| Developed by | Approved by |
| --- | --- |
| Director<br>V. Vovchak<br><br>_____<br><br>(signature and L.S.) | Director general<br>M. Zavgorodniy<br><br>_____<br><br>(signature and L.S.) |

# Revamping of sintering and blast-furnace production at OJSC "Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky"

## UA1000274, Track 1

# Annual Monitoring Report

Version 3 dated 23$^{d}$ of August 2012
Monitoring period: 1$^{st}$ April 2012 – 30$^{th}$ June 2012

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## List of abbreviations

DIISW - PJSC «Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky»;
AIE – Accredited Independent Entity;
JI – Joint Implementation;
BF – Blast Furnaces;
SP – Sinter Plant;
FER – Fuel and Energy Resources.

## 1. Project summary

The proposed Joint Implementation project[1] considers complex resource-saving effect related with implementation of new SP and BF#4, gradual reconstruction of the remaining BFs ##8, 9, 12 and 1M with application of state of the art technologies and equipment. Also, project activity envisages technological improvements in the process of sintering and pig iron production.

The project measures and activities that have been and will be implemented at DIISW (concerning pig iron production process) lead to increase of SP and BFs productivity, reduction of specific coke, other fuel and materials consumption and, therefore, reduction of GHG emissions.

## 2. Status of the project pursuant to the monitoring period

Emission reductions during the period of 1st April 2012 to 30th June 2012 were achieved by implementation of the following measures:

| # | Measures | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Technological improvements of the BFs operation:**<br>- improvement of blast furnace coke quality;<br>- decreasing the silicon content in the pig iron;<br>- decreasing the BFs idle times and downtime;<br>- partial substitution of the limestone by lime;<br>- improvement of the quality of agglomerate. | | | | | | | | | |
| 2 | **Renewal and reconstruction of BF#1M** | | | | | | | | | |
| 3 | **Implementation of a new oxygen plant AKAp 40/53-4** | | | | | | | | | |
| 4 | **Modernization of the sintering process:**<br>- improvements of solid fuel burning process, which is part of the sintering charge;<br>- increase of the level of steel waste utilization;<br>- implementation of the state-of-the-art dust suppression and gas purification facilities;<br>- optimization of limestone decomposition reaction; | | | | | | | | | |

[1] The letter of approval was received from the Government of Ukraine (State Environmental Investment Agency of Ukraine, reference: 2077/23/7 dated 08/08/2011) and from the Government of the Netherlands (Ministry of Economic Affairs, reference: 2011JI15 of 10.05.2011).

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | - improvement of natural gas burning process, which is supplied to burners for the ignition of sintering charge;<br>- improvements of chemical composition of sinter charge;<br>- reduction of fine fraction content in agglomerate. | | | | | | | | | |

The following measures: *technological improvements of the BFs operation* and *modernization of the sintering process* are implemented from the beginning of the proposed project activity till 2020 (during the whole project lifetime).

## 3. Parameters monitored according to the monitoring plan

During the project activity the total pig iron production, fuel and energy resource consumption at the plant are being monitored. The baseline of the project is based on historical data of fuel and energy resources consumption for pig iron production at DIISW during the period of 01/01/1999 – 31/12/2003.

For the purpose of calculating GHG emission reduction units achieved by the project during the second quarter of 2012 the carbon emission factor for electricity consumption is based on the Order of the National Environmental Investment Agency of Ukraine № 75[2] dated 12/05/2011. In accordance with mentioned above decree issued by NEIA for the 1st – class electricity consumers the carbon emission factor equal to 1,090 $kgCO_{2e}$/kWh.

The use of the emission factor for the 1st-class electricity consumers is justified by the resolution of National Electricity Regulatory Commission of Ukraine № 1052 of 13 August 1998[3], according to the resolution the 1st – class electricity consumers are the consumers, who:
1) receive electricity from electricity supplier at the point of sale of electricity with the degree of voltage 27.5 kV and above;
2) connected to the power rails of power plants (except hydroelectric, which produce electricity periodically), as well as to power rails of substations of the electricity grid with voltage of 220 kV and above, regardless voltage level at the point of sale of electricity by the power supplier to consumer;
3) is the industrial enterprise with average monthly rate of electricity consumption - 150 million kWh and above for the technological needs of production, regardless of the voltage level at the point of sale of electricity by the power supplier to consumer.

Based on the information stated above, DIISW refers to the 1st – class electricity consumers[4].

[2] http://www.neia.gov.ua/nature/doccatalog/document?id=127498.
[3] http://energetik.org.ua/node/90.
[4] The following information is proved by electricity supply agreements.

All data, used in this chapter, are based on information, confirmed by DIISW documents. This information is available to the AIE, also regarding the interconnection with the baseline and project line tables, presented below.

Colors that are used in the tables are described below:

| Project line | Baseline |
|---|---|
| Name of each indicator | Name of each indicator |
| Volume of FER consumption | Volume of FER consumption |
| Emission factor for FER | Emission factor for FER |
| Volume of $CO_2$ emissions | |
| Blank cell | |

The emission factors for natural gas, coke and anthracite are identified in the following way:

1) Emission factor for natural gas consumption is based on actual calorific value of natural gas which is in accordance with DIISW average historical data for the monitoring period.

2) In order to calculate emission factor for coke due to its production and consumption based on actual carbon content, the following formula was used:

$EF_{ra} = (C_{coke} * 44/12) + 0,56$

where:

$EF_{ra}$ – emission factor for coke, tonnes $CO_{2e}$/tonne of coke;
$C_{coke}$ – carbon content of coke, %;
0,56 – $CO_{2e}$ emission factor for coke production, tonnes $CO_{2e}$/tonne of coke produced.

The carbon content of coke is calculated by the following formula:

$C_{coke} = 100 – (C_{ash} + C_{sulphur} + C_{volatile\ matters})$

where:

$C_{ash}$ – ash content of coke, %;
$C_{sulphur}$ – sulfur content of coke, %;
$C_{volatile\ matters}$ – volatile matters content of coke, %.

3) In order to follow conservativeness of the approach, taking into account that various ranks of anthracite are consumed under the project activity in different technological processes and also because it is complicated to calculate actual weighted average of anthracite net calorific value, the carbon emission factor for anthracite is based on carbon

content of anthracite which is in accordance with IPCC 1996 data[5] and on net calorific value of anthracite which in accordance with IPCC 2006 data[6].

## Project line

| Classification number | Data variable | Unit | 01.04.2012 – 30.06.2012 |
|---|---|---|---|
| P-1 | Total $CO_{2e}$ in the project scenario ($PE_i$) | Tonnes $CO_{2e}$ | 2 201 373 |
| P-2 | Total $CO_{2e}$ from Pig Iron ($TCPI_{p,i}$) | Tonnes $CO_{2e}$ | 1 976 833 |
| P-3 | Total Pig Iron Output ($TPII_{p,i}$) | Tonnes | 768 661 |
| P-4 | Total $CO_{2e}$ from fuel consumption in producing Pig Iron ($TCFCPI_{p,i}$) | Tonnes $CO_{2e}$ | 107 382 |
| P-5 | Quantity of each fuel ($fpi_p$) used in making Pig Iron ($Q_{fpi,p,i}$) | 1000 $m^3$ | |
| | Natural gas (NG) | 1000 $m^3$ | 56 154 |
| P-6 | Emission factor of each fuel $EF_{f,p}$ | Tonnes $CO_{2e}$/1000 $m^3$ | |
| | Natural gas (NG)[7] | Tonnes $CO_{2e}$/1000 $m^3$ | 1,912 |
| P-7 | Total $CO_{2e}$ from electricity consumption in producing Pig Iron ($TCEPI_{p,i}$) | Tonnes $CO_{2e}$ | 83 233 |
| P-8 | Electricity Consumed in producing Pig Iron ($ECPI_{p,i}$) | MWh | 76 361 |
| P-9 | Emissions Factor for Electricity Consumption $EF_{f,p}$[8] | Tonnes $CO_{2e}$/MWh | 1,090 |
| P-10 | Total $CO_{2e}$ from Inputs into Pig Iron ($TCIPI_{p,i}$) | Tonnes $CO_{2e}$ | 1 786 218 |
| P-11 | Total $CO_{2e}$ from fuel used to prepare Iron Ore ($TCFIO_{p,i}$) | Tonnes $CO_{2e}$ | 6 582 |
| P-12 | Quantity of each fuel ($fio_p$) used in Sintering ($Q_{fio,p,i}$) | 1000 $m^3$ | |
| | Natural gas (NG) | 1000 $m^3$ | 3 442 |
| P-13 | Emission factor of each fuel $EF_{f,p}$ | Tonnes $CO_{2e}$/1000 $m^3$ | |
| | Natural gas (NG) | Tonnes $CO_{2e}$/1000 $m^3$ | 1,912 |
| P-14 | Total $CO_{2e}$ from electricity consumption in preparing iron ore ($TCEIO_{p,i}$) | Tonnes $CO_{2e}$ | 32 991 |
| P-15 | Electricity Consumed in Sintering ($ECIO_{p,i}$) | MWh | 30 267 |

[5] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 - http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf.

[6] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors,* Table 1.2, page 18 - http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf.

[7] Emission factor for natural gas is based on Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf) and fixed net calorific value of natural gas which is in accordance with DIISW average historical data.

[8] http://www.neia.gov.ua/nature/doccatalog/document?id=127498.

| | | | |
|---|---|---|---|
| **P-16** | **Emissions Factor for Electricity Consumption $EF_{f,p}$** | **Tonnes $CO_{2e}$/MWh** | 1,090 |
| **P-17** | **Total $CO_{2e}$ from Reducing Agents in Pig Iron Production ($TCRAPI_{p,i}$)** | **Tonnes $CO_{2e}$** | **1 690 796** |
| **P-18** | **Quantity of each reducing agent ($rapi_p$) in Pig Iron Production ($Q_{rapi,p,i}$)** | **Tonnes** | |
| | **Reducing agent (coke)** | **Tonnes** | 410 285 |
| | **Reducing agent (anthracite)** | **Tonnes** | 57 451 |
| **P-19** | **Emission factor of each reducing agent, $EF_{ra,p}$** | **Tonnes $CO_{2e}$/Tonne** | |
| | **Emission factor (coke)[9]** | **Tonnes $CO_{2e}$/Tonne** | 3,754 |
| | **Default emission factor (anthracite)[10]** | **Tonnes $CO_{2e}$/Tonne** | 2,62 |
| **P-20** | **Total $CO_{2e}$ from other inputs ($TCOIPI_{p,i}$)** | **Tonnes $CO_{2e}$** | **55 850** |
| **P-21** | **Quantity of each other input ($oipi_p$) in Pig Iron Production ($Q_{oipi,p,i}$)** | **Tonnes** | |
| | **Limestone** | **Tonnes** | 112 998 |
| | **Dolomite** | **Tonnes** | 6 944 |
| | **Pellets** | **Tonnes** | 93 963 |
| **P-22** | **Emission factor of each other input, $EF_{oi,p}$** | **Tonnes $CO_{2e}$/Tonne** | |
| | **Default emission factor (limestone)[11]** | **Tonnes $CO_{2e}$/Tonne** | 0,44 |
| | **Default emission factor (dolomite)[12]** | **Tonnes $CO_{2e}$/Tonne** | 0,477 |
| | **Default emission factor (pellets)[13]** | **Tonnes $CO_{2e}$/Tonne** | 0,03 |
| **P-23** | **Total tonnes of $CO_{2e}$ related to the balance of process need of energy required for the project activity ($TCBPN_{p,i}$)** | **Tonnes $CO_{2e}$** | **224 540** |
| **P-24** | **Total $CO_{2e}$ from fuel consumption for balance of process needs of project activity ($TCFCBPN_{p,i}$)** | **Tonnes $CO_{2e}$** | **23 987** |

[9] Emission factor for coke consumption is based on actual carbon content of coke and emission factor for coke production which is in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf).

[10] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 - http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf. and 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors,* Table 1.2, page 18 - http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf.

[11] In accordance with Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for $CO_2$*, page 2.10 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf).

[12] In accordance with Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for $CO_2$*, page 2.10 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf).

[13] In accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf).

| | | | |
|---|---|---|---|
| P-25 | Quantity of each fuel ($fbpn_p$) used for balance of process needs ($Q_{fbpn,p,i}$) | 1000 $m^3$ | |
| | Natural gas (NG) | 1000 $m^3$ | 12 544 |
| | Coke oven gas (COG) | 1000 $m^3$ | 0 |
| | Emission factor of each fuel $EF_{f,p}$ | Tonnes $CO_{2e}$/1000 $m^3$ | |
| | Natural gas (NG) | Tonnes $CO_{2e}$/1000 $m^3$ | 1,912 |
| | Coke oven gas (COG) | Tonnes $CO_{2e}$/1000 $m^3$ | 0,798 |
| P-27 | Total $CO_{2e}$ from electricity consumption for balance of process needs of project activity ($TCEBPN_{p,i}$) | Tonnes $CO_{2e}$ | **200 552** |
| P-28 | Electricity Consumed for balance of process needs ($ECBPN_{p,i}$) | MWh | 183 993 |
| P-29 | Emissions Factor for Electricity Consumption $EF_{f,p}$ | Tonnes $CO_{2e}$/MWh | 1,090 |

## Baseline

| Classification number | Data variable | Unit | 01.04.2012 – 30.06.2012 |
|---|---|---|---|
| | | | 1999-2003 (baseline) |
| B-1 | Total $CO_{2e}$ in the baseline scenario ($BE_i$) | Tonnes $CO_{2e}$ | **40 421 235** |
| B-2 | Total $CO_{2e}$ from Pig Iron ($TCPI_{b,i}$) | Tonnes $CO_{2e}$ | **34 547 572** |
| B-3 | Total Pig Iron Output ($TPII_{b,i}$) | Tonnes | 12 160 278 |
| B-4 | Total $CO_{2e}$ from fuel consumption in producing Pig Iron ($TCFCPI_{b,i}$) | Tonnes $CO_{2e}$ | **1 701 168** |
| B-5 | Quantity of each fuel ($fpi_b$) used in making Pig Iron ($Q_{fpi,b,i}$) | 1000 $m^3$ | |
| | Natural gas (NG) | 1000 $m^3$ | 889 601 |
| B-6 | Emission factor of each fuel $EF_{f,b}$ | Tonnes $CO_{2e}$/1000 $m^3$ | |
| | Natural gas (NG) | Tonnes $CO_{2e}$/1000 $m^3$ | 1,912 |
| B-7 | Total $CO_{2e}$ from electricity consumption in producing Pig Iron ($TCEPI_{b,i}$) | Tonnes $CO_{2e}$ | **885 967** |
| B-8 | Electricity Consumed in producing Pig Iron ($ECPI_{b,i}$) | MWh | 812 814 |
| B-9 | Emissions Factor for Electricity Consumption $EF_{f,b}$ | Tonnes $CO_{2e}$/MWh | 1,090 |
| B-10 | Total $CO_{2e}$ from Inputs into Pig Iron ($TCIPI_{b,i}$) | Tonnes $CO_{2e}$ | **31 960 437** |
| B-11 | Total $CO_{2e}$ from fuel used to prepare Iron Ore ($TCFIO_{b,i}$) | Tonnes $CO_{2e}$ | **234 747** |
| B-12 | Quantity of each fuel ($fio_b$) used in Sintering ($Q_{fio,b,i}$) | 1000 $m^3$ | |
| | Natural gas (NG) | 1000 $m^3$ | 122 757 |

| | | | |
|---|---|---|---|
| **B-13** | **Emission factor of each fuel $EF_{f,b}$** | **Tonnes $CO_{2e}$/1000 $m^3$** | |
| | **Natural gas (NG)** | **Tonnes $CO_{2e}$/1000 $m^3$** | 1,912 |
| **B-14** | **Total $CO_{2e}$ from electricity consumption in preparing iron ore ($TCEIO_{b,i}$)** | **Tonnes $CO_{2e}$** | **780 147** |
| **B-15** | **Electricity Consumed in Sintering ($ECIO_{b,i}$)** | **MWh** | 715 731 |
| **B-16** | **Emissions Factor for Electricity Consumption $EF_{f,b}$** | **Tonnes $CO_{2e}$/MWh** | 1,090 |
| **B-17** | **Total $CO_{2e}$ from Reducing Agents in Pig Iron Production ($TCRAPI_{b,i}$)** | **Tonnes $CO_{2e}$** | **29 164 228** |
| **B-18** | **Quantity of each reducing agent ($rapi_b$) in Pig Iron Production ($Q_{rapi,b,i}$)** | **Tonnes** | |
| | **Reducing agent (coke)** | **Tonnes** | 7 500 315 |
| | **Reducing agent (anthracite)** | **Tonnes** | 384 305 |
| **B-19** | **Emission factor of each reducing agent, $EF_{ra,b}$** | **Tonnes $CO_{2e}$/Tonne** | |
| | **Emission factor (coke)** | **Tonnes $CO_{2e}$/Tonne** | 3,754 |
| | **Default emission factor (anthracite)** | **Tonnes $CO_{2e}$/Tonne** | 2,62 |
| **B-20** | **Total $CO_{2e}$ from other inputs ($TCOIPI_{b,i}$)** | **Tonnes $CO_{2e}$** | **1 781 315** |
| **B-21** | **Quantity of each other input ($oipi_b$) in Pig Iron Production ($Q_{oipi,b,i}$)** | **Tonnes** | |
| | **Limestone** | **Tonnes** | 2 063 162 |
| | **Dolomite** | **Tonnes** | 1 699 180 |
| | **Pellets** | **Tonnes** | 2 100 503 |
| **B-22** | **Emission factor of each other input, $EF_{oi,b}$** | **Tonnes $CO_{2e}$/Tonne** | |
| | **Default emission factor (limestone)** | **Tonnes $CO_{2e}$/Tonne** | 0,44 |
| | **Default emission factor (dolomite)** | **Tonnes $CO_{2e}$/Tonne** | 0,477 |
| | **Default emission factor (pellets)** | **Tonnes $CO_{2e}$/Tonne** | 0,03 |
| **B-23** | **Total tonnes of $CO_{2e}$ related to the balance of process need of energy required for the project activity ($TCBPN_{b,i}$)** | **Tonnes $CO_{2e}$** | **5 873 664** |
| **B-24** | **Total $CO_{2e}$ from fuel consumption for balance of process needs of project activity ($TCFCBPN_{b,i}$)** | **Tonnes $CO_{2e}$** | **1 240 859** |
| **B-25** | **Quantity of each fuel ($fbpn_b$) used for balance of process needs ($Q_{fbpn,b,i}$)** | **1000 $m^3$** | |
| | **Natural gas (NG)** | **1000 $m^3$** | 638 349 |
| | **Coke oven gas (COG)** | **1000 $m^3$** | 25 250 |
| **B-26** | **Emission factor of each fuel $EF_{f,b}$** | **Tonnes $CO_{2e}$/1000 $m^3$** | |

| | | | |
|---|---|---|---|
| | **Natural gas (NG)** | **Tonnes $CO_{2e}$/1000 $m^3$** | 1,912 |
| | **Coke oven gas (COG)** | **Tonnes $CO_{2e}$/1000 $m^3$** | 0,798 |
| **B-27** | **Total $CO_{2e}$ from electricity consumption for balance of process needs of project activity ($TCEBPN_{b,i}$)** | **Tonnes $CO_{2e}$** | **4 632 805** |
| **B-28** | **Electricity Consumed for balance of process needs ($ECBPN_{b,i}$)** | **MWh** | 4 250 280 |
| **B-29** | **Emissions Factor for Electricity Consumption $EF_{f,b}$** | **Tonnes $CO_{2e}$/MWh** | 1,090 |
| **B-30** | **Total $CO_{2e}$ per 1 tonne of Pig Iron produced ($TCPTPIP_b$)** | **Tonnes $CO_{2e}$/1 t. of Pig Iron Produced** | **3,32404** |

| | | | |
|---|---|---|---|
| **B-1** | **Total $CO_2$ in the baseline scenario ($BE_i$) during the second quarter of 2012** | **Tonnes $CO_2$** | **2 555 059** |

The calculations of GHG emission reductions, indicated in the tables, are based on the actual data of output, FER consumption, systemized in forms developed under the JI project according to the methodology. The information regarding emission reductions data are given in the next chapter.

Calculation of emission reductions is based on conservative assumptions, which can be proved by the following facts:
- the price of natural gas in the baseline period was lower than in the project line period. That's why there were no substitutions of natural gas by coal as it was in project line period. As a result, such substitution decreased the total amount of emission reductions;
- the quality of iron-bearing materials in project line period sometimes was lower in comparison with the baseline period. That was the reason of the total amount of emission reductions decrease.

No leakages are generated during considered monitoring period.

## 4. Emission reductions calculations

The emission reductions[14], examined in this monitoring report, were generated during the whole monitoring period. The monitoring was based on actual data (mentioned in the reporting documents) of output production and FER consumption under the project line and baseline scenarios as it is required by the JI Project Design Document (PDD).

| | 01.04.2012 – 30.06.2012 |
|---|---|
| **Baseline Emissions, t $CO_{2e}$** | **2 555 059** |
| **Project Emissions, t $CO_{2e}$** | **2 201 373** |
| **Emission Reductions, t $CO_{2e}$** | **353 686** |

The amount of emission reductions that was actually generated during the 2-nd quarter of 2012 was lower than it was expected in PDD (approximately 564 959 tonnes of $CO_{2e}$) because of the following reasons. First of all, taking into account that during this monitoring period the quality of raw materials and other inputs consumed under the project activity was low, the actual level of specific fuel and energy resources consumption per unit of output was a bit higher than it was expected in PDD. Secondly, taking into account that such measures as technological improvements of the BFs operation and modernization of the sintering process were not fully implemented as planned, it has also influenced on decrease of actual volumes of emission reductions in comparison with estimations in PDD.

## 5. Measures to ensure the accuracy of the results

The quality assurance procedures are based on the Plant's ISO 9001:2001 quality management system (QMS), which was further upgraded to the more recent ISO 9001:2008[15] version[16]. The QMS covers the whole of the Plant's production process. Furthermore, an OHSAS 18001:2007 industrial safety management system and an ISO 14001:2004 environmental management system were implemented in 2009[17]. Compliance audits for the mentioned above standards are performed in accordance with "Guidance on quality management systems" and other regulatory documents of DIISW. The bureau of standardized certification is responsible for management, realization and storage of audits data. The audits are conducted on monthly basis in accordance with schedule developed at

[14] Project and baseline emissions (which are provided in this chapter) are rounded to the whole figure (1t) and are based on calculations which are demonstrated in the attached excel file. The file is provided to the verifier.
[15] http://www.dmkd.dp.ua/system/files/u21/sert.jpg.
[16] Certificates were issued by UkrSEPRO (# UA 2.008.06119 dated 21/06/2011) and TÜV THÜRINGEN (TIC 15 100 127865 dated 31/01/2012).
[17] Relevant certificates were issued by TÜV THÜRINGEN (# TIC 15 116 10202 dated 02/03/2010 and # TIC 15 104 10697 dated 02/03/2010, respectively).

the beginning of each year by the group of accredited auditors of the bureau of standardized certification. In addition, the Plant has a number of other certificates[18], which proof the project monitoring quality assurance.

During this monitoring period, planned audits on compliance to the standards of ISO 9001:2008, ISO 14001 and OHSAS 18001 were conducted. Verifiers have been provided with the report on audit on compliance to the standard of ISO 14001 dated 10/07/2012, report on audit on compliance to the standard of OHSAS 18001 dated 14/05/2012 and two reports on audit on compliance to the standard of ISO 9001:2008 dated 25/06/2012 and 19/06/2012.

All the equipment used for monitoring purposes is in line with national legislative requirements and standards. The documented instructions to operate the facilities are stored at working places. Verification and calibration of equipment are conducted at the plant in accordance with in STP 230-35-07 Metrological Support of Measuring Equipment. List of monitoring equipment is provided in Annex 1. The data cross check as well as internal audits and corrective actions are taken as defined in STP 230-18-03 *Quality Management System Internal Audits* and according to the standards ISO 9001:2008, ISO 14001 and OHSAS 18001.

The procedure of electricity meters verification is quite a long process. Therefore, in order to prevent errors in metering electricity, meters that are to be verified removed, and instead are installed other verified meters, but of the same type, or with admissible deviation concerning types and which meet the technical requirements. Removed meters are sent for verification, where they are calibrated and then installed, perhaps, in some other place. Thus, during the monitoring period, there were replaced the following electricity meters: # 11 of electric substation of blast-furnace shop, electricity meters ## 114, 115, 126, 128, 129 and 137 of electric substation of water supply shop, electricity meter # 150 of electric substation of Oxygen shop and electricity meter # 159 of electric substation of CHP.

In case of having problems with certain monitoring equipment, the accounting system is organized in such way that allows double checking of all the data. Ultimately all information can be proven by independent invoices from the third parties.

## 6. Roles and obligations

Control over consumption of energy resources, input material and production is monitored by a separate unit of the steel mill (Unit for Control and Automation) with a help of different meters all operating in accordance to the national regulations of Ukraine and documented in Guiding Metrological Instructions of DIISW. Responsibilities for monitoring are defined in the table below[19].

[18] Relevant information may be provided upon request.

[19] Responsibility for data monitoring is determined by the Order # 327 issued by PJSC "DIISW" from 23.03.12.

| Responsibility | Specialist Responsible |
|---|---|
| Project coordinator | Technical Department Head |
| Collection, systematization, preparation and storage of data for the development of monitoring reports | Head of Planning-economic department, acting head of environment department |
| Data for Blast Furnaces | Blast Furnace Shop Manager |
| Data for Sinter Plant | Sinter Plant Manager |
| Metrological data | Chief Metrologist – head of metrology laboratory |
| Data for balance of process needs | Head of CHP, Chief Energy Specialist – head of chief energy specialist administration |

The monitoring procedures and responsibilities at DIISW are regulated by STP 230-35-07 *Metrological Support of Measuring Equipment* and national regulations, including:
1) *Metrological Product Quality Assurance* (RMI-I-19.0.1-07);
*2) Metrological Due Diligence of Documentation* (RMI-I-19.0.2-07) and STP 11.02-00 *Organisation and Performance of Metrological Due Diligence of Standards and Technical Documentation;*
3) *Management of Metering Devices* (RMI-I-19.1.1-07).

The procedures for calibration of all monitoring equipment are described in RMI-I.19.0.1-07 and RMI-I.19.1.1-07.

Control of metering process and requirements to metrological support of metering equipment is assured as provided in DSTU 3921.1-1999 (ISO 10012-1:1992) *Requirements to Quality Assurance of Metering Equipment* and DSTU 3921.2- 2000 (ISO 10012-2:1997) *Quality Assurance by Means of Metering Equipment*[20].

The Chief Metrological Specialist (Head of Instrumentation and Control (I&C) Department) is in charge for maintenance of the monitoring equipment and installations as well as for their accuracy required by paragraphs 2.1.1, 3.1.1, 7.1 of the Regulation PP 229-Э-056-863/02-2005 *On Metrological Services of the Iron Works*, STP 230-35-07 *Metrological Support of Measuring Equipment*, *Guideline on Plant Metrology Department*, and I.19.0.1-07. In case of defect discovered in the monitoring equipment the actions of the personnel are determined by STP 230-35-07 *Metrological Support of Measuring Equipment*, *Guideline on Plant Metrology Department*, and I.19.0.1-07 (p.5.4.4).

The measurement of the parameters included into the monitoring plan of the project is envisaged by the provisions of the STP 230-35-07 *Metrological Support of Measuring Equipment*, *Guideline on Plant Metrology Department*, and I.19.0.1-07 (paragraph 5.3.2).

[20] The instructions have been developed in accordance with ISO 9001:2001 requirements. They secure accuracy of all the measurements done using monitoring equipment.

The measurements are conducted on continuous basis and automatically according to the STP 230-35-07 Metrological Support of Measuring Equipment and I-19.1.1-07 (p. 5.4). The results of the measurements are being used by relevant services and technical personnel of the Steel Mill.

Data on materials and FER consumption used for monitoring reports preparation are stored electronically and in printed documents in the bureau of chief accounting of the plant. Data was compiled in day-to-day records, quarterly records, and annual records. All records were finally stored in Planning Department. For emission reductions calculations Planning-economic department and Chief Energy Specialist department use costs data for the corresponding period.

DIISW has organized appropriate staff training to operate the project equipment. With the project equipment introduction the workers had the opportunity to update their working skills, stimulated by the permanent educational theoretical and practical courses at the Steel Plant. In the reporting period the following trainings were conducted[21]:

- The course on professional training and professional development of personnel in the Blast Furnace shop;
- The course on professional training and professional development of personnel in the Sinter shop.

[21] The confirming documents were provided to the verifier.

## Annex 1: The list of monitoring equipment

| Classification number | Explanation | Type of monitoring equipment | Serial number | Frequency of verification (calibration) | Date of last verification (calibration) |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| **P-3**<br>**B-3** | Scales for weighing pig iron | 2390BB-200E/1C | 90 | Once a year | 10.2011 |
| **P-5**<br>**B-5** | BF-1m Natural gas consumption meter | Сафир-М | 02619588 | Once in 2 years | 04.2012 |
| **P-5**<br>**B-5** | BF-1m Natural gas pressure meter | Сафир –М | 03484802 | Once in 2 years | 06.2012 |
| **P-5**<br>**B-5** | BF-1m Natural gas consumption meter | Сафир –М | 03981694 | Once in 2 years | 04.2012 |
| **P-5**<br>**B-5** | BF-1m Natural gas pressure meter | Сапфир –М | 02800644 | Once in 2 years | 02.2012 |
| **P-5**<br>**B-5** | BF-8 Natural gas consumption meter | Сапфир- М | 03850732 | Once in 2 years | 07.2010 |
| **P-5**<br>**B-5** | BF-8 Natural gas pressure meter | Сафир- М | 03393821 | Once in 2 years | 04.2012 |
| **P-5**<br>**B-5** | BF-8 Natural gas consumption meter | Сапфир- М | 03831731 | Once in 2 years | 02.2012 |
| **P-5**<br>**B-5** | BF-8 Natural gas pressure meter | Сапфир – М | 03483807 | Once in 2 years | 07. 2010 |

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|---|---|---|---|---|---|
| **P-5**<br>**B-5** | BF-9<br>Natural gas consumption meter | Метран-100 | 66737 | Once a year | 03.2012 |
| **P-5**<br>**B-5** | BF-9<br>Natural gas pressure meter | Метран-100 | 65430 | Once a year | 03.2012 |
| **P-5**<br>**B-5** | BF-9<br>Natural gas consumption meter | Метран-100 | 133425 | Once a year | 09.2011 |
| **P-5**<br>**B-5** | BF-9<br>Natural gas pressure meter | Метран-100 | 135282 | Once a year | 06.2012 |
| **P-5**<br>**B-5** | BF-12<br>Natural gas consumption meter | Сафир –М | 10612957 | Once in 2 years | 07.2010 |
| **P-5**<br>**B-5** | BF-12<br>Natural gas pressure meter | АИР-20 | 31275 | Once a year | 07.2011 |
| **P-5**<br>**B-5** | BF-12<br>Natural gas consumption meter | Сапфир –М | 07173694 | Once in 2 years | 07.2010 |
| **P-5**<br>**B-5** | BF-12<br>Natural gas pressure meter | Сапфир –М | 03493886 | Once in 2 years | 07.2010 |
| **P-8**<br>**B-8** | Electric substation of Blast-furnace shop | | | | |
| | Electricity meter #9 | И670 | 130180 | Once in 2 years | 10.2010 |
| | Electricity meter #10 | И670 | 068744 | Once in 2 years | 12.2010 |
| | Electricity meter #11 (before replacement) | ИТ | 111336 | Once in 2 years | 04.2010 |
| | Electricity meter #11 | ИТ | 112041 | Once in 2 years | 05.2012 |

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|---|---|---|---|---|---|
| | (after replacement) | | | | |
| | Electricity meter #12 | ЕвроАльфа | 01132780 | Once in 8 years | 02.2006 |
| | Electricity meter #13 | ЕвроАльфа | 01132784 | Once in 8 years | IV 2006 |
| | Electricity meter #14 | ЕвроАльфа | 01132775 | Once in 8 years | IV 2006 |
| | Electricity meter #15 | ЕвроАльфа | 01132773 | Once in 8 years | IV 2006 |
| | Electricity meter #16 | ЕвроАльфа | 01132770 | Once in 8 years | IV 2006 |
| | Electricity meter #17 | ЕвроАльфа | 01132767 | Once in 8 years | 02.2006 |
| | Electricity meter #18 | ЕвроАльфа | 01132769 | Once in 8 years | IV 2006 |
| | Electricity meter #19 | ЕвроАльфа | 01132774 | Once in 8 years | 02.2006 |
| | Electricity meter #20 | ЕвроАльфа | 01132789 | Once in 8 years | IV 2006 |
| | Electricity meter #21 | ЕвроАльфа | 01132791 | Once in 8 years | IV 2006 |
| | Electricity meter #22 | ЕвроАльфа | 01132768 | Once in 8 years | IV 2006 |
| | Electricity meter #23 | ЕвроАльфа | 01132786 | Once in 8 years | IV 2006 |
| | Electricity meter #24 | И670 | 193791 | Once in 2 years | 03.2012 |
| | Electricity meter #26 | И670 | 361580 | Once in 2 years | 05.2011 |
| | Electricity meter #27 | И670 | 304986 | Once in 2 years | 05.2011 |
| | Electricity meter #28 | И681 | 655731 | Once in 2 years | 05.2011 |
| | Electricity meter #29 | И670 | 905679 | Once in 2 years | 02.2011 |
| **Р-12**<br>**В-12** | Sinter plant Natural gas consumption meter | Сафир М<br>Сафир М | 03939733<br>03639990 | Once in 2 years<br>Once in 2 years | 04.2011<br>01.2012 |
| **Р-12**<br>**В-12** | Sinter plant Natural gas pressure meter | | 08397518 | Once in 2 years | 04.2011 |

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| **P-12**<br>**B-12** | Sinter plant Natural gas pressure meter | Сапфир 2М | 33822 | Once a year | 02.2012 |
| **P-15**<br>**B-15** | Electric substation of Sinter plant | | | | |
| | Electricity meter #1 | И670М | 365718 | Once in 2 years | 11.2011 |
| | Electricity meter #2 | И670 | 736250 | Once in 2 years | 10.2010 |
| | Electricity meter #3 | ИТ | 113199 | Once in 2 years | 08.2011 |
| | Electricity meter #4 | И670М | 429768 | Once in 2 years | 11.2011 |
| | Electricity meter #5 | И670Д | 619098 | Once in 2 years | 09.2010 |
| | Electricity meter #6 | И670М | 946661 | Once in 2 years | 11.2011 |
| | Electricity meter #7 | И670 | 130888 | Once in 2 years | 11.2011 |
| | Electricity meter #8 | ЕвроАльфа | 01132785 | Once in 6 years | 02.2006 |
| **P-15**<br>**B-15** | Electric substation of Lime shop | | | | |
| | Electricity meter #69 | И43 | 192130 | Once in 2 years | 10.2011 |
| | Electricity meter #70 | И670 | 473710 | Once in 2 years | 07.2010 |
| | Electricity meter #71 | И670 | 552166 | Once in 2 years | 06.2011 |
| | Electricity meter #72 | И670 | 584132 | Once in 2 years | 07.2010 |
| **P-18**<br>**B-18** | Scales for weighing coke and anthracite | 2370ВВ-150Е/2С | 70 | Once a year | 11.2011 |
| **P-18**<br>**B-18** | Scales for weighing coke and anthracite | 2329ВВ-50 Е/1Д | 29 | Once a year | 11.2011 |
| **P-21**<br>**B-21** | Scales for weighing limestone, | 2370ВВ-150Е/2С | 70 | Once a year | 11.2011 |

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| | dolomite and pellets | | | | |
| **Р-21 В-21** | Scales for weighing limestone, dolomite and pellets | 2329ВВ-50 Е/1Д | 29 | Once a year | 11.2011 |
| **Р-25 В-25** | CHP Natural gas consumption meter | Сапфир | 517758 | Once a year | 09.2011 |
| **Р-28 В-28** | Electric substation of Water supply shop | | | | |
| | Electricity meter #106 | И670 | 095716 | Once in 2 years | 07.2010 |
| | Electricity meter #107 | ИТ | 691814 | Once in 2 years | 03.2010 |
| | Electricity meter #108 | И670Д | 363453 | Once in 2 years | 06.2011 |
| | Electricity meter #109 | И670 | 127301 | Once in 2 years | 07.2010 |
| | Electricity meter #110 | И670 | 771697 | Once in 2 years | 07.2010 |
| | Electricity meter #111 | И43 | 006194 | Once in 2 years | 12.2010 |
| | Electricity meter #112 | И43 | 047260 | Once in 2 years | 04.2011 |
| | Electricity meter #113 | И687 | 355820 | Once in 2 years | 05.2011 |
| | Electricity meter #114 (before replacement) | И670 | 146522 | Once in 2 years | 05.2010 |
| | Electricity meter #114 (after replacement) | И670 | 112201 | Once in 2 years | 05.2012 |
| | Electricity meter #115 (before replacement) | И670 | 366136 | Once in 2 years | 05.2010 |
| | Electricity meter #115 | И670 | 719571 | Once in 2 years | 05.2012 |

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|---|---|---|---|---|---|
| | (after replacement) | | | | |
| | Electricity meter #116 | И670М | 644511 | Once in 2 years | 08.2010 |
| | Electricity meter #117 | И670М | 643487 | Once in 2 years | 08.2010 |
| | Electricity meter #118 | И670 | 793273 | Once in 2 years | 08.2010 |
| | Electricity meter #119 | И670 | 350061 | Once in 2 years | 08.2010 |
| | Electricity meter #120 | И43 | 237322 | Once in 2 years | 08.2011 |
| | Electricity meter #121 | И43 | 155427 | Once in 2 years | 10.2011 |
| | Electricity meter #122 | И670М | 130498 | Once in 2 years | 07.2010 |
| | Electricity meter #123 | И670 | 649492 | Once in 2 years | 02.2012 |
| | Electricity meter #124 | И670 | 193831 | Once in 2 years | 01.2011 |
| | Electricity meter #125 | И670М | 011918 | Once in 2 years | 08.2011 |
| | Electricity meter #126 (before replacement) | И670 | 303419 | Once in 2 years | 06.2010 |
| | Electricity meter #126 (after replacement) | И670 | 740734 | Once in 2 years | 05.2012 |
| | Electricity meter #127 | ИТ | 690221 | Once in 2 years | 11.2011 |
| | Electricity meter #128 (before replacement) | И670 | 233827 | Once in 2 years | 04.2010 |
| | Electricity meter #128 (after replacement) | И670М | 366162 | Once in 2 years | 04.2012 |
| | Electricity meter #129 (before replacement) | И670М | 096018 | Once in 2 years | 04.2010 |

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| | Electricity meter #129 (after replacement) | И670 | 642969 | Once in 2 years | 04.2012 |
| | Electricity meter #130 | И670 | 305171 | Once in 2 years | 02.2012 |
| | Electricity meter #131 | И670 | 377759 | Once in 2 years | 11.2010 |
| | Electricity meter #132 | И670 | 188830 | Once in 2 years | 06.2011 |
| | Electricity meter #133 | И670 | 192034 | Once in 2 years | 06.2011 |
| | Electricity meter #136 | И670 | 605102 | Once in 2 years | 02.2012 |
| | Electricity meter #137 (before replacement) | И670 | 082160 | Once in 2 years | 05.2010 |
| | Electricity meter #137 (after replacement) | И670 | 691911 | Once in 2 years | 05.2012 |
| | Electricity meter #138 | И670М | 095620 | Once in 2 years | 10.2011 |
| | Electricity meter #139 | И670М | 506019 | Once in 2 years | 08.2010 |
| **Р-28 В-28** | Electric substation of Oxygen shop | | | | |
| | Electricity meter #142 | И670 | 754749 | Once in 2 years | 12.2010 |
| | Electricity meter #143 | И43 | 201587 | Once in 2 years | 10.2011 |
| | Electricity meter #145 | И670 | 143541 | Once in 2 years | 02.2012 |
| | Electricity meter #146 | И670М | 157116 | Once in 2 years | 08.2010 |
| | Electricity meter #147 | И670 | 233755 | Once in 2 years | 01.2012 |
| | Electricity meter #148 | И670М | 036772 | Once in 2 years | 01.2012 |
| | Electricity meter #149 | И670 | 062944 | Once in 2 years | 01.2012 |
| | Electricity meter #150 | И670 | 619944 | Once in 2 years | 04.2010 |

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|---|---|---|---|---|---|
| | (before replacement) | | | | |
| | Electricity meter #150 (after replacement) | И670М | 329704 | Once in 2 years | 05.2012 |
| | Electricity meter #151 | И670 | 919610 | Once in 2 years | 03.2012 |
| | Electricity meter #152 | ЕТ | 8876 | Once in 6 years | 09.2006 |
| | Electricity meter #153 | ЕТ | 8875 | Once in 6 years | 09.2006 |
| **Р-28 В-28** | Electric substation of Gas shop | | | | |
| | Electricity meter #166 | И670 | 690556 | Once in 2 years | 08.2011 |
| | Electricity meter #167 | И670 | 168047 | Once in 2 years | 08.2011 |
| | Electricity meter #168 | И670 | 232756 | Once in 2 years | 03.2011 |
| | Electricity meter #169 | И670 | 134849 | Once in 2 years | 09.2010 |
| | Electricity meter #170 | И670 | 672417 | Once in 2 years | 02.2012 |
| | Electricity meter #171 | И670 | 712689 | Once in 2 years | 03.2011 |
| | Electricity meter #172 | И670М | 021916 | Once in 2 years | 12.2011 |
| **Р-28 В-28** | Electric substation of CHP | | | | |
| | Electricity meter #154 | И670 | 069187 | Once in 2 years | 09.2011 |
| | Electricity meter #155 | И670 | 374202 | Once in 2 years | 03.2012 |
| | Electricity meter #156 | ИТ | 313176 | Once in 2 years | 11.2010 |
| | Electricity meter #157 | И670 | 115317 | Once in 2 years | 10.2011 |
| | Electricity meter #158 | И670 | 754589 | Once in 2 years | 10.2011 |
| | Electricity meter #159 (before | И670 | 233380 | Once in 2 years | 12.2009 |

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|---|---|---|---|---|---|
| | replacement) | | | | |
| | Electricity meter #159 (after replacement) | И670М | 366527 | Once in 2 years | 05.2012 |
| | Electricity meter #160 | И670 | 306278 | Once in 2 years | 12.2010 |
| | Electricity meter #161 | И670 | 793115 | Once in 2 years | 07.2010 |
| | Electricity meter #162 | И670 | 681225 | Once in 2 years | 11.2010 |
| | Electricity meter #163 | И670 | 603211 | Once in 2 years | 11.2010 |
| | Electricity meter #164 | И670 | 350258 | Once in 2 years | 03.2012 |