the planned output of slab steel billet in EAFP MMK was taken into account (table E.1-1.).

Project emissions for 2010 were calculated with formulae of Section D.1.1.2 using the MMK's actual values of monitoring parameters for six months of 2010 in annualized terms (except slab steel billet production data).

Table E.1-1. Actual (2010) and planned (2011-2012) output of slab steel billet in EAFP MMK

| # | Parameter, data unit | 2010[51] | 2011[52] | 2012[53] |
|---|---|---|---|---|
| 1. | P $_{slab\ steel\ EAFP\ MMK}$, tons | 779,783 | 1,378,000 | 1,895,000 |

For the calculation of project emissions in 2011-2012 specific coefficients of 2008 were used, because 2008 – the most representative year (the global financial crisis had an influence upon the production factors in 2009 and the beginning of 2010).

Table E.1-2. The value of specific coefficients 2011-2012

| # | Parameter, data unit | Value |
|---|---|---|
| 1. | SPE $_{metallurgical\_coke}$, t $CO_2$/t | 0.994 |
| 2. | SPE $_{pig\ iron}$, t $CO_2$/t | 0.798 |
| 3. | SPE $_{EAFP}$, t $CO_2$/t | 0.110 |
| 4. | Share of steel produced in EAF, nondimensional | 0.90 |

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[51] Actual output of slab steel billet in EAFP MMK according to technical report of EAFP (data for 12 months).

[52] Annual production programme of MMK (dated January 2011)

[53] Strategic programme of MMK

| 5. | Share of steel produced in DBSU, nondimensional | 0.10 |
|----|----|----|
| 6. | $SC_{pig\ iron\_EAFP}$, t pig iron/t steel | 0.325 |
| 7. | $SC_{scrap\_EAFP}$, t scrap/t steel | 0.801 |
| 8. | $SC_{skip\_metallurgical\_coke}$, t coke/t steel | 0.461 |
| 9. | $SEC_{steel\ refinement\ and\ casting\ EAFP}$, MWh/t | 0.055 |
| 10. | $SEC_{grid\_steel\_EAF}$, MWh/t | 0.294 |
| 11. | $SV_{N2\_EAFP}$, 1,000 $m^3$/t steel | 0.009 |
| 12. | $SV_{pure\_N2\_EAFP}$, 1,000 $m^3$/t steel | 0.0008 |
| 13. | $SV_{pure\_Ar\_EAFP}$, 1,000 $m^3$/t steel | 0.001 |
| 14. | $SEC_{O2\_PJ}$, MWh/1,000 $m^3$ | 0.471 |
| 15. | $SV_{O2\_EAFP}$, ths. $m^3$/ t steel | 0.055 |
| 16. | $SC_{air\ blast\ generation}$, ths. $m^3$/t pig iron | 2.514 |
| 17. | $EF_{air\ blast\ generation\_PJ}$, t $CO_2$/1,000 $m^3$ | 0.053 |
| 18. | $EF_{own\ generation\_PJ}$, t $CO_2$/ MWh | 0.832 |
| 19. | TDL, % | 7.36 |

The value of share of steel produced in EAF was estimated by the following formula:

$$\omega_{arc\text{-}furnace\ steel\ in\ EAFP} = \sum P_{steel\_EAF} / \sum P_{profiled\ \&slab\ steel\_EAFP} \qquad \textbf{(E.1.-4)}$$

Where:

$\omega_{arc\text{-}furnace\ steel\ in\ EAFP}$ - share of steel produced in EAF, nondimensional

$\sum P_{steel\_EAF}$ – total smelting of steel in EAF-180, ths. t

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

The value of share of steel produced in DBSU was estimated by the following formula:

$$\omega_{steel\ of\ DBSU\ in\ EAFP} = (\sum P_{profiled\&slab\ steel\_EAFP} - \sum P_{steel\_EAF}) / \sum P_{profiled\&slab\ steel\_EAFP} \qquad \textbf{(E.1.-5)}$$

Where:

$\omega_{steel\ of\ DBSU\ in\ EAFP}$ – share of steel produced in DBSU, nondimensional

$\sum P_{steel\_EAF}$ – total smelting of steel in EAF-180, ths. t

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

$CO_2$ emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of slab steel billet were estimated by another equation than in the PDD. 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 2011-2012.

Accordingly $CO_2$ emissions from consumption of electricity from corporate MMK grid for production of nitrogen, pure nitrogen, and argon during production of slab steel billet in EAFP in 2011-2012 were estimated by the following formula:

$$PE_{EC\_Ar\_N2\_slab\_steel} = (EC_{N2\_slab\_steel} + EC_{pure\ N2\_slab\_steel} + EC_{Ar\_slab\_steel}) * EF_{own\ generation\_PJ}$$

$$(E.1.-6)$$

Where:

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

$EC_{N2\_slab\_steel}$ - Electricity consumption for production of nitrogen, which is used during production of slab steel billet in EAFP, GWh

$EC_{pure\ N2\_slab\_steel}$ - Electricity consumption for production of pure nitrogen, which is used during production of slab steel billet in EAFP, GWh

$EC_{Ar\_slab\_steel}$ - Electricity consumption for production of argon, which is used during production of slab steel billet in EAFP, GWh

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

$CO_2$ emissions from consumption of electricity from corporate grid of MMK, for production of oxygen for production of slab steel billet in 2011-2012 were estimated by the following formula:

$$PE_{EC\_O2\_slab\_steel} = EC_{O2\_slab\_steel} * EF_{own\ generation\_PJ} \qquad (E.1.-7)$$

Where:

$PE_{EC\_O2\_slab\_steel}$ - $CO_2$ emissions from consumption of electricity from corporate grid of MMK, for production of oxygen needed for production of slab steel billet, thousand tons of $CO_2$

$EC_{O2\_slab\_steel}$ - Electricity consumption for production of oxygen, which is used during production of slab steel billet in EAFP, GWh

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

$CO_2$ emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) were estimated by the follow formula:

$$PE_{EC\_slab\_steel\_other\ EAFP} = (SEC_{steel\ refinement\ and\ casting\ EAFP} * P_{slab\ steel\_EAFP} + SEC_{steel\_OHFP} * P_{slab\ steel\_EAFP} * \omega_{steel\ of\ DBSU\ in\ EAFP}) * EF_{own\ generation\_PJ}$$

$$(E.1.-8)$$

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 slab 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

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

$SEC_{steel\_OHFP}$ – Specific consumption of electricity in OHFP, MWh/t

$\omega_{\text{steel of DBSU in EAFP}}$ – share of steel produced in DBSU, nondimensional

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

Table E.1-3: Project $CO_2$ emissions, tons $CO_2$/year

| Parameter | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| *Project emissions from metallurgical shops (BPCP, BFP, EAFP)* | | | | | |
| Output of coke in BPCP for production of corresponding amount of pig iron | 215,083 | 104,196 | 149,532 | 205,078 | 282,020 |
| Output of pig iron in BFP for production of slab steel billet | 374,470 | 163,749 | 217,622 | 357,051 | 491,010 |
| Production of slab steel billet in EAFP | 158,406 | 68,862 | 122,530 | 151,037 | 207,704 |
| *Project emissions from electricity consumption in EAFs, other technological equipment in the EAFP, oxygen compressor shops* | | | | | |
| Electricity consumption by EAFs | 222,439 | 23,073 | 102,327 | 212,092 | 291,665 |
| Electricity consumption for production of consumed nitrogen, pure nitrogen, argon | 2,998 | 0,748 | 1,305 | 2,373 | 3,264 |
| Electricity consumption by other technological equipment (including DBSU) in the EAF plant | 63,418 | 28,354 | 49,768 | 63,755 | 87,674 |
| Electricity consumption for production of oxygen | 29,774 | 8,978 | 15,012 | 29,932 | 41,162 |
| *Project emissions from generation of air blast* | | | | | |
| Consumption of air blast for production of corresponding amount of pig iron | 62,550 | 33,468 | 47,222 | 59,640 | 82,016 |
| **Total:** | **1,129,139** | **431,430** | **705,319** | **1,080,959** | **1,486,514** |

### E.2.    Estimated leakage:

$CO_2$ emissions during utilization of the blast furnace dust at the cement factory are considered as leakages in the monitoring plan of the JI Project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works". This PDD had been determined by independent expertise (determination) by Bureau Veritas[54]. To avoid double counting, $CO_2$ emissions during utilization of blast furnace dust at the cement factory are not calculated in this project.

### 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 from metallurgical shops (BPCP, BFP, EAFP)* | | | | | |
| Output of coke in BPCP for production | 215,083 | 104,196 | 149,532 | 205,078 | 282,020 |

---

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

| | | | | | |
|---|---|---|---|---|---|
| of corresponding amount of pig iron | | | | | |
| Output of pig iron in BFP for production of slab steel billet | 374,470 | 163,749 | 217,622 | 357,051 | 491,010 |
| Production of slab steel billet in EAFP | 158,406 | 68,862 | 122,530 | 151,037 | 207,704 |
| *Project emissions from electricity consumption in EAFs, other technological equipment in the EAFP, oxygen compressor shops* | | | | | |
| Electricity consumption by EAFs | 222,439 | 23,073 | 102,327 | 212,092 | 291,665 |
| Electricity consumption for production of consumed nitrogen, pure nitrogen, argon | 2,998 | 0.748 | 1,305 | 2,373 | 3,264 |
| Electricity consumption by other technological equipment (including DBSU) in the EAF plant | 63,418 | 28,354 | 49,768 | 63,755 | 87,674 |
| Electricity consumption for production of oxygen | 29,774 | 8,978 | 15,012 | 29,932 | 41,162 |
| *Project emissions from generation of air blast* | | | | | |
| Consumption of air blast for production of corresponding amount of pig iron | 62,550 | 33,468 | 47,222 | 59,640 | 82,016 |
| **Total:** | **1,129,139** | **431,430** | **705,319** | **1,080,959** | **1,486,514** |

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**E.4.    Estimated baseline emissions:**

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Baseline emissions in 2008-2009 were calculated using the formulae in Section D.1.1.4. The output of slab steel billet in EAFP MMK is equal in the project and in the baseline.

Data for the calculation of integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet were taking from annual report (also released quarterly) "Analysis of the expenditure of materials and process fuel by production of pig iron, steel and rolled iron at ferrous metallurgy works", "Corporation CHERMET", LLC, where technique of steel production, volume of steel production and specific consumption of carbon-bearing raw materials, fuel and energy (consumption of pig iron, natural gas, electrodes, electricity, oxygen) are identified.

Because of the absence of data of changes in specific consumption of carbon-bearing raw materials, fuel and energy at the metallurgical works of Russia and the volume of steel production the value of integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet in 2011-2012 is equal to the value of 2010. Recently, structural changes took place in the ferrous metallurgy (as a result of reconstruction of steelmaking process in the metallurgical works, open-hearth plants were dismantled), so baseline is dynamic. According to the Strategy of development of the metallurgical industry of Russia until 2020 the open-hearth plants will be fully dismantled in several years and the share of oxygen converter plants will increase in perspective [55]. Thereby usage of 2010 year as the most representative creates a more realistic baseline.

Table E.4-1. Actual and planned output of slab steel billet in EAFP MMK and integrated $CO_2$ emission factor for steel production at the Russian metallurgical works with capacity for production of slab steel billet

| # | Parameter, data unit | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|

---

| 1. | $P_{slab\ steel\ EAFP\ MMK}$, tons | 1,445,229 | 372,454 | 779,783 | 1,378,000 | 1,895,000 |
|----|------|------|------|------|------|------|
| 2. | $EF_{integrated\_Russian\ metallurgical\ plants}$, t $CO_2$/t | 1.103 | 1.132 | 1.148 | 1.148 | 1.148 |

The data of specific consumption of carbon-bearing raw materials for production one ton steel by scrap technique at JSC "Ashinskiy metallurgical works" and "Metallurgical Plant Petrostal" Closed JSC were absent in the reports of "Corporation CHERMET", LLC in 2008-2010. Only total volume of steel production by scrap technique is known for these enterprises.

Scrap technique of steel production is implemented at four pipe plants, which are not considered for the determination of baseline emissions, so they are chosen as reference.

Table E.4-2. Specific $CO_2$ emissions from production of one ton of steel by scrap technique at the pipe plants, which are not included under the project boundary

| # | Pipe plant | 2008 | 2009 | 2010 |
|---|-----------|------|------|------|
| 1. | JSC "Vyksa Steel Works" | 0.680 | 0.704 | 0.709 |
| 2. | JSC "Seversky Pipe Plant" | 0.752 | 0.736 | 0.00 |
| 3. | JSC "Taganrog Steel Works" | **0.550** | **0.623** | **0.619** |
| 4. | OJSC "Chelyabinsk Tube Rolling Plant" | 0.844 | 0.856 | 0.751 |

General $CO_2$ emission factor for steel production by scrap technique at OJSC "Ashinskiy metallurgical works" and "Metallurgical Plant Petrostal" Closed JSC is assumed to be equal to specific $CO_2$ emissions from production of one ton of steel at JSC "Taganrog Steel Works", as the lowest and therefore most conservative value (in according to IPCC Guidelines 2006, Chapter 4, table 4.1. $CO_2$ emission factor of steel production by Open Hearth Furnace is 1.72 t $CO_2$/ t steel).

The share of steel production at OJSC "Ashinskiy metallurgical works" and "Metallurgical Plant Petrostal" Closed JSC is 1.7 % in the whole volume of steel production by Russian metallurgical works with capacity for production of slab steel billet (data of 2008-2010), so the uncertainty is insignificant when the above-described method is used.

The data of specific consumption of carbon-bearing raw materials, fuel and energy for production one ton steel by arc-furnace technique at JSC "Amurmetal", "Metallurgical Plant "Kamasteel", LLC, "Novorossmetal", LLC and JSC "United Metallurgical Company" were absent in the reports of "Corporation CHERMET", LLC in 2008-2010. Only total volume of steel production by arc-furnace technique is known for these enterprises.

JI project "Production modernisation at OJSC Amurmetal, Komsomolsk-on-Amur, Khabarovsk Krai, Russian Federation" is implemented at JSC "Amurmetal". PDD was published in UNFCCC website in 2010[56]. The value of specific consumption of carbon-bearing raw materials, fuel and energy is taken from PDD because the most modern technology of steel production is used.

There are facilities for the production of pig iron at JSC "Amurmetal". The plant consists of scrap preparing shop, EAFPs and two rolling mills. A similar situation is observed at "Metallurgical Plant "Kamasteel", LLC, "Novorossmetal", LLC and JSC "United Metallurgical Company", so the similar specific consumptions of raw materials, fuel and energy are used for the listed above enterprises.

The share of steel production at "Metallurgical Plant "Kamasteel", LLC, "Novorossmetal", LLC and JSC "United Metallurgical Company" is 2.7 % in the whole volume of steel production by Russian

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[56]http://ji.unfccc.int/JI_Projects/DB/UVNZRJEB5WZQ7N9UR9YINGKVG1QXM0/PublicPDD/QL4F4O8TJVW1IVEFPUFEJRK9FRF0TM/view.html

metallurgical works with capacity for production of slab steel billet (data of 2009), so the uncertainty is insignificant when the above-described method is used.

Table E.4-3. Baseline $CO_2$ emissions, tons $CO_2$/year

| Parameter | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| Consumption of pig iron for production of slab steel | 1,467,728 | 390,566 | 832,020 | 1,470,311 | 2,021,945 |
| Consumption of natural gas for production of slab steel | 33,703 | 6,148 | 12,213 | 21,583 | 29,680 |
| Consumption of oxygen for production of slab steel | 44,593 | 11,421 | 24,037 | 42,477 | 58,414 |
| Consumption of electrodes for production of slab steel | 1,612 | 0,414 | 0,866 | 1,530 | 2,103 |
| Consumption of electricity for production of slab steel | 45,915 | 13,138 | 25,665 | 45,355 | 62,371 |
| **Total:** | **1,594,353** | **421,738** | **894,802** | **1,581,255** | **2,174,513** |

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

We used Equation D.1.4.-1. to estimate total emission reductions (**1,842,992 tCO$_2$-eq.**) and average annual emission reductions (**368,598 tCO$_2$-eq.**)

During the credit period of 2013-2020, projected annual emission reductions will be equal to those in 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 | 1,129,139 | 0 | 1,594,353 | 465,214 |
| 2009 | 431,430 | 0 | 421,738 | 0 |
| 2010 | 705,319 | 0 | 894,802 | 189,483 |
| 2011 | 1,080,959 | 0 | 1,581,255 | 500,297 |
| 2012 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| Total (tonnes of $CO_2$ equivalent) | 4,833,361 | 0 | 6,666,662 | 1,842,992 |

Project emissions are more than baseline emissions in 2009. Emission reductions are absent and equal a zero in 2009.

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 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| 2014 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| 2015 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| 2016 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| 2017 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| 2018 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| 2019 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| 2020 | 1,486,514 | 0 | 2,174,513 | 687,999 |
| Total (tonnes of CO$_2$ equivalent) | 11,892,115 | 0 | 17,396,105 | 5,503,990 |

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

| **SECTION F.   Environmental impacts** |
|---|

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

Article 32 of the Federal Law on environmental protection #7-FZ 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."

Installation slab CCM #5 was composed of construction the complex EAFP MMK.

Complex EAFP consists of:

- EAF-180 #1,2;

- DBSU #32;

- LFA #1,2,3. 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 slab CCM #5;

- Section continuous casting machines №1, 2;

- Slab CCM №5.

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 result in considerable reductions of negative environmental impacts because resource-saving technologies of steel smelting and casting have been implemented. Project implementation brings about considerable reductions of harmful emissions.

Commissioning of electric arc furnace plant complex at MMK has 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) are 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 have been implemented to reduce air emissions.

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

- Electric arc at LFA;

- Ventilation equipment;

- Central conditioners

Several measures are implemented 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 reduce noise pollution outside the plant building below the applicable environmental standard. Residential areas haven't been affected by the sources of noise pollution.

Project implementation has impacts on surface waters. To reduce water pollution a closed-loop water supply system with chemical treatment has been implemented for cooling of CCM №1, 2, 5 and LFA. Polluted waste waters after secondary cooling pass through the pumping station and 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 is associated with 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.

Transboundary effects were not determined because as a result of project implementation and realization of several environmental measures which are listed above, the impact of MMK on the ambient air is regional in nature.

The realization of technical solutions under the proposed project has accompanied with 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.

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**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:**

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

A central city newspaper "Magnitogorskiy Rabochiy" 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 <u>PROJECT PARTICIPANTS</u>

| | |
|---|---|
| Organisation: | OJSC "Magnitogorsk Iron and Steel Works" |
| Street/P.O.Box: | Kirova |
| Building: | 93 |
| City: | Magnitogorsk |
| State/Region: | Chelyabinsk Region |
| Postal code: | 455000 |
| Country: | Russia |
| Phone: | +7 (3519) 24-40-09 |
| Fax: | +7 (3519) 24-73-09 |
| E-mail: | |
| URL: | www.mmk.ru |
| Represented by: | |
| Title: | Manager of environmental and regional programs |
| Salutation: | Mr. |
| Last name: | Mitchin |
| Middle name: | |
| First name: | Andrey |
| Department: | Department for relations with state authorities and markets protection |
| Phone (direct): | +7 (3519) 24-40-09 |
| Fax (direct): | +7 (3519) 24-73-09 |
| Mobile: | |
| Personal e-mail: | mitchin@mmk.ru |

| | |
|---|---|
| Organisation: | Carbon Trade & Finance Sicar S.A. |
| Street/P.O.Box: | Route de Treves |
| Building: | 6a |
| City: | Senningerberg |
| State/Region: | - |
| Postal code: | L-2633 |
| Country: | Luxembourg |
| Phone: | +35226945752 |
| Fax: | +35226945754 |
| E-mail: | Info@carbontradefinance.com |
| URL: | http://www.carbontradefinance.com/ |
| Represented by: | |
| Title: | Executive Director |
| Salutation: | Mr. |
| Last name: | Ramming |
| Middle name: | |
| First name: | Ingo |
| Department: | - |
| Phone (direct): | +35226945752 |
| Fax (direct): | +35226945754 |
| Mobile: | +4915116702663 |
| Personal e-mail: | Ingo.ramming@carbontradefinance.com |

Annex 2

## BASELINE INFORMATION

**Metallurgical enterprises of Russia with capacity for production of the slab steel billet**

OJSC "Cherepovets Steel Mill"

OJSC "Cherepovets Steel Mill" (CherMK) is the second largest steel mills in Russia and is part of the metallurgical division of OJSC "Severstal"[57]. The mill is a full cycle metallurgical enterprise.

The products of CherMK include five types of proceedings:

- Production of coke

- Blast furnace production

- Oxygen-converter plant, open hearth furnace plant (closed at the end of 2008) and electric arc furnace plant;

- **Manufacture of flat-rolled metal (bold text confirms that enterprises produce slab steel billets and products from its)**

- Production of long-rolled metal products

Casting of steel is carried out in continuous casting machines.

Thus the company can offer its customers a wide range of products: hot rolled and cold rolled steel products, including blank rectangular billet (slab) OST 14-17-75 150-260x300-1080 mm[58], formed shapes and pipes, rolled sections, as well as various coke and related products.
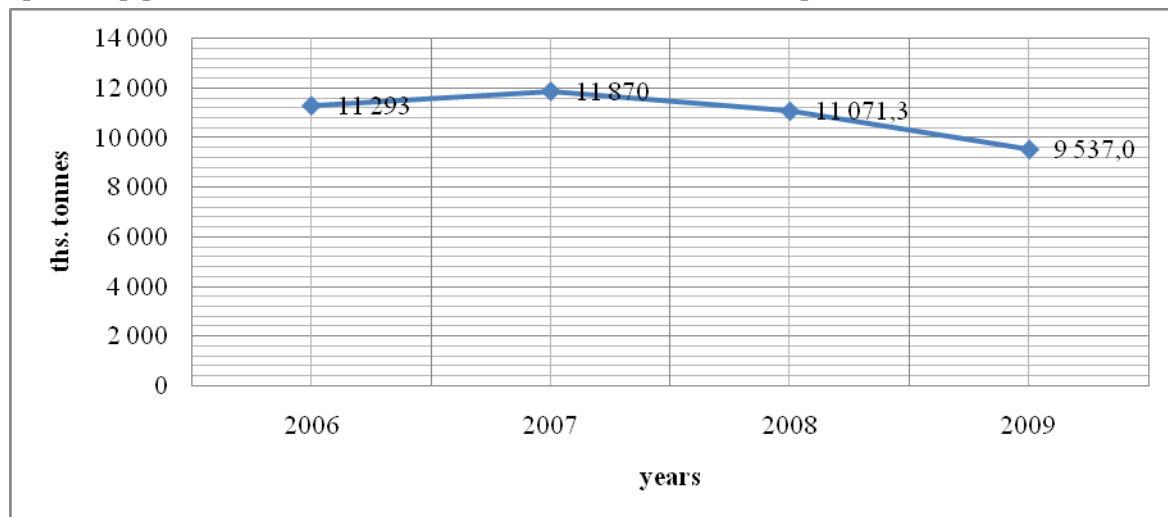


Figure 2-1. Steel production by CherMK

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[57] http://www.metaprom.ru/pub197.html

[58] http://www.metall-online.net/manufacters/manufacters_188.html
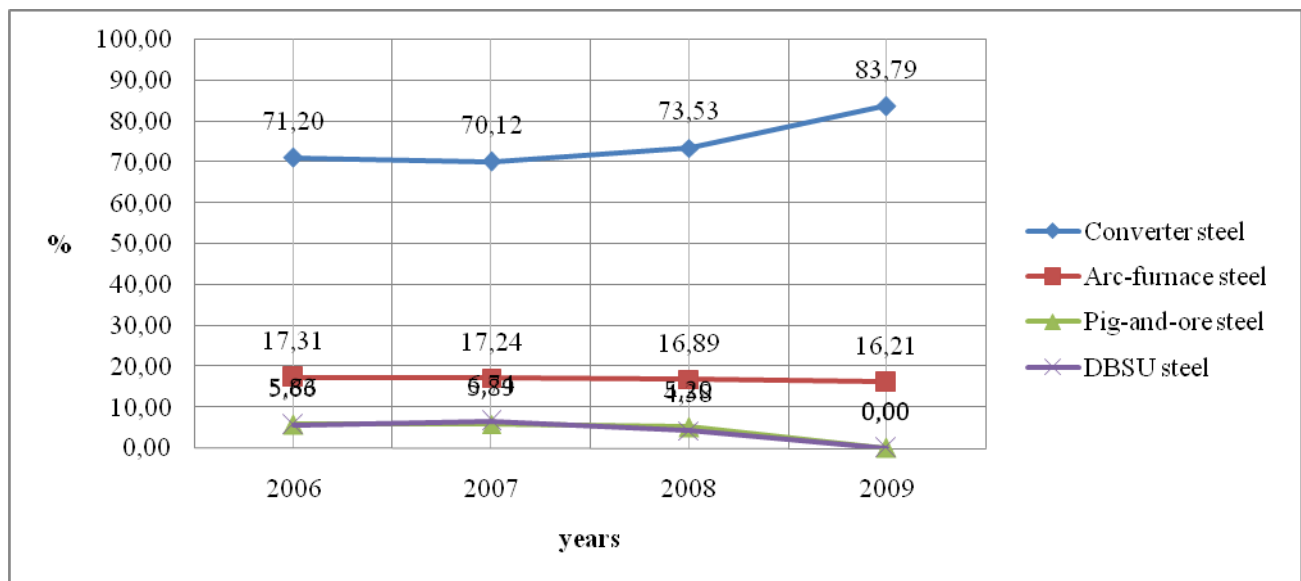
Figure 2-2. The dynamics of change in the share of different techniques of steel smelting at CherMK

OJSC "Magnitogorsk Iron and Steel Works (MMK) (oxygen-converter plant)

Oxygen-converter plant was built in a short time: from driving the first pile to the first smelting passed only five years. The plant was opened in November 2, 1990. It was then put into operation the basic units: converter # 1, steel refining aggregate #1, **slab** CCM #1, etc. The second converter and continuous **slab** casting machines # 2,3,4 were completed by 1994. In 1999 the third converter was introduced.

At the end of 2009 in oxygen-converter plant was launched the continuous casting machine #6 with capacity 1,650,000 tons of **slab billet** per year for the mill "5000". In addition to the machine in the processing chain there is a complex for off-furnace steel processing - ladle furnace and two-position degasser.

Commissioning of the entire complex allows serial casting of the steel slab billet for automobile industry, production of high quality thick plate on the mill "5000", and significantly expands the range of metal grades melted in the oxygen-converter plant[59].

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[59] http://www.mmk.ru/rus/press/news/article.wbp?article-id=0B7C586A-AC10-1016-0178-460DE624A597
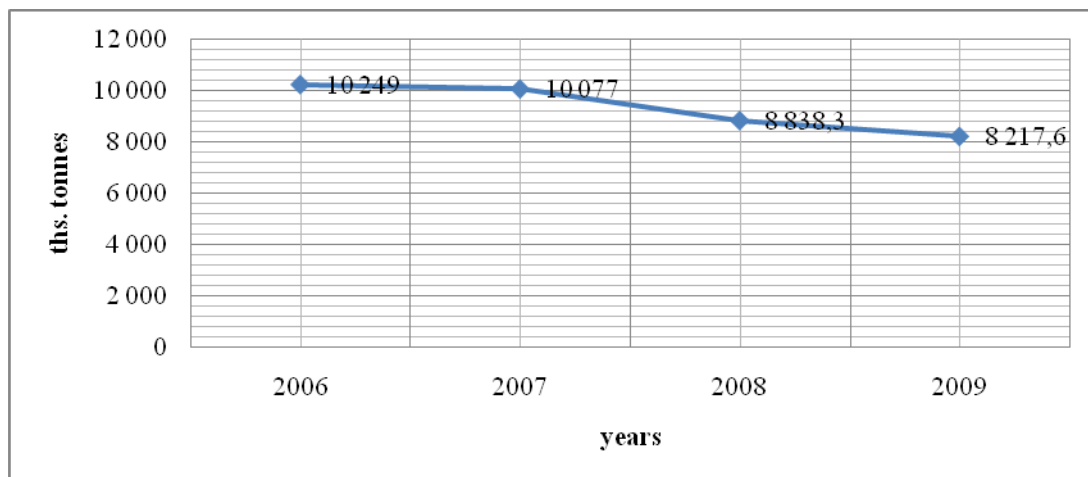
Figure 2-3. Production of converter steel at the MMK

OJSC "Novolipetsk Steel" (NLMK)

JSC "NLMK" - one of the world's largest steel companies. As a company with a full metallurgical cycle, NLMK produces pig iron, **slabs**, cold rolled, hot rolled, galvanized, dynamo, transformer steel and steel with polymer coating, as well as a wide range of long products. At NLMK main production site in Lipetsk the steel is produced by oxygen-converter technique[60].

The NLMK steel mill in Lipetsk includes:

- Agglomeration production with four sinter machines;

- Two blast furnace with five blast furnaces total of 11,400 m3;

- Two converter plant, consisting of two converters with a capacity of 300 tons each, three converter capacity of 160 tons each, and nine continuous casting machines: six curvilinear, one radial and two vertical type;

- Production of hot rolled steel at continuous wide-strip hot-rolling mill 2000 with capacity of 5.4 million tons per year;

- Three cold rolling mill workshops.

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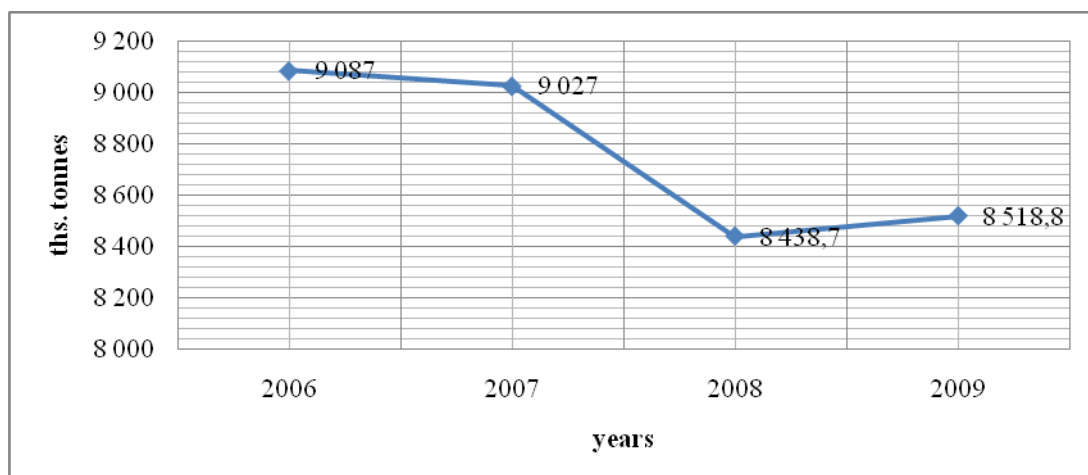
[60] http://www.nlmk.ru/our_operations/production/id-7.html

Figure 2-4. Steel production by NLMK


OJSC "West Siberian Iron and Steel Plant" (ZSMK or Zapsib)

JSC "ZSMK" (Zapsib) is an enterprise of EVRAZ group. Zapsib is a largest steel producer in Siberia. Production facilities include coke production, agglomeration production, steel smelting capacity, three blast furnaces, blooming mill, continuous casting machines and four rolling mills[61].

Steelmaking facilities West Siberian Iron and Steel plant include four independent departments: the oxygen-converter plant # 1 equipped with three converters with a capacity of 160 tons, the oxygen-converter # 2 with two converters with a capacity of 350 tons, ladle furnace installations, slab and section continuous casting machines, etc.


Construction of slab CCM of VAI-FUCHS with annual production capacity of 2.4 million tons of slabs was carried out for 18 months and in September 2005 it was commissioned. Dimensional specification of CCM allows casting slab with thickness of 200, 250 mm, width 1050-1750 mm and a length of 6000-12000 mm with qualitative characteristics that satisfy foreign consumers[62].
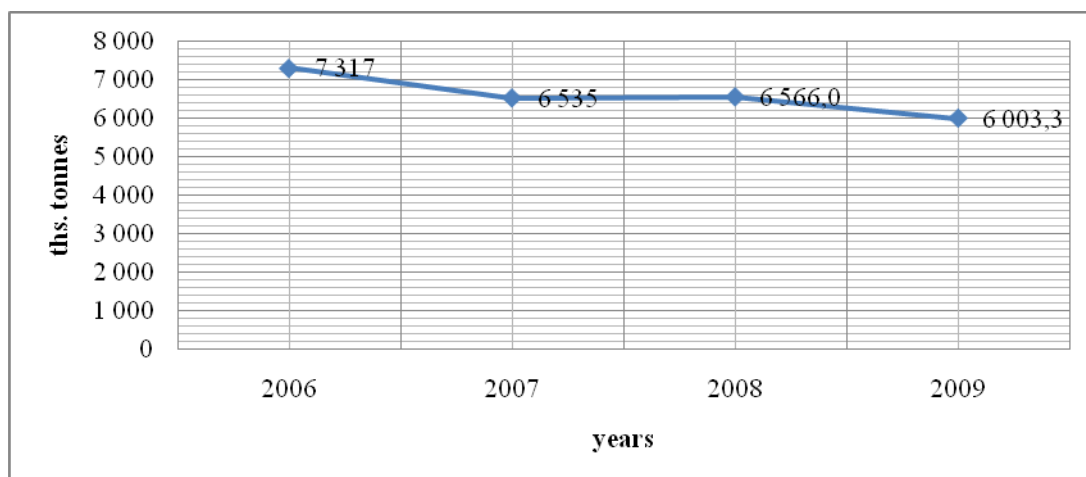


Figure 2-5. Steel production by Zapsib


OJSC "Nizhny Tagil Iron and Steel Plant" (NTMK)

NTMK is the world's largest enterprise for processing vanadium-titanium magnetite ore into the commercial product in the blast furnaces and converters by special technologies. The plant produces vanadium iron, vanadium slags (main raw material for extraction of vanadium), the firstborn of converter steel naturally alloyed by vanadium and other products.

Converter steel is continuously casted by three continuous casting machines of combined type with production of the following billet:

CCM # 1 – casting of circular section billet with diameter of 430 mm, metal rails and steel grades for special purposes (ball bearing, alloy, etc.) in the blank rectangular 300x360 mm.

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[61] http://www.metaprom.ru/pub129.html

[62] http://www.zsmk.ru/redistributions_splp.jsp

CCM # 2 – casting of **slab billet** of max section 240x1515 mm and bloom billet section 240x440 mm for pipe billet production.

CCM #3 – casting of shaped workpieces with section 530/395x165 mm for universal beam mill. In addition it is possible to cast the rectangular pieces of max section 200x550 mm[63].
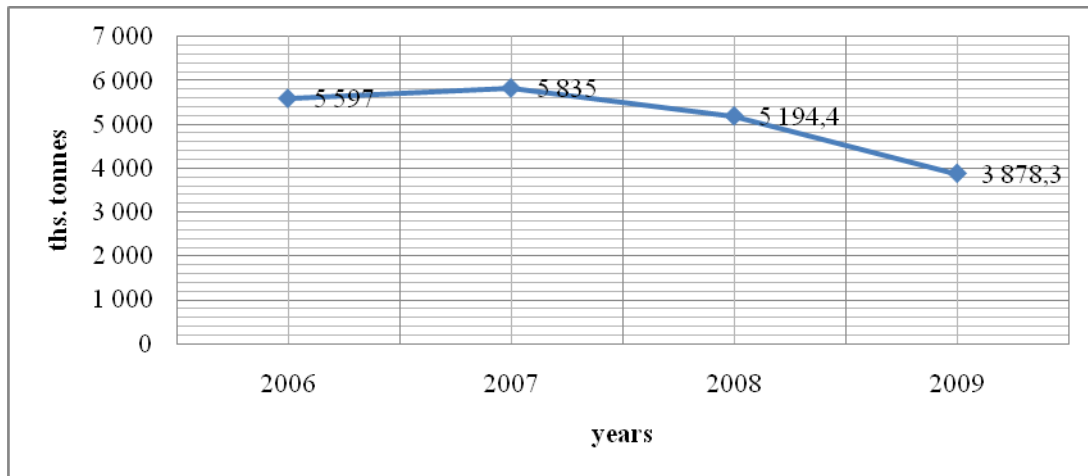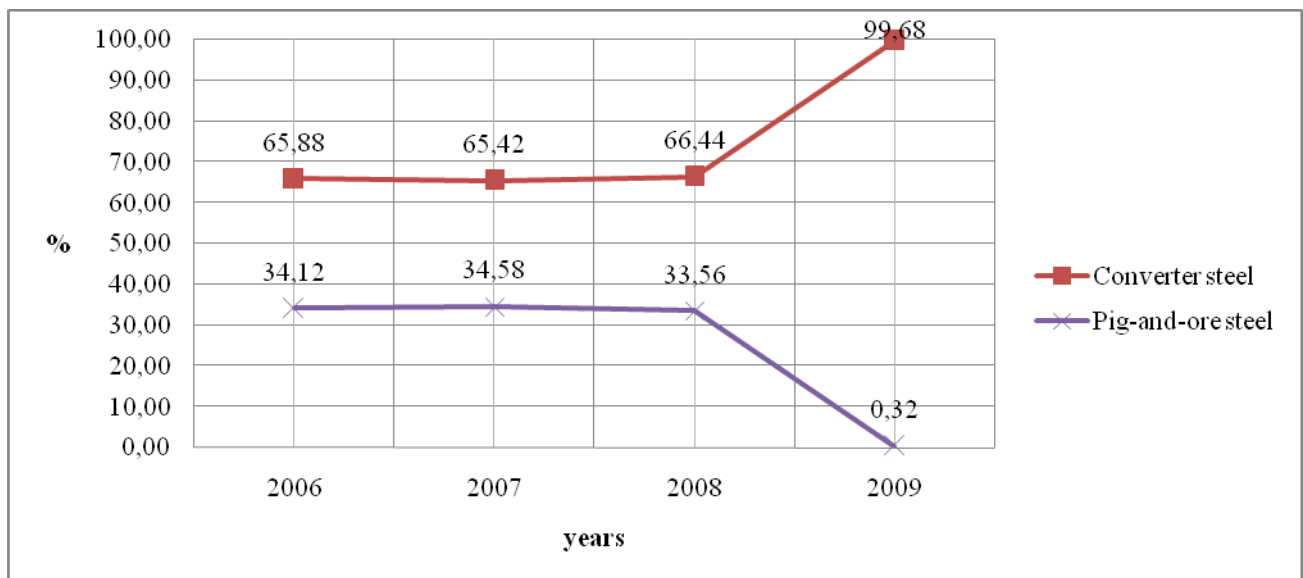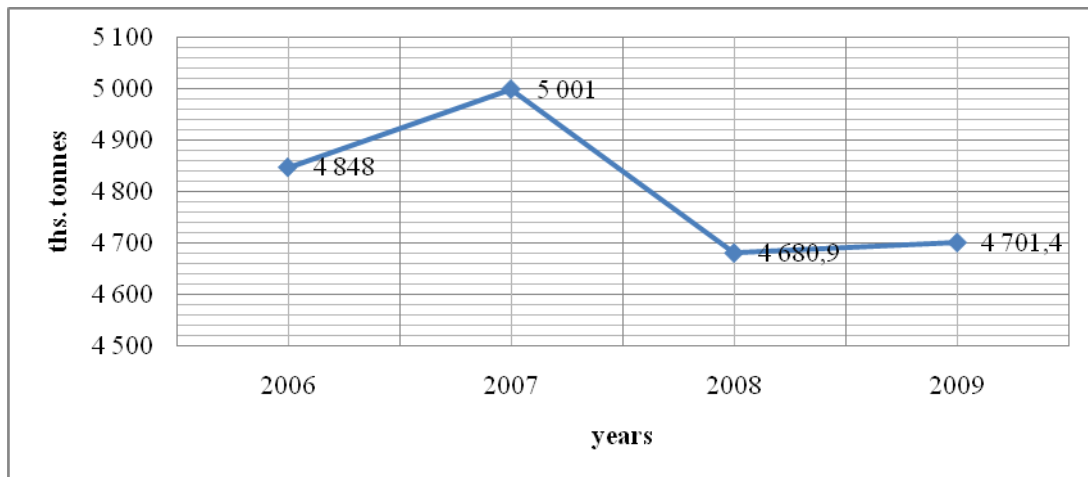


Figure 2-6. Steel production by NTMK



Figure 2-7. The dynamics of change in the share of different techniques of steel production at NTMK

OJSC "Chelyabinsk Metallurgical Plant" (ChMK)

Chelyabinsk Metallurgical Plant – one of the Russia's largest full metallurgical cycle mills to produce high-quality and high-quality steels. The mill produces steel **semi-finished flat** and long **products** of carbon steel and profiled steel.

The main production sites for steel smelting and casting at Chelyabinsk Metallurgical Plant (together with the Chelyabinsk branch of the Ural Forge") include the converter shop with three oxygen

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[63] http://www.ntmk.ru/ru/manufacture/technologies5_2.php

converters, and three shops with electric arc furnaces, including two large furnaces with capacity of 100 and 125 tons respectively; four continuous casting machines, blooming mill.

In addition to rolled section steel plants the ChMK has a rolling shop for hot-rolled sheet products: the continuous plate mill to produce **hot-rolled sheet** width of 1,800 mm and a thickness of 20 mm and semi-continuous rolling mill to produce hot rolled coils of width to 1,500 mm and a thickness of 6 mm, as well as cold-rolled products plant to produce **cold rolled stainless steel sheet** 0.3-4 mm.

Besides Chelyabinsk Metallurgical Plant (together with "Mechel-Coke") has eight coke batteries, seven sintering machines and three blast furnaces[64].



Figure 2-8. Steel production by ChMK
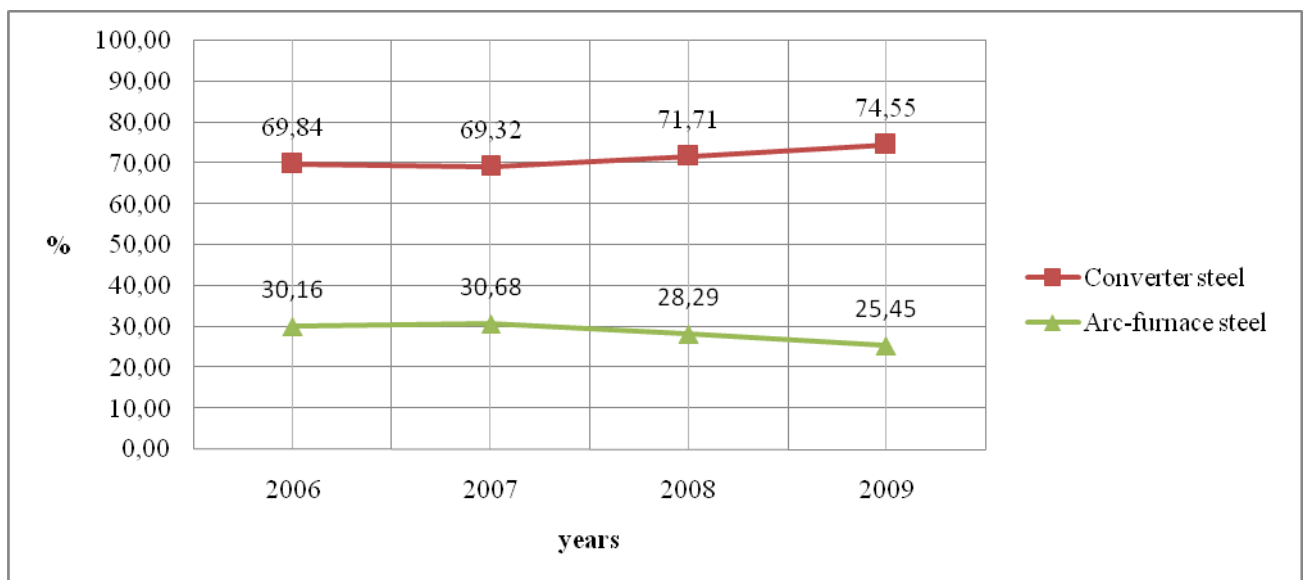


Figure 2-9. The dynamics of change in the share of different techniques of steel production at ChMK

OJSC "Ural Steel"

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[64] http://www.mechel.ru/about/production_capacity/info.wbp?id=97805ffb-8e2a-4db7-b9bf-35664b629269

"Ural Steel" integrated works (part of the Metalloinvest") known as the largest enterprise in South-Ural region and one of the 8 leading steel plants in Russia.

To date "Ural Steel" produces more than a hundred grades of carbon alloyed and low-alloyed steel, **thick plate, universal broadband** and section rolled metal, refractory, coke and chemical products[65].

"Ural Steel" incorporates the by-product coke plant, sinter production, blast furnaces. Steel production is carried out in the open-hearth furnace shop and electric-arc furnace shop.

Rolled metal production consists of blooming slabbing mill, **sheet rolling plants** and section rolling plant, as well as the production of moldings[66].
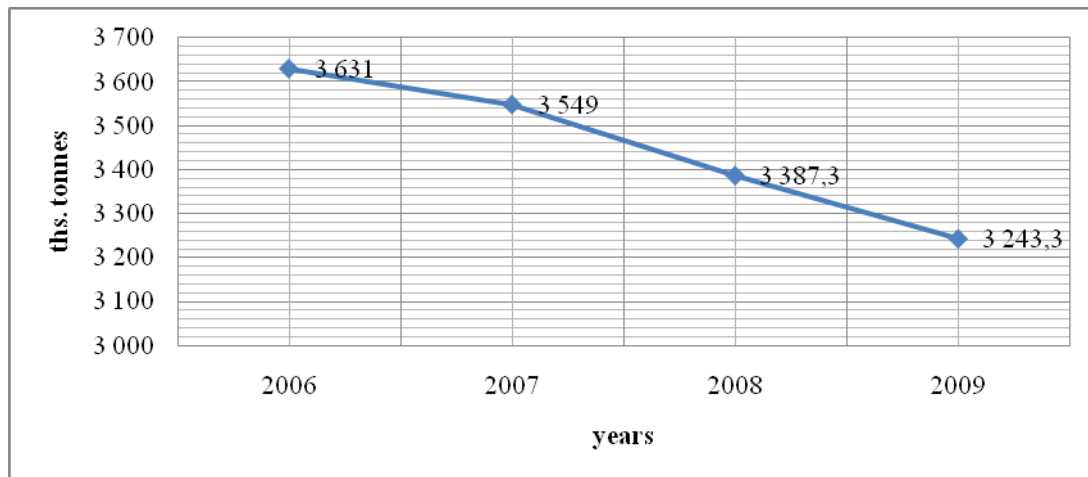


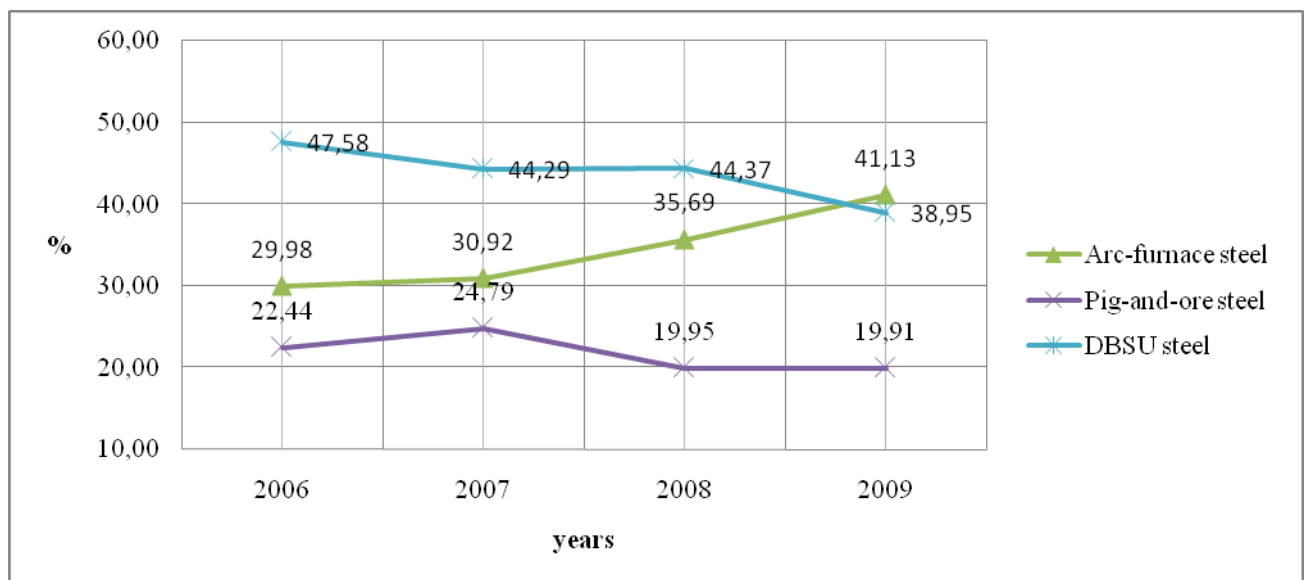Figure 2-10. Steel production by Ural Steel



Figure 2-11. The dynamics of change in the share of different techniques of steel production at Ural Steel

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[65] http://metalloinvest.com/rus/factorys/metallyrgiceskii-divizion/yral_skaa-stal_/yralstal_now/

[66] http://metalloinvest.com/rus/factorys/metallyrgiceskii-divizion/yral_skaa-stal_/technology/

OJSC "Novokuznetsk Iron and Steel Works"

Novokuznetsk Iron and Steel Works is a leading manufacturer of rail products in Russia and the only enterprise producing tram rails. One of the main competitive advantages of NKMK is the ability to produce over 150 kinds of steel rail and construction grades.

In general the product range of NKMK exceeds 100 units. It is rolled metal (circles, share breaker billet), billet for re-rolling, channels, angles, steel grinding balls, **rolled sheet**, coke products, tubular billet and **ship steel** for the needs of the river shipbuilding.

In 2002-2008 the NKMK has implemented a Programme of modernization. The top priority was to increase the arc-furnace steel output[67]. Steel is produced in electric-arc furnaces, casting is performed by continuous casting machines.
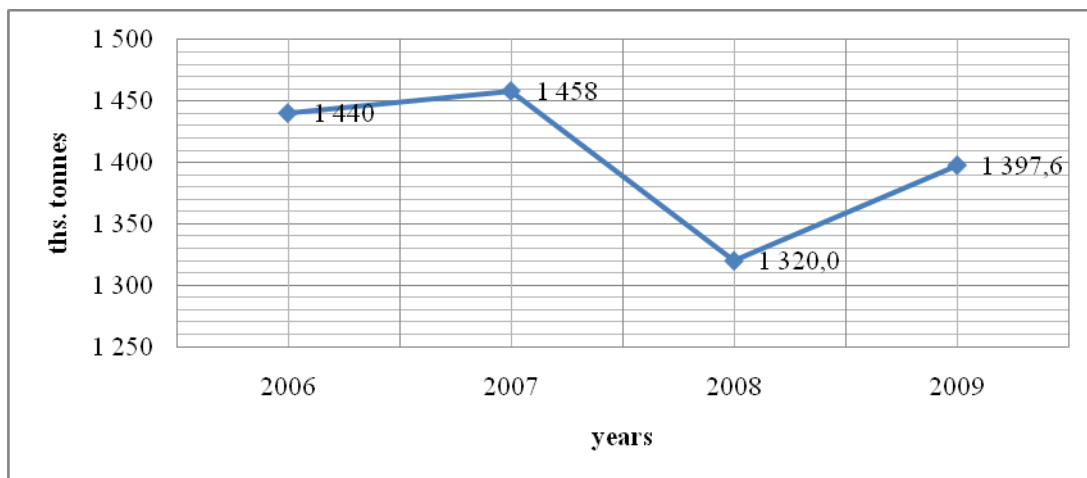


Figure 2-12. Steel production by NKMK

OJSC "Amurmetall"

In 2007 the only one ferrous metallurgy enterprise in the Far East - Plant – Amurmetal celebrated 10 years old. Management of the company embarked on a significant increase in production volumes. With this purpose in 2004 it was developed a plan for technical and economic development of the company until 2011, whose main task was to create in the Russian Far East a modern steel mill with an output of at least 2 million tons of liquid steel per year.

In February 2009 the company successfully passed the certification of slabs for shipbuilding by one of the world's leading ship classification bodies - Germanischer Lloyd. As a result it was received an approval to manufacture the following products: **blank slab** of continuously produced from conventional and high-strength steel for shipbuilding **sheet metal** of various grades[68].

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[67] http://www.nkmk.ru/portal/page?_pageid=1113,3145866&_dad=portal&_schema=PORTAL

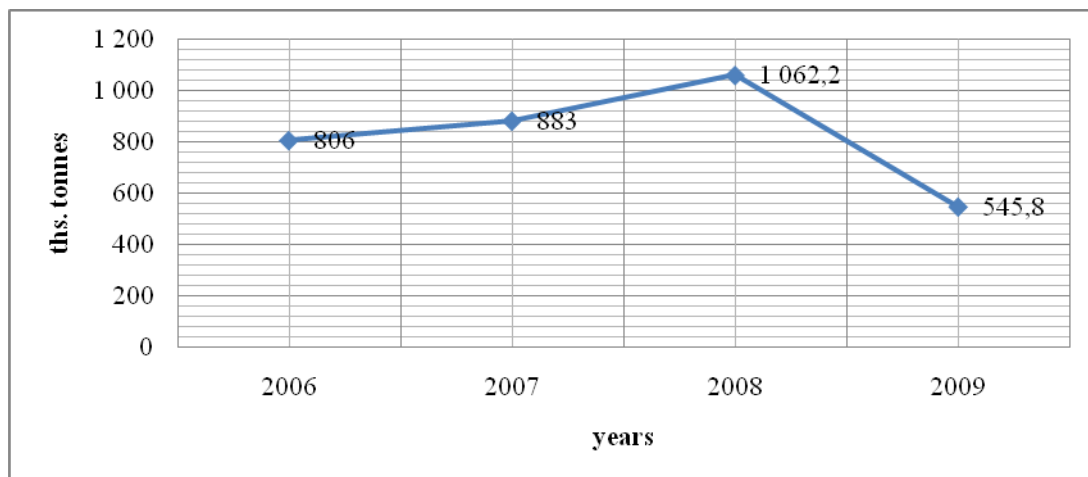[68] http://www.amurmetal.ru/ru/group_development/quality_policy/

Figure 2-13. Steel production by Amurmetall

OJSC "Ashinsky metallurgical works"

Metallurgical complex of JSC "Ashinsky metallurgical works" has a complete production cycle, and offers consumers a wide range of products: **sheet metal** (from steel of ordinary quality and from low-alloyed one), structural, heat resistant, corrosion-and heat-resistant steels and alloys[69].

Steel is smelted by open-hearth technology (process scrap). Casting of steel is carried out in continuous casting machine. In 2010 the open-hearth furnaces are replaced by electric arc furnace.
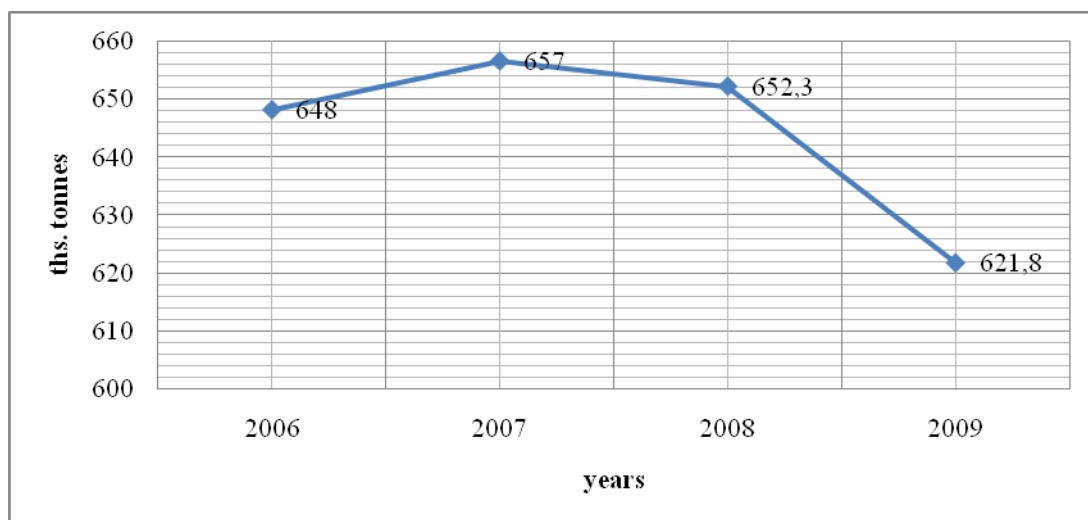


Figure 2-14. Steel production by Ashinsky metallurgical plant

OJSC «Krasny oktyabr»

Volgograd metallurgical works «Krasny oktyabr» is one of the largest producers of quality roll metal of special steel grades for enterprises of motor industry, aircraft industry, chemical industry, petroleum industry, power machine building in Russia.

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[69] http://www.metaprom.ru/pub203.html

Today the first stage of wide-ranging reconstruction has been finished at OJSC "Krasny oktyabr". The goal of reconstruction – expansion of production special steel marks steel. The volume of production also increased in two times and reached - 715 thousand tons of steel a year (in 2006) [70].

Steel is produced by arc-furnace technique, semiproduct is casted in CCM.

Electric arc-furnace plant consists of the follow processes:

- Electric arc;

- Electroslag;

- Of-furnace treatment of metal.

Metallurgical works produces profiled and **slab steel billet** with weight 5.5 – 11.5 tones[71].
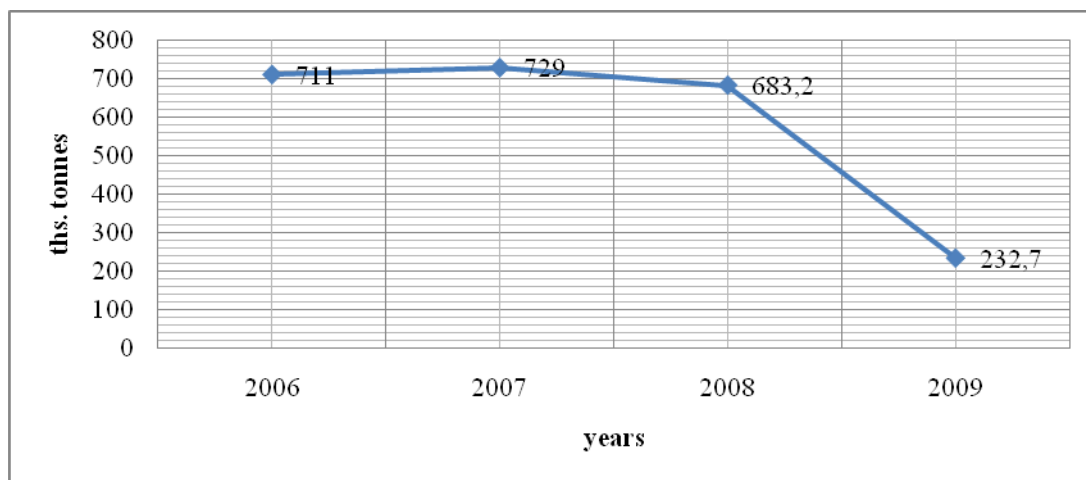


Figure 2-15. Steel production by OJSC "Krasny oktyabr"

JSC "United Metallurgical Company"

JSC "OMK-Steel" was created by 03.08.2009. The branch of JSC "OMK - Steel" – **Sheet-Rolling Complex** was built in 2008 in Vyksa District of Nizhny Novgorod region. The project was implemented in the shortest period and with the unique technologies. Introduction of the first stage of the Complex is allowed to provide the Pipe electric welding plants of Vyksa metallurgical works and Almetievsk pipe plant with a high quality hot rolled steel for production of small and medium diameter pipes conformed to international standards. The Sheet-Rolling Complex also is provided the opportunity to develop production of high-quality rolled steel for the automotive industry, shipbuilding, railway wagons, tanks and other rolling stock used JSC "Russian railways".

The capacity of the first stage of the Complex is 1.5 million tons of rolls a year. It is planned to increase capacity to 3 million tons and increase range of products[72].

Steel is produced by arc-furnace technique, semiproduct is casted in CCM. The volume of arc-furnace steel production is 724.9 thousand tones in 2009.

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[70] http://www.vmzko.ru/history.htm

[71] http://www.vmzko.ru/proizvodstvo.htm

[72] http://www.omk.ru/ru/company/structure/lpk/

<center>"Novorossmetal", LLC</center>

"Novorossmetal", LLC was created in 2003. Includes metallurgical works in Novorossiysk and a network of more than 40 sites of collecting scrap in the South Federal District. In 2007, "Novorossmetal", LLC produced 460 thousand tons of steel billet[73].

Production capacity was increased by 285% to 500 thousand tons of **slab steel billet** per year in 2006 compared with 2005[74].

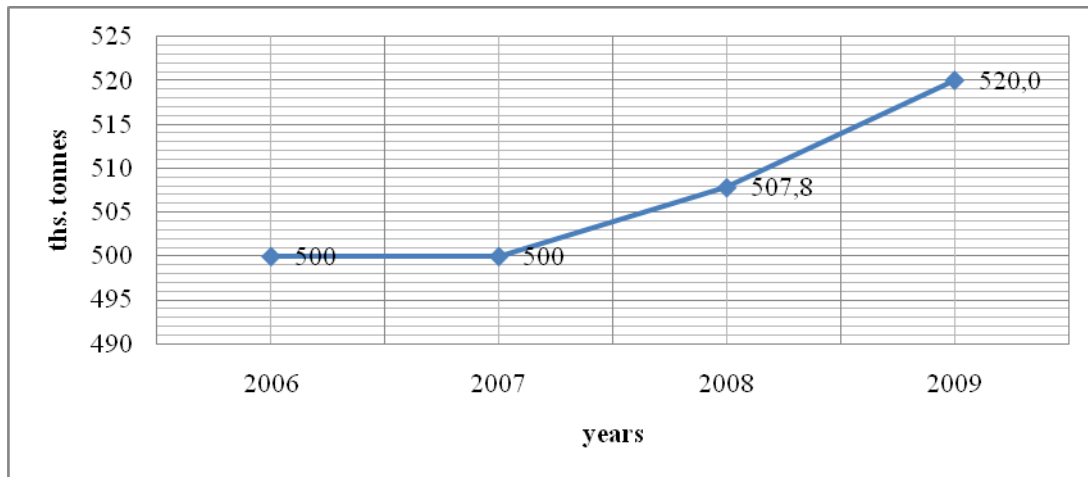Steel is produced by arc-furnace technique, semiproduct is casted in CCM.



<center>Figure 2-16. Steel production by "Novorossmetal", LLC</center>

<center>"Metallurgical Plant Petrostal" Closed JSC</center>

Currently the Plant is a supplier of steel rolled metal products for various industries, construction and transport.

Te Plant consists of seven shops: drop-hammer, steel-smelting, rolling, forge-and-stamping, casting, oxygen and maintenance shop.

Four open-hearth furnaces with capacity of 85 tons are installed in steel-smelting shop. Steel is produced by scrap technique, semiproduct is casted in CCM.

The production of rolling shop:

- Round bars of diameter 28 - 180 mm;

- A square billet with a side of 63-200 mm;

- Strips of thickness 10-30 mm and a width of 40-300 mm;

- Special shaped profiles of the equivalent section;

- Rolling metal hot calibrated high precision circular diameter of 27-72 mm;

- **Flat steel billet** with height of 50-100 mm and with width of 200-300 mm ore with height of 100 mm and with width of 330-400 mm;

- And other products.

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[73] http://www.metaldaily.ru/news/news21859.html

[74] http://www.rusmet.ru/news.php?act=show_news_item&id=28779
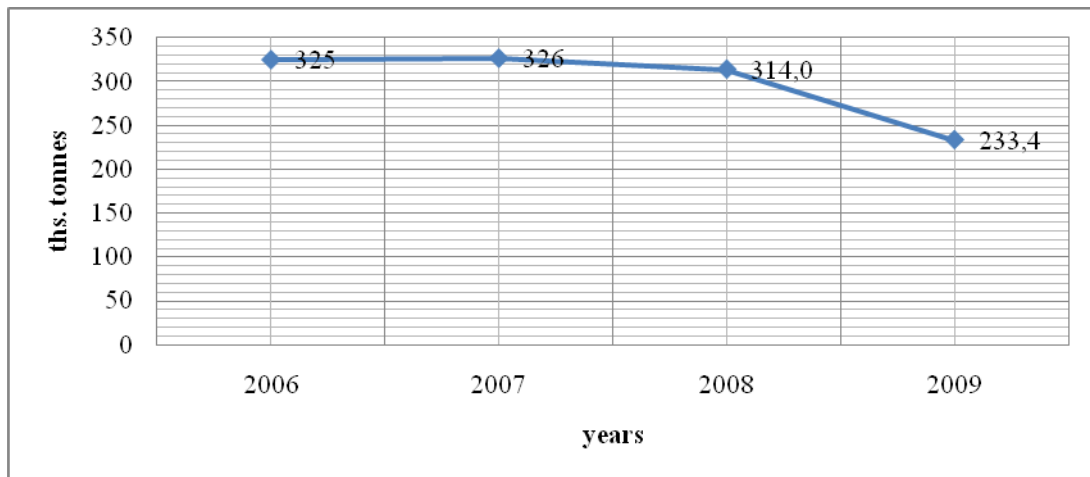
Figure 2-17. Steel production by "Metallurgical Plant Petrostal" Closed JSC

"Metallurgical Plant "Kamasteel", LLC (composed of Holding OJSC «Motovilikhinskiye zavody»)

The steel production of OJSC «Motovilikhinskiye zavody» is a modern technological process of production of steel, forging, forming, hot-rolled slab and profiled steel billet. OJSC «Motovilikhinskiye zavody» is a full-cycle metallurgical complex.

Steel is produced by arc-furnace EAF-60 of FUCHS Systemtechnik, semiproduct is casted in four CCMs: two produced **slab steel billet** and two produce profiled steel billet.



Figure 2-18. Steel production by "Metallurgical Plant "Kamasteel", LLC

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
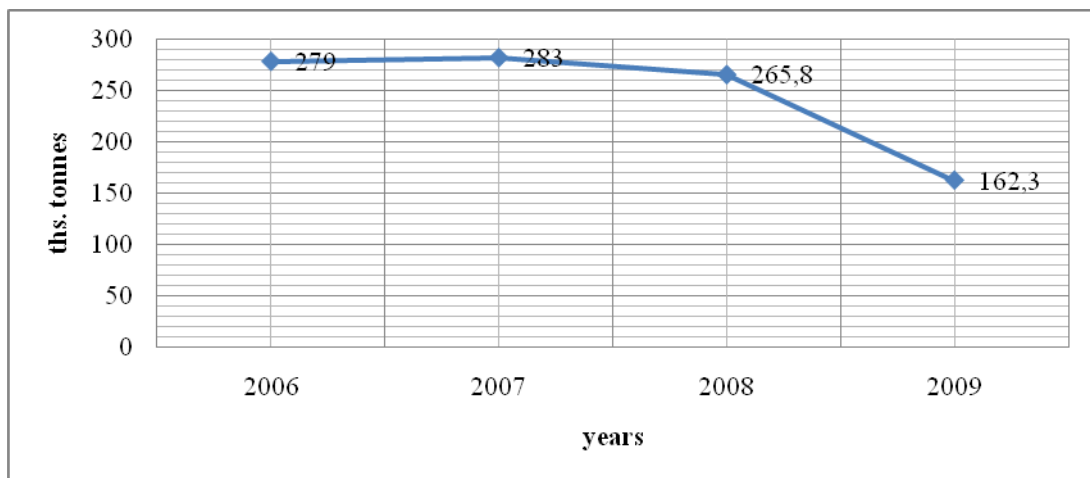
Electricity is supplied to OJSC "MMK" from own generating capacities (CHPP, CPP, SABPP, SP) and the external grids (OJSC "Chelyabinsk Energy", Unified Energy Systems of Urals), under the contract with Magnitogorsk Energy Company Ltd. (MEC). External grid electricity is supplied by 11 high-voltage lines 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 crediting 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 | 0.5 |
|  |  | CA 4U-I672M | 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 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 EFs 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 4-1.

Figure 4-1. 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:

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

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

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.

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

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_5 EG_y} \qquad (4.2)$$

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 are 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).

$$EF_{EL,m,y} = EF_{CO2fuel} \ x \ b_{m,y} \hspace{5cm} (4.3)$$

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

$$EF_{grid,CM,y} = EF_{grid,OM,y} \ x \ w_{OM} + EF_{grid,BM,y} \ x \ w_{BM}, \hspace{3cm} (4.4)$$

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.

**Uncertainties and final values of emission factors**

The Tool doesn't require the uncertainty analysis of the emission factors. Nevertheless the developers followed the recommendations of "Bureau Veritas Certification" which made verification of the emission factors calculated in this study. We believe that this is in line with the main principle of JI projects to implement conservative approaches wherever appropriate. From the formulas used to calculate OM and BM emission factors we can conclude that the uncertainties are caused by the following parameters of a power plant:

- FC – fuel consumption of power plants;
- NCV – net calorific values of fuel of different types;
- $EF_{CO2}$ – fuel emission factors;
- EG – net electricity generation.

Other uncertainties connected with distortion of data in the reports 6-tp or non presentation of such reports by some power plants are considered negligible. Data in the reports 6-tp is usually cross-checked by commercial and accountant documentation and as well by specialists of the companies to which power plants belong. The national system of statistic reports' collecting is in action for decades, it is

established by Russian law and is hold in appropriate state by national regulations, no serious violation discipline was ever found by RosStat in the power industry where more than 320 thermal power plants are under strict control. The director and the chief accountant of each plant are legally responsible for the accuracy of the information reported in the 6-tp form and are subject to prosecution if the data are reported incorrectly.

Fuel consumption and net electricity generation are parameters that are measured instrumentally at power plants. According to the standards of JSC "UES of Russia" the error of calibration of scales for weighing solid fuel should not be more than ±1.75%, residual oil in the range of ±0.5-0.8%, gas ±0.3-1.0% (Source: Methodological Guidelines on Fuel Accounting by TPPs, RD34.09.105-95, Moscow, ORGRES, 1997). Electricity is measured by certified meters with the error of ±0.2-0.5%. Net calorific values are defined in certified calorimeters with the error of ±0.2-0.5%.

Maximal aggregated error of measurements of FC, EG and NCV is:

for TPPs with gas:  $1 - 0.99 \times 0.995 \times 0.995 = 0.02$ (or 2%);

for TPPs with residual oil: $1 - 0.992 \times 0.995 \times 0.995 = 0.018$ (or 1.8%);

for TPPs with coal:   $1 - 0.9825 \times 0.995 \times 0.995 = 0.027$  (or 2.7%).

For the purpose of this study we used the IPCC default emission factors for stationary combustion in the energy industries (Source: 2006 IPCC Guidelines for National GHG Inventories). In these Guidelines one can find "lower" and "upper" values, the deviations from default factors constitute: natural gas from -3.2% to +3.9%, residual oil ± 2.5%, coal from -3.5% to +4%.  We assumed these deviations as uncertainty of $EF_{CO2}$.

We applied the following formula commonly used to calculate combined uncertainty when all uncertainties $U_i$ have equal weights (from [9]):

$$U_{total} = [(U_1)^2 + (U_2)^2 + \ldots + (U_n)^2]^{1/2},$$

where $U_i$ are the percentage uncertainties associated with each of the quantities.

In the case under consideration the formula has only 2 components with equal weights: aggregated accuracy of measurements and uncertainty of $EF_{CO2}$.

Gas fired TPPs:
$U_{gas} = [2^2 + 3.9^2]^{1/2} = 4.4\%$,

Residual fuel oil fired TPPs:
$U_{oil} = [1.8^2 + 2.5^2]^{1/2} = 3.1\%$,

Coal fired TPPs:
$U_{coal} = [4^2 + 2.7^2]^{1/2} = 4.8\%$.

In all of the calculations above maximal values of $U_i$ for $EF_{CO2}$ from the indicated ranges are used.

Appropriate amendments are made to the emission factors for the cases when $EF_{CM}$ and  $EF_{OM}$ applicable as described in Section 7. The share of residual oil in the fuel mix of RESs is lower than 5%, there is no contribution of oil fired TPPs in the build margin.  Taking into account that  gas is dominating in BM and OM in all of the RESs except Siberia we assumed that for those RESs the uncertainty equals 4.4%. For RES Siberia where coal is dominating the uncertainty is assumed 4.8%. The final values of emission factors for RESs are presented in Tables 8-1 and 8-2.

Table 4-2. 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 into account uncertainty) | $EF_{CM}$ (tCO$_2$/MWh) |
|---|---|---|
| "Center" | 0.535 - 4.4% | 0.511 |
| "North-West" | 0.574 – 4.4% | 0.548 |
| "Mid Volga" | 0.529 – 4.4% | 0.506 |
| "Urals" | 0.566 - 4.4% | 0.541 |
| "South" | 0.523 - 4.4 % | 0.500 |
| "Siberia" | 0.939 - 4.8 % | 0.894 |

RES from East is the isolated power system operating separately from UES of Russia. It has the following specific features:

− Dominance of TPPs in the structure of generating facilities (more than 70% of installed capacity), which have the limited control range;

− Limited possibilities of using the control ranges of Zeyskaya HPP and Bureiskaya HPP because of necessity of navigation support at rivers Zeya and Amur;

− Location of main generating sources in the North-West part, though the main consumption areas are located at RES North-East;

− One of the highest shares (almost 21%) of residential load in electricity consumption in other power systems of UES of Russia;

− Large length of transmission lines.

The share of gas in the fuel mix at TPPs constitutes 12%, the share of coal is 80%, the share of fuel oil (mazut) is 8%. The share of gas in this set of fuels for TPPs in Republic Sakha is substantially higher (43%, while the share of coal is here 57%) than on the average for RESs. The share of gas in Khabarovsk Krai and Sakhalin region constitutes 21% and 12%, while the share of coal is 57% and 81% correspondingly. TPPs of Kamchatka are operational only with mazut delivered by sea. The coal is the main fuel in other regions. Its share in the structure of organic fuels for TPPs constitutes 95-99%.

Table 4-3. Final $EF_{CM}$ values for the case of increase of power delivery to the grid or/and increase of electricity consumption from the grid.

| Power system | Correction of $EF_{CM}$ for uncertainty | $EF_{CM}$ (tCO$_2$/MWh) |
|---|---|---|
| RES "East" | 0.864 – 4.7 % | 0.823 |

Annex 5

**LIST OF ABBREVIATIONS**

| | |
|---|---|
| BFG | Blast-furnace gas |
| BFP | Blast-furnace plant |
| BL | Blooming mill |
| 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 |
| ERU | Emission reduction unit |
| IMP and LDW | Integrated mining-and-processing, limestone and dolomite works |
| IPCC | Intergovernmental Panel on Climate Change |
| JI | Joint Implementation |
| JSC | Joint stock company |
| LFA | Ladle-furnace aggregate |
| MMK | Magnitogorsk iron and steel works |
| MPDS | Maximum Permissible Discharge of Sewage document |
| MPE | Maximum Permissible Emissions |
| NG | Natural gas |
| OCP | Oxygen-converter plant |
| OCS | Oxygen-compressor shop |
| OHFP | Open-hearth furnace plant |
| OJSC | Open joint stock company |
| PNPPW | Permissible Norm of Producing and Placement of Wastes document |
| QMS | Quality management system |
| RES | Regional power system |
| RF | Russian Federation |
| SABPP | Steam-air blowing power plant |
| SP | Steam plant |
| TEE | Turbine expansion engine |

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.**

V. F. Rashnikov,
Director General OJSC "MMK"