



JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
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**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: 01

Date: 15.04.2008

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



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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 “Kriogenmash” (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 117,000 MW-hours/year in 2008 and by 151,000 MW-hours/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 105,000 tons of CO₂/year in 2008 and 135,000 tons of CO₂/year over the subsequent period. The total reduction will be about 642,000 tons of CO₂ over the crediting period from 2008 to 2012.

A.3. Project participants:

Party involved	Legal participants of the Project (if applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine	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.

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 1,316 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.

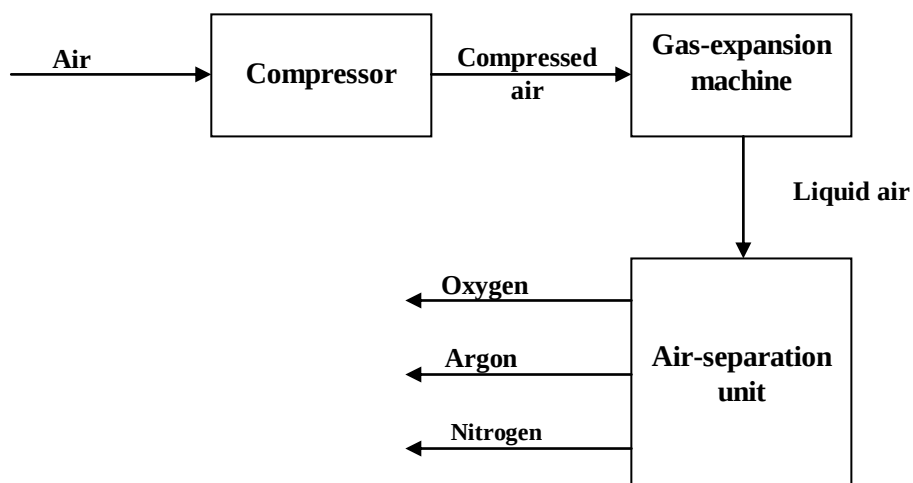
A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

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 $-192\text{ }^{\circ}\text{C}$). 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 ($t_{\text{boil}} = -195,8\text{ }^{\circ}\text{C}$) and argon ($t_{\text{boil}} = -189,4\text{ }^{\circ}\text{C}$) and liquid oxygen remains ($t_{\text{boil}} = -183\text{ }^{\circ}\text{C}$). 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 m³(O₂)/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 m³/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 VRU-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	721-1,441
Oxygen losses	%	3-5
Volume fraction of oxygen	%	99.5
Specific power consumption for production at the OCP	MW-h / 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 1,000 kW pump with a 160 kW pump. 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 “Kriogenmash”, Russia).

Electricity is to be saved by:

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



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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 117,000 MW-hours/year in 2008 and 151,000 MW-hours/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 105,000 tons of CO₂/year in 2008 and 135,000 tons of CO₂/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 “Kriogenmash”, 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 tons of CO₂ equivalent
2008	104,326
2009	134,463
2010	134,463
2011	134,463
2012	134,463
Total estimated amount of emission reductions over the crediting period, tons of CO ₂ -equivalent	642,178
Estimated average annual amount of emission reductions over the crediting period, tons of CO ₂ - equivalent	128,436

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. Barriers analysis.
3. Investment analysis.
4. Common practice analysis.

Step 1. Identification of alternative scenarios

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:

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 methodology 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 m³/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.

Description of the alternative scenarios

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

Retrofitting of the air-separation units KtK-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 KtK-35-3 и KAr-30 is 30,000 m³(O₂)/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 m³/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 “Kriogenmash” are identical in design to units KtK-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 m³(O₂)/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 m³/year).

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

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 m³/year) to ensure the functioning of the primary productions of the JSC “Zaporizhstal”. The output of the VRU-60 is 60,000 m³(O₂)/hour.

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

The operation of air-separation units is subject to the operating rules and regulations PTEPPRV-89. There are no other normative legal documents which could affect the project implementation.

In accordance with the operating rules and regulations PTEPPRV-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.

The life time for air-separation units KtK-35-3 and KAr-30 is 31 and 27 years accordingly; thus, their further service without overhaul is to be restricted by current legislation and regulations. However, development of the Project according to the alternative scenario 1 envisages retrofitting of the existing equipment, therefore, the alternative scenario is not to be excluded from further consideration until barriers that prevent such retrofitting will be identified.

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

Conclusion: To choose the Baseline and justify additionality, all three alternative scenarios will be discussed later as they comply with current legislation and regulations.

Step 2. Barriers analysis

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 barriers on the alternative scenarios is considered within the barriers analysis:



- *Investment barrier.* The following fact serves as indicator of the presence of this barrier to a certain alternative: Similar activities are defined as activities that rely on broadly similar technologies or practices, are of a similar scale, take place in a comparable environment with respect to the regulatory framework and are undertaken in the relevant geographical area. Hence, the absence of this barrier to a certain alternative scenario means that there is a higher probability of investment in its development than for other variants with a similar barrier.
- *Technological barrier.* The engineering and economic feasibility of the alternative is to be considered within this stage taking into consideration the availability of the particular technology used in the proposed project activities for the companies in the relevant geographical area.

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

Investment barrier.

The investment barrier does not significantly affect alternative scenarios 1 and 2 due to the fact that the activities provided by these scenarios; retrofitting of the existing air-separation units (alternative scenario 1) and construction of air-separation units identical to those that have been successfully operated at the plant for a long time (alternative scenario 2) and widely used and typical for such project types. The absence of an investment barrier is confirmed also by the fact that for the construction of units KAAr-32, the required design documentation has been developed at the JSC “Zaporizhstal” and construction of the new block has started.

An investment barrier exists for the alternative scenario 3 (construction of VRU-60 manufactured by Air Liquide) since the proposed technology and equipment are not common for the iron-and steel works of Ukraine. The application of the JSC “Kriogenmash” air-separation units with uncontrollable oxygen take-off is standard practice.

Conclusion: Significant risks related to investment in the alternative scenarios do not exist only for scenarios 1 and 2. A considerable investment barrier exists for alternative scenario 3.

Technological barrier.

Retrofitting of the equipment according to *alternative scenario 1* could be implemented as the per simplified or expanded version depending on the depreciation of the equipment. The replacement of any modules and the extension of the lifetime up to 10 years accordingly is possible with the expanded version for retrofitting of the air-separation units. Retrofitting of the plants of type KAr-30 and KtK-35-3 is common practice since the JSC “Kriogenmash” has carried out retrofitting of the units of type KAr-30 at KGGMK “Krivorozhstal” (2004), the JSC “ISPAT-Karmet” (2002), the JSC “NLMC” (2002r.), the JSC “NTMC” (2001).¹ Despite this, the technical implementation of this scenario is not feasible as retrofitting of the air-separation units requires financial expenditure but does not ensure a sufficient level of equipment reliability in the long term.

A technological barrier does not exercise significant influence on the implementation of *alternative scenario 2* because the air-separation units of type KAAr-32 are similar in design to the equipment that has been successfully used at the JSC “Zaporizhstal” for more than 30 years. While commissioning the air-separation units of type KAAr-32, significant changes in the technical regulations of the OCP work,

¹ As per the information placed on the official web-site of the JSC “Kriogenmash” - <http://www.cryogenmash.ru/>



customization of the units operation to the process cycle of the plant and re-training of operating personal would be not required.

The development of the Project according to *alternative scenario 3* is limited by the presence of significant technological barriers due to the fact that the oxygen production process and the equipment used in the air-separation unit VRU-60 are non-standard (new) for the JSC “Zaporizhstal”. For the technical implementation of alternative scenario 3, the following barriers must be overcome:

- the necessity to work out and approve technical regulations for operation of the equipment that has not been previously used in the plant,
- customization of the new equipment operation to the process cycle of the plant,
- training of the personnel to operate and maintain the new equipment.

The above-listed technological barriers for alternative scenario 3, are connected with the financial expenditures to overcome them and for this reason they act as significant obstacles to this scenario.

Conclusion: A technological barrier exists for alternative scenarios 1 and 3 and does not exist for alternative scenario 2.

The influence of the barriers determined within sub-stage 2a on the implementation of the alternative scenarios of the project for the OCP reconstruction is presented in Table B.1.-1.

Table B.1.-1. Influence of the barriers on the development of the alternative scenarios.

Alternative scenarios	Barriers	
	Investment	Technological
№ 1	Does not exist	Exists
№ 2	Does not exist	Does not exist
№ 3	Exists	Exists

Conclusion: None of the barriers presented exercise any significant influence on the development of alternative scenario 2 representing the reconstruction of the OCP at the JSC “Zaporizhstal” by the construction of air-separation units of type KAAr-32 manufacture by the JSC “Kriogenmash”. Therefore, this alternative is the **Baseline scenario**. The above-stated barriers prevent the implementation of alternatives 1 and 3.

In spite of all the existing investment and technological barriers, 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 significant investment and 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.

A cost-benefit analysis of the Project is based on the assumption that its implementation will provide electric power savings versus the Baseline scenario and the use of the JI mechanism will make it possible to attract additional revenue for the Project - ERU sales.

ERU sales at a price of 10-12 Euro/t CO₂ will provide a rate of profit at 2.6-3.2% more than without the ERU sales. A discounted payback period for the project with ERU sales will be reduced by 4-5 years versus the situation without ERU sales (16 years). Consequently, the JI mechanism will assist in overcoming the barriers stated above.

As the Baseline scenario has been determined, according to the Combined tool to identify the baseline scenario and demonstrate additionality, one can proceed to Stage 4 “Common practice analysis” omitting Stage 3 “Investment analysis”.

Step 3. Investment analysis

Does not apply.

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 utilization of the JSC “Kriogenmash” equipment is common practice for the air-separation units in the iron-and-steel works in Ukraine and Russia. The JSC “Kriogenmash” air-separation units have been successfully operated at most of the iron-and-steel works in Ukraine and Russia.

The JSC “Zaporizhstal” has operated the JSC “Kriogenmash” air-separation units since 1976. For the period of their operation, these units proved their reliability and compliance with all requirements for the provision of the metallurgical production of the JSC “Zaporizhstal” with process gases (oxygen, nitrogen, argon). In this regard, replacement of the worn-out air-separation units was scheduled at the JSC “Zaporizhstal” only using the JSC “Kriogenmash” equipment; namely units KAAr-32. The JSC “Zaporizhstal” has developed and approved all the required project design documentation and had begun the construction of a building to install a new air-separation unit (manufactured by the JSC “Kriogenmash”) – the foundation of the new block was constructed on the territory of the plant.

Conclusion: Therefore, the technology proposed in this Project (VRU-60, manufactured by Air Liquide) is not common with the iron-and steel works in Ukraine and is new for the JSC “Zaporizhstal”. This proves that the proposed Project does not fall under the category of common practice and accordingly is to be *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:
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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.



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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.

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, 517,000-598,000 MW-h/year of electric power directly by the OCP and an additional amount of about 14,000-16,000 MW-h/year of electric power for the re-circulating water supply for the OCP would have been consumed according to the Baseline scenario. Consequently, the total consumption of electric power would have been 531,000-613,000 MW-h/year in the absence of the Project. This would lead to GHG emissions in the power grid of Ukraine to the amount of about 474,000-548,000 tons of CO₂ / year². 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	MW-h/year	517,335	597,607	597,607	597,607	597,607
Electric power consumption by the water supply plant (WSP)	MW-h/year	13,589	15,697	15,697	15,697	15,697
Total electric power consumption for oxygen generation	MW-h/year	530,924	613,304	613,304	613,304	613,304
GHG emission factor	t CO ₂ / MW-h/year	0.893	0.893	0.893	0.893	0.893
GHG emissions	t CO ₂	474,115	547,680	547,680	547,680	547,680

Project GHG emissions

The electric power consumption in the OCP for oxygen generation at the required level (390,000,000 m³/year) will be 406,000-456,000 MW-h/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%. The electric power consumption by the WSP for the re-circulating water supply for the OCP will be about 8,500-7,000 MW-h/year. Therefore, the specific electric power consumption will be 414,000-463,000 MW-h/year in the event of the Project implementation. This will lead to GHG emissions

² Emission factor of 0.893 t CO₂/MW-hour was used for estimating emissions in the power system of Ukraine, (according to the survey Global Carbon B. V.: Project “Introduction of efficiency measures at ISTIL mini steel mill, Ukraine”).



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within the power grid of Ukraine amounting to about 370,000-413,000 tons of CO₂/year.³ 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	MW-h/year	405,600	455,684	455,684	455,684	455,684
Electric power consumption by the WSP	MW-h/year	8,497	7,045	7,045	7,045	7,045
Total electric power consumption for oxygen generation	MW-h/year	414,097	462,729	462,729	462,729	462,729
GHG emission factor	t CO ₂ / MW-h/year	0.893	0.893	0.893	0.893	0.893
GHG emissions	t CO ₂	369,789	413,217	413,217	413,217	413,217

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”, namely:

- Reduction in the electric power consumption for oxygen production by the OCP,
- Reduction in the electric power consumption by the WSP for manufacturing water pumping utilized by the OCP.

Thus, GHG emission 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 642,178 tons of CO₂.

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	474,115	547,680	547,680	547,680	547,680
GHG emissions according to the Project scenario	t CO ₂	369,789	413,217	413,217	413,217	413,217
Reductions of GHG emissions	t CO ₂	104,326	134,463	134,463	134,463	134,463

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

³ An emission factor of 0.893 t CO₂/MW-hour was used for estimating emissions in the power system of Ukraine, (according to the survey Global Carbon B. V.: Project “Introduction of efficiency measures at ISTIL mini steel mill, Ukraine”).



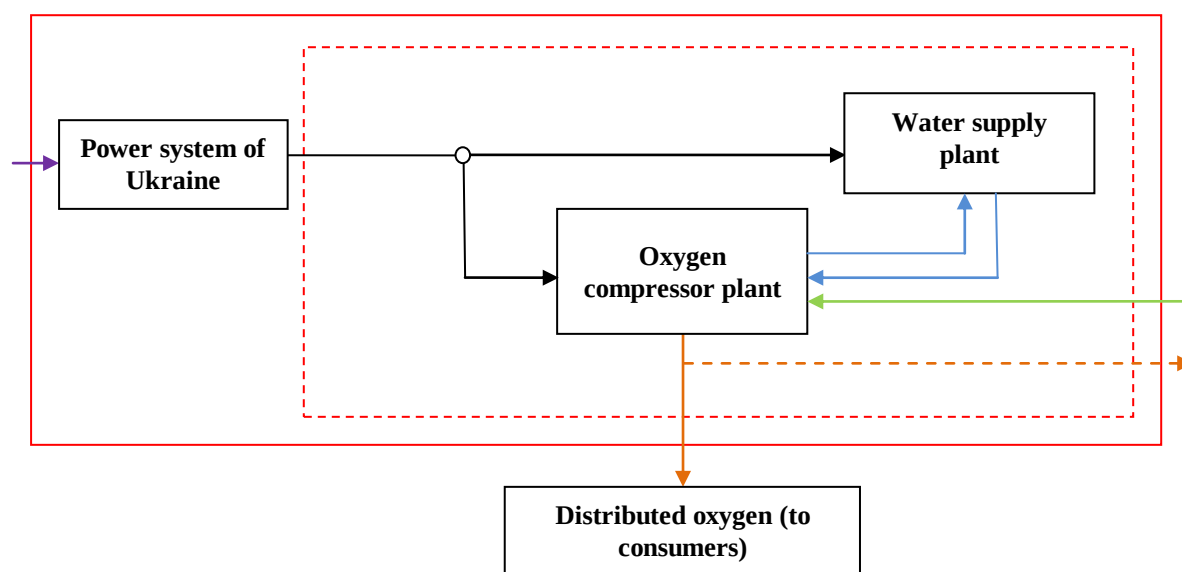
- Power plants of the Ukrainian grid

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.

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 implementation of the project will make it possible to reduce manufacturing water consumption by the OCP and to reduce electric power consumption for water pumping to the WSP. This ensures a reduction in electric power utilization from the power system and a corresponding reduction in GHG emissions from the power plants of Ukraine.
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 ₂ O	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 ₂ O	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.: +7 495 975 78 35 ext. 113

Fax: +7 495 975 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:

Date of commissioning of the Project: February 19, 2008.

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 and open-hearth plants.

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.
3. Reduction in manufacturing water consumption.

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.

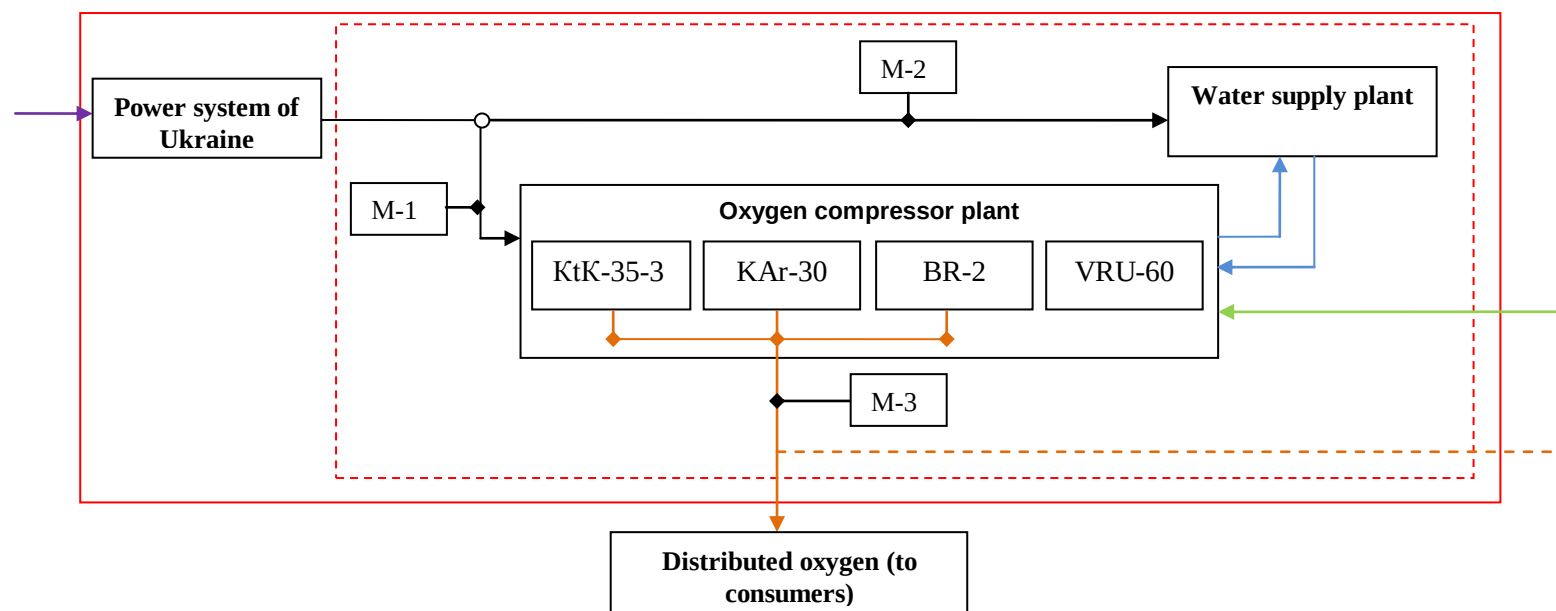
The main features to be considered in the monitoring plan:

- 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 and water supply plant.
- When monitoring for GHG emissions within the Baseline scenario, the following values are to be assumed constant for the whole monitoring period:
 - specific electric power consumption for production in the OCP,
 - specific manufacturing water consumption for production in the OCP,
 - specific electric power consumption by the WSP for the re-circulating water supply for the OCP.
- 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 diagram below shows the monitoring points to be used when monitoring the stated parameters.



	Electric power
	Fuel-and-power resources (TPR)
	Oxygen
	Oxygen losses
	Technical water
	Air
	Boundary of the JSC “Zaporizhstal”
	Project boundary

Monitoring points	Description
M-1	Electric power consumption by the OCP
M-2	Electric power consumption by the WSP for the re-circulating water supply for the OCP
M-3	Oxygen production in the reserved air-separation units

**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
M-1	EC_{OCP, PJ} Electric power consumption by the OCP	Electric power meter	MW-h	m	Monthly	100 %	Electronic and paper	To be registered by the plant of networks and substations of the JSC “Zaporizhstal”
M-2	EC_{WSP, PJ} Electric power consumption by the WSP for reverse water supply for the OCP	Electric power meter	MW-h	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 CO₂ equivalent):

Project CO₂ emissions are evaluated by the formula:

$$\mathbf{D.1.} \quad PE_{EC} = EC_{PJ} * EF_{el}$$

PE_{EC} - *project emissions, tons of CO₂*

EC_{PJ} - *total electric power consumption from the power system for the OCP needs within the Project activity, MW-h*

EF_{el} - *emission factor during electric power generation supplied by the power system of Ukraine, t CO₂/MW-h*



A GHG Emission coefficient for the power system of Ukraine (EF_{el}) equal to 0.893 t CO₂/MW-hour is assumed in the calculations (according to the survey Global Carbon B. V.: Project “Introduction of efficiency measures at the ISTIL mini steel mill, Ukraine”).

The total electric power consumption for the OCP needs of the JSC “Zaporizhstal” is determined by the formula:

$$D.1.1. \quad EC_{PJ} = EC_{OCP, PJ} + EC_{WSP, PJ}$$

$EC_{OCP, PJ}$ - electric power consumption by the OCP due to the Project activity, MW-h

$EC_{WSP, PJ}$ - electric power consumption by the WSP for the re-circulating water supply for the OCP due to the Project activity, MW-h

D.1.1.3. Relevant data necessary for determining the <u>baseline</u> of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number (Please use numbers to ease cross-referencing to D.2.)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
M-3	OP_{RP} 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”

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO₂ equivalent):

Baseline CO₂ emissions are calculated by the formula:

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D.2. $BE_{EC} = EC_{BL} * EF_{el}$

BE_{EC} - *Baseline emissions, tons of CO₂*

EC_{BL} - *total electric power consumption from the power system for the OCP needs according to the Baseline, MW-h*

EF_{el} - *emission coefficient during electric power generation supplied by the power system of Ukraine, t CO₂/MW-h*

The total electric power consumption for the OCP needs of the JSC “Zaporizhstal” is determined from the formula:

D.2.1. $EC_{BL} = EC_{OCP, BL} + EC_{WSP, BL}$

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

$EC_{WSP, BL}$ - *electric power consumption by the WSP for the re-circulating water supply for the OCP according to the Baseline, MW-h*

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

D.2.1.1. $EC_{OCP, BL} = OP_{BL} * fc_{E, OP, BL}$

OP_{BL} - *total oxygen production according to the Baseline, thousand m³*

$fc_{E, OP, BL}$ - *specific electric power consumption for production in the OCP according to the Baseline, MW-h/thousand m³(O₂)*

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

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D.2.1.2.	$OP_{BL} = f_{C_{OP, BL}} * T_{OP} + OP_{RP}$
$f_{C_{OP, BL}}$	- output of the air-separation units according to the Baseline, thousand m ³ /hour
T_{OP}	- operational time for the air-separation units, hours
OP_{RP}	- oxygen production output in the reserved air-separation, thousand m ³

The output value for the air-separation units according to the Baseline ($f_{C_{OP, BL}}$) is assumed to be equal to 60,000 m³(O₂)/hour, (performance of two units KAAr-32 with an output of 30,000 m³(O₂)/hour). Since oxygen take-off is uncontrollable in the units KAAr-32, the output of the blocks according to the Baseline does not depend on the amount of oxygen consumed by the production units of the JSC “Zaporizhstal” and is assumed to be constant over the whole crediting period.

The oxygen production rate in the air-separation units in reserve (OP_{RP}) is to be considered directly in the monitoring if the units will be utilized for oxygen production. This situation could occur with an increase in the requirement of the production units of the JSC “Zaporizhstal” of more than 44,000,000 m³(O₂)/month or over 60,000 m³(O₂)/hour of oxygen.

The specific electric power consumption for production in the OCP according to the Baseline ($f_{C_{E, OP, BL}}$) is assumed to be equal to 1.137 MW-h /thousand m³ (O₂) that corresponds to the average value for 2005-2007 according to the actual work data for the OCP (Annex 2). The specific electric power consumption according to the Baseline is assumed to be constant over the whole crediting period.

The electric power consumption for manufacturing water pumping by the WSP for the OCP needs according to the Baseline is determined by the formula:

D.2.1.3.	$EC_{WSP, BL} = OP_{BL} * f_{C_{TWC, OP, BL}} * f_{C_{E, TWC}}$
$f_{C_{TWC, OP, BL}}$	- specific manufacturing water consumption for production in the OCP according to the Baseline, m ³ (water) /m ³ (O ₂)
$f_{C_{E, TWC}}$	- specific electric power consumption by the WSP for the re-circulating water supply for the OCP according to the Baseline, MW-h / thousand m ³ (water)



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The specific manufacturing water consumption $f_{C_{TWC}, OP, BL}$ for production in the OCP and the specific electric power consumption for manufacturing water pumping $f_{C_{E, TWC}}$ by the WSP are evaluated in accordance with the actual work data for the OCP in 2005-2007 (Annex 2) and is equal to $0.181 \text{ m}^3(\text{water}) / \text{m}^3(\text{O}_2)$ and $0.165 \text{ MW-h/thousand m}^3(\text{water})$ respectively. These parameters remain constant over the whole crediting period.

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 CO₂ 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;
- CO₂ emissions from fuel utilization during TPR transportation by motor-vehicle and railway transport.

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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 CO₂ 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 CO₂ equivalent):

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

ER_{EC} – Emission reductions, tons of CO₂

BE_{EC} – Baseline emissions, tons of CO₂

PE_{EC} – Project emission, tons of CO₂

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**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. M-1	Low	Instruments to be used - <i>power meters</i> . Calibration is performed once every 4 years
Table D1.1.1. M-2	Low	Instruments to be used - <i>power meters</i> . Calibration is performed once every 4 years
Table D1.1.1. M-3	Low	Instruments to be used - <i>flow-rate meter</i> . Calibration is performed once a year

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 and WSP (for the re-circulating water supply for the OCP) is performed daily by an head of 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 technical bureau of the plant of networks and substations draws up a summarized report of the electric power consumption by the OCP and WSP (for the re-circulating water supply for the OCP) for the passed month and submits it to the power bureau of Chief power engineer department.

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A primary record of the amount of oxygen produced in the air-separation units in reserve will be conducted daily by an engineer from the recording bureau of the Chief power engineer department in case if these units would be operational. The daily oxygen generation data will be archived in electronic and paper format. After each month, the head of technical bureau of OCP according to data 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 power engineer from the power bureau of the Chief power engineer department submits received data to deputies of the chief engineer for approval; then the power engineer submits the data to the LEP.

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 at the LEP 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.: +7 495 975 78 35 ext. 113

Fax: +7 495 975 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 provisions of the Methodological tool “Tool to calculate project emissions from electricity consumption“ Version 01.

E1.1. $PE_{EC} = EC_{PJ} * EF_{el}$

PE_{EC} - Project emissions, tons of CO₂

EC_{PJ} - total electric power consumption for the OCP needs from the power system within the Project activity, MW-h

EF_{el} - CO₂ emission factor during electric power generation supplied by the power system of Ukraine, t CO₂/MW-h

A GHG emission factor (EF_{el}) equal to 0.893 t CO₂/MW-hour was assumed for the power system of Ukraine (according to the survey Global Carbon B. V.: Project “Introduction of efficiency measures at the ISTIL mini steel mill, Ukraine”).

The total electric power consumption for the OCP demands within the Project activity is evaluated by the formula:

E1.1.1. $EC_{PJ} = EC_{OCP, PJ} + EC_{WSP, PJ}$

$EC_{OCP, PJ}$ - electric power consumption by the OCP within the Project activity, MW-h

$EC_{WSP, PJ}$ - electric power consumption by the WSP for the re-circulating water supply within the Project activity, MW-h

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



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E1.1.1.1. $EC_{OCP, PJ} = OP_{PJ} * f_{CE, OP, PJ}$

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

$f_{CE, OP, PJ}$ - specific electric power consumption for production in the OCP within the Project activity, MW-h/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:

E1.1.1.2. $OP_{PJ} = OC_{PJ} / (1 - W_{LOST, PJ})$

OC_{PJ} - oxygen requirements of the JSC “Zaporizhstal” plants within the Project activity, thousand m^3

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

The value of the annual requirement for distributed oxygen (OC_{PJ}) 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 ($f_{CE, OP, PJ}$) will be about 1.11 MW-h / thousand $m^3(O_2)$ according to the data of the actual work of the OCP for March, 2008.

The electric power consumption by the water supply plant for pumping manufacturing water for the OCP under the Project scenario is determined by the formula:

E1.1.1.3. $EC_{WSP, PJ} = OP_{PJ} * f_{CTWC, OP, PJ} * f_{CE, TWC, PJ}$

$f_{CTWC, OP, PJ}$ - specific manufacturing water consumption for production in the OCP within the Project activity, $m^3(\text{water}) / m^3(O_2)$

$f_{CE, TWC, PJ}$ - specific electric power consumption for pumping manufacturing water in the WSP for the re-circulating water supply for the OCP within the Project activity, MW-h/thousand $m^3(\text{water})$

The specific manufacturing water consumption for production under the Project scenario ($f_{CTWC, OP, PJ}$) will be 0.120 $m^3(\text{water}) / m^3(O_2)$ according to the actual data of the OCP work for March, 2008. According to the design data, the electric power consumption by the WSP for pumping manufacturing water ($f_{CE, TWC, PJ}$) will be 0.143 MW-h / thousand $m^3(\text{water})$.

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The calculation of the Project CO₂ emissions performed in accordance with the formulae described above is presented in Table E.1.1.

Table E.1.1. Calculation of the Project CO₂ 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	MW-h / thousand m ³ (O ₂)	1.110	1.110	1.110	1.110	1.110
Electric power consumption by the OCP	MW-h/year	405,600	455,684	455,684	455,684	455,684
Specific manufacturing water consumption for the re-circulating for the OCP	m ³ (water) / m ³ (O ₂)	0.151***	0.120	0.120	0.120	0.120
Specific electric power consumption by the WSP	MW-h / thousand m ³ (water)	0.154***	0.143	0.143	0.143	0.143
Electric power consumption by the WSP	MW-h/year	8,497	7,045	7,045	7,045	7,045
Total electric power consumption	MW-h/year	414,097	462,729	462,729	462,729	462,729
Emission factor	tCO ₂ / MW-h	0.893	0.893	0.893	0.893	0.893
CO ₂ emissions	t CO ₂ / year	369,789	413,217	413,217	413,217	413,217

* The requirement of the plants for oxygen in 2008 under the Project scenario is assumed equal to 338,000,000 m³(O₂) (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 %.

*** Since the pumps for the re-circulating water supply for the OCP will be replaced in the middle of 2008, the specific manufacturing water and electric power consumption in 2008 are estimated as an average value for the Project data and the Baseline.

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;



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- CO₂ 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	t CO ₂	369,789	413,217	413,217	413,217	413,217
Leakages	t CO ₂	-	-	-	-	-
Total CO ₂ emissions	t CO ₂	369,789	413,217	413,217	413,217	413,217

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 provisions of the Methodological tool “Tool to calculate project emissions from electricity consumption” Version 01.

E4.1.
$$BE_{EC} = EC_{BL} * EF_{el}$$

BE_{BL} - Baseline emissions, tons of CO₂

EC_{BL} - total electric power consumption for the needs of the OCP according to the Baseline, MW-h

EF_{el} - emission factor during electric power generation supplied by the power system of Ukraine, t CO₂/MW-h

The total electric power consumption for the needs of the OCP of the JSC “Zaporizhstal” is calculated by the formula:

E4.1.1.
$$EC_{BL} = EC_{OCP, BL} + EC_{WSP, BL}$$

$EC_{OCP, BL}$ - electric power consumption by the OCP according to the Baseline, MW-h



$EC_{WSP, BL}$ - *electric power consumption by the WSP for the re-circulating water supply for the OCP according to the Baseline, MW-h*

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

E 4.1.1.1. $EC_{OCP, BL} = OP_{BL} * f_{C_{E, OP, BL}}$

OP_{BL} - *oxygen production according to the Baseline, thousand m³*

$f_{C_{E, OP, BL}}$ - *specific electric power consumption for production in the OCP according to the Baseline, MW-h/thousand m³(O₂)*

The oxygen production rate of the OCP of the JSC “Zaporizhstal” is 525,600,000 m³ (O₂)/year as the total output of the two air-separation units KAAr-32 is 60,000 m³ (O₂)/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 ($f_{C_{E, OP, BL}}$) is defined in accordance with the actual work data of the OCP for 2005-2007 (Annex 2) and is equal to 1.137 MW-h/ thousand m³ (O₂).

The electric power consumption in the water supply plant for pumping manufacturing water for the OCP needs is calculated by the formula:

E4.1.1.2. $EC_{WSP, BL} = OP_{BL} * f_{C_{TWC, OP, BL}} * f_{C_{E, TWC, BL}}$

$f_{C_{TWC, OP, BL}}$ - *specific manufacturing water consumption for oxygen production by the OCP according to the Baseline, m³(water) /m³(O₂)*

$f_{C_{E, TWC, BL}}$ - *specific electric power consumption by the WSP for the re-circulating water supply for the OCP according to the Baseline, MW-h/thousand m³(water)*

The specific manufacturing water consumption for production in the OCP according to the Baseline ($f_{C_{TWC, OP, BL}}$) and specific electric power consumption by the WSP for the re-circulating water supply for the OCP ($f_{C_{E, TWC, BL}}$) are determined in accordance with the actual work data of the OCP for 2005-2007 and are equal to 0.181 m³(water)/m³(oxygen) and 0.165 MW-h/thousand m³(water) respectively.

The estimation of CO₂ 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 CO₂ 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	MW-h / thousand m ³ (O ₂)	1.137	1.137	1.137	1.137	1.137
Electric power consumption by the OCP	MW-h / year	517,335	597,607	597,607	597,607	597,607
Specific manufacturing water consumption for the re-circulating water supply for the OCP	m ³ (water) / m ³ (O ₂)	0.181	0.181	0.181	0.181	0.181
Specific electric power consumption by the WSP	MW-h / thousand m ³ (water)	0.165	0.165	0.165	0.165	0.165
Electric power consumption by the WSP	MW-h / year	13,589	15,697	15,697	15,697	15,697
Total electric power consumption	MW-h / year	530,924	613,304	613,304	613,304	613,304
Emission factor	tCO ₂ / MW-h	0.893	0.893	0.893	0.893	0.893
CO ₂ emissions	t CO ₂ / year	474,115	547,680	547,680	547,680	547,680

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

E 5.1.
$$ER_{EC} = BE_{EC} - PE_{EC}$$

ER_{EC} - emission reductions in the Project, tons of CO₂

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	369,789	-	474,115	104,326
2009	413,217	-	547,680	134,463
2010	413,217	-	547,680	134,463
2011	413,217	-	547,680	134,463
2012	413,217	-	547,680	134,463
Total	2,022,657	-	2,664,835	642,178

**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**

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Salutation:	
Last name:	
Middle name:	
First name:	
Department:	
Phone (direct):	
Fax (direct):	-
Mobile:	-
Personal e-mail:	-

Annex 2**BASELINE INFORMATION**

Additional Baseline information comprises:

- The operational records for the OCP of the JSC “Zaporizhstal” for 2005-2007.
- CO₂ emission factor for the power system of Ukraine for the Projects resulting in a saving of electric power

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	MW-h	595,567	639,667	619,248	618,160.67
6	Specific electric power consumption by the OCP for production ($fc_{E, OP, BL}$)	MW-h / 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	MW-h	15,323.8	15,920.9	17,203.1	16,149.3
10	Specific consumption from the OCP recirculation water ($fc_{E, TWC}$)	MW-h / thousand m ³ (O ₂)	0.155	0.176	0.163	0.165

Table 2. CO₂ 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 / MW-h	0.893	0.893	0.893	0.893	0.893

(Source: Global Carbon B. V.: Project “Introduction of efficiency measures at ISTIL mini steel mill, Ukraine”)

Annex 3MONITORING PLAN

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	$EC_{OCP, PJ}$	MW-h / month												
Electric power consumption by the WSP	$EC_{WSP, PJ}$	MW-h / month												
Total electric power consumption	EC_{PJ}	MW-h / month												
Emission factor	EF_{el}	t CO ₂ / MW-h												
Project emissions	PE_{EC}	t CO 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 OCP	$fc_{OP, BL}$	thousand m ³ (O ₂) / hour												
Number of working hours per month	T_{OP}	hours / month												
Oxygen production by reserved blocks	OP_{PJ}	thousand m ³ (O ₂) / month												
Total oxygen production	OP_{BL}	thousand m ³ (O ₂) / month												
Specific electric power consumption by the OCP	$f_{CE, OP, BL}$	MW-h / thousand m ³ (O ₂)												

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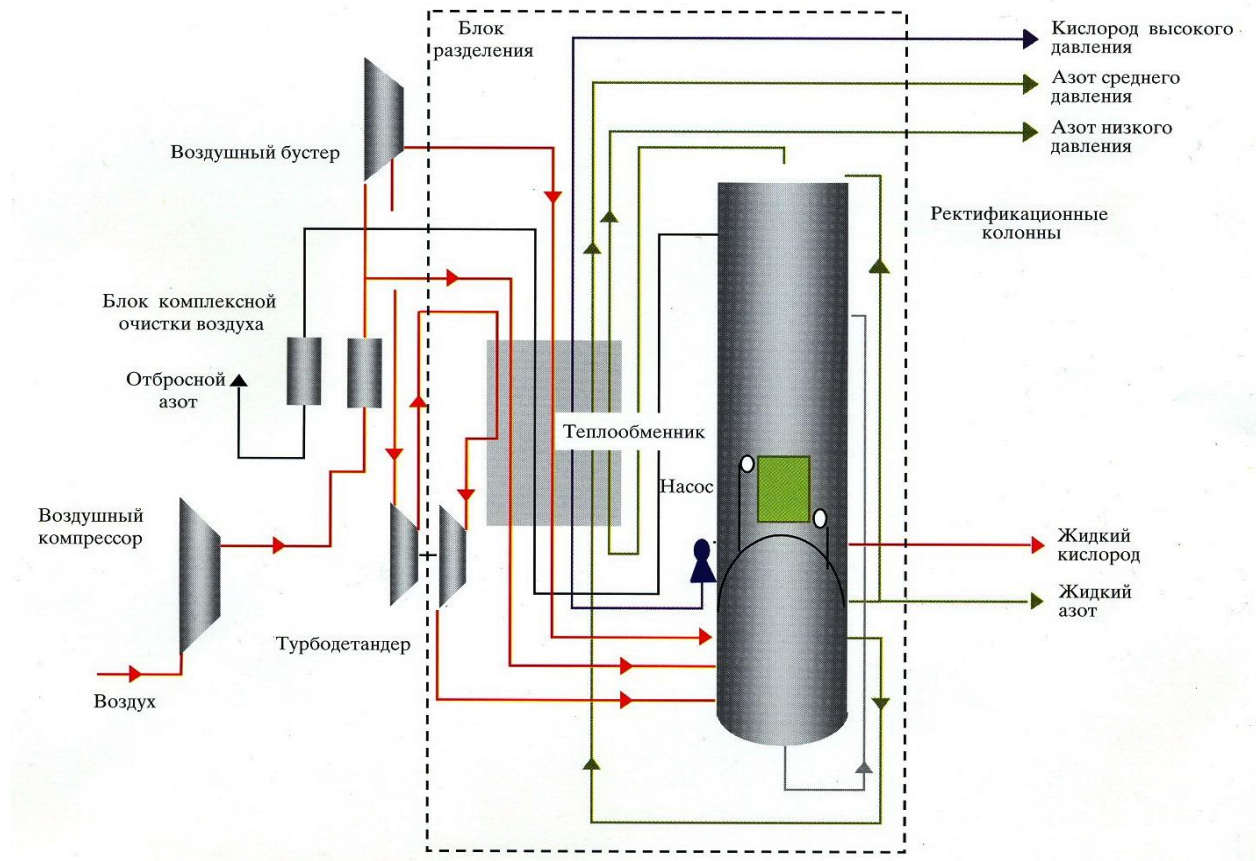
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Electric power consumption by the OCP	$EC_{OCP, BL}$	MW-h / month												
Specific manufacturing water consumption	$fc_{TWC, OP, BL}$	m ³ / m ³ (O ₂)												
Specific electric power consumption by the WSP	$fc_{E, TWC}$	MW-h / thousand m ³ (water)												
Electric power consumption by the WSP	$EC_{WSP, BL}$	MW-h / month												
Total electric power consumption	EC_{BL}	MW-h / month												
Emission factor	EF_{el}	t CO ₂ / MW-h												
Baseline emissions	BE_{EC}	t CO 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}	t CO ₂ / month												
Baseline emissions	BE_{EC}	t CO ₂ / month												
Emission reductions	ER_{EC}	t CO ₂ / month												

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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



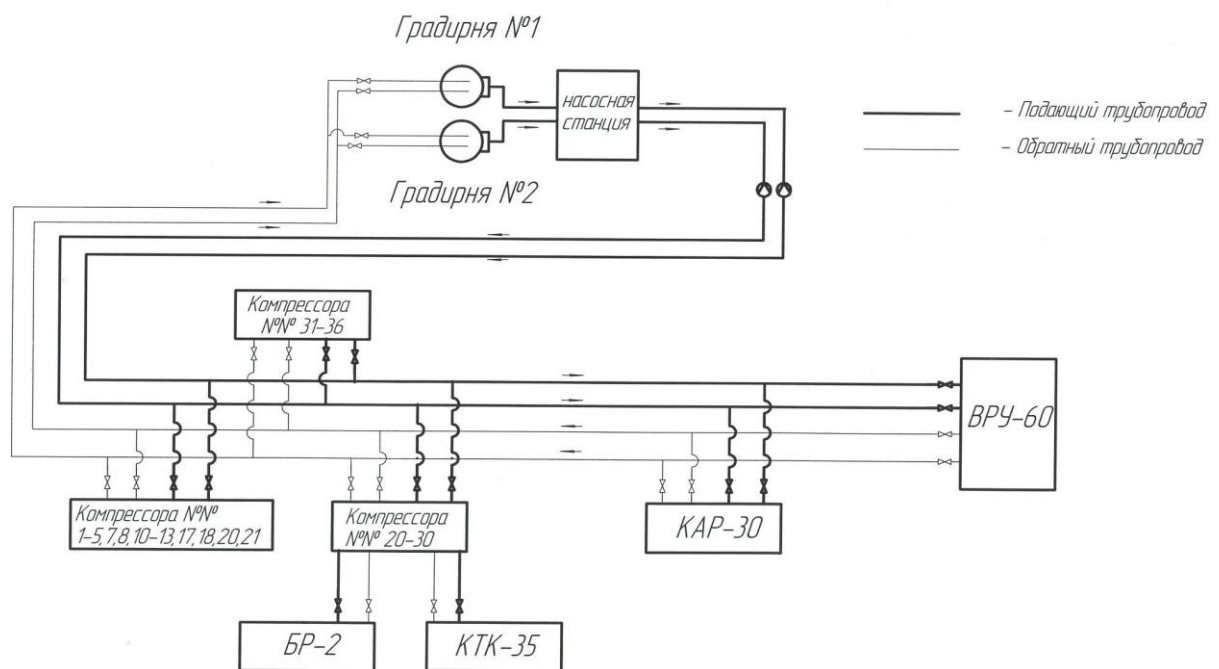
Жидкий кислород – Liquid oxygen

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

Подводящий 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:



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- main heat exchanger E01;
 - turbine expander with braking gas blower ET01/ 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.