JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
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CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Reconstruction of the oxygen compressor plant at the JSC “Zaporizhstal”, Ukraine.

Version: 03

Date: 03.08.2009

A.2. Description of the project:

In order to provide pig-iron and open-hearth steel productions with oxygen at the set level as well as to replace the worn-out air-separation units, the project for reconstruction of the oxygen compressor plant is being implemented at the JSC “Zaporizhstal”.

The JSC “Zaporizhstal” is one of the largest metallurgical works in Ukraine. With respect to the production output, the JSC “Zaporizhstal” is among the four largest firms of Ukraine. The JSC “Zaporizhstal” is a manufacturer of high-quality metal products – pig iron, steel, flat products of carbon, low-alloyed, alloyed and stainless steel, joist webs, tinplate, construction materials and consumer goods. The complex is one of the main suppliers of flat products and molded sections for the machine-building industry in Ukraine and tinplate for the food-processing industry.

The JSC “Zaporizhstal” comprises the following production units:

1. Sintering plant (6 sintering machines)
2. Blast-furnace plant (4 blast furnaces)
3. Open-heart plant (9 open-hearth furnaces)
4. Foundry plant
5. Slabbing mill “1150”
6. Hot-rolling mill (NTLS 1680)
7. Cold-rolling mill

The primary plants of the integrated iron-and steel complex JSC “Zaporizhstal” (blast-furnace and open-hearth) must be provided with oxygen that is used in the process of iron and open-hearth steel smelting. Currently, oxygen for blast-furnace and open-hearth plants is generated in the oxygen compressor plant (OCP) of the JSC “Zaporizhstal” with the application of two air-separation units: unit KtK-35-3 and unit KAr-30. Besides, unit BR-2 has been standing ready for use since 2007, is available with the OCP.

As the lifetime for the air-separation units specified in accordance with the operating rules (PTEPPRV-89) expires in 2008 for the block KtK-35-3 and for the block KAr-30 – in 2010, the operational need to reconstruct the OCP to provide the primary production operations of the complex with oxygen has emerged at the JSC “Zaporizhstal”.

The OCP reconstruction at the JSC “Zaporizhstal” is implemented by the construction of the air-separation unit VRU-60, manufactured by Air Liquide (France). The air-separation unit VRU-60 generates oxygen by the same process as the unit KAr-30, however, the VRU-60 has a number of design advantages that will make it possible to provide the production needs with the required amount of oxygen upon achievement following effects:

- reduction in electric power consumption by 34%;
- reduction in manufacturing water consumption by 20%;
- generation of oxygen with pressure of 1.2 MPa without subsequent compression;
- decrease of oxygen losses during production;
- increase of oxygen concentration up to 99.5% (now the oxygen concentration is 95 - 96%).

The start-up of the VRU-60 will allow the OCP output for the generation of oxygen, nitrogen and argon to be increased as well.

In the absence of this project (the construction of the air-separation unit VRU-60 manufactured by Air Liquide), reconstruction of the OCP would have been implemented by the construction of a brand new air-separation unit KAAr-32 manufactured by the JSC "Cryogenmash" (Russia). The construction of units KAAr-32 has been scheduled to be carried out at the JSC "Zaporizhstal" since 1990. To implement the project for the construction of the unit KAAr-32, the whole design project document has been developed and approved and construction of this block has started (the foundation has been built). The air-separation unit KAAr-32 is similar to the unit KAr-30 in operation at the plant. Construction of the unit KAAr-32 would make it possible to provide oxygen generation at the required level and to cover the full oxygen needs of the plant's manufacturing processes.

The implementation of the project for the construction of the VRU-60 will make it possible, versus the situation in the absence of this project, to significantly reduce the electric power consumption supplied for the OCP operation by the power grid of Ukraine by 94,300 MWh/year in 2008 and by 121,000 MWh/year in 2009-2012. This will lead to a reduction in greenhouse gas emissions within the Ukrainian grid owing to the reduction in fossil fuels to be utilized for the generation of the equivalent quantity of electric power. The reductions in GHG emissions as a result of the project implementation for the construction of the air-separation unit VRU-60, will be 84,500 tons of CO_2/year in 2008 and 108,600 tons of CO_2/year over the subsequent period. The total reduction will be about 518,800 tons of CO_2 over the crediting period from 2008 to 2012.

The air-separation unit VRU-60 was putted into operation December 2007.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	JSC "Zaporizhstal"	No

A.4. Technical description of the project:

A.4.1. Location of the project:

The project for reconstruction of the oxygen compressor plant at the JSC "Zaporizhstal" is being implemented within the integrated iron-and-steel works of the JSC "Zaporizhstal" located in the city of

Zaporizhzhya, Zaporizhzhya region, Ukraine. The geographical coordinates of project: 47°52’ N.; 35°09’ E.

A.4.1.1. Host Party(ies):

Ukraine is situated in the south-eastern part of Central Europe. It occupies an area of 603 000 sq. km. Ukraine stretches for 1316 km from the west to the south and for 893 km from the north to the south. In the south Ukraine is washed by the Black Sea and the Sea of Azov. In the north Ukraine borders Belarus, in the east and north-west Russia, in the south-west Hungary, Romania and Moldova and Poland and in the west Slovakia. Ukraine comprises 24 administrative districts.

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

Zaporizhzhya region: it is situated in the south-east of Ukraine. The area of the Zaporizhzhya region is 27,200 sq. km (4.5% of the area of Ukraine). Population – 2,023,800 people (4% of the population of Ukraine). The Zaporizhzhya region borders Dnipropetrvsk, Kherson and Donetsk regions and in the south-east its coast is washed by the waters of the Sea of Azov.

The Zaporizhzhya region is one of the most developed industrial regions of Ukraine. Over 90% of total industrial production is in heavy industry, the electric power industry and machine-construction. Over 160 large manufacturing corporations operate in the region.

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

The city of Zaporizhzhya is the administrative capital of the Zaporizhzhya region situated on the Dnieper river. The population of the city of Zaporizhzhya is about 855,500 people (2007).

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

The project for reconstruction of the oxygen compressor plant at the JSC "Zaporizhstal" is being implemented directly on the JSC "Zaporizhstal" located in the industrial area of the Zavodskoy district of the city of Zaporizhzhya. To ensure the operation of the brand new air-separation unit, the existing infrastructure of the plant will be used including for the provision of the VRU-60 with electric power, manufacturing water and air.

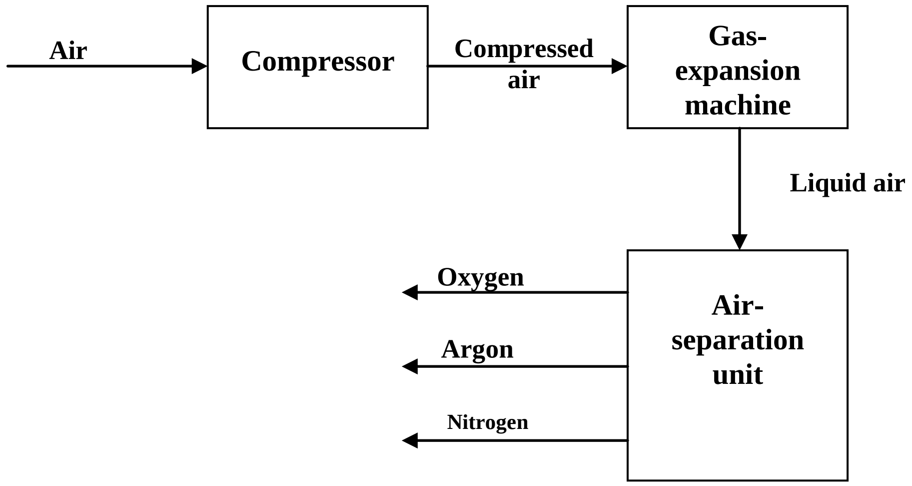
A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

The construction of a new air-separation unit VRU-60 is specified for in the project. The main elements of the air-separation unit are as follows:

- turbo-compressor;
- gas-expansion machine intended for compressed air expansion;
- unit for liquefied air separation.

Air liquefaction is firstly performed in the air-separation unit by pre-compression by the compressor to a pressure of about 0.6 MPa and subsequent expansion in the gas-expansion machine causing cooling to the temperature at which air transforms into a liquid state (below -192 °C). Then liquid air comes to the separation unit for rectification – the separation of liquid air into components by double gradual evaporation; nitrogen volatilizes firstly during evaporation (t_{boil}= -195,8 °C) and argon (t_{boil} = -189,4 °C) and liquid oxygen remains (t_{boil} = -183 °C). By repeating the evaporation, the required purity of oxygen can be achieved. A schematic diagram of the air separation plant is shown in Fig. A.4.2.-1. A more detailed process flow diagram for the VRU-60 as well as the constitution of the unit equipment is shown in Annex 4.

Fig. A.4.2.-1. Schematic operational diagram for the air separation plant.



The basic performance indicators for the VRU-60 are shown in Table A.4.2.-1.

The air-separation unit VRU-60 provides for two basic operational modes: main run mode and operation mode without booster compressor. High-pressure oxygen (13 bar) is generated in the main run mode that makes it possible to supply oxygen to consumers without additional compression. At operation without booster compressor, low-pressure oxygen (1.05 bar) is generated and additional compression is required.

Due to the utilization of special rectifying towers, the VRU-60 allows the amount of air being processed to be controlled and correspondingly the oxygen to be generated within 50-100% of the max. output (60,000 $m^3(O_2)$/hour), respectively. Therefore, oxygen generation is to be provided at an amount not exceeding the current requirements of the plants of the complex in oxygen. This allows oxygen losses to be provided during production which do not exceed the design values by 3-5%.

Control over oxygen generation in unit VRU-60 is one of the design advantages of this unit versus units KAAr-32. Oxygen generation is uncontrollable in units KAAr-32 (control is possible only within 95-100%), thus oxygen is generated at a constant rate (30,000-32,000 m^3/hour). Therefore, if generated oxygen is not fully consumed by the plants of the firm, it is to be discharged into the air. Oxygen losses during production exceeded 19 % in 2005-2007 (Annex 2).

Table A.4.2.-1. Expected performance indices for the VRU-60 after the project implementation.

Indicators	Units of measurement	Design values for ВРУ-60*
Oxygen production	mln. m^3/year	263-526
Nitrogen production	mln. m^3/year	175.2
Argon production	mln. m^3/year	5.2-10.4
Specific output	thousand m^3 (O_2)/day	721-1441
Oxygen losses	%	3-5
Volume fraction of oxygen	%	99.5
Specific power consumption for production at the OCP	MWh/thousand $m^3(O_2)$	1.110
Specific manufacturing water consumption for production at the OCP	m^3/m^3 (O_2)	0.120

* Performance indicators for the VRU-60 are shown taking into account of the possible capacity control of the plant from 50-100%

Reconstruction of the OCP also envisages replacement of the re-circulating water supply pumps for the OCP: replacement of the 1000 kW pump with a two 80 kW pumps. It is due to the fact that lesser amount of manufacturing water will be required for oxygen generation by the OCP after reconstruction. The re-circulating water supply scheme is given in Annex 4.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

The construction of the new air-separation unit VRU-60 (manufactured by Air Liquide, France) at the JSC "Zaporizhstal" will make it possible to achieve significant electricity saving versus the Baseline scenario – the construction of the air-separation unit KAAr-32 (manufactured by the JSC "Cryogenmash", Russia).

Electricity is to be saved by:

- reduction of oxygen losses,
- oxygen production without subsequent compression,

- reduction in manufacturing water consumption.

Electricity saving in the oxygen compressor plant of the JSC “Zaporizhstal” will lead to a reduction in the supply of electric power from the grid of Ukraine. Thus, the reduction in the supply of electric power from the grid will enable electric power generation at the electricity-generating plants of Ukraine to be decreased at the equivalent rate. This will lead to a reduction in the emissions of GHG as a result of the reduction in the consumption of fuel-and-energy resources for electric power.

Electricity saving as a result of the Project implementation will be 94,300 MWh/year in 2008 and by 121,000 MWh/year in 2009-2012 versus the Baseline scenario. Consequently, the implementation of the project will allow GHG emissions to be reduced at the electricity-generating plants of Ukraine due to the fuel saved in electric power generation for the JSC “Zaporizhstal”. This amounts to approximately 84,500 tons of CO_2/year in 2008 and 108,600 tons of CO_2/year in 2009-2012.

The current legislation of Ukraine does not restrict activities causing GHG emissions in the field of control of anthropogenic GHG emissions. Therefore, the Project for the reconstruction of the OCP at the JSC “Zaporizhstal” could develop according to any of the possible scenarios which make it possible to provide oxygen production at the required level (alternative scenarios are discussed in section B.1.). Reconstruction of the OCP by construction of the air-separation units KAAr-32 manufactured by the JSC “Cryogenmash”, which is the Baseline scenario, would be the most acceptable project scenario for the JSC “Zaporizhstal” (the justification for the Baseline scenario is given in section B.1.). In such a way, the Baseline scenario does not contradict national and sectoral policies in the field of GHG emissions control and would have been realized in the absence of the project. This would prevent the reductions in GHG emissions to be achieved.

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

Length of crediting period:	Estimate of annual emission reductions in tones of CO_2 equivalent
2008	84,531
2009	108,571
2010	108,571
2011	108,571
2012	108,571
Total estimated amount of emission reductions over the crediting period, tons of CO_2-equivalent	518,814
Estimated average annual amount of emission reductions over the crediting period, tons of CO_2-equivalent	103,763

A.5. Project approval by the Parties involved:

The project for the reconstruction of the oxygen compressor plant at the JSC “Zaporizhstal” was supported by a Letter of Endorsement from the Ministry for the Protection of the Environment of Ukraine acknowledging the possibility to implement this project as a Joint Implementation Project.

SECTION B. Baseline

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

The provisions set forth in the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality (Version 02.1)" developed and approved for CDM (Clean Development Mechanism) projects are used for the description and justification of the Baseline.

The procedure proposed by this tool prescribes the consideration and analysis of alternative scenarios to the Project activities in accordance with the following steps:

1. Identification of alternative scenarios.
2. Barrier analysis.
3. Investment analysis.
4. Common practice analysis.

<u>Step 1. Identification of alternative scenarios</u>

The identification of alternative scenarios is to be performed in order to choose the baseline scenario according to the project for the OCP reconstruction at the JSC "Zaporizhstal".

Sub-step 1a. Determination of alternative scenarios in respect to the present Project:

In compliance with Combined tool it's necessary to identify relevant alternative scenarios: "*provide an overview of other technologies or practices that provide outputs or services (e.g. electricity, heat or cement) with comparable quality, properties and application areas as the proposed CDM project activity and that have been implemented previously or are currently underway in the relevant geographical area*".

For provision with oxygen and other technological gases the plants at the metallurgical works may be considered the following alternative scenarios that have been implemented previously or are currently underway in the relevant geographical area[1]:

1. Construction of new Air-separation units with different output:
   - 1.1. ASUs with output 15,000 $m^3(O_2)$/hour (e.g. ISTIL mini steel mill.[2]);
   - 1.2. ASUs with output 30,000 – 40,000 $m^3(O_2)$/hour (e.g. JSC "Alchevsk Iron & Steel Works"[3], JSC "Enakievo Iron & Steel Works"[4])
   - 1.3. ASUs with output 60,000 $m^3(O_2)$/hour (e.g. JSC "Alchevsk Iron & Steel Works".[5])

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[1] Under *the relevant geographical area* we consider the metallurgical works <u>in the Host country – Ukraine</u> (this is in accordance with Combined tool: "*The relevant geographical area should in principle be the host country of the proposed CDM project activity").*

[2] Date source: Journal "Technical gases" # 2, 2007.

[3] Date source: Journal "Technical gases" # 3, 2006.

[4] Date source: www.emz.com.ua

[5] Date source: PDD "Revamping and Modernization of the Alchevsk Steel Mill - Using Higher Efficiency Technology to replace Open Hearth Furnaces (OHF), Ingot Casting and Blooming Mills" / http://ji.unfccc.int/index.html

2. Retrofitting of the existing air-separation units and continuing their operation (e.g. JSC “ArcelorMittal Kryvyi Rih”[6])

3. Oxygen and other technological gases supply from the outside (e.g. Donetskstal[7])

A list of the alternative scenarios of the Project for the reconstruction of the OCP at the JSC “Zaporizhstal” is to be made up based on the provision of the methodological tool that “*all alternative scenarios must be available to the project participants and must provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity”*. In the context of the Project for the reconstruction of the OCP at the JSC “Zaporizhstal”, the provision of the plants of the JSC “Zaporizhstal” with oxygen at the required level (about 390,000,000 $m^3(O_2)$/year) is the main criterion for choosing alternative scenarios.

Alternative scenarios:

1. Retrofitting of the existing air-separation units (KtK-35-3, KAr-30) and continuing their operation.

2. Reconstruction of the OCP by constructing two air-separation units KAAr-32 which are identical in design to the existing equipment.

3. Implementation of the Project (construction of the unit VRU-60) without it being registered as a JI Project.

4. Reconstruction of the OCP by construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour.

Description of the alternative scenarios

Alternative scenario 1. Retrofitting of the existing air-separation units (КtК-35-3, KAr-30) and continuing their operation.

Retrofitting of the air-separation units КtК-35-3 and KAr-30 could be implemented according to a simplified or expanded variant depending on the level of depreciation of the equipment. In the expanded variant of retrofitting, replacement of almost all the modules of the air-separation units is possible that will extend their lifetime for up to 10 years. The output of the units КtК-35-3 и KAr-30 is 30,000 $m^3(O_2)$/hour. Retrofitting of the air-separation units will make it possible to generate oxygen at the amount required for the production units of the JSC “Zaporizhstal” (about 390,000,000 $m^3(O_2)$/year).

Alternative scenario 2. Reconstruction of the OCP by constructing two air-separation units KAAr-32 which are identical in design to the existing equipment.

The air-separation units KAAr-32 manufactured the JSC “Cryogenmash” are identical in design to units КtК-35-3 and KAr-30 and have been successfully operated at the JSC “Zaporizhstal” for over 30 years. The output of one unit KAAr-32 is 30,000 – 32,000 $m^3(O_2)$/hour. This is comparable to the output of the existing air-separation units. The construction of two air-separation provided by this alternative scenario will make it possible to generate oxygen at the required level (about 390,000,000 $m^3(O_2)$/year).

Alternative scenario 3. Implementation of the Project (construction of the unit VRU-60) without it being registered as a JI Project.

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[6] Date source: http://www.cryogenmash.ru/production/cryogenic_launches/upgrade.php
[7] Date source: PDD “Introduction of energy efficiency measures at ISTIL mini steel mill, Ukraine” / http://ji.unfccc.int/index.html

Construction of the unit VRU-60 (manufactured by Air Liquide) will make it possible to replace the worn-out air-separation units and to generate oxygen at the set level (about 390,000,000 $m^3(O_2)$/year) to ensure the functioning of the primary productions of the JSC "Zaporizhstal". The output of the VRU-60 is 60,000 $m^3(O_2)$/hour.

Alternative scenario 4. Reconstruction of the OCP by construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour.

Construction of two air-separation units with adjustable output capacity (manufactured by Air Liquide, Linde, Cryogenmash or other producer) with common capacity 60,000 $m^3(O_2)$/hour. The output per unit can be 20,000-40,000 $m^3(O_2)$/hour (average output is 30,000 $m^3(O_2)$/hour per unit). This alternative scenario will make it possible to generate oxygen at the required level (about 390,000,000 $m^3(O_2)$/year) and to replace the worn-out air-separation units.

Alternative scenarios that are excluded from consideration:

1. Construction of ASUs with output 15,000 $m^3(O_2)$/hour and 40,000 $m^3(O_2)$/hour. These ASUs do not conform to the required level of oxygen production (about 390,000,000 $m^3(O_2)$/year).

2. Oxygen and other technological gases supply from the outside. Not far from JSC "Zaporizhstal" there are not works that have a capacity for oxygen supply for JSC "Zaporizhstal" (oxygen and other technological gases do not produced at JSC "Zaporizhcoks" and JSC "Dneprospecstal" that are located not far from JSC "Zaporizhstal").

3. Construction of several (more than two) air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour. This scenario is less financial attractive than alternative scenario 4 as the construction of additional ASUs leads to increase of investment as a result of increase of metalware (pipelines, heat exchangers, energy equipment and others), cost of designing, construction and commissioning. From the following consideration will be clear that alternative scenario 4 is financial less attractive than other alternative scenarios, it signifies that this scenario is also not attractive.

4. Construction of two air-separation units with adjustable output capacity other than 20,000-40,000 $m^3(O_2)$/hour per unit with common capacity 60,000 $m^3(O_2)$/hour. This scenario is a technological unattractive in comparison with alternative scenario 4 as there is a technological barrier for two ASUs operation one of them has capacity less than 20,000 $m^3(O_2)$/hour *(see Barrier analysis for alternative scenario 4).*

Sub-step 1b. Compliance of the chosen alternatives with current legislation and regulations

In accordance with Combined tool *"The alternative(s) shall be in compliance with all mandatory applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions".* The operation of air-separation units is subject to the operating rules and regulations PTE PPRV-89. There are no other normative legal documents which could affect the project implementation.

In accordance with the operating rules and regulations PTE PPRV-89, new air-separation units could be operated without overhaul for 20 years with a potential lifetime extension of another 10 years. After overhaul, the life time for the air-separation units is subject to extension after a state technical expert examination is conducted and favorable results regarding the operation of the equipment is given. In accordance with PTE PPRV-89 the commission of experts can extend the lifetime to 30 years.[8]

[8] The Rules for technical operating of equipment for production of products of air separation for metallurgical plants (PTE PPRV-89), approved by Ministry of Metallurgy, 1989.

Air separation units КtК-35-3 and КAr-30 was put into operation in 1975 and 1978. Their lifetime was extended in year 2001. In accordance with decision of commission of experts (2001) the lifetime of ASUs КtК-35-3 and КAr-30 was extended till 2007 year.[9] In year 2007 the lifetime of КtК-35-3 and КAr-30 will be already 33 and 30 years. So the continuation of operating the ASUs КtК-35-3 and КAr-30 after 2008 is not in compliance with technical regulatory requirements. Besides the Retrofitting of the air-separation units (manufactured the JSC "Cryogenmash") is not possible after 30 or more years operating of ASUs. [10].

Alternative scenarios 2, 3 and 4 conform fully to the requirements of the current legislation and could be implemented.

Outcome of Step 1b: The list of alternative scenarios to the project activity that are in compliance with mandatory legislation and regulations:

Alternative scenario 2. Reconstruction of the OCP by constructing two air-separation units KAAr-32 which are identical in design to the existing equipment.

Alternative scenario 3. Implementation of the Project (construction of the unit VRU-60) without being registered as a JI Project.

Alternative scenario 4. Reconstruction of the OCP by construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour.

<u>Step 2. Barriers analysis</u>

Barriers that could affect the development of the alternative scenarios stated above are discussed at this stage.

Sub-step 2a. Determination of barriers that could prevent the implementation of the alternative scenarios.

The effect of the following barrier on the alternative scenarios is considered within the barriers analysis:

- Technological barrier. *"The Risk of technological failure: the process/technology failure risk in the local circumstances is significantly greater than for other technologies that provide services or outputs comparable to those of the proposed CDM project activity, as demonstrated by relevant scientific literature or technology manufacturer information."*

Technological barrier means the risk of technological failure of ASUs that occurs in case of use of the particular equipment type in OCP of JSC "Zaporizhstal" (according to alternative scenarios). That may cause the break of plant's basic technological processes (production of pig iron-steel-rolled steel), despite of using of all possibilities for the risk prevention. The break of plant's basic technological processes is unacceptable as it leads to large economical losses.

Main consumers of oxygen in JSC "Zaporizhstal" are blast-furnaces and open-hearth furnaces of the steel works. The characteristics of blast-furnace plant and open-hearth plant for oxygen consumption are presented in the table B.1-1.

[9] Decision of commission of experts about permission for operation of air separation units, dated 15.12.2001

[10] Date source: http://www.cryogenmash.ru/production/cryogenic_launches/upgrade.php , http://www.regnum.ru/expnews/237102.html

Table B.1-1. The characteristics of blast-furnace plant and open-hearth plant JSC "Zaporizhstal"

Parameter	Blast-furnace plant	Open-hearth plant and other plants
Purpose of the oxygen usage	Process intensification	Carbon oxidation / Process needs
Optimal consumption[11]	20,000 m^3/hour	40,000 m^3/hour
Average consumption[12]	7,500 m^3/hour	32,000 m^3/hour
Minimal consumption[13]	0 m^3/hour	20,000 m^3/hour

In the blast-furnace plant oxygen is used for the pig iron production process intensification – increase of the blast furnaces' output and reduction of specific consumption of fuel and raw materials. Average oxygen consumption for the pig iron production is 17.85 m^3/ton of pig iron or 7,500 m^3/hour (day) (table B.1-1.). Melting of the pig iron can be done without oxygen but it leads to negative effects: reduction of pig iron output by 3,3% (or about 320 tons per day) and increase of coke consumption by 3,3% (or 158 tons per day)[14].

In the open-hearth plant oxygen is used for burning process intensification and for the heat conductance increase. Also it is used for oxidation of carbon and other admixtures of pig iron for getting steel. Average oxygen consumption for steel production in the open-hearth plant of JSC "Zaporizhstal" is 83.62 m^3/ton of steel or 32,000 m^3/hour (day) (table B.1-1.). The open-hearth plant of JSC "Zaporizhstal" cannot work in the absence of oxygen because of the technological peculiarities of the open-hearth furnaces. Technological peculiarities of the open-hearth furnaces are: one-channel open-hearth furnaces of the plant were refurbished for the work with the oxygen injection through the arch-like oxygen forms with modification of heads' construction and furnaces' understructure. Implementation of these changes in open-hearth furnaces construction will not allow using solid oxidizer (iron ore) in furnace burden. Therefore, absence of oxygen will be a reason of open-hearth furnaces stopping and it will pose the work's stop of all shops participating in metal production process including pig iron production and rolled metal output.

It is to identify which type of technological failure in OCP may happen in the Air Separation units that bring to ASUs shutdown and consequently to impossibility of production and distribution of oxygen. The technological failures are provided in table below. These failure may happen in all types of ASUs independently on producer of ASUs (e.g. Air Liquide, Linde or Cryogenmash) and independently on productivity of ASUs (15,000 $m^3(O_2)$/hour, 30,000 $m^3(O_2)$/hour or 60,000 $m^3(O_2)$/hour).

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[11] Optimal oxygen distribution by oxygen output 60,000 m^3/hour. The oxygen consumption in Open-hearth plant and other plants (40,000 m^3/hour) includes oxygen consumption in Open-hearth plant (36,000 m^3/hour) and oxygen distribution for autogenous needs (2,000 m^3/hour) and for JSC "Dneprospecstal" (2,000 m^3/hour).

[12] Assessed in accordance with technical report of JSC "Zaporizhstal" for match 2008.

[13] Instruction for actions of staff of oxygen-compressor plant, blast-furnace plant, open-hearth plant and gas-plant by shut down of air separation unit VRU-60, approved by Technical Director, 2008. In accordance with Instruction in case of VRU-60 shut down the oxygen from liquid oxygen reservoir will be distributed in rate 20,000 m^3/hour including 16,000 m^3/hour for Open-hearth plant, 2,000 m^3/hour for autogenous needs and 2,000 m^3/hour for JSC "Dneprospecstal".

[14] Assessment in accordance with Technological instruction ТИ 226-Д-06-2006 "Operation of blast-furnace plant"

Table B.1-2. The technological failures by ASUs that provide to ASUs shutdown[15]

№	Definition of technological failure
1.	Pressure fall after the turbo compressors as a result of stop of one or more turbo compressors that are in the process.
2.	Faults in the work of constrained valve of complex cleaning device VRU-60 and in the system of changeover of regeneration device KAr-30, BR-2, induced by malfunction of air changeover or electric pneumatic valve.
3.	Exceed of allowed concentration of CO_2 in the air carried into the cooled part of ASU.
4.	Exceed of allowed explosive admixtures' concentration in liquid oxygen or in primary krypton concentrate in ASU.
5.	Gas or cryogenic liquids in internal parts of the ASU.
6.	Stop of turbo-expander of ASU.
7.	Miscellaneous faults in operation process of ASU that are results of valve breaks, adjusting fittings, controlling and measuring apparatus and automation, software.

These technological failures (table B.1-2.) are probable for each type of ASUs and may happen independently on life's span of equipment. The technological failures may be occur both in the old ASUs and in the new ASUs. For example five cases of ASU emergency shutdown were happen at time of VRU-60 operation in the JSC "Zaporizhstal".[16]

If the said barriers will not be overcome by one of the alternatives stated above, it is to be excluded from further analysis.

Sub-step 2b. Elimination of alternative scenarios, which are prevented by the identified barriers

Technological barrier

Alternative scenario 2

The operation of two ASUs KAAr-32 does not exclude the risk of technological failure for these ASUs (how described above this risk may be arisen in each ASU), but the occurrence of technological failure at same time in two ASUs is almost impossible as these ASUs will be operated independently. All equipment in the ASUs KAAr-32 will be duplicated (Annex 2), also external equipment included air compressors and compressors for oxygen compression is for each ASU different.

Therefore it is possible the stop of one ASU KAAr-32 operation and continuation of other ASU KAAr-32 operation. In this case the output of oxygen will be decreased from 60,000 – 64,000 $m^3(O_2)$/hour (the oxygen production of two ASUs KAAr-32) to 30,000 – 32,000 $m^3(O_2)$/hour (the oxygen production of one ASU KAAr-32).

Depended on difficulty of technological failure the operation of OCP may be continued with one ASU (KAAr-32) till second ASU (KAAr-32) or reserved ASUs (KtK-35-3, KAr-30) will be put into

[15] Date source: Operating instruction for Air separation units: VRU-60, KAr-30, BR-2.

[16] Date source: Aggregate journal for VRU-60.

operation. Till restorative OCP operating with required oxygen output 44,500 – 60,000 $m^3(O_2)$/hour (table B.1-1.) the oxygen output in OCP will be on level 30,000 – 32,000 $m^3(O_2)$/hour. This provides to stopping of oxygen supply to Blast-furnace plant and to appearance of negative consequences by blast-furnaces operation (Analysis in Step 2a). But the oxygen output on level 30,000 – 32,000 $m^3(O_2)$/hour will be sufficient for Open-hearth furnaces operation in required volume – not less than 16,000 $m^3(O_2)$/hour (table B.1-1.).

So in case of technological failure in *alternative scenario 2* that provides to one ASU shut down other ASU KAAr-32 will be operated. The oxygen produced in one KAAr-32 will be sufficient for open-hearth plant in the JSC "Zaporizhstal" therefore the basic technological process (production of pig iron – steel – rolled steel) will not be broken.

A technological barrier does not exercise significant influence on the implementation of *alternative scenario 2.*

Alternative scenario 3

In case the technological failures (identified in table B.1-2) would be arisen by operation of VRU-60 causing shut down of VRU-60 the oxygen production and supply to consumer will stop. In this situation the following actions for oxygen supply are possible:

1. Usage of reservoir of liquid oxygen,

2. Take into operation the reserved ASUs.

The reservoir of liquid oxygen was developed on stage VRU designing taking into account that the risk of technological failure by operation of VRU-60 is possible. The reservoir of liquid oxygen has the volume 500 m^3. 399,000 m^3 of gaseous oxygen can be generated from 500 m^3.[17] This volume of oxygen is sufficient for steel plant operation during 20 hours in case of the stopping oxygen supply for Blast-furnace plant and the minimal consumption of oxygen 20,000 $m^3(O_2)$/hour including 16,000 $m^3(O_2)$/hour for open-hearth plant (table B.1-1). If during 20 hours the technological failure in OCP cannot be removed that provide to break of plant's basic technological processes (production of pig iron-steel-rolled steel).

The reserved ASUs (KtK-35-3, KAr-30) can be put into operation by malfunction of VRU-60 but that require 50 hours for KAr-30 and 60 hours for KtK-35-3 till beginning of oxygen production and distribution.[18]

So in case of technological failure in *alternative scenario 3* that provides to VRU-60 shut down for time more 20 hours the basic technological process (production of pig iron – steel – rolled steel) will be broken. The stopping of basic technological process can last 30-40 hours until the reserved ASUs will be taking into operation.

The development of the Project according to *alternative scenario 3* is limited by the presence of technological barrier.

Alternative scenario 4

The operation of two ASUs with adjustable output capacity with capacity 20,000-40,000 $m^3(O_2)$/hour per unit and common capacity 60,000 $m^3(O_2)$/hour does not exclude the risk of technological failure for these ASUs (how described above this risk may be arisen in each ASU), but the occurrence of

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[17] The assessment is presented in Annex 2 of PDD.
[18] Rules for Air separation units (KtK-35-3, KAr-30) operation: КЛ 0031.000.000 ИЭ-03, КЛ.0001.000.000 ИЭ-02.

technological failure at same time in two ASUs is almost impossible as these ASUs will be operated independently (*see barrier analysis for alternative scenario 2*).

So in case of technological failure in *alternative scenario 4* that provides to one ASU shut down other ASU will be operated. The oxygen produced in one ASU (by capacity 20,000-40,000 $m^3(O_2)$/hour per unit) will be sufficient for open-hearth plant in the JSC "Zaporizhstal" (table B.1-1.) therefore the basic technological process (production of pig iron – steel – rolled steel) will not be broken.

A technological barrier does not exercise significant influence on the implementation of *alternative scenario 4.*

Outcome of Step 2b: List of alternative scenarios to the project activity that are not prevented by any barrier:
Alternative scenario 2. Reconstruction of the OCP by constructing two air-separation units KAAr-32 which are identical in design to the existing equipment.

Alternative scenario 4. Reconstruction of the OCP by construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour.

The technological barrier prevents the implementation of alternatives 3. In spite of the existing technological barrier, the JSC "Zaporizhstal" took the decision to reconstruct the OCP using the Air Liquide equipment. The choice in favor of the air separation plant was made also with consideration of the saving of electric power from the power grid of Ukraine. This will lead to reductions in greenhouse gas emissions from the power plants of Ukraine.

Explanation of how registration of the Project as a JI (Joint Implementation) project will reduce the effect of the barriers that prevent the Project being implemented in the absence of the use of the JI mechanism.

An analysis of the barriers demonstrated the existence of technological barriers to the implementation of the Project activity including those related to financial expenditures to overcome them. Therefore, the registration of the Project as a JI project and attracting investments due to the sales of emission reduction units (ERU) will help to overcome the said barriers and to improve the attractiveness for the Project activity.

In accordance with analysis of technological barrier for alternative scenario 3 there is a risk of technological failure that bring to the basic technological process (production of pig iron – steel – rolled steel) stopping during 30-40 hours until the reserved ASUs will be taking into operation.

The shut down of Open-hearth plant at JSC "Zaporizhstal" (by normal economic conditions) lead to losses of commodity rolled steel at rate of 11,700-15,500 tons. The economical losses for JSC "Zaporizhstal" because of Open-hearth plant stopping during 30 hours would be 5.1 million Euro. In this case the profit of ERU sales can eliminate the probable economical losses. ERU sales at a price of 10 Euro/t CO_2 will provide a rate of profit at 5.2 million Euro per credit period.[19] That will be sufficient for covering of economical losses by implementation of project in accordance with *alternative scenario 3*. Consequently, the JI mechanism will assist in overcoming the barriers stated above.

In accordance with Combined tool *if the CDM alleviates the identified barriers that prevent the proposed project activity from occurring, project participants may choose investment analysis for baseline identification.*

[19] The assessment of economical losses and profit of ERUs sale is presented in Annex 2 of PDD.

Step 3. Investment analysis

This step serves to determine which of the alternative scenarios in the short list remaining after step 2 is the most economically or financially attractive. For this purpose, an investment comparison analysis is conducted for the remaining alternative scenarios after step 2. If the investment analysis is conclusive, the economically or financially most attractive alternative scenario is considered as the baseline scenario.

The investment analysis is provided for *remaining alternative scenarios after step 2*:

Alternative scenario 2. Reconstruction of the OCP by construction two air-separation units KAAr-32 which are identical in design to the existing equipment.

Alternative scenario 4. Reconstruction of the OCP by construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour.

As *the most suitable financial indicator* for investment analysis is identified *the unit cost of service* - the specific cost of oxygen production. The results of investment analysis[20] is provided in table B.1-3.

Table B.1-3. Specific cost of oxygen production

№	Parameter	Alternative scenario 2 - Construction of two air-separation units KAAr-32	Alternative scenario 4 - Construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour
1.	Investment, th.€	44,428.57	64,461.14
2.	Operating costs, th.€	12,533.84	12,536.70
3.	Depreciation, th.€	4,442.86	6,446.11
4.	Oxygen generation, th.cub.m / year	525,600.00	525,600.00
5.	**Specific cost of oxygen production, € / th.cub.m**	**32.30**	**36.12**

Therefore the alternative scenario 2 is more financial attractive as alternative scenario 4: the specific cost for oxygen production for alternative scenario 2 (32.30 € / th.cub.m) less on 10.6% than for alternative scenario 4 (36.12 € / th.cub.m).

The sensitivity analysis[21] for confirming the results of investment analysis provided in tables B.1-4. and B.1-5.

[20] The investment analysis is based on Techno-commercial propositions of Air Liquide, Linde, Cryogenmash; Consultation with equipment developers and designers; Regulation about scheduled preventive maintenance of the energy equipment of the Ferrous Metallurgy Ministry system enterprises; Registers of defects; Instructions and cost norms of ferrous metallurgy energy economy objects repairs. *The calculation is provided in attached excel file.*

[21] *The calculation of sensitivity analysis is provided in attached excel file.*

Table B.1-4. The sensitivity analysis for investment cost

№	Parameter	Alternative scenario 2 - Construction of two air-separation units KAAr-32		Alternative scenario 4 - Construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour	
1.	**Change of investment**	**- 10%**	**+ 10%**	**- 10%**	**+ 10%**
2.	**Investment, th.€**	**39,985.71**	**48,871.43**	**58,015.03**	**70,907.26**
3.	Operating costs, th.€	12,533.84	12,533.84	12,536.70	12,536.70
4.	**Depreciation, th.€**	**3,998.57**	**4,887.14**	**5,801.50**	**7,090.73**
5.	Oxygen production, th.cub.m / year	525,600.00	525,600.00	525,600.00	525,600.00
6.	**Specific cost of oxygen production, € / th.cub.m**	**31.45**	**33.14**	**34.89**	**37.34**

Table B.1-5. The sensitivity analysis for operating costs

№	Parameter	Alternative scenario 2 - Construction of two air-separation units KAAr-32		Alternative scenario 4 - Construction of two air-separation units with adjustable output capacity with common capacity 60,000 $m^3(O_2)$/hour	
1.	**Change of operating costs**	**- 10%**	**+ 10%**	**- 10%**	**+ 10%**
2.	Investment, th.€	44,428.57	44,428.57	64,461.14	64,461.14
3.	**Operating costs, th.€**	**11,280.45**	**13,787.22**	**11,283.03**	**13,790.36**
4.	Depreciation, th.€	4,442.86	4,442.86	6,446.11	6,446.11
5.	Oxygen production, th.cub.m / year	525,600.00	525,600.00	525,600.00	525,600.00
6.	**Specific cost of oxygen production, €/th.cub.m**	**29.91**	**34.68**	**33.73**	**38.50**

The provided sensitivity analysis makes it clear that the change of investment and operating costs in range of ±10% hasn’t influence on the financial attractiveness of alternative scenarios.

Outcome of step 3:

The sensitivity analysis confirms the result of the investment comparison analysis. The most financially attractive alternative scenario is Alternative scenario 2 (Reconstruction of the OCP by construction two air-separation units KAAr-32 which are identical in design to the existing equipment). The Alternative scenario 2 is *considered as baseline scenario*.

Step 4. Common practice analysis

As stated in the Combined tool the previous steps shall be completed with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and geographical area. This test is **a credibility check** to demonstrate additionality which complements the barrier analysis.

The similar activities to the proposed project (Construction of VRU-60 (Air Liquide) in JSC "Zaporizhstal") that have been implemented previously or are currently underway in the relevant geographical area (metallurgical works in Ukraine) include:

1. Construction of VRU-60 (Air Liquide) in JSC "Alchevsk Iron & Steel Works"[22]
2. Construction of VRU-60 (Air Liquide) in JSC "Azovstal Iron & Steel Works"[23]
3. Construction of VRU-60 (Air Liquide) in JSC "Ilylch Iron & Steel Works of Mariupol"[24]

In metallurgical plants in Ukraine there have been implemented also other projects of Air-separation units construction:

1. Construction of VRU-35 (Linde) with output 35 000 $m^3(O_2)$/hour in JSC "Enakievo Iron & Steel Works"[25]

2. Construction of KtA-40/30-1 (Cryogenmash) with output 30 000 $m^3(O_2)$/hour in JSC "Alchevsk Iron & Steel Works"[26]

3. Construction of KAr-30M1 (Cryogenmash) with output 30 000 $m^3(O_2)$/hour in JSC "ArcelorMittal Kryvyi Rih"[27]

These projects are not with comparable output to project activity therefore that are excluded from the following analysis. But these projects of ASUs construction with output 30 000 – 35 000 $m^3(O_2)$/hour (Linde, Cryogenmash) confirm the possibility of Baseline scenario (construction in JSC "Zaporizhstal" ASUs KAAr-32 (Cryogenmash)).

In accordance with Combined tool *"If similar activities to the proposed project activity are identified, then compare the proposed project activity to the other similar activities and assess whether there are essential distinctions between the proposed project activity and the similar activities. Explain why the similar activities did not face barriers to which the proposed project activity is subject".*

The essential distinction between the proposed project activity and the similar activities is the absence of technological barrier (in accordance with definition of technological barrier by Step 2a) by construction of VRU-60 in other steel works.

The technological barrier defined above as "the risk of technological failure of ASUs that occurs in case of use the particular equipment type; and that may cause to break of plant's basic technological processes (production of pig iron-steel-rolled steel), despite of using of all possibilities for the risk prevention." As described in Step 2 the risk of technological failure of ASUs can be prevented by using of two or more ASUs at the same time.

Until construction at metallurgical works in Ukraine the ASUs with high production (60,000 $m^3(O_2)$/hour) this risk was absent as the common practice was the operation of several ASUs with middle (30,000-32,000 $m^3(O_2)$/hour) and little (15,000 $m^3(O_2)$/hour) output at the same time. The

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[22] Date source: PDD "Revamping and Modernization of the Alchevsk Steel Mill - Using Higher Efficiency Technology to replace Open Hearth Furnaces (OHF), Ingot Casting and Blooming Mills" / http://ji.unfccc.int/index.html

[23] Date source: http://azovstal.metinvestholding.com/ru/press/news/2007/11/129/

[24] Date source: http://www.ugmk.info/news/1169478848.html

[25] Date source: www.emz.com.ua

[26] Date source: PDD "Revamping and Modernization of the Alchevsk Steel Mill - Using Higher Efficiency Technology to replace Open Hearth Furnaces (OHF), Ingot Casting and Blooming Mills" / http://ji.unfccc.int/index.html

[27] Date source: Journal "Technical gases" # 3, 2006.

information about the type and number of ASUs that was operated to 2004 in metallurgical works in Ukraine is presented in table B.1-6.

Table B.1-6. ASUs in metallurgical works in Ukraine.[28]

№	Metallurgical works	Number	Type
1	JSC “Alchevsk Iron & Steel Works”	3	KtK-35
2	JSC “Azovstal Iron & Steel Works”	5	KAr-30, KAAr-32
3	JSC "Ilylch Iron & Steel Works of Mariupol"	2	BR-2M, KtK-35-3
5	JSC “Zaporizhstal”	3	BR-2, KAr-30, KtK-35-3

In the JSC “Alchevsk Iron & Steel Works” three ASUs of two VRU-60 and of one KtA-40/30-1 are operated. Therefore the technological barrier for similar activities in JSC “Alchevsk Iron & Steel Works” does not exist.[29]

The information about the number and type of ASUs that are operated now in JSC "Ilylch Iron & Steel Works of Mariupol" and JSC “Azovstal Iron & Steel Works” are not available as this is a commercial classified information. But it is possible to assess whether the operation of one ASU VRU-60 is sufficient for steel production at these steel works.

For assessment the following parameters are used:

- Steel production (tons per year),
- Specific oxygen consumption (m^3(oxygen) / ton of steel).

Steel production per year is determined for year 2007 based on data from World Steel Association.

The specific oxygen consumption is determined based on actual data for JSC “Zaporizhstal”. The assessment of specific oxygen consumption is conservative as:

1. The considered steel works (JSC “Azovstal Iron & Steel Works”, JSC "Ilylch Iron & Steel Works of Mariupol", JSC “Zaporizhstal”) have the similar process structure (blast furnaces, open-hearth furnaces, oxygen steel-making converters (except JSC “Zaporizhstal”), rolling mills). Therefore the consumption of oxygen for steel production must be approximately equal.

2. The specific oxygen consumption is determined only for steel plant JSC “Zaporizhstal” and does not include the oxygen consumption in other plants (blast furnaces and other facilities). Although the oxygen consumption in blast furnaces and other facilities may be more than 40% of total oxygen production (table B.1-1.).

The results of analysis are presented in table B.1-7.

[28] Journal “Technical gases” #3, 2004.

[29] Date source: PDD “Revamping and Modernization of the Alchevsk Steel Mill - Using Higher Efficiency Technology to replace Open Hearth Furnaces (OHF), Ingot Casting and Blooming Mills” / http://ji.unfccc.int/index.html

Table B.1-7. Assessment of Oxygen consumption

№	Metallurgical works	Crude steel output[30], t steel/year	Specific oxygen consumption[31], $m^3(O_2)$/t steel	Oxygen consumption[32], m^3/year	Oxygen consumption[33], m^3/hour
1	JSC "Ilylch Iron & Steel Works of Mariupol"	7,000,000	83.62	585,340,000	66,819.6
2	JSC “Azovstal Iron & Steel Works”	6,300,000	83.62	526,806,000	60,137.7
3	JSC “Zaporizhstal”	4,600,000	83.62	384,652,000	43,910.0

In accordance with table B.1-7. we can make a conclusion that JSC "Ilylch Iron & Steel Works of Mariupol" and JSC “Azovstal Iron & Steel Works” operate other ASUs in addition to VRU-60 (Air Liquide). So there was not a technological barrier for construction of VRU-60 in JSC "Ilylch Iron & Steel Works of Mariupol" and JSC “Azovstal Iron & Steel Works”. Therefore the common practice is the operation of several ASUs at the same time.

Conclusion: Similar activities to the proposed project (construction of VRU-60 (Air Liquide)) are observed but essential distinctions (technological barrier) between the proposed project activity and similar activities are reasonably explained (technological barrier exist for proposed project and does not exist for similar activities), then the proposed project activity is **additional**.

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:

The analysis represented in sub-section B.1. demonstrates clearly that the Project is not the Baseline scenario and that the Project activity is additional with regard to the situation that would have occurred in its absence.

While producing oxygen at the JSC “Zaporizhstal”, electric power supplied by the power grid of Ukraine is consumed that leads to GHG emissions from the power plants of Ukraine which occur as a result of the utilization of fossil fuels for electric power generation.

The reduction of electric power consumption (for oxygen generation) to be achieved within the Project implementation will make it possible to reduce the use of electric power and will, therefore, ensure reductions in GHG emissions related to electric power production in the Ukrainian grid. Reductions in GHG emissions would have been impossible without the Project activity.

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[30] Presented crude steel output in 2007 year. / World steel in figures 2008. 2nd edition. World steel association, 2008.

[31] Assessed in accordance with technical report of JSC “Zaporizhstal” for match 2008.

[32] The Oxygen consumption per year is assessed as Crude steel output (ton steel/year) multiplied with Specific oxygen production (m^3/ton steel).

[33] The Oxygen consumption per hour is assessed as Oxygen consumption (m^3/year) divided by operating hours per year (8760 hours/year).

Electric power saving in the Project scenario is to be achieved as a result of:

- reduction of oxygen losses,
- oxygen production without subsequent compression,
- reduction in manufacturing water consumption.

Baseline GHG emissions

To generate oxygen in the OCP to the amount required for the iron and steel production, 479,100-553,500 MWh/year of electric power directly by the OCP would have been consumed according to the Baseline scenario. This would lead to GHG emissions in the power grid of Ukraine to the amount of about 429,300-495,900 tons of CO_2 / year[34]. GHG emissions according to the Baseline over the crediting period (2008-2012) are shown in Table B.2.-1.

Table B.2.-1. Baseline GHG emissions.

Indicators	Unit of measurement	2008	2009	2010	2011	2012
Electric power consumption by the OCP	MWh/year	479,115	553,457	553,457	553,457	553,457
GHG emission factor	tCO_2/MWh	0.896	0.896	0.896	0.896	0.896
GHG emissions	tCO_2/year	429,287	495,897	495,897	495,897	495,897

Project GHG emissions

The electric power consumption in the OCP for oxygen generation at the required level (390,000,000 m^3/year) will be 384,800-432,300 MWh/year as the Project implementation will allow a reduction in the specific power consumption for production in the OCP and a reduction in oxygen losses up to 5-10%. This will lead to GHG emissions within the power grid of Ukraine amounting to about 344,800-387,300 tons of CO_2/year.[35] GHG emissions according to the Project scenario over the crediting period (2008-2012) are shown in Table B.2.-2.

Table B.2.-2. Project GHG emissions

Indicators	Unit of measurement	2008	2009	2010	2011	2012
Electric power consumption by the OCP	MWh/year	384,772	432,284	432,284	432,284	432,284
GHG emission factor	tCO_2/ MWh/year	0.896	0.896	0.896	0.896	0.896
GHG emissions	tCO_2	344,756	387,327	387,327	387,327	387,327

Reductions of GHG emissions.

Taking into account the abovementioned, reductions of GHG emissions will be enabled in the power grid system of Ukraine due to the reduction in electric power use for oxygen generation at the JSC “Zaporizhstal”.

[34] An emission factor of 0.896 t CO_2/MW-hour was used for estimating emissions in the power system of Ukraine, (according to the survey Global Carbon B. V.: “Ukraine - Assessment of new calculation of CEF”).

[35] An emission factor of 0.896 t CO_2/MW-hour was used for estimating emissions in the power system of Ukraine, (according to the survey Global Carbon B. V.: “Ukraine - Assessment of new calculation of CEF”).

Thus, GHG emissions reductions due to the Project activity are evident and are impossible without the Project implementation. Annual reductions of GHG emissions are shown in Table B.2.-3. The total amount of reductions over the crediting period (2008-2012) will be 518,814 tons of CO_2.

Table B.2.-3. GHG emission reductions.

Indicators	Unit of measurement	2008	2009	2010	2011	2012
GHG emissions according to the Baseline	t CO_2	429,287	495,897	495,897	495,897	495,897
GHG emissions according to the Project scenario	t CO_2	344,756	387,327	387,327	387,327	387,327
Reductions of GHG emissions	t CO_2	84,531	108,571	108,571	108,571	108,571

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

The Project boundary includes the following installations:

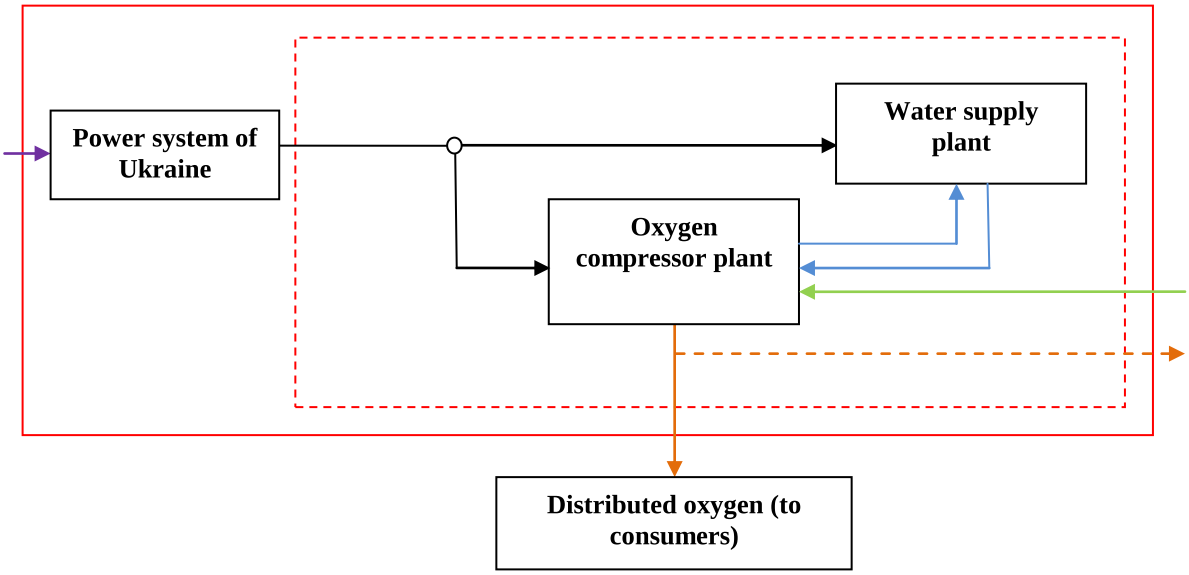
- Facilities of the JSC "Zaporizhstal":
  - Oxygen compressor plant
  - Water supply plant
- Power plants of the Ukrainian grid

A description of the activities of these installations resulting in GHG emissions is given in Table B.3-1. The boundary of the Project is shown in Fig. B.3-1. The List of equipment that consume electricity in Oxygen compressor plant and Water supply plant is presented in Annex 3.

Table B.3-1. Facilities included in the Project boundary and description of how they affect GHG emissions

№	Facilities	Description
1.	Oxygen compressor plant	Electric power supplied from the grid of Ukraine is consumed in the course of oxygen production by the OCP of the JSC "Zaporizhstal". Thus, oxygen production by the OCP causes GHG emissions in the power plants of Ukraine due to the utilization of fossil fuels for electric power generation. As a result of the Project implementation, a reduction in the specific electric power consumption for oxygen generation will occur that ensure a reduction in the electric power utilization from the power system and a corresponding reduction in GHG emissions from the power plants of Ukraine.
2.	Water supply plant	For pumping manufacturing water utilized in the course of production in the OCP, electric power supplied by the power system of Ukraine is consumed by the WSP. Therefore, the WSP functioning causes GHG emissions in the power plants of Ukraine due to the utilization of fossil fuels for electric power generation. The electricity consumption in WSP in baseline scenario and in project scenario would be the same as the technical design of the pumps in WSP is equal in both scenarios. Therefore the emissions reduction would not be happen by project implementation.
3.	Power grid of Ukraine	The production requirement in electric power for the OCP and WSP of the JSC "Zaporizhstal" is covered by electric power supplies from the power system of Ukraine. This causes GHG emissions in the power plants of Ukraine due to the utilization of fossil fuels for electric power generation. A decrease in electric power utilized for the functioning of the OCP and WSP according to the Project scenario will ensure the reduction in GHG emissions in the power system of Ukraine.

Fig. B.3-1. Project boundary



	Electric power
	Fuel-and-power resources (FPR)
	Oxygen
	Oxygen losses
	Technical water
	Air
	Project scope
	Boundaries of the JSC “Zaporizhstal”

Sources of greenhouse gas emissions as well as greenhouse gases included in the estimation of emission reductions according to the Baseline and Project scenarios are shown in Table B.3-2.

Table B.3-2. Sources of greenhouse gas emissions included/excluded from the project boundaries.

	Source	Gas	Is it included?	Description
Baseline scenario	Power system of Ukraine (electric power production)	CO_2	Included	Emissions during fossil fuel combustion for electric power generation.
		CH_4	Excluded	Excluded for simplification. Conservative approach.
		N_2O	Excluded	Excluded for simplification. Conservative approach.
Project scenario	Power system of Ukraine (electric power production)	CO_2	Included	Emissions during fossil fuel combustion for electric power generation.
		CH_4	Excluded	Excluded for simplification. Conservative approach.
		N_2O	Excluded	Excluded for simplification. Conservative approach.

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

Date of baseline setting: 15/04/2008.

The baseline was developed by:

National Carbon Sequestration Foundation (Moscow);

Contact person: Mr. Roman Kazakov;

Tel.: +7 499 788 78 35 ext. 113

Fax: +7 499 975 78 35 ext. 107

E-mail: KazakovRA@ncsf.ru

The National Carbon Sequestration Foundation is not a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the Project: November 19, 2004.

C.2. Expected operational lifetime of the project:

The expected operational lifetime of the Project is 20 years: 2008-2028.

C.3. Length of the crediting period:

Length of crediting period: from February 19, 2008 to December 31, 2012.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The Project activity is aimed at oxygen generation by the OCP at a sufficient amount for the primary production units of the JSC "Zaporizhstal" – blast-furnace, open-hearth plants and other facilities.

Reductions in GHG emissions in the OCP reconstruction project are achieved due to the reduction in electric power consumption (as compared with the Baseline scenario) for oxygen production through:

1. Reduction in oxygen losses.
2. Oxygen production without subsequent compression.

To determine these effects at the stage of the Project implementation, monitoring of the parameters under the Project and Baseline scenarios will be carried out.

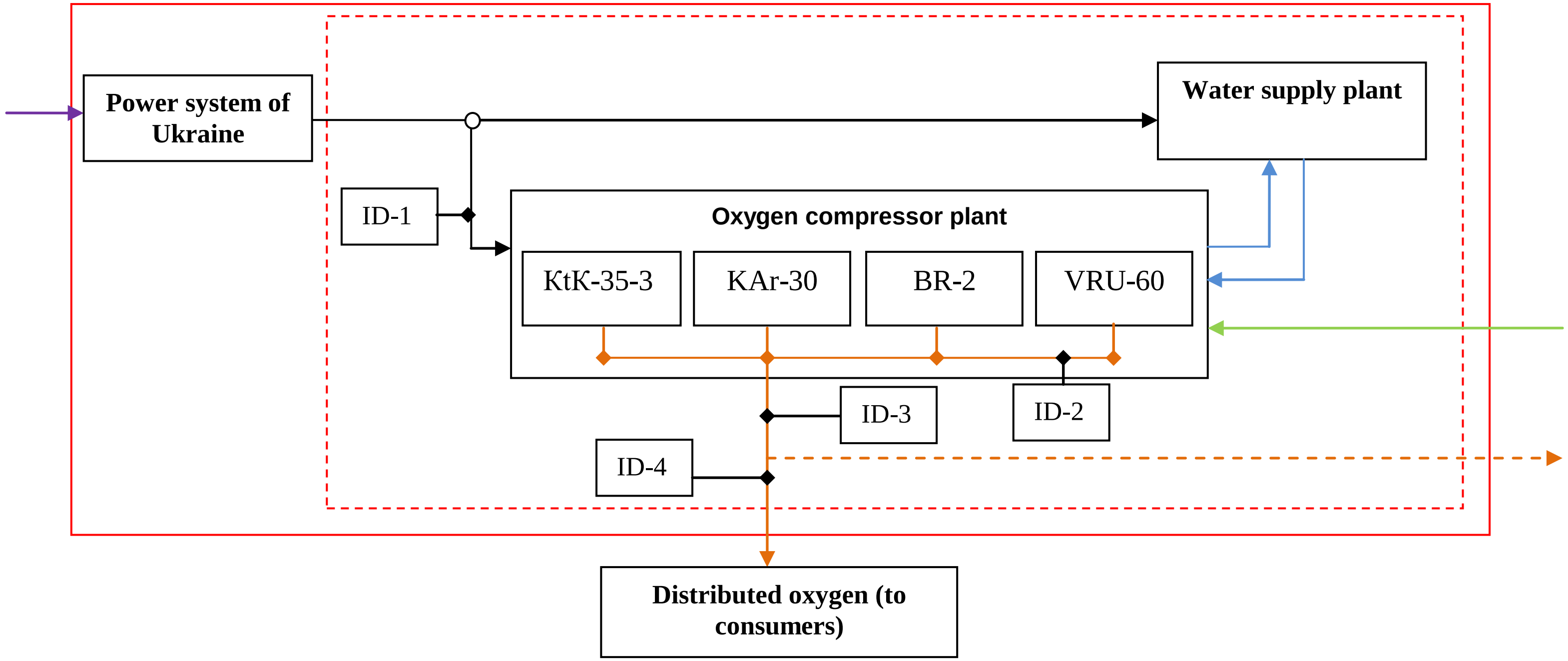
The monitoring of the Baseline and Project GHG emissions from electric power consumption is based on the generic approach of the Methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01).

The main features to be considered in the monitoring plan:

- When monitoring for GHG emissions within the framework of the Project and Baseline scenario, actual values are to be monitored:
    - Electric power consumption by the OCP,
    - Oxygen production in the air-separation unit VRU-60 and reserved air-separation units,
    - Distributed oxygen.
- Under monitoring of GHG emissions, the possibility of commissioning air-separation units currently standing in reserve is provided: KAr-30, KtK-35-3 and BR-2. This situation may occur in the event of a significant increase in oxygen consumption by the plants of the JSC "Zaporizhstal", for example, due to an increase in iron and steel production. In this case, records for the volume of oxygen production in the reserved air-separation units are to be maintained within the Baseline.

- The followings parameters will be estimated based on actual date for OCP: total oxygen production according to the Baseline, output of the air-separation units (KAAr-32), operational time for the air-separation units.

The diagram below shows the monitoring points to be used when monitoring the stated parameters.



→ (black)	Electric power
→ (purple)	Fuel-and-power resources (TPR)
→ (orange)	Oxygen
- - → (orange dashed)	Oxygen losses
→ (blue)	Technical water
→ (green)	Air
- - - (red dashed)	Boundary of the JSC “Zaporizhstal”
—— (red)	Project boundary

Monitoring points	Description
ID-1	Electric power consumption by the OCP
ID-2	Oxygen production in the air-separation unit VRU-60
ID-3	Oxygen production in the reserved air-separation units
ID-4	Distributed oxygen

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
ID-1 $EC_{OCP, PJ, y}$	*Electric power consumption by the OCP*	*Electric power meter*	*MWh*	*m*	*Monthly*	*100 %*	*Electronic and paper*	*To be registered by the plant of networks and substations of the JSC "Zaporizhstal"*

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

Project CO_2 emissions are evaluated by the formula:

D.1. $$PE_{EC,y} = EC_{OCP,PJ,y} * EF_{CO2,ELEC,y}$$

$PE_{EC,y}$ **- *project emissions from electric power consumption, tCO_2***

$EC_{OCP,PJ,y}$ **- *electric power consumption by the OCP due to the Project activity, MWh***

$EF_{CO2,ELEC,y}$ **- *emission factor during electric power generation supplied by the power system of Ukraine, tCO_2/MWh***

The electric power consumption by the OCP due to the Project activity will be measured directly (ID-1). The list of meters for electricity consumption measurement are provided in Annex 3.

A GHG Emission factor for the power system of Ukraine ($EF_{CO2,ELEC,y}$) equal to 0.896 t CO_2/MWh is assumed in the calculations (according to the survey Global Carbon B. V.: "Ukraine - Assessment of new calculation of CEF").

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
ID-2 $P_{oxygen,VRU-60,y}$	*Oxygen production in the air-separation unit VRU-60*	*Flow-rate meter*	*thousand* m^3	*m*	*Monthly*	*100 %*	*Electronic and paper*	*To be registered by the Chief Power Engineer Department at the JSC "Zaporizhstal"*
ID-3 $P_{oxygen,RASU,y}$	*Oxygen production in the reserved air-separation units*	*Flow-rate meter*	*thousand* m^3	*m*	*Monthly*	*100 %*	*Electronic and paper*	*To be registered by the Chief Power Engineer Department at the JSC "Zaporizhstal"*
ID-4 $D_{oxygen,PJ,day}$	*Distributed oxygen*	*Flow-rate meter*	*thousand* m^3	*m*	*Daily*	*100 %*	*Electronic and paper*	*To be registered by the Chief Power Engineer Department at the JSC "Zaporizhstal"*

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 are calculated by the formula:

D.2. $BE_{EC,y} = EC_{OCP,BL,y} * EF_{CO2,ELEC,y}$

$BE_{EC,y}$ - ***Baseline emissions from electric power consumption,*** tCO_2

$EC_{OCP,BL,y}$ - ***electric power consumption by the OCP according to the Baseline, MWh***

$EF_{CO2,ELEC,y}$ - ***emission factor during electric power generation supplied by the power system of Ukraine,*** tCO_2/MWh

The electric power consumption by the OCP for oxygen production is calculated by the formula:

D.2.1 $EC_{OCP,BL,y} = P_{oxygen,BL,y} * SEC_{oxygen,BL}$

$P_{oxygen,BL,y}$ - ***total oxygen production according to the Baseline, thousand*** m^3

$SEC_{oxygen, BL}$ - ***specific electric power consumption for production in the OCP according to the Baseline, MWh/thousand*** $m^3(O_2)$

The total oxygen production according to the Baseline is calculated by the formula:

D.2.2 $P_{oxygen,BL,y} = \Sigma (SP_{oxygen,BL,j} * T_{OCP,j}) + P_{oxygen,RASU,y}$

$SP_{oxygen,BL,j}$ - ***output of the air-separation units (KAAr-32) according to the Baseline in operating conditions j, thousand*** $m^3(O_2)$***/hour***

$T_{OCP,j}$ - ***operational time for the air-separation units in operating conditions j, hours***

$P_{oxygen,RASU,y}$ - ***oxygen production output in the reserved air-separation units, thousand*** $m^3(O_2)$

In Baseline scenario are considered the following equipment in the OCP: two units KAAr-32 and reserved units (KAr-30, KtK-35-3 and BR-2). The total oxygen production in the Baseline scenario include the oxygen production in the ASUs KAAr-32 and in the reserved units. The oxygen production in Baseline depend on the needs of oxygen in the steel plant (distributed oxygen). On the bases of distributed oxygen in project scenario (ID-4 – direct monitored) can be supposed how would be operated the equipment in the OCP – the operating conditions (j) (table D.1-1.). The dates of specific oxygen production in units KAAr-32 ($SP_{oxygen,\ BL}$) and oxygen production in reserved ASUs ($P_{oxygen,RASU,y}$) are determined as optimal work of equipment for appropriate distributed oxygen (table D.1-1.).

The operational time for the air-separation units ($T_{OCP,y}$) in operating conditions (j) will be determined by equation D.2.3.:

D.2.3 $T_{OCP,j} = N_{day,\ j} * 24$

$N_{day,j}$ ***- number of days then the OCP was operated in operating conditions j (table D.1-1.), day***

24 ***- hours per day, hour***

The number of days then the OCP was operated in operating conditions j will be determined based on actual date of Distributed oxygen ($D_{oxygen,PJ,day}$) – ID-4.

The specific electric power consumption for production in the OCP according to the Baseline ($SEC_{oxygen,BL}$) is calculated by the equation D.2.4. This is a conservative approach.

D.2.4 $SEC_{oxygen,BL} = EC_{OCP,PJ,y} / (P_{oxygen,VRU\text{-}60,y} + P_{oxygen,RASU,y})$

$EC_{OCP,PJ,y}$ ***- electric power consumption by the OCP due to the Project activity, MWh***

$P_{oxygen,VRU\text{-}60,y}$ ***- oxygen production output in the air-separation unit VRU-60, thousand*** $m^3(O_2)$

The electric power consumption by the OCP ($EC_{OCP,PJ,y}$), oxygen production output in the air-separation unit VRU-60 ($P_{oxygen,VRU\text{-}60,y}$) and oxygen production output in the reserved air-separation units $P_{oxygen,RASU,y}$ will be measured directly (monitoring points: ID-1, ID-2, ID-3).

The list of meters for ID-2, ID-3, ID-4 are presented in Annex 3.

Table D.1-1. The operation of OCP in Baseline scenario

Operating conditions (j)	**Distributed oxygen[1] ($D_{oxygen,PJ,day}$), $m^3(O_2)$/day**	**Number and type of ASUs[2]**	**Specific oxygen production[3] in ASUs KAAr-32 ($SP_{oxygen,BL}$), $m^3(O_2)$/hour**	**Oxygen production in reserved ASUs[4] ($P_{oxygen,RASU,y}$), $m^3(O_2)$/hour**
1.*	$D_{oxygen,PJ,day}$ < 1,368,000	2 x KAAr-32	60,000	0
2.	1,368,000 – 1,413,600	2 x KAAr-32	62,000	0
3.	1,413,600 – 1,459,200	2 x KAAr-32	64,000	0
4.	$D_{oxygen,PJ,day}$ > 1,459,200	2 x KAAr-32, reserved units (KAr-30 and/or BR-2)	60,000	Direct monitored (ID-4)

1. Distributed oxygen ($D_{oxygen,PJ,day}$) is determined based on Specific oxygen production in ASUs KAAr-32 (30,000 – 32,000 $m^3(O_2)$/hour) including inevitable losses by oxygen production (5 %).

2. There is presented the number and type of ASUs that could be operated for appropriate Distributed oxygen ($D_{oxygen,PJ,day}$).

3. The Specific oxygen production in ASUs KAAr-32 is determined based on oxygen production in one unit at the rate 30,000 – 32,000 $m^3(O_2)$/hour and combination of two KAAr-32 for production of oxygen in appropriate volume ($D_{oxygen,PJ,day}$).

4. The oxygen production in the reserved air-separation units ($P_{oxygen,RASU,y}$) will be monitored directly if the reserved units would be put into operation. This situation could occur with an increase of distributed oxygen ($D_{oxygen,PJ,day}$) more than 1,459,200 $m^3(O_2)$/day.

* The most probable scenario for Baseline scenario is the operation of two units KAAr-32 (with Specific oxygen production in rate 60,000 $m^3(O_2)$/hour) without reserved ASUs.

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

This option is not to be used

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

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

This option is not to be used

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

Within the project, leakages happen in the process of TPR (natural gas, power-generating coal, fuel oil) supply to the power plants of Ukraine due to:

- physical leakages while supplying natural gas via the gas transmission system;
- CO_2 emissions from fuel utilization during TPR transportation by motor-vehicle and railway transport.

Since TPR are supplied to the power plants of Ukraine in larger amounts in the Baseline, there are more leakages than in the Project activity. Therefore, these leakages are to be not taken into account with relation to the conservative estimate.

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

This kind of monitoring is not to be applied

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

This section is not to be filled (see above).

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):

D 3. $$ER_{EC,y} = BE_{EC,y} - PE_{EC,y}$$

$ER_{EC,y}$ – ***Emission reductions, tCO_2***

$BE_{EC,y}$ – ***Baseline emissions, tCO_2***

$PE_{EC,y}$ – ***Project emissions , tCO_2***

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

Monitoring of the environmental impact is not carried out for the VRU-60 since the operation of the OCP of the JSC “Zaporizhstal” does not have any significant environmental impact. This is confirmed by the environmental impact assessment performed at the stage of the development of the design documentation and presented in the design documentation for the construction of the unit VRU-60 (DT – 346135, Volume 3). This issue is discussed in more detail in section F.1.

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 D1.1.1 *ID-1 ($EC_{OCP, PJ, y}$)*	*Low*	Instruments to be used - *power meters*. Calibration is performed once every 4 years
Table D1.1.3 *ID-2 ($P_{oxygen,VRU-60,y}$)*	*Low*	Instruments to be used - *flow-rate meter*. Calibration is performed once a year
Table D1.1.3 *ID-3 ($P_{oxygen,RASU,y}$)*	*Low*	Instruments to be used - *flow-rate meter*. Calibration is performed once a year
Table D1.1.3 *ID-4 ($D_{oxygen,PJ,day}$)*	*Low*	Instruments to be used - *flow-rate meter*. Calibration is performed once a year

The Metrology and Automation Department of JSC "Zaporizhstal" is responsibility for meter calibration.

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

The evaluation of the actual reductions in GHG emissions will be conducted monthly by an engineer from the laboratory for environmental protection (LEP) of the JSC "Zaporizhstal" in accordance with the formulae given in sections D 1.1. and D 1.4. The calculation model to be developed in Excel format will be used for the monitoring of emission reductions. The format of the calculation model is presented in Annex 3.

A primary record of the electric power consumption by the OCP is performed daily by an engineer from the technical bureau of the plant of networks and substations of the JSC "Zaporizhstal" according to the power meter readings. The daily electric power consumption data is to be archived in electronic and paper form. At the end of each month the head of bureau draws up a summarized report of the electric power consumption by the OCP for the passed month and submits it to the power bureau of Chief power engineer department.

A primary record of the amount of oxygen produced in the air-separation unit VRU-60, in the reserved air-separation units and distributed oxygen will be conducted daily by an engineer from the recording bureau of the Chief power engineer department. The daily oxygen generation and distribution data will be archived in electronic and paper format. After each month, the engineer of the recording bureau will draw-up a summarized report for oxygen production in the air-separation units in reserve for the last month and submits it to the power bureau of Chief power engineer department.

The engineer from the Chief power engineer department submits received data to deputy of the chief engineer for approval.

The procedures for the collection of primary data for the monitoring of GHG emissions, for data submission and for calculations performance will be included in the current reporting system of the JSC "Zaporizhstal". Initial data for calculating GHG emission reductions and calculation results will be stored in paper and electronic format during the whole crediting period and for two years after the crediting period.

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

Developer of the monitoring plan:

"National Carbon Sequestration Foundation" (Moscow);

Contact person: Mr. Roman Kazakov;

Tel.: +7 499 788 78 35 ext. 113

Fax: +7 499 788 78 35 ext. 107

E-mail: KazakovRA@ncsf.ru

"National Carbon Sequestration Foundation" is not a participant of this Project.

SECTION E. Estimation of greenhouse gas emission reductions

The calculation of the GHG emission reductions for the Baseline and Project scenario is performed only for the power system of Ukraine in accordance with the defined Project boundary (section B.3.).

The estimation of the GHG emission reductions is performed based on the forecasted data of the operation of the OCP of the JSC "Zaporizhstal" in 2008-2012. In accordance with the forecast, the commissioning of air-separation units currently in reserve (BR-2, KtK-35-3, KAr-30) will not be needed for oxygen generation at the required level. Therefore commissioning of additional air-separation units is not to be considered for the estimation of GHG emission reductions (unlike section D).

E.1. Estimated project emissions:

Source of GHG emissions: power system of Ukraine

The estimation of the Project GHG emissions in the power system of Ukraine relating to electric power production supplied to the JSC "Zaporizhstal" for the OCP was performed using the formula E1.1 in accordance with the generic approach of the Methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01).

E1.1. $$PE_{EC,y} = EC_{OCP,PJ,y} * EF_{CO2,ELEC,y}$$

$PE_{EC,y}$ ***- Project emissions from electric power consumption, tCO_2***

$EC_{OCP,PJ,y}$ ***- electric power consumption by the OCP within the Project activity, MWh***

$EF_{CO2,ELEC,y}$ ***- CO_2 emission factor during electric power generation supplied by the power system of Ukraine, tCO_2/MWh***

A GHG emission factor ($EF_{CO2,ELEC,y}$) equal to 0.896 tCO_2/MWh was assumed for the power system of Ukraine (according to the survey Global Carbon B. V.: "Ukraine - Assessment of new calculation of CEF").

The electric power consumption by the OCP for oxygen production is determined by the formula:

E1.1.1. $$EC_{OCP,PJ,y} = P_{oxygen,PJ,y} * SEC_{oxygen, PJ}$$

$P_{oxygen,PJ,y}$ ***- oxygen production within the Project activity, thousand $m^3(O_2)$***

$SEC_{oxygen, PJ}$ ***- specific electric power consumption for production in the OCP within the Project activity, MWh/thousand $m^3(O_2)$***

The oxygen production rate of the OCP is determined by the oxygen requirements of other plants of the JSC "Zaporizhstal", primarily by the blast-furnace and open-hearth plants, and is calculated by the formula:

E1.1.2. $P_{oxygen,PJ,y} = D_{oxygen,PJ,y} / (1-W_{LOST,PJ})$

$D_{oxygen,PJ,y}$ - ***oxygen requirements of the JSC "Zaporizhstal" plants within the Project activity, thousand $m^3(O_2)$***

$W_{LOST,PJ}$ - ***oxygen losses during production within the Project activity, %***

The value of the annual requirement for distributed oxygen ($D_{oxygen,PJ,y}$) of the JSC "Zaporizhstal" plants is assumed to be equal to 390,000,000 $m^3(O_2)$/year over the whole crediting period (according to the forecasted data of the operation of the complex in 2008-2012).

Oxygen losses ($W_{LOST,PJ}$) occurring during production are defined in accordance with the project design documentation for the new air-separation unit and is equal to $W_{LOST,PJ}$ = 5%.

In the Project scenario, the specific electric power consumption ($SEC_{oxygen,PJ}$) will be about 1.053 MWh/thousand $m^3(O_2)$ according to the data of the actual work of the OCP during March-July, 2008.

The calculation of the Project CO_2 emissions performed in accordance with the formulae described above is presented in Table E.1.1.

Table E.1.1. Calculation of the Project CO_2 emissions.

Indicators	Unit of measurement	2008	2009	2010	2011	2012
Requirement of the plants for oxygen	Thousand $m^3(O_2)$/year	338,000*	390,000	390,000	390,000	390,000
Oxygen losses during production	%	7.5%**	5.0%	5.0%	5.0%	5.0%
Oxygen production	Thousand $m^3(O_2)$/year	365,405	410,526	410,526	410,526	410,526
Specific electric power consumption by the OCP	MWh / thousand $m^3(O_2)$	1.053	1.053	1.053	1.053	1.053
Electric power consumption by the OCP	MWh/year	384,772	432,284	432,284	432,284	432,284
Emission factor	tCO_2/MWh	0.896	0.896	0.896	0.896	0.896
CO_2 emissions	tCO_2/year	344,756	387,327	387,327	387,327	387,327

* The requirement of the plants for oxygen in 2008 under the Project scenario is assumed equal to 338,000,000 $m^3(O_2)$ (less than for the subsequent years 2009-2012) as the crediting period starts at 19.02.2008.

** Oxygen losses during production in 2008 under the Project scenario are assumed equal to 7,5%, as during 2008 (in the period of the equipment customization to the technological cycle of the firm), oxygen losses could be 10-5 %.

E.2. Estimated leakage:

Within the project, leakages happen in the process of TPR (natural gas, power-generating coal, fuel oil etc) supply to the power plants of Ukraine.

- physical leakages while supplying natural gas via the gas transmission system;
- CO_2 emissions from fuel utilization during TPR transportation by motor-vehicle and railway transport.

Since TPR are supplied to the power plants of Ukraine in larger amounts in the Baseline, there are more leakages than in the Project activity. Therefore, these leakages are not to be taken into account with relation to the conservative estimate.

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

Table E3.1. Total emissions within the Project activity

Parameter	Unit of measurement	2008	2009	2010	2011	2012
Emissions in the power system	tCO_2	344,756	387,327	387,327	387,327	387,327
Leakages	tCO_2	-	-	-	-	-
Total CO_2 emissions	tCO_2	344,756	387,327	387,327	387,327	387,327

E.4. Estimated baseline emissions:

Source of GHG emissions: power system of Ukraine

The estimation of the Baseline GHG emissions in the power system of Ukraine relating to the electric power supplied to the JSC "Zaporizhstal" for the OCP was calculated by the formula E4.1 in accordance with the generic approach of the Methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01).

E4.1. $BE_{EC,y} = EC_{OCP,BL,y} * EF_{CO2,ELEC,y}$

$BE_{EC,y}$ - ***Baseline emissions from electric power consumption, tCO_2***

$EC_{OCP,BL,y}$ - ***electric power consumption by the OCP according to the Baseline, MWh***

$EF_{CO2,ELEC,y}$ - ***emission factor during electric power generation supplied by the power system of Ukraine, tCO_2/MWh***

The electric power consumption by the OCP for oxygen production is calculated by the formula:

E 4.1.1. $EC_{OCP,BL,y} = P_{oxygen,BL,y} * SEC_{oxygen,BL}$

$P_{oxygen,BL,y}$ - ***oxygen production according to the Baseline, thousand $m^3(O_2)$***

$SEC_{oxygen,BL}$ - ***specific electric power consumption for production in the OCP according to the Baseline, MWh/thousand $m^3(O_2)$***

The oxygen production rate of the OCP of the JSC “Zaporizhstal” is 525,600,000 m^3 (O_2)/year as the total output of the two air-separation units KAAr-32 is 60,000 m^3 (O_2)/hour. The oxygen production rate according to the Baseline remains constant over the whole crediting period as the air-separation units KAAr-32 are uncontrollable.

The specific electric power consumption according to the Baseline *($SEC_{oxygen,BL}$)* is defined in accordance with the actual work data of the OCP for March-July, 2008 and is equal to 1.053 MWh/ thousand m^3 (O_2).

The estimation of CO_2 emissions in the Baseline scenario performed in accordance with the formulae stated above is presented in Table E.4.1.

Table E.4.1. Estimation of CO_2 emissions in the Baseline scenario.

Indicators	Unit of measurement	2007	2009	2010	2011	2012
Oxygen production	thousand $m^3(O_2)$/year	455,000	525,600	525,600	525,600	525,600
Specific electric power consumption by the OCP	MWh/thousand $m^3(O_2)$	1.053	1.053	1.053	1.053	1.053
Electric power consumption by the OCP	MWh/year	479,115	553,457	553,457	553,457	553,457
Emission factor	tCO_2/MWh	0.896	0.896	0.896	0.896	0.896
CO_2 emissions	tCO_2/year	429,287	495,897	495,897	495,897	495,897

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

E 5.1. $$ER_{EC,y} = BE_{EC,y} – PE_{EC,y}$$

$ER_{EC,y}$ – ***Emission reductions, tCO_2***

$BE_{EC,y}$ – ***Baseline emissions, tCO_2***

$PE_{EC,y}$ – ***Project emissions , tCO_2***

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

Year	Emissions in the Project scenario (tons of CO_2 equivalent)	Leakages (tons of CO_2 equivalent)	Emissions in the Baseline (tons of CO_2 equivalent)	Reduction in emissions (tons of CO_2 equivalent)
2008	344,756	-	429,287	84,531
2009	387,327	-	495,897	108,571
2010	387,327	-	495,897	108,571
2011	387,327	-	495,897	108,571

2012	387,327	-	495,897	108,571
Total	1,894,062	-	2,412,876	518,814

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:

An environmental impact assessment (EIA) of a project is an integral and binding part of the design documentation for construction, expansion, reconstruction and so on of any economic or industrial facility.

An analysis of the Environmental impact of the project "Reconstruction of the OCP at the JSC "Zaporizhstal" was performed as part of the preparation of the design documentation in accordance with the requirements of the law of Ukraine "On environment protection". The EIA results are available in the design documentation for the construction of the unit VRU-60 (DT – 346135, Volume 3).

The main EIA findings are given below:

- No hazardous polluting emissions are emitted and waste waters are not disposed into open water reservoirs while the OCP is constructed and operated along with the construction of VRU-60.
- The main potential environmental impact of the air separation production is noise from the operation of the compressor equipment and from the emission of waste gases. To reduce the noise level, noise-absorbing materials and noise suppressors are utilized. Since the Project makes it possible to have 3 compressors in reserve, the number of noise sources and the total noise level will be reduced.
- The re-circulating water supply, individual fire-fighting main, domestic and storm water sewers are provided by the OCP. Since 3 compressors are put into reserve, the amount of re-circulating water consumed will be reduced.
- The structured packings and molecular sieves utilized in the technical process operate without replacement during the whole lifetime of the primary equipment. Therefore, there are no solid wastes.
- Used turbine oil to the amount of 0.5 t/year will be disposed at the regeneration plant in the existing oils storage facility.
- There are no other hazardous factors (radiation, ultrasonic).

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The environmental impact is insignificant. The Project's technical design for construction of the air-separation unit VRU-60 at the JSC "Zaporizhstal" received a favorable evaluation by the state environmental expertise from the Ministry for the Protection of the Natural Environment of Ukraine (State environmental expert review №244/05 dated 15.07.2005).

SECTION G. Stakeholders' comments

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

Information on the construction of the VRU-60 at the JSC "Zaporizhstal" was published in the mass media – Newspaper "Sem' Dney" dated 22.11.2007. The material comprises a brief description of technical, economic and ecological aspects of the Project. The publication led to no comments from the readers.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organization:	The JSC "Zaporizhstal"
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URL:	http://www.zaporizhstal.com/
Represented by:	
Title:	Deputy Technical Director
Salutation:	Mr.
Last name:	Lykov
Middle name:	Abramovich
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Fax (direct):	-
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ANNEX 2

BASELINE INFORMATION

Additional Baseline information comprises:

- The operational records for the OCP of the JSC "Zaporizhstal" for 2005-2007
- CO_2 emission factor for the power system of Ukraine for the Projects resulting in a saving of electric power
- Assessment of time for that the liquid oxygen will be sufficient for steel works in case of VRU-60 shut down
- Assessment of economical losses for JSC "Zaporizhstal" because of Open-hearth plant stopping
- Scope of the outfit KAAr-32

Table 1. Operational records for the oxygen-compressor plant of the JSC "Zaporizhstal" for 2005-2007

№	Name	Units of measurement	2005	2006	2007	Average value
1	Oxygen production	thousand m^3	507,949	579,269	545,813	544,344
2	Distributed oxygen	thousand m^3	401,727	439,724	441,475	427,642
3	Oxygen losses	thousand m^3	106,222	139,545	104,338	116,702
4	Oxygen losses	%	20.9	24.1	19.1	21.4
5	Electric power consumption by the OCP for production	MWh	595,567	639,667	619,248	618,160.67
6	Specific electric power consumption by the OCP for production ($fc_{E, OP, BL}$)	MWh / thousand $m^3(O_2)$	1.172	1.104	1.135	1.137
7	Amount of manufacturing water utilized by the OCP	thousand m^3	99 076.2	90 305.1	105 268.9	98 216.7
8	Specific manufacturing water consumption for production in the OCP ($fc_{TWC, OP, BL}$)	$m^3/m^3(O_2)$	0.195	0.156	0.193	0.181
9	Electric power consumption for recirculation water in the OCP	MWh	15 323.8	15 920.9	17 203.1	16 149.3
10	Specific consumption from the OCP recirculation water($fc_{E, TWC}$)	MWh / thousand $m^3(O_2)$	0.155	0.176	0.163	0.165

Table 2. CO_2 emissions factor for the power grid system of Ukraine for projects resulting in the saving of electric power

Indicator	Unit of measurement	2008	2009	2010	2011	2012
Emission factor	t CO_2 / MWh	0.896	0.896	0.896	0.896	0.896

(Source: Global Carbon B. V.: "Ukraine - Assessment of new calculation of CEF")

Table 3. Assessment of time for that the liquid oxygen will be sufficient for steel works in case of VRU-60 shut down

Indicator	**Units of measurement**	**Value**
Volume of liquid oxygen reservoir[36]	m^3	500.0
Volume of gaseous oxygen that can be generated from liquid oxygen[37]	m^3/m^3	798.0
Volume of gaseous oxygen[38]	m^3	399,000
Pump capacity [39]	m^3/hour	20,000
Time for steel works operation[40]	hour	20

Table 4. Assessment of economical losses for JSC "Zaporizhstal" because of Open-hearth plant stopping.[41]

Indicator	**Units of measurement**	**Value**
Duration of Open-hearth plant stopping	hour	30-40
Production of hot-rolled steel	ton	8,300 – 11,000
Production of cold-rolled steel	ton	3,400 – 4,500
Cost of hot-rolled steel	Euro/ton	421.8
Cost of cold-rolled steel	Euro/ton	467.9

[36] Liquid oxygen reservoir (V-40), Annex 4 "Production and equipment flow schemes".

[37] Glizmanenko D.L. Oxygen production - Manual. 1972.

[38] Assessed as 500.0 m^3 (liquid oxygen) x 798.0 m^3(gaseous oxygen)/m^3(liquid oxygen) = 399,000 m^3(gaseous oxygen)

[39] Liquid oxygen pump (P 41), Annex 4 "Production and equipment flow schemes"

[40] Assessed as 399,000 m^3(gaseous oxygen) / 20,000 m^3/hour = 19.95 hours (20 hours)

[41] The assessment is provided for normal economic conditions – first six month 2008.

Economical losses for hot-rolled steel	thousand Euro	3,501 – 4,640
Economical losses for cold-rolled steel	thousand Euro	1,590 – 2,106
Common economical losses for rolled steel	**thousand Euro**	**5,092 – 6,746**
GHG emission reductions	tCO_2/crediting period	518,814
Price of ERU	Euro/tCO_2	8-12
ERU selling	**thousand Euro**	**4,151 – 6,226**

Table 5. Scope of the outfit KAAr-32

№	Equipment of Air separation unit	Number
1	Separation unit	1
2	Block of regenerators	1
3	Turbine expander	2
4	Block of armature for turbine expander	2
5	Block of pumps	1
6	Scrubber of nitrogen-water cooling	2
7	Evaporator of oxygen	1
8	Steam heater	1
9	Electricity heater	1
10	System for crude argon cleaning	1
11	Control system and control-measuring instruments	1

Annex 3

MONITORING PLAN

The meters included in the monitoring plan

1. The meters for electricity consumption

№	Location of meters: Substation, connection	Type of meters
A. Meters for electric consumption in Oxygen Compressor Plant (OCP)		
1.	M1 : 55-1/12	EA05RL-B-4
2.	M1 : 55-2/63	EA05RL-B-4
3.	M1 : 55-3/48	EA05RL-B-4
4.	M1 : 55-4/62	EA05RL-B-4
5.	M1 : СД-1/1	EA05RALX-B-4
6.	M1 : СД-2/40	EA05RALX-B-4
7.	M1 : СД-6/16	EA05RALX-B-4
8.	M1 : СД-17/58	EA05RALX-B-4
9.	ПС-10 : КТП-ККЦ/6к	EA05RL-B-4
10.	M3 : 55-5/3	EA05RL-B-4
11.	M3 : 355-1/21	EA05RL-B-4
12.	M3 : 355-2/30	EA05RL-B-4
13.	M3 : СД-26/9	EA05RALX-B-4
14.	M3 : СД-21/27	EA05RALX-B-4
15.	M3 : СД-29/29	EA05RALX-B-4
16.	M3 : СД-20/12	EA05RALX-B-4
17.	M3 : СД-23/14	EA05RALX-B-4
18.	M3 : СД-27/18	EA05RALX-B-4
19.	M3 : СД-28/20	EA05RALX-B-4
20.	M3 : СД-30/28	EA05RALX-B-4
21.	M3 : СД-32/45	EA05RALX-B-4
22.	M3 : СД-31/47	EA05RALX-B-4
23.	M3 : СД-33/49	EA05RALX-B-4
24.	M3 : СД-34/51	EA05RALX-B-4
25.	M3 : СД-22/42	EA05RALX-B-4
26.	M3 : СД-35/46	EA05RALX-B-4
27.	M3 : СД-36/48	EA05RALX-B-4
28.	M3 : АД-1/19	EA05RALX-B-4

Type of meters: microprocessor electronic meters - “Euro-Alpha”

2. The meters for oxygen production in Air-separation units and oxygen distribution

№	Location of meters	Type of meters
A. Meters for oxygen production in VRU-60		
1.	Oxygen Compressor Plant	Primary sensor: Rosemount Second meter: Controller
2.	Oxygen Compressor Plant	Primary sensor: Rosemount Second meter: Controller
B. Meters for oxygen production in KtK-35-3		
1.	Oxygen Compressor Plant	Primary sensor: ДМ-3538 Second meter: ВФС with КСФ-3
2.	Oxygen Compressor Plant	Primary sensor: ДМ-3538 Second meter: ВФС with КСФ-3
C. Meters for oxygen production in KAr-30		
3.	Oxygen Compressor Plant	Primary sensor: ДМ-3538 Second meter: КСД-250 with ДИСК-250
D. Meters for oxygen production in BR-2		
4.	Oxygen Compressor Plant	Primary sensor: ДМ-3538 Second meter: КСД-250 with ДИСК-250
5.	Oxygen Compressor Plant	Primary sensor: ДМ-3538 Second meter: КСД-250 with ДИСК-250
D. Meters for oxygen distribution		
6.	Oxygen Compressor Plant (input in Open-hearth plant №1)	Primary sensor: Сафир-М Second meter: СПГ-762
7.	Oxygen Compressor Plant (input in Open-hearth plant №2)	Primary sensor: ДМ-3538 Second meter: КСД-3
8.	Oxygen Compressor Plant (input in Open-hearth plant №3)	Primary sensor: ДМ-3538 Second meter: КСД-3
9.	Oxygen Compressor Plant (input in Dneprospecstal)	Primary sensor: ДМ-3538 Second meter: КСД-3
10.	Oxygen Compressor Plant (input in autogenous plant)	Primary sensor: ДМ-3538 Second meter: КСД-3
11.	Oxygen Compressor Plant (input in autogenous plant)	Primary sensor: ДМ-3538 Second meter: КСД-3
12.	Oxygen Compressor Plant (input in heat and power plant)	Primary sensor: АРГ 31.2 Second meter: ДИСК-250

The equipment that consumes electricity into the project boundary

1. Equipment in the Oxygen Compressor Plant

№	Number and type of compressor	Capacity, kW	Operated / reserved
1.	СД - 26	12.000	reserved
2.	СД - 27	12.000	operated
3.	СД - 28	12.000	reserved
4.	СД - 17	12.000	reserved
5.	СД - 1	10.000	reserved
6.	СД - 2	10.000	reserved
7.	СД - 22	10.000	operated
8.	СД - 30	10.000	operated
9.	СД - 33	10.000	operated
10.	СД - 34	10.000	reserved
11.	СД - 35	10.000	reserved
12.	СД - 36	10.000	reserved
13.	СД - 29	9.000	operated
14.	СД - 11	4.000	operated
15.	СД - 12	4.000	reserved
16.	СД - 13	4.000	operated
17.	СД - 20	3.500	reserved
18.	СД - 21	3.500	reserved
19.	СД - 23	3.200	reserved
20.	СД - 31	3.150	reserved
21.	СД - 32	3.150	reserved
22.	СД - 6	3.150	reserved
23.	СД - 7	1.500	reserved
24.	СД - 8	1.500	reserved
25.	СД - 10	1.500	reserved
26.	СД - 18	1.500	reserved
27.	СД - 24	1.500	reserved
28.	СД - 25	1.500	reserved
29.	СД - 3	1.000	reserved
30.	СД - 4	1.000	operated
31.	СД - 5	1.000	operated
32.	АД-1	6.400	operated

2. Equipment in the Water Supply Plant

№	**Number and type of pumps**	**Capacity, kW**
1.	Circulation pumps, 3 pcs. (reserved)	400
2.	Delivery pumps, 6 pcs. (3-4 pcs. reserved)	1.000
3.	*Circulation pumps, 2 pcs. (project)*	*80*

Calculation model for monitoring of project emissions, baseline emissions and emissions reductions

GHG emissions monitoring for the Project and Baseline scenarios as well as calculation of emission reductions will be carried out on a monthly basis in accordance with the provisions of section D and using the calculation model in Excel format. The format of the calculation model is shown below.

Project scenario

Indicators	Index (PDD)	Unit of measurement	January	February	March	April	May	June	July	August	September	October	November	December
Electric power consumption by the OCP	$EC_{OCP,PJ,y}$	MWh/month												
Emission factor	$EF_{CO2,ELEC,y}$	tCO_2/MWh												
Project emissions	$PE_{EC,y}$	tCO_2/month												

Baseline scenario

Indicators	Denomination (PDD)	Unit of measurement	January	February	March	April	May	June	July	August	September	October	November	December
Output of the air-separation units	$SP_{oxygen,BL,j}$	thousand m^3 (O_2)/hour												
Operational time per month	$T_{OCP,j}$	hours/month												
Oxygen production by reserved blocks	$P_{oxygen,RASU,y}$	thousand m^3 (O_2)/month												
Total oxygen production	$P_{oxygen,BL,y}$	thousand m^3 (O_2)/month												
Specific electric power consumption by the OCP	$SEC_{oxygen,BL}$	MWh/thousand m^3 (O_2)												
Electric power consumption by the OCP	$EC_{OCP,BL,y}$	MWh/month												
Emission factor	$EF_{CO2,ELEC,y}$	tCO_2/MWh												
Baseline emissions	$BE_{EC,y}$	tCO_2/month												

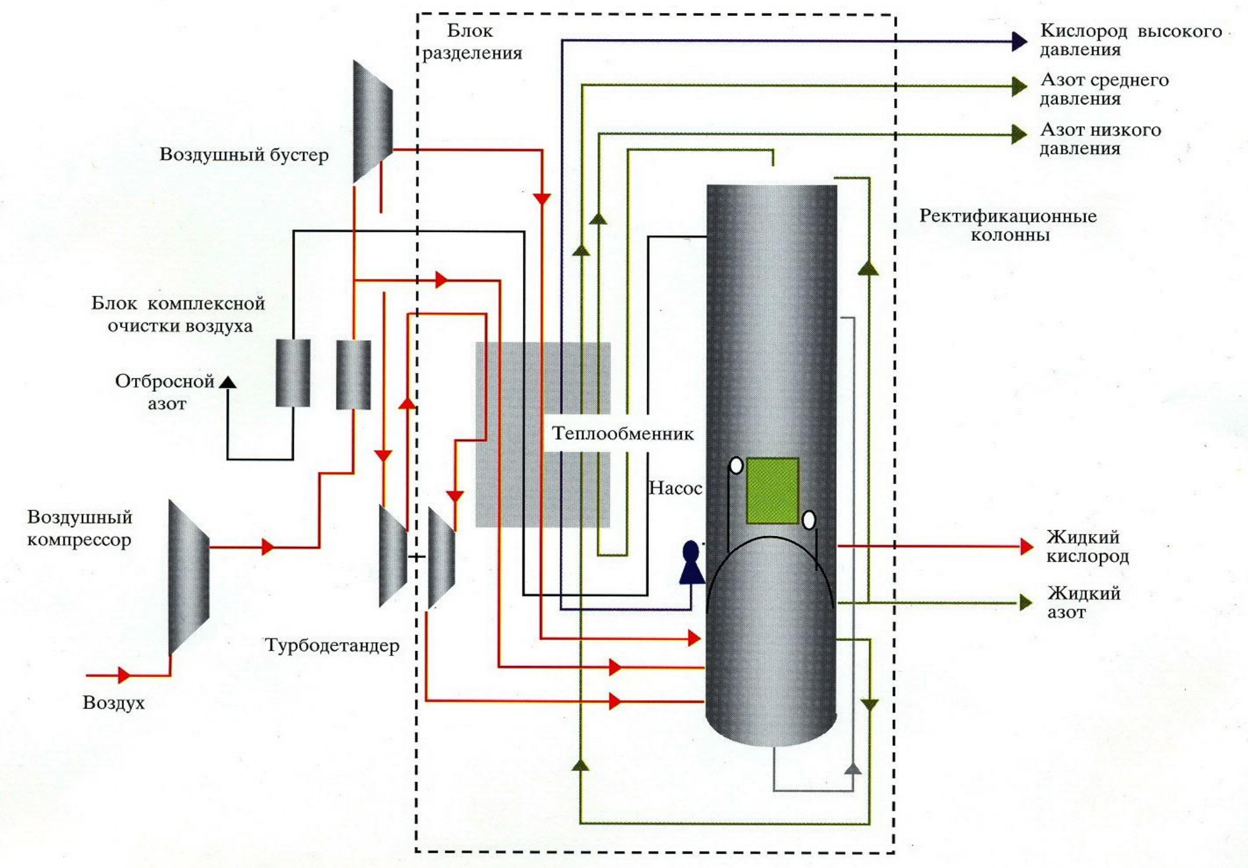
Emission reductions

Indicators	Denomination (PDD)	Unit of measurement	January	February	March	April	May	June	July	August	September	October	November	December
Project emissions	$PE_{EC,y}$	tCO_2/month												
Baseline emissions	$BE_{EC,y}$	tCO_2/month												
Emission reductions	$ER_{EC,y}$	tCO_2/month												

Annex 4

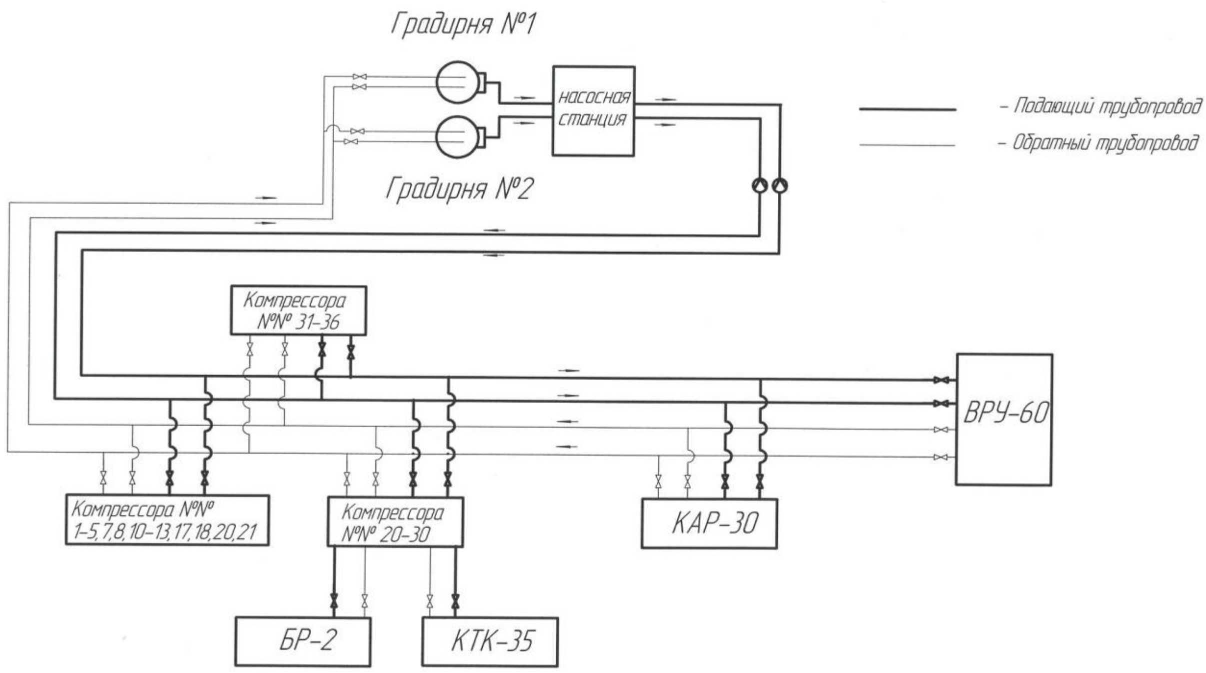
Production and equipment flow schemes

1. **Oxygen production flow scheme VRU-60**



Блок разделения – Separation unit
Воздушный бустер – Air booster
Блок комплексной очистки воздуха – Unit for integrated air purification
Отбросной азот – Waste nitrogen
Воздушный компрессор – Air compressor
Воздух – Air
Турбодетандер – Turbine expander
Кислород высокого давления – High-pressure oxygen
Азот среднего давления – Medium-pressure nitrogen
Азот низкого давления – Low-pressure nitrogen
Ректификационные колонны – Rectification towers
Жидкий кислород – Liquid oxygen
Жидкий азот – Liquid nitrogen
Теплообменник – Heat exchanger
Насос – Pump

2. Scheme of the re-circulating water supply for the OCP



Градирня – Cooling tower
Компрессора – of Compressor
Насосная станция – Pumping plant
Подающий трубопровод – Supply pipe-line
Обратный трубопровод – Return pipe-line

3. Scope of the outfit VRU-60

- air-water tower E07
- nitrogen-water tower E60
- unit for integrated air purification R01/R02
- air booster compressor C05
- cool unit including:
  - main heat exchanger E01;
  - turbine expander with braking gas blower ETOl/ ET01 C;
  - crude argon tower K10;
  - pure argon tower K11;
  - bottom tower K01;

    - top tower K02;
    - pure nitrogen tower K03;
    - tower Kr/Xe K90;
    - tower Ne/He K70;
    - condensers E10, E15, E16;
    - fluid-flow pumps P01 1/2; P03 1/2; P10.
- auxiliary equipment including:
    - control system and control-measuring instruments;
    - liquid oxygen tank V40;
    - evaporator E 41;
    - liquid oxygen pumps P 41 1/2.

Annex 5

Process control system

1. Organizational control system for the operation of the OCP.

The management personnel of the OCP of the JSC "Zaporizhstal" includes the following specialists:

1. Manager of the units department – to be responsible for the safe and economical operation of all the air-separation units.

2. Manager of the CMI sector of the OCP – to be responsible for the performance of the CMI devices of the OCP.

3. Manager of the APCS sector – to be responsible for the performance and operation of the automated production control system.

4. Manager of the IED (industrial engineering department) – to be responsible for record-keeping, analysis and control of the production technical and economic index.

2. Process control system.

The Control system of the VRU-60 is based on the software and hardware of the distributed control system Centum CS3000 and the safety system Prosafe-RS of the firm "Yokogawa". Safety and control systems ensure safe control and the reliable regulation of a number of parameters of the air-separation plant. The control system has a stratified architecture. Controllers managing the units and operators' workstations are arranged on the central control desk of the unit. Modules for the local collection and processing of sensors and modules for actuators control are located in Modin situated directly in the unit. Thus, the advantages of local measurement and central remote monitoring and control are ensured. The total control process of the unit is displayed on screens at two workstations in the form of still images of the system which are grouped by the process principle.