PROJECT DESIGN DOCUMENT

JOINT IMPLEMENTATION PROJECT

“Greenhouse gases emissions reduction due to the modernization of the production facilities of Odessa Refinery”

Position of the manager of the organization, which developed the document

LLC ‘KT-Energy’

Director		Mr. Tomlyak Kyryl
(position)	(signature)	(name)

Date:

Position of the manager of economic entity, which is the owner of the project site at which realization of joint implementation project is planned

PJSC “LUKOIL-ODESSA REFINERY”

Director General		Mr. Chaheev Valerij
(position)	(signature)	(name)

Date:

Kyiv, November, 2012

JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM FOR SMALL-SCALE PROJECTS
Version 01.1 - in effect as of: 27 October 2006

CONTENTS

SECTION A. General description of the small-scale project

A.1. Title of the small-scale project:

Greenhouse gases emissions reduction due to the modernization of the production facilities of Odessa Refinery

Project pertains to the sectoral scope 5. Chemical industry, Group II.

JI PDD version number: 2.0.

Data of Completion: 28th of November, 2012

A.2. Description of the small-scale project:

Situation before project implementation

Before project implementation Odessa Refinery operated outdated primary oil refining equipment, including furnaces for fuel combustion without implementation of any significant energy efficiency measures since 1979.

Baseline scenario

The baseline scenario of the project foresees continuation of previously existing practice with the operation of primary oil refining equipment consisting of atmospheric and vacuum distillation unit (hereafter "AVD unit") without implementation of modernization activity, including furnaces replacement (see also section B for details).

History of the project

Before project implementation the Odessa refinery operated outdated equipment including primary oil refining units resulted in higher organic fuel combustion amounts. Considering the additional revenues of the ERU sales project owner decided to implement the reconstruction of the AVD unit in 2002.

Project scenario

Project foresees modernisation of the AVD unit at the Odessa refinery including reconstruction of its columns, vacuum and atmospheric parts, partial replacement of oil refining equipment and complete replacement of the furnaces where the fuel for primary oil refining is combusted.

Purpose of the project

The purpose of the project is the increased efficiency of the energy resources used accompanied by greenhouse gases emission reductions.

Non technical project summary

Within project boundaries project envisages modernization of the AVD unit at the Odessa Refinery through the implementation of energy saving measures and replacement of the furnaces, where the organic fuel is being combusted for the needs of primary oil refining. Realised activity will allow to reduce the specific fuel consumption for primary oil refining and to improve the efficiency of furnaces operation, and thus will lead to reduction of GHG emissions.

Expected results of the project:

Project activity aims to achieve the following results:

- greenhouse gases emission reductions in the amount of 114 672 tonnes of CO_{2e} for the period of 2008-2012 and 420 464 tonnes of CO_{2e} for the period 2008-2020,
- lowering of specific fuel consumption for oil refining at the AVD unit from 0.872 GJ/tonne of refined oil (average for 2000-2003) to 0.573 GJ/tonne (average for 2008-2010).

Grounds for the project implementation

Project implementation was started on the grounds of the necessity to optimize energy resources consumption at the Enterprise with the utilisation of Kyoto Protocol flexible mechanisms. Information about energy consumption of the Enterprise is presented in the table below.

Table A.2.-1. Main activity indicators of Odessa Refinery

Data	2000	2001	2002	2003
Oil refining, tonnes	724 981	1 084 039	1 443 759	1 556 955
Total fuel use, GJ	654 355	908 879	1 209 307	1 415 719

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)
Party A: Ukraine (Host Party)	Legal entity A1: PJSC "LUKOIL-ODESSA REFINERY"	No
Party B: Switzerland (is not a Host Party)	Legal entity B1: LITASCO SA	No

PJSC "LUKOIL-ODESSA REFINERY" is a company operating a refinery plant with simple refining scheme, located in Odessa. At the moment Odessa Refinery is one of the most modern equipped and technical balanced plant among six Ukrainian refineries. The share of Odessa refinery in the internal market of Ukrainian petrol and diesel fuel is 6% and 8% respectively. Nominal capacity of primary oil refining of Odessa refinery is about 7% of total capacity of refineries in Ukraine.

Economic activity types of the Odessa Refinery according to Ukrainian Classification for Economic Activities (KVED): 23.20 Products of oil refining; 51.51Wholesale fuel trading; 50.5 Retail fuel trading.

LITASCO SA belongs to and heads the LITASCO Group – LUKOIL international trading and supply company. Main activity of the LITASCO SA consists in marketing production of crude oil and petroleum products in the markets outside of Russia, including sourcing and optimization the delivery of crude oil to LUKOIL refineries outside of Russia and petroleum products to other LUKOIL Companies. LITASCO SA participates in projects aimed on the reduction of greenhouse gas emissions in the Russian Federation and Ukraine as a participant of JI projects.

A.4. Technical description of the small-scale project:

A.4.1. Location of the small-scale project:

Project area location – Ukraine, Odessa region, Odessa city, 1/1 Shkodova gora str.

Fig. A.4.-1. Project area location, Odessa, Ukraine

A.4.1.1. Host Party(ies):

Ukraine

Article 5 of the Kyoto Protocol requires 'Annex 1 Parties to having in place, no later than 2007, national systems for the estimation of greenhouse gas emissions by sources and removal by sinks.' National Inventory System of Ukraine was created by Government Decision "Procedure of the Functioning National System of the Estimation of Anthropogenic Emissions by Sources and Removals by Sinks of GHG not Controlled by the Montreal Protocol" (21.04.06, №554).

According to Article 7 of the Kyoto Protocol Ukraine have submitted annual greenhouse gas inventories on a regular basis. First National Inventory report was submitted on 20th of February, 2004. The last one was submitted on 13th of April, 2012. Ukraine has also submitted its Fifth National Communication report on 29th of December 2009.

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

Odessa region

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

Odessa

A.4.1.4. Detail of physical location, including information allowing the unique identification of the small-scale project:

The project is implemented at the project site of PJSC "LUKOIL-ODESSA REFINERY" in Odessa city, 1/1 Shkodova gora str. The geographical coordinates of the project site are the following: 46°30' N, 30°41' E.

Fig. A.4.-2. Project site location, Odessa city, 1/1 Shkodova gora str

A.4.2. Small-scale project type(s) and category(ies):

The joint implementation project at PJSC "LUKOIL-ODESSA REFINERY" is a small scale project.

The small scale project conforms to the type (II): Energy efficiency improvement projects which reduce energy consumption, on the supply and/or demand side, by up to 60 gigawatt hours electric (GWh el.) per year (or an appropriate equivalent) (in accordance with paragraph 7 of "Provisions for joint implementation small scale projects", Version 3[1]).

The small scale project conforms to the category H. Energy efficiency and fuel switching measures for industrial facilities (according to the APPENDIX B of Decision 4/CMP.1 [2]).

The proposed JI project foresees the implementation of the energy efficiency technologies at the Odessa Refinery' units of primary oil refining that would result in lower fossil fuel consumption. Annual decrease of energy consumption is in range of 432 – 632 TJ (which could be considered as an appropriate equivalent of 40.0-58.5 GWh (e)), that conforms the requirements to the small scale projects provided in "Provisions for joint implementation small scale projects", Version 3 (paragraph 7)[3].

Modernization activity introduced within the proposed project could not be referred as a common practice technology in the refinery industry in Ukraine (see also Section B.2).

[1] http://ji.unfccc.int/Ref/Documents/Provisions_for_JI_SSC_projects.pdf

[2] http://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf#page=30

[3] http://ji.unfccc.int/Ref/Documents/Provisions_for_JI_SSC_projects.pdf

A.4.3. Technology(ies) to be employed, or measures, operations or actions to be implemented by the small-scale project:

The aim of project execution is the increase of energy resources consumption efficiency and greenhouse gases emission reduction during primary oil refining.

Odessa Refinery has been built and commissioned in 1937. Design layout of the Refinery included asphalt- vacuum and bitumen units and units of the two-coil cracking.

As a result of a number of reconstructions the asphalt-vacuum unit has been reequipped to the atmospheric-and-vacuum distillation unit (AVD unit).

Atmospheric and vacuum distillation unit (electrical desalting plant (CDU) and atmospheric and vacuum distillation unit, CDU-AVD unit or AVD unit) is designed for primary crude oil refining. Main products of the unit are semi-finished products (see the table A.4.-1. below), which are proceeded to other units of the Refinery for producing of ready-to-use products.

Table A.4.-1. Products of the AVD unit

Product	Type	Share, % mass
Liquefied hydrocarbon gas	semi-finished product	0,42-0,69
Straight-run gasoline	semi-finished product	13-16
Kerosene-gasoil fraction	semi-finished product	30-34,3
Residual asphalt	semi-finished product	25-29
Vacuum gasoil	ready to use product	20-23

The AVD unit includes the following equipment:

1. Unit of the electrical dehydration and desalting of the crude oil (hereafter CDU unit);
2. Block of the preliminary evaporation of gasoline (separation of the hydrocarbon gas and gasoline fraction from the desalinized oil);
3. Atmospheric distillation unit (rectification of the oil in order to receive the distillate fraction);
4. Vacuum distillation unit (vacuum distillation of residual fuel oil with the obtaining of the weighted diesel fraction, vacuum gasoil and residual asphalt);
5. Unit of the gasoline stabilization (obtaining of the stable gasoline fraction and liquefied hydrocarbon gas);
6. Unit of the amine treatment (purification of the hydrocarbon gas and liquefied hydrocarbon gas from hydrogen sulphide);
7. Unit of the alkalinity (purification of the liquefied hydrocarbon gas from mercaptans);
8. Auxiliary unit (junction of the alkali solution, junction of the corrosion inhibitor solution and neutralizer, junction of the demulsifier supply, drainage system, flare system, cooling unit of the pump's front compactions).

The crude oil is refined at the high temperature and pressure, which require significant consumption of heat energy; therefore AVD unit is equipped with furnaces. The parameters of AVD unit's furnaces before project implementation are presented below.

Table A4.-2. Furnaces of the AVD unit before modernization

Furnace	Type	Functions	Actual efficiency
P-2	One-cell radiation-convection three-flow furnace	Heating of the crude oil before the pre-evaporation and heating of the residual fuel oil before vacuum column	66.1%
P-1	Two-cell dual-slope radiation-convection three-flow furnace	Heating of the topped crude oil	41.5%

The furnaces used refinery gas and residual fuel oil as a fuel.

Refinery gas is a mixture of hydrocarbon gases (C_1, C_2, C_3, i-C_4, n-C_4, i-C_5, n-C_5 and H_2). According to the information of the Refinery's laboratory refinery gas of the AVD unit has the following parameters (average values):

- net caloric value – 12 050 kcal/kg;
- gas density (under the standard physical conditions) – 1.947 kg/m^3.

Refinery gas combusted at the AVD unit is delivered from plant's gas supply system and are supplied from three refinery gas flows generated at the visbreaking unit, reforming units and the AVD unit itself.

Within the project boundaries pent-roof furnace P-2 at the vacuum unit was replaced by a new vertical box-type furnace P-102; pent-roof furnace P-1 at the atmospheric unit was replaced be new vertical box-type furnace P-101/1,2. The furnace consists of two sections P-101/1 and P101/2 that have different performance parameters.

Before modernization **After modernization**

Fig. A.4.-3. Furnaces of the AVD unit before (on the left) and after modernization (on the right)

The information about the parameters of new furnaces installed at the AVD unit (main used technical parameters) is presented in table A.4.-3.

Table A.4-3. Furnaces of the AVD unit after modernization

Furnace	Type	Actual efficiency
P -102	radiation-convection, two-flow, slab, box-type, vertical furnace with integral air heater and superheater	79.1%
P-101/1,2: section P-101/1	radiation-convection, two-flow, slab, box-type, vertical furnace with integral air heater and superheater	79.4%
P-101/1,2: section P-101/2	radiation-convection, two-flow, slab, box-type, vertical furnace with integral air heater and superheater	78.2%

Besides the furnaces replacement the following energy saving measures were implemented at the AVD unit within the project boundaries:

1. Modernization activity at the atmospheric part of the AVD unit (atmospheric distillation unit);

Main modernization activity at the atmospheric distillation unit consists in the switching to the single two-columned scheme of the fuel flow and products separation. Simultaneously the scheme of circulating irrigation of the main atmospheric column K-2 has been changed with the purpose of increase of the heat recovery in the heat exchange unit. At the moment AVD unit is functioning by the three streaming scheme.

The existed columns K-1 and K-2 were replaced by the columns K-1 and K-2 and equipped with distillation plates of the company "KOCH GLITSCH SCHWEIZ GmbH".

Internal arrangement of the columns K-1, K-2 was replaced. 14 new valve plates with optimized active section were installed at the column of the preliminary topping K-1. Besides, 29 new plates were installed at the column K-2 in order to increase unit's efficiency via selection of the two side oil fractions (kerosene and diesel).

2. Modernization activity at the vacuum part of the AVD unit (vacuum distillation unit);

The scheme of the main vacuum column K-3 has been changed to the four section model that allowed increasing of heat recovery in the unit of the oil heating. Also in order to maximize utilization of the internal arrangement of the column section #1 was dismantled and two new sections with optimized cuts were settled.

Installation of four new plates has been conducted in the evaporating section of the column with the view of improvement of selection of the gas oil fraction from the tar oil.

3. Heat exchange unit;

One of the most important modernization activity at the AVD unit consists in installation of the new heat exchanger produced by Alfa Laval. In addition a binding scheme of heat exchangers was improved, which altogether with Alfa Laval heat exchanger installation allowed to achieve high temperature of oil in column K-2 (up to 239 °C). Installation of the heat exchanger TPG-800 was implemented at the entrance in CDU unit.

Thus heat exchange scheme was modernized for more effective utilization of heat of residual fuel oil at the column K-2 and residual asphalt at the column K-3.

4. Block of gasoline stabilization;

The construction of the gasoline stabilization unit for straight-run gasoline fraction with nominal productivity of 520 thousand tonnes was implemented within the project. Gasoline stabilization unit was equipped with the stabilization column, reboilers, heat exchangers, pumps, gas separators, column of the monoethanol amine purification, pipelines etc.

5. Modernization activity at the furnaces equipment;

New furnaces P -1/1.2 and P-2 were adjusted to the new operation modes caused by the AVD unit modernization, which included:

- Replacement of the blow fan BDN9u by one with higher capacity;
- Replacement of the six burners GP-1,7D by ones with higher capacity;

- Replacement of the adapter and increasing of the height and diameter of the towel.

6. Auxiliary blocks modernization.

Besides the measures described above the following modernization activity was implemented:
- Modernization of the unit of the amine treatment;
- Replacement of submerged refrigerators by air-type ones;
- Replacement of outdated and worn-out pumping equipment;
- Installation of reflux tanks on blocks of preliminary evaporation and atmospheric part.

As a result of the project realization the specific fuel consumption for primary oil refining decreased from 0.872 GJ/t (average value for 2000-2003) to 0.573 GJ/t (average value for three years after the reconstruction 2008-2010).

Implementation schedule and cost of the project

The date of the beginning of the project investment phase is 17.04.2003, when the contract for purchase of furnace P-102 was signed. The contract on furnace P101/1,2 was signed on 23.09.2003.

The date of the exploitation phase beginning is 25.02.2004, when the furnace P-102 has been commissioned. The date of the beginning of the furnace P-101/1,2 exploitation is 18.03.2005.

The date of investment phase ending is 20.12.2007, when modernisation of the AVD unit was ended and it was commissioned.

The planned date of ending of exploitation phase of the project is 20.12.2027.

In the end of 2007 the AVD unit and its furnaces were already operational. Thus, the start of the crediting period is the 1st of January, 2008.

Total estimated project cost is about UAH 130.223 million (VAT excluded). See also section B.2 for details. The project is financed by the credit resources.

The project uses the state-of-the-art technology, which will result in a significantly better performance than commonly used technologies in the Host country. Technologies used by the AVD reconstruction are not likely to be substituted by other or more efficient technologies within the project period. All the technological parameters of the project equipment meet environment protection normative requirements.

Due to the use of modern technology project requires initial training of the personal. The trainings on technical maintenance of the AVD unit and its furnaces were conducted for all responsible workers operating AVD unit.

A.4.4. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed small-scale project, including why the emission reductions would not occur in the absence of the proposed small-scale project, taking into account national and/or sectoral policies and circumstances:

Anthropogenic emissions of greenhouse gases will be reduced due to decreasing of the organic fuel (refinery gas, residual fuel oil) consumption at the AVD unit of the Odessa refinery. Total amount of greenhouse gases emissions reduction over the first crediting period 2008-2012 is 114 672 tonnes of CO_2 equivalent.

Taking into account prevailing practice and financial barriers described in details in Section B, it is concluded that emission reductions would not occur in the absence of the proposed project.

Only CO_2 emissions concerned with fossil fuel combustions are included in the project boundary and addressed in PDD. CH_4 emissions and NO_x emissions were considered negligibly low and were not taken into consideration. Detailed description of project boundaries is presented in Section B.

A.4.4.1. Estimated amount of emission reductions over the crediting period:

Total reduction of greenhouse gases emissions within the defined project boundaries over the first crediting period 2008-2012 is 114 672 tonnes of CO_2 equivalent. Total reduction of greenhouse gases emissions within the defined project boundaries over the expected second crediting period 2013-2020 is 305 792 tonnes of CO_2 equivalent. The extension of the crediting period beyond 2012 is subject to Host country approval. Overall emissions reduction due to project realisation during the period 2008-2020 is 420 464 tonnes of CO_2 equivalent. Estimates of total as well as annual emissions reduction for the crediting period 2008-2020 are provided in the table below.

	Years
Length of the crediting period	13
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	41 666
2009	43 513
2010	29 493
2011	–
2012	–
Subtotal estimated emission reductions over the period 2008-2012 (tonnes of CO_2 equivalent)	114 672
Annual average of estimated emission reductions over the first commitment period (tonnes of CO_2 equivalent)	22 934
2013	38 224
2014	38 224
2015	38 224
2016	38 224
2017	38 224
2018	38 224
2019	38 224
2020	38 224
Subtotal estimated emission reductions over the period 2013-2020 (tonnes of CO_2 equivalent)	305 792
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	420 464
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	32 343

A.4.5. Confirmation that the proposed small-scale project is not a debundled component of a larger project:

The proposed project is not a debundled component of a larger project. PJSC "LUKOIL-ODESSA REFINERY" is not a project participant to any joint implementation or small-scale joint implementation project with a publicly available determination in accordance with paragraph 34 of the JI guidelines.

The proposed project doesn't meet the requirements defining debundled project in accordance with paragraph 15 of "Provisions for joint implementation small scale projects", Version 3 [4]. Thus the project participants aren't involved in the JI project which apply the same technology/measure and pertains to the same project category, whose determination has been made publicly available within the previous 2 years and has project boundary within 1 km of the proposed project's boundary.

A.5. Project approval by the Parties involved:

The substantiating materials for obtaining the Letter of Endorsement for the JI project have been submitted to the State Environmental Investment Agency of Ukraine. The Letter of Endorsement for the project providing its support for further development of proposed joint implementation project #3410/23/7 has been issued on 13.11.2012.

In accordance with the "Requirements for the Joint Implementation Projects preparation" approved by National Environmental Investment Agency of Ukraine (Order #33 from 25th of June, 2008) to receive a Letter of Approval for the JI project the project proponent should provide to the National Environmental Investment Agency of Ukraine the final determination report of the proposed project along with project design documentation and the copy of Letter of Endorsement.

Therefore the final PDD will be sent along with the final determination report to the State Environmental Investment Agency of Ukraine for the Letter of Approval, which usually is expected within 30 days after PDD submission.

The Letter of Approval from Switzerland was issued by the designated focal point in Switzerland (The Federal Office for the Environment (FOEN)) on 23.11.2012.

[4] http://ji.unfccc.int/Ref/Documents/Provisions_for_JI_SSC_projects.pdf

SECTION B. Baseline

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

The baseline scenario has been established in accordance with Appendix B of the JI Guidelines and in accordance with the Guidance on Criteria for Baseline Setting and Monitoring by the JISC.

The Guidance on Criteria for Baseline Setting and Monitoring established by the JISC states: '*The baseline for a JI project is the scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of GHGs that would occur in the absence of the proposed project.'*

Taking into account guidelines mentioned above project participants established the baseline using JI specific approach by identifying and listing possible alternatives on the basis of conservative assumptions and identifying the most plausible one.

The indicative simplified baseline and monitoring methodology for small-scale CDM project activities "AMS-II.D.: Energy efficiency and fuel switching measures for industrial facilities - Version 12.0 categories"[5] was analysed and some elements were used where appropriate. Namely, the approach for the defining of project boundaries (the physical, geographical site of the industrial production facility, processes or equipment that are affected by the project activity), emission calculations (calculations based on fuel combustion volumes), approach of baseline establishment based on the baseline energy consumption (historical average energy consumption levels) of the equipment and technological processes within the project boundaries was partly applied.

Analysis of alternatives for the project activity

Plausible alternatives for the joint implementation project were examined based on the existing practice analysis, national and sectoral policies and project specific circumstances.

The following two alternative scenarios to the project activity consistent with mandatory laws and regulations were assumed:

- continuation of previously existing practice without implementation of modernization activity at the AVD unit and its furnaces replacement (Alternative 1);
- introduction of modernization activity at the AVD unit and its furnaces replacement without being registered as joint implementation project (Alternative 2).

Alternative 1

Alternative 1 foreseeing continuation of previously existing practice without implementation of modernization activity at the AVD unit and its furnaces replacement corresponds to national and sectoral policies and circumstances, such as national reform initiatives and local fuel availability and thus assumed as a plausible and realistic scenario.

Continuation of the outdated equipment operation is common practice for the Ukrainian refineries as it is described in common practice analysis (see section B2).

Unsatisfactory condition of equipment operated at the AVD unit predermined low efficiency and productivity indicators. Inadequate technological scheme of the primary oil refining has envisaged

[5] http://cdm.unfccc.int/methodologies/DB/U8L8P68DK81OUF5X0KOR212O09NXYC

operation on two independent technological flows entailing a double set of equipment (pumps, heat exchangers, instrumentation, columns equipment etc.). However mentioned defects of the AVD didn't hinder the operation of the unit, evidenced by data of oil refining during some years before modernization activity (6.3 million of the refined oil during 2000-2004).

It should be also mentioned that primary oil refining doesn't affect the expansion of the final product assortment of the Refinery. And thus AVD modernization could not be caused in the absence of project activity by changes in legislation on standards for petroleum products.

Therefore, in the absence of measures foreseen by the proposed project AVD unit would have been operated without requiring any substantial reconstruction activity except for current maintenance. Thus, the continuation of previously existing practice is the most plausible baseline scenario.

Alternative 2

Alternative 2 foresees introduction of modernization activity at the AVD unit and its furnaces replacement without being registered as joint implementation project. This alternative foresees implementation of all measures of the project scenario but without being registered as a joint implementation project and thus without additional revenues from ERUs sale. This alternative is a plausible scenario but it is not the most financially attractive for the project owner as shown in Section B.2 and thus cannot be considered as a baseline scenario.

Therefore, Alternative 1 – continuation of previously existing practice without implementation of modernization activity at the AVD unit and its furnaces replacement – is the most plausible and realistic scenario without execution of joint implementation project and is considered as a baseline scenario.

Emission reductions will be defined based on monitoring data regarding actual organic fuel consumption volumes (refinery gas, residual fuel oil), its net caloric value and oil refining volumes, and thus cannot be earned for decreases in activity levels outside the project activity or due to force majeure.

The basic assumptions of the baseline methodology in the context of the project activity could be summarized as following:

- oil refining volumes are assumed based on the historical and forecasted data from the enterprise; oil refining volumes are conservatively assumed equal both in the baseline and project scenarios;
- specific fuel consumption for primary oil refining was assumed based on historical data on organic fuel (refinery gas, residual fuel oil) consumption and oil refining volumes;
- shares of fuel types (refinery gas, residual fuel oil) in the total fuel consumption by the furnaces of the AVD unit were conservatively assumed equal both in the baseline and project scenarios;
- emission factors for organic fuels combustion (refinery gas, residual fuel oil) were assumed based on values provided by the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 including oxidation factors for different fuel types ;
- net calorific values of the organic fuels (refinery gas, residual fuel oil) were assumed based on the historical and forecasted data from the enterprise and National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine.

Detailed information about the parameters used to estimate baseline scenario greenhouse gases emissions within the project boundaries as well as key factors and data sources are clearly described in the tables below.

Data / Parameter	P_y
Data unit	tonne
Description	Oil refining at the AVD unit in year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Report on consumption of the coal equivalent and natural fuel
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise. Measurement methods and procedures are described in details in Section D.
QA / QC procedures (to be) Applied	QA / QC is assured by regular calibration of measurement equipment in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment. See Section D for details.
Any comment	

Data / Parameter	SFC_{BSL}
Data unit	GJ/tonne
Description	Baseline specific indicator of fuel consumption for oil refining at the AVD unit
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value for the last four years of AVD unit operation before modernization activity (2000-2003) based on the historical data of the enterprise was assumed.
Value of data applied (for ex ante calculations / determinations)	0.872
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. In line with the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12).
QA / QC procedures (to be) Applied	For conservative purposes data for the last 4 years before reconstruction have been used for the calculation of baseline specific indicator of fuel consumption for oil refining, while the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12) recommends using data for 3 years only.
Any comment	

Data / Parameter	$Sh_{RG,y}$
Data unit	%
Description	Share of refinery gas in the total fuel consumption by the furnaces of the AVD unit in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Calculations are based on data of fuel consumption and its net caloric values according to the Report on consumption of the coal equivalent and natural fuel
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise. Measurement and calculations methods and procedures are described in details in Section D.
QA / QC procedures (to be) Applied	QA / QC is assured by regular calibration of measurement equipment of fuel consumption and its net caloric value in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment. See Section D for details.
Any comment	

Data / Parameter	$Sh_{RFO,y}$
Data unit	%
Description	Share of residual fuel oil in the total fuel consumption by the furnaces of the AVD unit in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Calculations based on data of fuel consumption an its net caloric values according to the Report on consumption of the coal equivalent and natural fuel
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise. Measurement and calculations methods and procedures are described in details in Section D.
QA / QC procedures (to be) Applied	QA / QC is assured by regular calibration of measurement equipment of fuel consumption and its net caloric value in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment. See Section D for details.
Any comment	

Data / Parameter	$EF_{CO2, RG, y}$
Data unit	tonne CO_2e/ GJ
Description	Greenhouse gases emission factor for combustion of refinery gas in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine
Value of data applied (for ex ante calculations / determinations)	For ex-ante calculations carbon content factor for ethylene, propylene, butylene, butadiene and other petroleum gases or hydrocarbon gases, except natural gas for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 was used. See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved values and thus assumed as conservative.
QA / QC procedures (to be) Applied	
Any comment	Carbon emission factor for refinery gas (kg of C per GJ) was converted to greenhouse gases emission factor (tonnes of CO_2 per GJ) based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories) by multiplying by 44/12 and dividing on 1000.

Data / Parameter	$EF_{CO2, RFO, y}$
Data unit	tonne CO_2e/ GJ
Description	Greenhouse gases emissions factor for combustion of residual fuel oil in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine
Value of data applied (for ex ante calculations / determinations)	For ex-ante calculations carbon content factor for heavy residual fuel oils for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 was used. See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) Applied	
Any comment	Carbon emission factor for residual fuel oil (kg of C per GJ) was converted to greenhouse gases emission factor (tonnes of CO2 per GJ) based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories) by multiplying by 44/12 and dividing on 1000.

Data / Parameter	**$OXID_{RG,y}$**
Data unit	%
Description	Carbon oxidation factor for combustion of refinery gas in year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the values according to National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 were used. See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) Applied	
Any comment	

Data / Parameter	**$OXID_{RFO,y}$**
Data unit	%
Description	Carbon oxidation factor for combustion of residual fuel oil in year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine.
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the values according to National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 were used. See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) Applied	
Any comment	

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 small-scale project:

In accordance with Article 6 of the Kyoto Protocol a joint implementation project has to provide a reduction in emissions by sources, or an enhancement of net removals by sinks, which is additional to any that would otherwise occur. This supposes that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources of GHGs.

JI specific approach has been used to demonstrate that anthropogenic emissions of greenhouse gases will be reduced below those that would have occurred in the absence of project activity. Financial analysis and common practice analysis were used to demonstrate project additionality.

Realistic and credible alternatives available to the project owner (see Section B.1), that provide outputs comparable with the proposed joint implementation project activity are the following:

- continuation of previously existing practice without implementation of modernization activity at the AVD unit and its furnaces (Alternative 1);
- introduction of modernization activity at the AVD unit and its furnaces replacement without being registered as joint implementation project (Alternative 2).

All alternatives are compliant with national law and regulations.

Financial Analysis

Financial analysis was used to demonstrate that proposed project activity is not the most financially attractive. The benchmark analysis based on IRR indicator was used to perform the analysis. The average interest rate for the loans in national currency as of the January 2003 was used as benchmark.

The following data on the investments schedule were used during the investment analysis. Investments were financed by the credit funds.

Table B.2.-1. Investments cost of the project (VAT excluded) in UAH.

Year	2003	2004	2005	2006	2007	2008	Total
Total investment	5 886 363	18 873 230	17 635 577	21 773 123	65 706 316	348 649	130 223 257

Financial analysis was performed assuming data available for the project owners at the time of making a decision about project realization, and also taking into consideration conservative assumptions about price increase rates.

Provided calculations represent incomes and outlays connected to the project realization (additional fuel savings), and don't include any activity of the Enterprise except primary oil refining at the AVD unit.

Information about the price of the fuel for the Enterprise as for the time of making a decision about project realization as well as information about other key data, which were used in the financial analysis, is presented in Table B 2-2 below. All prices are indicated with VAT excluded.

Table B 2-2. Assumptions used in the financial analysis

Residual fuel oil, UAH/tonne	614.18	Price for the Enterprise as for 2003. Data provided by the Enterprise
IRR benchmark, %	21.4	Average interest rate for the loans in national currency as of 01/2003 (including overdraft)
ERU price, UAH	100	Market data
Assumed inflation rate, %	9.4%	Average inflation rate for the four years period before project implementation (2000-2003) according to the date of the State statistics Committee of Ukraine
Lifespan of equipment, years	20	Defined according to the equipment specification

The results of the financial analysis are the following.

Table B 2-3. Results of the financial analysis

Scenario	IRR, %
Benchmark	21.4
Project scenario	11.7
Project scenario with ERU sales	13.2

The results of the financial analysis demonstrate that the project scenario is not the most financially attractive for the project owners.

Sensitivity analysis was used to demonstrate the robustness of the conclusion about project scenario economic attractiveness. Fluctuations of the following main input parameters were assumed during sensitivity analysis: residual fuel oil price, investment, ERU price. The results of the sensitivity analysis are provided below.

Table B 2-4. Results of the sensitivity analysis

Residual fuel oil price change	**-10%**	**-5%**	**No change**	**5%**	**10%**
Benchmark	21.4				
IRR Project	11.0	11.3	11.7	12.1	12.4
IRR Project with ERU sales	12.5	12.8	13.2	13.6	13.9
Investment change	**-10%**	**-5%**	**No change**	**5%**	**10%**
IRR Project	12.5	12.1	11.7	11.4	11.0
IRR Project with ERU sales	14.2	13.7	13.2	12.8	12.4
ERU price change	**-10%**	**-5%**	**No change**	**5%**	**10%**
IRR Project	11.7	11.7	11.7	11.7	11.7
IRR Project with ERU sales	13.1	13.1	13.2	13.3	13.4

Overall, sensitivity analysis confirms the conclusion of the financial analysis. IRR fluctuations (depending on investment, fuel and ERU prices changes) show the insensibility of projects' attractiveness comparing to the benchmark. Therefore, it is demonstrated that the project scenario is not the most financially attractive for the project owner.

Thus besides the financial barrier the project faced a number of technical barriers and operation risks. As it was stated above, only 6 refineries function in Ukraine. Their equipment and technological schemes are comparatively unique and experience of the modernization hardly could be applied at any other refinery.

Besides the modernization of the AVD unit performed at the Odessa refinery is the only such case in Ukrainian refinery industry. Thus Enterprise faces technological barriers and technological risks of proper equipment operation (decrease of efficiency over time, need of additional technological improvements etc.). The proposed project improves energy efficiency of oil refining processes and the returns on investment depend on the oil refining volume. Thus, lower oil refining volumes will cause less attractive economic performance and using of Kyoto protocol flexible mechanisms allows minimizing this barrier.

Among other barriers that prevent the project realization are unstable oil prices. Odessa Refinery operates by tolling scheme and raw material – oil – is supplied from Russia. Ukraine refinery sector depends heavily on importing Russian crude oil, which covers some three quarters of Ukrainian demand[6]. Such factors as the rise in the excise taxes, transportation costs, quotas introduction and other market changes significantly influence the profitability and feasibility of the development program implementation.

One more important barrier for the project implementation is market conditions consisting of the following:

- oil prices fluctuation caused by the world market conditions, fluctuation of the dollar exchange rate, changes in Russia export custom duties and political situations;
- changes in duties and other import charges by the oil purchase;
- availability of the crude oil for refining connected with transportation aspects;
- changes of the legislation concerning petroleum products standardisation etc.

Common practice analysis

The GHG emissions reduction as a result of modernization of the production facilities of the Odessa Refinery within the project implementation requires significant capital investment and could not be implemented without additional incentives such as, in particular, income from the sale of emission reduction units.

Analysis of current practice demonstrates that the continuation of the exploitation of morally and physically obsolete equipment is a common practice for the oil refining industry.

There are six oil refineries plants in Ukraine. All refineries were constructed decades ago and generally operate with obsolescent equipment at low refining margins and short of European standards for product quality. Main reason of a crisis in the oil-refining sector among others is the absence of modern oil refining capacities for output of products of improved standards [7].

According to the study of the Oleksandr Rasumkov Ukrainian centre of the economic and political researches[8] the following activities were performed at the Ukrainian refineries:

- **Drohobych Refinery** was stopped in 2005 for reconstruction of the primary oil refining units. Modernization activity was delayed in 2008 due to the lack of financial resources.
- **Kremenchuk Refinery's** approved plans of modernization include activity aimed at the adapting the quality of gasoline and diesel fuels to European standards (reduction of the sulphur content in light petroleum and increase of the production of high-octane gasoline). Full-scale reconstruction of the refinery was postponed due to lack of financial resources.
- **Lysychansk Refinery** realized in 2005 modernization of the gasoline isomerisation unit and partial rehabilitation of the regulation system of the AVD unit. Plan of the modernization doesn't

[6] Viachaslau Herasimovich. Ukrainian Oil Refinery Sector Review. Center for Social and Economic Research. http://www.case-ukraine.com.ua/u/publications/e9c7feea5be204cd8cc69fc00904b15f.pdf

[7] Same as above

[8] Oil refining industry of the Ukraine: condition, problems and prospects. Analytical report. – National security and defense magazine – #3 (75). – 2006. – P. 3-35.
http://www.razumkov.org.ua/files/category_journal/NSD75_ukr.pdf

foresee any modernization activity at the AVD unit and are aimed at the release of diesel fuel according to Euro-4 standard.

- **Nadvirna Refinery** requires (according to the conclusion of the disponent of state share of the Enterprise – Ministry of Energy and Coal Industry of Ukraine) modernization of the primary oil refining system amidst other activities. However, since modernization of the basic technological equipment requires significant financial resources, scheduled reconstruction is still at the stage of design and construction works for a durable period of time;
- **Kherson Refinery** stopped operation in 2005 in order to modernise technology unit AVD-2 and thenceforth is not operational. Some modernization activity was performed in 2001-2003 on the purpose of expansion of oil refining products. At the moment the refinery does not function as its' products doesn't comply with the approved standards.

Summing up, continuation of the outdated equipment operation at the Ukrainian refineries is caused by the following reasons:

- modernization of the basic technological equipment of the refineries requires significant financial resources, which are often unavailable;
- modernization measures at the refineries mainly foresee the measures allowing the release of a new type of fuels or improving the quality of existing products to comply with the relevant standards. In case of not compliance with the enforced standards refineries often stop functioning due to lack of resources for reconstruction.

Energy strategy of Ukraine foresees development of the refinery industry through increasing of the depth of oil refining via construction of the new refining units (catalytic cracking, hydrocracking and visbreaking etc). Modernization of the existing facilities of the primary oil refining is not considered in the Energy strategy of Ukraine[9].

Generally the continuation of the outdated equipment operation is a common practice for Ukrainian industry due to lack of financial resources and high cost of credit financing as well as high investment risks in the country. Most of the modernisation projects are being implemented with the additional economic incentives such as low cost international financing or using flexible mechanisms of Kyoto protocol and involving additional investments due to sale of emission reduction units. Namely, there are a number of joint implementation projects, which are being realized in Ukraine at the moment, having been triggered by carbon financing (the baseline scenario is the continuation of the previously existed practice of using outdated equipment) in different sectors of the economy (thermal power stations reconstruction, energy efficiency improvements in sugar industry, energy efficiency improvements in metallurgical industry etc.).

Summing up, it could be concluded that it is common practice for Ukraine to continue exploitation of low efficient and energy intensive equipment.

Thus, based on financial analysis and common practice analysis it could be concluded that the project is additional and greenhouse emission reductions would not have been occurred in the absence of joint implementation activity.

Therefore, the most plausible and realistic scenario without realization of proposed joint implementation project (baseline scenario) is the continuation of previously existing practice without implementation of modernization activity at the AVD unit and its furnaces replacement. The amount of oil refining at the AVD, as well as fuel shares are assumed equal under the baseline and project scenarios. GHG emissions due to AVD operation in the baseline scenario in the period of the modernization activity are not considered by the ERU calculation since they are not included in the crediting period. Project scenario

[9] Energy strategy of Ukraine till 2030
http://eneco.com.ua/data/Ukrainian%20Energy%20Strategy%20up%20to%202030.pdf

foresees implementation of the modernization activity at the AVD unit and replacement of its furnaces (P-2 and P-1).

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

Project boundaries embrace equipment and technological processes of the AVD unit, including fuel consumption (refinery gas, residual fuel oil) for primary oil refining.

Project boundaries include the sources of all significant greenhouse gases emissions that are under control of the project participants and connected with project activity, namely fossil fuels consumption for primary oil refining at the AVD unit.

The project boundaries include AVD unit of the Odessa Refinery and its furnaces (P-101/1,2 and P-102), where the primary oil refining takes place.

Only CO_2 emissions concerned with organic fuel combustions are included in the project boundary and addressed in PDD. CH_4 emissions and NO_x emissions were considered negligibly low and were not taken into consideration.

Table B 3-1. Sources of emissions included in consideration or excluded of it

	Source	Gas	Incl./Excl.	Justification/Explanation
Baseline	Emissions due to organic fuel (refinery gas, residual fuel oil) combustion for primary oil refining at the AVD unit	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
Project	Emissions due to organic fuel (refinery gas, residual fuel oil) combustion for primary oil refining at the AVD unit	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative

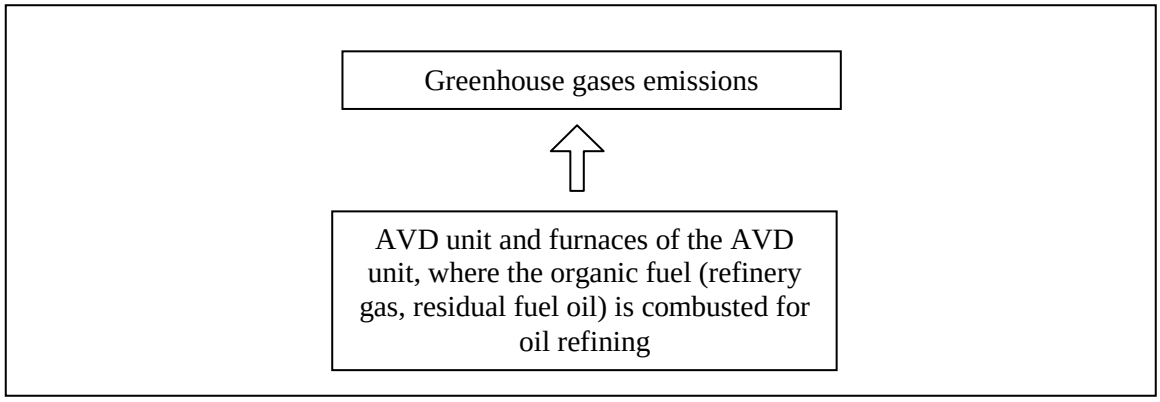

Fig. B-3.1 The scheme of project boundaries under the project and baseline scenarios.

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: 17/07/2012

The information about the organization, which is responsible for setting the baseline and developed project design documentation, is presented below.

LLC 'KT-Energy' (registered in Ukraine)
15 B/22 Biloruska st., Kiev, 04119, Ukraine
Tel/Fax. + (38 044) 493 83 32, info@kt-energy.com.ua

Kyryl Tomlyak, Director
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LLC 'KT-Energy' is not a project participant listed in annex 1.

SECTION C. Duration of the small-scale project / crediting period

C.1. Starting date of the small-scale project:

Project realization start date is the 17th of April, 2003.

C.2. Expected operational lifetime of the small-scale project:

Expected operational lifetime of the project is 20 years (or 240 months).

C.3. Length of the crediting period:

According to Glossary of Joint Implementation Terms ('Glossary of Joint Implementation Terms', Version 3), approved at 22nd meeting of Joint Implementation Supervisory Committee, crediting period is the period for which reductions in anthropogenic emissions by sources or enhancements of anthropogenic removals by sinks may be determined by an Accredited independent entity. Projects starting as of 2000 may be eligible as JI projects if they meet the requirements of the JI guidelines, but ERUs shall only be issued for a crediting period starting after the beginning of 2008. The project participants shall choose the starting date of the crediting period to be on or after the date the first emission reductions are generated by the JI project and the crediting period shall not extend beyond the operational lifetime of the project.

Start of the crediting period for proposed project activity is 1st of January, 2008.

End of the first crediting period is December 31st, 2012.

Thus, the length of the first commitment period is 5 years (60 months).

The start date of the second commitment period is expected to be January 1st, 2013 and the end date of the second commitment period is expected to be December 31st, 2020. The length of the second commitment period is expected to be 8 years or 96 months. The second commitment period does not extend beyond the operational lifetime of the project and is a subject to the Host Party approval. The length of the expected second commitment period could be changed based on adopted international or national regulations. The estimates of emission reductions are presented separately for the first and second commitment periods in section E below.

Thus, the length of the crediting period is 13 years (156 months).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

JI specific approach was chosen for monitoring of greenhouse emission reductions in accordance with paragraph 9 (a) of the 'Guidance on criteria for baseline setting and monitoring'. Detailed theoretical description, assumptions, formulae, data sources and key factors used in the monitoring plan is described below.

Monitoring plan ensures the collection and archiving of all relevant data necessary for measuring anthropogenic emissions and calculation of GHGs emission reductions occurring within the project boundary during the crediting period. Monitoring plan provides also quality assurance and control procedures for the monitoring process and procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed JI project.

Monitoring plan is established in accordance with Host Party regulations, namely in accordance with Decree of Cabinet of Ministers of Ukraine #206 dated 22.02.2006 'On Approval of the Procedure of Drafting, Review, Approval and Implementation of Projects Aimed at Reduction of Anthropogenic Emissions of Greenhouse Gases' and "Requirements for the Joint Implementation Projects preparation" approved by National Environmental Investment Agency of Ukraine (Order #33 from 25th of June, 2008).

The monitoring plan will serve to trace Project Emissions, Baseline Emissions and to calculate Emission Reductions in accordance with the gathered data fixed by direct measurement of specific related parameters through the application of technical devices and calculations.

Project owner has developed and enforced the system of monitoring of parameters used for calculation of GHG emission reductions at the Enterprise, which defines the procedure of gathering and storing of necessary data and responsibility and is integrated in the correspondent applied standard of the Enterprise[10,11].

Data on oil refining and fuel consumption will be gathered and submitted to the monthly monitoring reports by the AVD unit accounting group based on the data from the relevant reports (production and technical report on raw material processing) and automatic control systems. Data on fuel's net caloric value will be obtained from the Central Plant's Laboratory and National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine.

Data on oil refining and fuel consumption is being collected every three hours by the accounting operator of the AVD unit and documented in the Journal (regime sheet). Regime sheets are archived for three years at the plant.

Production information concerning oil refining and fuel consumption is analysed by Department of the expenditure's planning and production economy according to the following reporting forms:

- "Production and technical report on the processing of raw materials", including the information of the oil refining and fuel consumption, is prepared by the specialists of the AVD unit and Production and Dispatch Department on the daily and monthly basis.
- "Balance of the refinery gas" is prepared by the Chief power engineering specialist department.
- "Cumulative sheet on the movement of the liquid fuels" including data on residual fuel oil combustion is prepared by the Chief power engineering specialist department.

[10] Standard of the Enterprise: Management of the energy sources. СТП ИСМ-14-2012

[11] Standard of the Enterprise: Technical and economic Planning. СТП СМК-7.1-28-2012

Central plant's laboratory two times per month determines caloric value of refinery gas and provides data in the form of "Reference on definition of the density, calorific value and component composition of the refinery gases" to the Chief power engineering specialist department and other technical departments.

Net caloric value of the refinery gas and residual fuel oil is defined based on data of the chromatographic system and calorimeter respectively, according to the procedures approved by the State standard "GOST 21261-91 – Oil refining products. Method of the determination of the higher and calculation of the lower caloric value". Carbon content of the refinery gas is recalculated according to the approved State standard "GOST 10679-76 – Liquefied hydrocarbon gases. Method of the determination of the hydrocarbon composition".

Based on data of fuel consumption and its caloric value the Chief power engineering specialist department prepares on monthly, quarterly and yearly basis the "Report on consumption of the coal equivalent and natural fuel" that is saved in the department for 10 years.

All information on fuel consumption, oil refining and fuels net caloric value is being gathered and fixed in the electronic accounting system of the AVD unit, integrated in to the plants technological processes control system – automatic management system (AMS) introduced at the enterprise in 2003. Automatic management system serves as well as a reserve data storage system. Interactive system of the technological processes management (IRS system) functions at the refinery since 2007. It optimises production processes including fuel consumption based on data archived from AMS.

Based on the collected data the annual monitoring reports on actual GHG emission reductions due to implementation of JI project will be prepared. The monitoring reports must be delivered by the contractual party to an accrediting independent entity (AIE) at regular intervals. This entity examines the reports. Monitoring data will be kept for at least 2 years after the end of the last transfer of ERUs.

Detailed information relating to the collection and archiving of all relevant data necessary for estimating or measuring project emissions, determining baseline emissions, and assessing leakage effects provided below.

Formulae used to calculate Emission reductions

Emission reductions for the project are estimated as the difference between baseline and project emissions:

$$\boldsymbol{ER_y = BE_y - PE_y} \quad \textbf{(1.0)}$$

Formulae used to calculate Project emissions

Project greenhouse gases emissions are connected with organic fuel consumption for primary oil refining at the AVD unit.

$$PE_y = \sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y} \times OXID_{i,y}) \quad (2.0)$$

where,

$\boldsymbol{PE_y}$ – project greenhouse gases emissions in year *y* due to organic fuel combustion at the AVD unit, tonne CO_2e.

$FC_{i,y}$ – amount of the organic fuel of the type *i* (refinery gas[12], residual fuel oil) that was combusted during year *y* in the furnaces of the AVD unit, tonnes, and namely:

$FC_{RG,y}$ – amount of refinery gas that was combusted during year *y* in the furnaces of the AVD unit, tonnes.

$FC_{RFO,y}$ – amount of residual fuel oil that was combusted during year *y* in the furnaces of the AVD unit, tonnes.

$NCV_{i,y}$ – net caloric value of the fuel of the type *i* (refinery gas[13], residual fuel oil) that was combusted during year *y* in the furnaces of the AVD unit, GJ/tonne, and namely:

$NCV_{RG,y}$ – net caloric value of refinery gas combusted during year *y* in the furnaces of the AVD unit, GJ/ tonne.

$NCV_{RFO,y}$ – net caloric value of residual fuel oil combusted during year *y* in the furnaces of the AVD unit, GJ/ tonne.

$EF_{CO2,i,y}$ – greenhouse gases emission factors for combustion of fuel type *i* (refinery gas, residual fuel oil), that was combusted in the furnaces of the AVD unit in the year *y*, tonnes CO_2e/ GJ. The following emission factors were used:

$EF_{CO2,RG,y}$ – greenhouse gases emission factor for refinery gas combustion in year *y*, tonnes CO_2e/ GJ.

$EF_{CO2,RFO,y}$ – greenhouse gases emission factor for residual fuel oil combustion in year *y*, tonnes CO_2e/ GJ.

$OXID_{i,y}$ – carbon oxidation factor for combustion of fuel type *i* (refinery gas, residual fuel oil) in year *y*, namely:

$OXID_{RG,y}$ – carbon oxidation factor for combustion of refinery gas in year *y*.

$OXID_{RFO,y}$ – carbon oxidation factor for combustion of residual fuel oil in year *y*.

Formulae used to calculate Baseline scenario emissions

Baseline greenhouse gases emissions are connected with organic fuel consumption for primary oil refining at the AVD unit.

$$BE_y = SFC_{BSL} \times P_y \times \sum_i \left(Sh_{i,y} \times EF_{CO2,i,y} \times OXID_{i,y}\right) \quad (3.0)$$

where,

BE_y – baseline greenhouse gases emissions in year *y* due to organic fuel combustion at the AVD unit, tonnes CO_2e.

SFC_{BSL} – baseline specific indicator of fuel consumption for oil refining at the AVD unit, GJ/tonne. The parameter was estimated ex-ante according to the formula below based on the data of the fuel consumption and oil refining during four years before the implementation of the modernization measures at AVD unit.

P_y – oil refining at the AVD unit in year *y*, tonnes. Oil refining volumes are considered to be equal in project and baseline scenarios and will be monitored during the crediting period to calculate emission reduction units.

$Sh_{i,y}$ – share of fuel type *i* (refinery gas, residual fuel oil) in the total fuel consumption by the furnaces of the AVD unit in the year *y*. Shares of fuel are considered equal in the project and baseline scenarios and are to be monitored during the crediting period to calculate emission reduction units. Activities

[12] The data on consumption of refinery gas in the AVD furnaces at the Odessa Refinery is being reported in tonnes according to the form "Balance of the refinery gas" approved by the Standards of the Enterprise Energy resources management and doesn't contradict to the units of measurement indicated in the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010.

[13] The data on net caloric value of refinery gas is being reported in tonnes according to the form "Reference on definition of the density, calorific value and component composition of the refinery gases" approved by the Standards of the Enterprise Energy resources management and doesn't contradict to the units of measurement indicated in the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010.

concerning AVD unit modernization do not affect the ratio of different fuels combustion. Applied shares of the fuel:

Sh **$_{RG,y}$** – share of refinery gas in the total fuel consumption by the furnaces of the AVD unit in the year *y*.

Sh **$_{RFO,y}$** – share of residual fuel oil in the total fuel consumption by the furnaces of the AVD unit in the year *y*.

$EF_{CO2,i,y}$ – greenhouse gases emission factors for combustion of fuel type *i* (refinery gas, residual fuel oil), that was combusted in the furnaces of the AVD unit in the year *y*, tonnes CO_2e/ GJ. The following emission factors were used:

$EF_{CO2,RG,y}$ – greenhouse gases emission factor for refinery gas combustion in year *y*, tonnes CO_2e/ GJ.

$EF_{CO2,RFO,y}$ – greenhouse gases emission factor for residual fuel oil combustion in year *y*, tonnes CO_2e/ GJ.

$OXID_{i,y}$ – carbon oxidation factor for combustion of fuel type *i* (refinery gas, residual fuel oil) in year *y*, namely:

$OXID_{RG,y}$ – carbon oxidation factor for combustion of refinery gas in year *y*.

$OXID_{RFO,y}$ – carbon oxidation factor for combustion of residual fuel oil in year *y*.

Baseline specific indicator of fuel consumption for oil refining at the AVD unit was estimated on the basis of the actual data on the combustion of all types of fuel in the furnaces of the AVD unit during 4 years (2000-2003) before the project implementation. Baseline specific indicator of fuel consumption for oil refining was estimated according to the following formula:

$$SFC_{BSL} = \left(\sum_{y} \frac{(FC_{RG,y} \times NCV_{RG,y} + FC_{RFO,y} \times NCV_{RFO,y})}{P_y}\right)/4 \qquad (4.0)$$

where:

$FC_{RG,y}$ $FC_{RFO,y}$ – amount of the organic fuel (refinery gas, residual fuel oil, respectively), that was combusted during year *y* in the furnaces of the AVD unit, tonnes.

P_y – oil refined at the AVD unit during year *y*, tonnes.

$NCV_{RG,y}$ $NCV_{RFO,y}$ – net caloric value of the fuel – refinery gas, residual fuel oil, respectively – that was combusted during year *y* in the furnaces of the AVD unit, GJ/tonne.

Table D 1-1. Data to be collected in order to monitor baseline and project emissions

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)
$FC_{RG,y}$ Refinery gas that was combusted during year *y* in the furnaces of the AVD unit	Diaphragm	tonnes	m	Daily	100%	Electronic / Paper
$FC_{RFO,y}$ Residual fuel oil that was combusted during year *y* in the furnaces of the AVD unit	Basis weight gauges	tonnes	m	Daily	100%	Electronic / Paper
$NCV_{RG,y}$ Net caloric value of refinery gas combusted during year *y* in the furnaces of the	Chromatographic system	GJ / tonne	m	Once per two weeks	100%	Electronic / Paper

AVD unit						
$\mathbf{NCV}_{RFO,y}$ Net caloric value of residual fuel oil combusted during year *y* in the furnaces of the AVD unit	Calorimeter	GJ / tonne	m	On request	100%	Electronic / Paper
$EF_{CO2,RG,y}$ Greenhouse gases emission factor for combustion of refinery gas in the year *y*	Data on chemical composition are defined by the chromatographic system	tonnes CO_2/GJ	c	Once per two weeks	100%	Electronic
$EF_{CO2,RFO,y}$ Greenhouse gases emission factor for combustion of residual fuel oil in the year *y*	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine	tonnes CO_2/GJ	e	Yearly	100%	Electronic
$OXID_{RG,y}$ Carbon oxidation factor for combustion of refinery gas in year *y*	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine	fraction of unit	e	Yearly	100%	Electronic
$OXID_{RFO,y}$ Carbon oxidation factor for combustion of residual fuel oil in year *y*	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine	fraction of unit	e	Yearly	100%	Electronic
P_y Oil refining at the AVD unit in year *y*	Diaphragm	tonne	m	Daily	100%	Electronic / Paper
$Sh_{RG,y}$ Share of refinery gas in the total fuel consumption by the furnaces of the AVD unit in the year *y*	Data on fuel consumption and its NCV	%	c	Monthly	100%	Electronic
$Sh_{RFO,y}$ Share of residual fuel oil in the total fuel consumption by the furnaces of the AVD unit in the year *y*	Data on fuel consumption and its NCV	%	c	Monthly	100%	Electronic

D.2. Data to be monitored:

Data to be monitored and parameters used in the calculations are described in the tables below.

Data / Parameter	$P_{,y}$
Data unit	tonne
Description	Oil refining at the AVD unit in year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Report on consumption of the coal equivalent and natural fuel.
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular calibration of measurement equipment in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment.
Any comment	

Data / Parameter	$Sh_{RG,y}$
Data unit	%
Description	Share of refinery gas in the total fuel consumption by the furnaces of the AVD unit in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Calculations based on data of fuel consumption an its net caloric values according to the Report on consumption of the coal equivalent and natural fuel
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular calibration of measurement equipment in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment.
Any comment	

Data / Parameter	$Sh_{RFO,y}$
Data unit	%
Description	Share of residual fuel oil in the total fuel consumption by the furnaces of the AVD unit in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Calculations based on data of fuel consumption an its net caloric

	values according to the Report on consumption of the coal equivalent and natural fuel
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular calibration of measurement equipment of fuel consumption and its net caloric value in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment.
Any comment	

Data / Parameter	$EF_{CO2, RG, y}$
Data unit	tonne CO_2e/ GJ
Description	Greenhouse gases emission factor for combustion of refinery gas in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Calculated based on the data on chemical composition defined by the chromatographic system
Value of data applied (for ex ante calculations / determinations)	For ex-ante calculations carbon content factor for ethylene, propylene, butylene, butadiene and other petroleum gases or hydrocarbon gases, except natural gas for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 was used. See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	Carbon emission factor for ethylene, propylene, butylene, butadiene and other petroleum gases or hydrocarbon gases, except natural gas for refinery industry (refinery gas) (in kg of C per GJ) was converted to greenhouse gases emission factor (in tonnes of CO_2 per GJ) based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories) by multiplying by 44/12 and dividing on 1000.

Data / Parameter	$EF_{CO2, RFO, y}$
Data unit	tonne CO_2e/ GJ
Description	Greenhouse gases emission factor for combustion of residual fuel oil in the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period

Source of data (to be) used	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine
Value of data applied (for ex ante calculations / determinations)	For ex-ante calculations carbon content factor for heavy residual fuel oils for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 was used. See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	Carbon emission factor for residual fuel oil (in kg of C per GJ) was converted to greenhouse gases emission factor (in tonnes of CO_2 per GJ) based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories) by multiplying by 44/12 and dividing on 1000.

Data / Parameter	**$OXID_{RG,y}$**
Data unit	%
Description	Carbon oxidation factor for combustion of refinery gas in year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine.
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	**$OXID_{RFO,y}$**
Data unit	%
Description	Carbon oxidation factor for combustion of residual fuel oil in year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine.
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and	The choice of data is based on the standardised and approved value and thus assumed as conservative.

procedures (to be) applied	
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$FC_{RG,y}$
Data unit	tonnes
Description	Amount of refinery gas that was combusted during year *y* in the furnaces of the AVD unit
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Report on consumption of the coal equivalent and natural fuel prepared based on diaphragm data.
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	Refinery gas consumption metering equipment will be calibrated regularly in accordance with producer requirements and national regulations.
Any comment	

Data / Parameter	$FC_{RFO,y}$
Data unit	tonnes
Description	Amount of residual fuel oil that was combusted during year *y* in the furnaces of the AVD unit
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Report on consumption of the coal equivalent and natural fuel prepared based on data of basis weight gauges.
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	Residual fuel oil metering equipment will be calibrated regularly in accordance with producer requirements and national regulations.
Any comment	

Data / Parameter	$NCV_{RG,y}$
Data unit	GJ/tonne
Description	Net caloric value of refinery gas combusted during year *y* in the furnaces of the AVD unit
Time of	Parameter is monitored during the crediting period

determination / monitoring	
Source of data (to be) used	Data provided by the Central Plant's Laboratory in the Form of Reference on definition of the density, calorific value and component composition of the refinery gases.
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. Data will obtained from the measurements at accredited laboratory of the Odessa refinery. The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular calibration of measurement equipment in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment.
Any comment	

Data / Parameter	**$NCV_{RFO,y}$**
Data unit	GJ/tonne
Description	Net caloric value of residual fuel oil combusted during year *y* in the furnaces of the AVD unit
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Data provided by the Central Plant's Laboratory and aggregated in Report on consumption of the coal equivalent and natural fuel.
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. Data will be obtained from the measurements at accredited laboratory of the Odessa refinery. The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular calibration of measurement equipment in accordance with the recommendations of manufacturer and high accuracy level of measurement equipment.
Any comment	

There are also established procedures of monitoring, collecting, and archiving of data on the environmental impacts of the project, namely emissions of pollutants into the atmospheric air. The control on the compliance with the maximum permissible emission of the polluting substances into the atmospheric air is carried out by the certified laboratory of environmental protection.

Besides, the enterprise files reports by the following official statistical forms:

- 2-tp (air) *Data on protection of atmospheric air*, which contains information on amounts of trapped and neutralized atmospheric pollutants, itemized emissions of specific pollutants, number of emission sources, measures on reduction of emissions into the atmosphere, emissions from particular groups of pollution sources;

- 2-tp (water resources) *Data on water use*, which presents information on consumption of water from natural sources, discharge of waste water, and content of pollutants in it, capacity of treatment facilities, etc.;

· 2-tp (waste) *Data on formation, use, neutralization, transportation and placement of industrial and household waste*, which presents the annual balance of waste flow, by waste types and hazard classes.

Data are monitored with compliance to Law of Ukraine "On metrology and metrological activities'.

D.3. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data	Uncertainty level of data (high / medium / low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P_y	*low*	Devices used: diaphragm FQIR 3501. Accuracy class index – 0.5. Metering equipment is calibrated once per year.
$FC_{RG,y}$	*low*	Devices used: diaphragm FQIR4313,4303,304. Accuracy class index – 0.5. Metering equipment is calibrated once per year.
$FC_{RFO,y}$	*low*	Devices used: basis weight gauges FQIR 4321/1,4321/2. Accuracy class index – 0.15 of mass. Metering equipment is calibrated once per 3 years.
$NCV_{RG,y}$	*low*	Net caloric value is defined at the central plant's laboratory accredited according to the current law. Refinery gas net caloric value is determined based on the component composition defined by the chromatographic system CVET 800 according to the standards GOST 10679 and GOST 14920. Metering equipment is calibrated once per year.
$NCV_{RFO,y}$	*low*	Net caloric value is defined at the central plant's laboratory accredited according to the current law. Calorimeter IKA C 2000 operating in the isotherm mode measures residual fuel oil high caloric value, base on which low net caloric value is calculated according to the Standard GOST 21261-91, 10679-79 and GOST 22667-82.
$EF_{CO2,RG}$	*low*	Refinery gas emission factor is to be calculated based on the data on refinery gas carbon content defined by the chromatographic system CVET 800 according to the standards GOST 10679 and GOST 14920. Metering equipment is calibrated once per year.

All measurement equipment is calibrated according to national regulations. Besides, quality control and quality assurance procedures for data monitored are assured by the general quality management system (ISO 9001-2008 valid from 30.04.2002) enforced at the enterprise and certified by the independent certification entity. Environmental management system ISO 14001:2004 is also introduced at the Enterprise from 02.09.2010.

D.4. Brief description of the operational and management structure that will be applied in implementing the monitoring plan:

All necessary data will be collected by existing departments of PJSC "LUKOIL-ODESSA REFINERY" and the reports will be prepared by the Head of CDU-AVD unit according to the monitoring system

described in Section D.1. Collection of information required for calculations of reductions of greenhouse gases emissions as a result of project implementation will be performed in accordance with procedures established at the enterprise. Data will be stored in operational journals of CDU-AVD unit, and in the relevant electronic databases. The official responsible for monitoring of greenhouse gases emission reductions is the Head of ecology and environmental monitoring department of PJSC "LUKOIL-ODESSA REFINERY". Calculations of greenhouse emission reductions will be prepared by LLC 'KT-Energy', Kyiv.

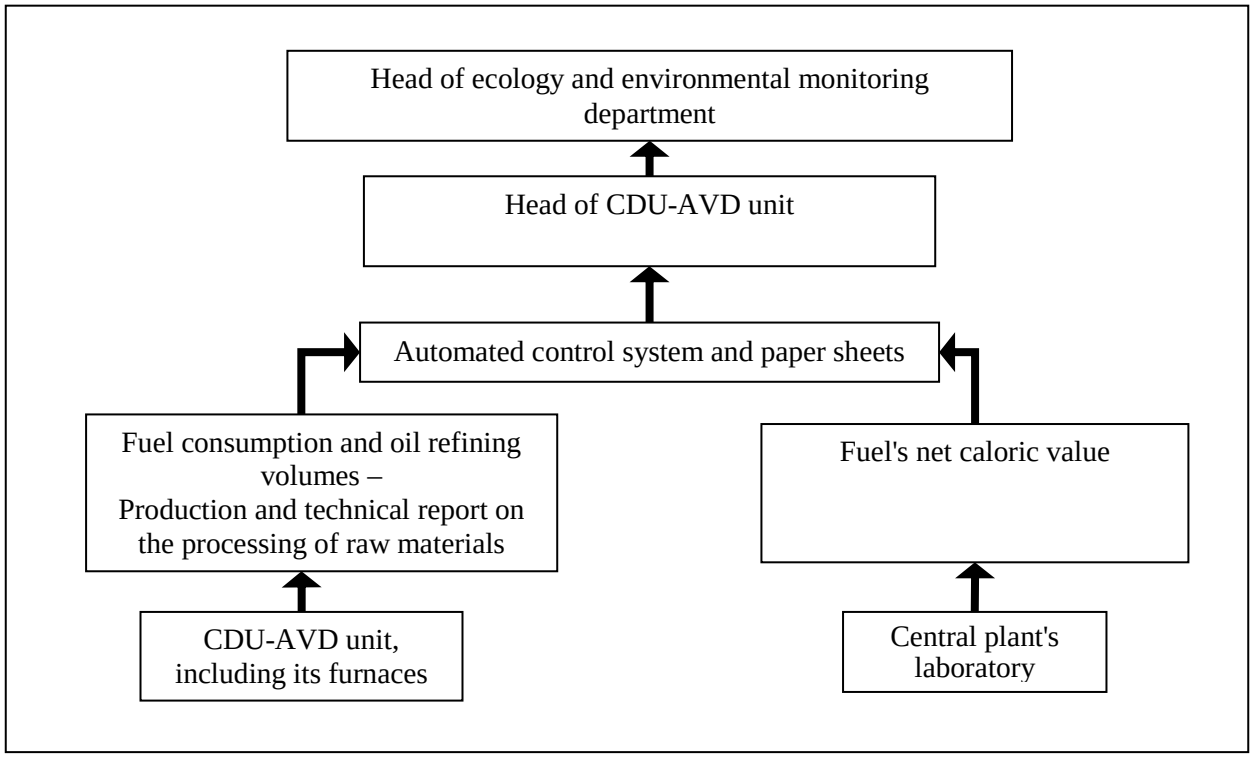

Fig. D-4.1 The scheme of established monitoring system.

All obtained data is being store in paper form for three years and in electronic control system for at least 2 years after the end of the crediting period or the last transfer of ERUs.

D.5. Name of person(s)/entity(ies) establishing the monitoring plan:

Date: 16/07/2012

The information about the organisation, which has established the monitoring plan and developed project design documentation, is presented below.

LLC 'KT-Energy' (registered in Ukraine)
15 B/22 Biloruska st., Kiev, 04119, Ukraine
Tel/Fax. + (38 044) 493 83 32, info@kt-energy.com.ua

Kyryl Tomlyak, Director
ktomlyak@kt-energy.com.ua
+38 (044) 493 83 32

LLC 'KT-Energy' is not a project participant listed in annex 1.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions and formulae used in the estimation:

The following assumptions were considered during calculation of project emissions:

- shares of fuel consumption, as well as fuel's net caloric value were considered equal in project and baseline scenarios;
- oil refining volumes were considered equal both in project and baseline scenarios;
- for the period of 2008-2010 the actual production data were used; for the years 2011-2012 production volumes were considered to be equal zero, as in 2011 Odessa Refinery did not perform oil refining due to objective reasons related to market conditions and also the oil refining isn't planned for 2012; organic fuel combustion with respect to the AVD unit, baseline greenhouse gases emissions as well as project greenhouse gases emissions for the years 2011-2012 were also set to zero; for the years 2013-2020 production volumes were calculated as an average value for the years 2008-2010.

Project greenhouse gases emissions are connected with organic fuel consumption for primary oil refining at the AVD unit and calculated according to the following formulae:

$$PE_y = \sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y} \times OXID_{i,y}) \quad (5.0)$$

where,

PE_y – project greenhouse gases emissions in year *y* due to organic fuel combustion at the AVD unit, tonnes CO_2e;

$FC_{i,y}$ – amount of the organic fuel of the type *i* (refinery gas, residual fuel oil) that was combusted during year *y* in the furnaces of the AVD unit, tonnes, and namely:

$FC_{RG,y}$ – amount of refinery gas that was combusted during year *y* in the furnaces of the AVD unit, tonnes;

$FC_{RFO,y}$ – amount of residual fuel oil that was combusted during year *y* in the furnaces of the AVD unit, tonnes;

$NCV_{i,y}$ – net caloric value of the fuel of the type *i* (refinery gas, residual fuel oil) that was combusted during year *y* in the furnaces of the AVD unit, GJ/tonne, and namely:

$NCV_{RG,y}$ – net caloric value of refinery gas combusted during year *y* in the furnaces of the AVD unit, GJ/tonne;

$NCV_{RFO,y}$ – net caloric value of residual fuel oil combusted during year *y* in the furnaces of the AVD unit, GJ/tonne;

$EF_{CO2,i,y}$ – greenhouse gases emission factors for combustion of fuel type *i* (refinery gas, residual fuel oil), that was combusted in the furnaces of the AVD unit in the year *y*, tonnes CO_2e/ GJ. The following emission factors were used:

$EF_{CO2,RG,y}$ – greenhouse gases emission factor for refinery gas combustion in year *y*, tonnes CO_2e/ GJ. The calculations were done using the carbon content factor for ethylene, propylene, butylene, butadiene and other petroleum gases or hydrocarbon gases, except natural gas (refinery gas) for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.29. on p. 458 for 2008, table П 2.35. on p. 464 for 2009 and table П 2.41. on p. 470 for 2010), that was converted to greenhouse gases emission factor based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

$EF_{CO2,RG,2008}$ = 0.0631 tonnes CO_2 / GJ;
$EF_{CO2,RG,2009}$ = 0.0631 tonnes CO_2 / GJ;
$EF_{CO2,RG,2010}$ = 0.0631 tonnes CO_2 / GJ.

$EF_{CO2,RFO,y}$ – greenhouse gases emission factor for residual fuel oil combustion in year *y*, tonnes CO_2e/ GJ. The calculations were done using the carbon content factor for heavy residual fuel oils

for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.29. on p. 458 for 2008, table П 2.35. on p. 464 for 2009 and table П 2.41. on p. 470 for 2010), that was converted to greenhouse gases emission factor based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

$EF_{CO2,RFO,2008}$ = 0.0774 tonnes CO_2 / GJ;
$EF_{CO2,RFO,2009}$ = 0.0774 tonnes CO_2 / GJ;
$EF_{CO2,RFO,2010}$ = 0.0774 tonnes CO_2 / GJ.

$OXID_{i,y}$ – carbon oxidation factor for combustion of fuel type *i* (refinery gas, residual fuel oil) in year *y*. The following oxidation factors were used:

$OXID_{RG,y}$ – carbon oxidation factor for combustion of refinery gas in year *y*.

The calculations were done using the carbon oxidation factor for the combustion of ethylene, propylene, butylene, butadiene and other petroleum gases or hydrocarbon gases, except natural gas (hereinafter – refinery gas) for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.30. on p. 459 for 2008, table П 2.36. on p. 465 for 2009 and table П 2.42. on p. 471 for 2010).

$OXID_{RG,2008}$ – 0.995;
$OXID_{RG,2009}$ – 0.995;
$OXID_{RG,2010}$ – 0.995.

$OXID_{RFO,y}$ – carbon oxidation factor for combustion of residual fuel oil in year *y*.

The calculations were done using the carbon oxidation factor for the combustion of heavy residual fuel oils for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.30. on p. 459 for 2008, table П 2.36. on p. 465 for 2009 and table П 2.42. on p. 471 for 2010).

$OXID_{RFO,2008}$ – 0.99;
$OXID_{RFO,2009}$ – 0.99;
$OXID_{RFO,2010}$ – 0.99.

Project emissions have been estimated on the basis of data that is presented in the table below.

Table E.1.-1. Data used for estimation of project emissions

Year	Refinery gas combustion, tonnes	Residual fuel oil combustion, tonnes	Refinery gas NCV, GJ/tonne	Residual fuel oil NCV, GJ/tonne
2008	12 304	15 202	46.31	40.45
2009	14 224	12 632	45.43	40.45
2010	11 010	8 088	45.72	40.45
2011	–	–	–	–
2012	–	–	–	–
2013	12 513	11 974	45.82	40.45
2014	12 513	11 974	45.82	40.45
2015	12 513	11 974	45.82	40.45
2016	12 513	11 974	45.82	40.45
2017	12 513	11 974	45.82	40.45
2018	12 513	11 974	45.82	40.45
2019	12 513	11 974	45.82	40.45
2020	12 513	11 974	45.82	40.45

Annual data (on fuel consumption and its NCV) for the years 2008-2010 used in the table above have been provided by the enterprise according to the technical reports. The same parameters for the years 2013-2020 were considered equal to the average of 2008-2010.

Estimated project emissions within the project boundary for the period 2008-2020 are presented in table below.

Table E.1.-2. Project emissions

Year	Project emissions due to refinery gas combustion, tonnes CO_{2e}	Project emissions due to residual fuel oil combustion, tonnes CO_{2e}	Total project emissions, tonnes CO_{2e}
2008	35 754	47 095	82 849
2009	40 549	39 133	79 682
2010	31 589	25 056	56 645
2011	–	–	–
2012	–	–	–
2013	35 964	37 095	73 059
2014	35 964	37 095	73 059
2015	35 964	37 095	73 059
2016	35 964	37 095	73 059
2017	35 964	37 095	73 059
2018	35 964	37 095	73 059
2019	35 964	37 095	73 059
2020	35 964	37 095	73 059

Thus, total project emissions during the period 2008-2012 will be 219 176 tonnes CO_{2e}. Total project emissions during the period 2013-2020 will be 584 472 tonnes CO_{2e}.

E.2. Estimated leakage and formulae used in the estimation, if applicable:

No leakage is expected during the project activity.

E.3. Sum of E.1. and E.2.:

Due to the fact that no leakage is expected during the project activity the sum of E.1 and E.2 equals E.1.

E.4. Estimated baseline emissions and formulae used in the estimation:

Baseline greenhouse gases emissions are connected with organic fuel consumption for primary oil refining at the AVD unit:

$$BE_y = SFC_{BSL} \times P_y \times \sum_i \left(Sh_{i,y} \times EF_{CO2,i,y} \times OXID_{i,y}\right) \quad (6.0)$$

where,

$\boldsymbol{BE_y}$ – baseline greenhouse gases emissions in year *y* due to organic fuel combustion at the AVD unit, tonnes CO_2e.

$\boldsymbol{SFC_{BSL}}$ – baseline specific indicator of fuel consumption for oil refining at the AVD unit, GJ/tonne. The parameter was estimated ex-ante according to the formula below based on the data of the fuel consumption and oil refining during four years before the implementation of the modernization measures at AVD unit.

P_y – oil refining at the AVD unit in year *y*, tonnes. Oil refining volumes are considered to be equal in project and baseline scenarios and will be monitored during the crediting period to calculate emission reduction units.

$Sh_{i,y}$ – share of fuel type *i* (refinery gas, residual fuel oil) in the total fuel consumption by the furnaces of the AVD unit in the year *y*. Shares of fuel are considered equal in the project and baseline scenarios and are to be monitored during the crediting period to calculate emission reduction units. Activities concerning AVD unit modernization do not affect the ratio of different fuels combustion. Applied shares of the fuel:

$Sh_{RG,y}$ – share of refinery gas in the total fuel consumption by the furnaces of the AVD unit in the year *y*.

$Sh_{RFO,y}$ – share of residual fuel oil in the total fuel consumption by the furnaces of the AVD unit in the year *y*.

$EF_{CO2,i,y}$ – greenhouse gases emission factors for combustion of fuel type *i* (refinery gas, residual fuel oil), that was combusted in the furnaces of the AVD unit in the year *y*, tonnes CO_2e/ GJ. The following emission factors were used:

$EF_{CO2,RG,y}$ – greenhouse gases emission factor for refinery gas combustion in year *y*, tonnes CO_2e/ GJ. The calculations were done using the carbon content factor for ethylene, propylene, butylene, butadiene and other petroleum gases or hydrocarbon gases, except natural gas (refinery gas) for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.29. on p. 458 for 2008, table П 2.35. on p. 464 for 2009 and table П 2.41. on p. 470 for 2010), that was converted to greenhouse gases emission factor based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

$EF_{CO2,RG,2008}$ = 0.0631 tonnes CO_2 / GJ;
$EF_{CO2,RG,2009}$ = 0.0631 tonnes CO_2 / GJ;
$EF_{CO2,RG,2010}$ = 0.0631 tonnes CO_2 / GJ.

$EF_{CO2,RFO,y}$ – greenhouse gases emission factor for residual fuel oil combustion in year *y*, tonnes CO_2e/ GJ. The calculations were done using the carbon content factor for heavy residual fuel oils for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.29. on p. 458 for 2008, table П 2.35. on p. 464 for 2009 and table П 2.41. on p. 470 for 2010), that was converted to greenhouse gases emission factor based on the ratio of carbon dioxide and carbon molar masses (according to step 6 on Page 1.8 of the Work book, Module "Energy" of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

$EF_{CO2,RFO,2008}$ = 0.0774 tonnes CO_2 / GJ;
$EF_{CO2,RFO,2009}$ = 0.0774 tonnes CO_2 / GJ;
$EF_{CO2,RFO,2010}$ = 0.0774 tonnes CO_2 / GJ.

$OXID_{i,y}$ – carbon oxidation factor for combustion of fuel type *i* (refinery gas, residual fuel oil) in year *y*. The following oxidation factors were used:

$OXID_{RG,y}$ – carbon oxidation factor for combustion of refinery gas in year *y*.

The calculations were done using the carbon oxidation factor for the combustion of ethylene, propylene, butylene, butadiene and other petroleum gases or hydrocarbon gases, except natural gas (hereinafter – refinery gas) for refinery industry according to the National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.30. on p. 459 for 2008, table П 2.36. on p. 465 for 2009 and table П 2.42. on p. 471 for 2010).

$OXID_{RG,2008}$ – 0.995;
$OXID_{RG,2009}$ – 0.995;
$OXID_{RG,2010}$ – 0.995.

$OXID_{RFO,y}$ – carbon oxidation factor for combustion of residual fuel oil in year *y*.

The calculations were done using the carbon oxidation factor for the combustion of heavy residual fuel oils for refinery industry according to the National inventory of anthropogenic emissions by

sources and removals by sinks of greenhouse gases in Ukraine in 1990-2010 (according to the table П 2.30. on p. 459 for 2008, table П 2.36. on p. 465 for 2009 and table П 2.42. on p. 471 for 2010).

$OXID_{RFO,2008}$ – 0.99;
$OXID_{RFO,2009}$ – 0.99;
$OXID_{RFO,2010}$ – 0.99.

Baseline specific indicator of fuel consumption for oil refining at the AVD unit was estimated on the basis of the actual data on the combustion of all types of fuel in the furnaces of the AVD unit during 4 years before the project implementation (2000-2003). Baseline specific indicator of fuel consumption for oil refining was estimated according to the following formula:

$$SFC_{BSL} = (\sum_{y} \frac{(FC_{RG,y} \times NCV_{RG,y} + FC_{RFO,y} \times NCV_{RFO,y})}{P_y})/4 \qquad (7.0)$$

where:
$FC_{RG,y}$ $FC_{RFO,y}$ – organic fuel (refinery gas and residual fuel oil, respectively), that was combusted during year *y* in the furnaces of the AVD unit, tonnes.
P_y – oil refined at the AVD unit during year *y*, tonnes.
$NCV_{RG,y}$ $NCV_{RFO,y}$ – net caloric value of the fuel – refinery gas and residual fuel oil, respectively – that was combusted during year *y* in the furnaces of the AVD unit, GJ/tonne.

The baseline specific indicator of fuel consumption equals 0.872 GJ/tonne.

Baseline emissions were estimated according to the data that is presented in the table below. Data used in the table (shares of the fuel types combusted at the AVD unit) are calculated based on data of fuel consumption and its NCV presented in section E.1 according to following formulas:

$$Sh_{RG,y} = \frac{FC_{RG,y} \times NCV_{RG,y}}{(FC_{RG,y} \times NCV_{RG,y} + FC_{RFO,y} \times NCV_{RFO,y})} \qquad (8.0)$$

$$Sh_{RFO,y} = \frac{FC_{RFO,y} \times NCV_{RFO,y}}{(FC_{RG,y} \times NCV_{RG,y} + FC_{RFO,y} \times NCV_{RFO,y})} \qquad (9.0)$$

Table E.4.-1. Data used for estimation of baseline emissions

Year	Oil refining at AVD unit, tonnes	Share of refinery gas in the total fuel consumption by the furnaces of the AVD unit	Share of residual fuel oil in the total fuel consumption by the furnaces of the AVD unit
2008	2 041 825	0.481	0.519
2009	2 051 636	0.558	0.442
2010	1 448 377	0.606	0.394
2011	–	–	–
2012	–	–	–
2013	1 847 279	0.549	0.451
2014	1 847 279	0.549	0.451
2015	1 847 279	0.549	0.451
2016	1 847 279	0.549	0.451
2017	1 847 279	0.549	0.451
2018	1 847 279	0.549	0.451
2019	1 847 279	0.549	0.451
2020	1 847 279	0.549	0.451

Estimated baseline emissions for the period of 2008-2020 are presented in table below.

Table E.4.-2. Baseline emissions

Year	Baseline emissions due to refinery gas combustion, tonnes CO_{2e}	Baseline emissions due to residual fuel oil combustion, tonnes CO_{2e}	Total baseline emissions, tonnes CO_{2e}
2008	53 736	70 779	124 515
2009	62 692	60 503	123 195
2010	48 036	38 102	86 138
2011	–	–	–
2012	–	–	–
2013	54 821	56 462	111 283
2014	54 821	56 462	111 283
2015	54 821	56 462	111 283
2016	54 821	56 462	111 283
2017	54 821	56 462	111 283
2018	54 821	56 462	111 283
2019	54 821	56 462	111 283
2020	54 821	56 462	111 283

Thus, total baseline emissions during the period 2008-2012 will be 333 848 tonnes CO_{2e}. Total baseline emissions during the period 2013-2020 will be 890 264 tonnes CO_{2e}.

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

Reductions of anthropogenic emissions by sources of greenhouse gases (GHGs) generated by joint implementation (JI) projects are estimated/calculated by comparing the quantified anthropogenic emissions by sources within the project boundary in the baseline scenario with those in the project scenario.

Table E.5.-1. Emission reductions

Year	Emission reductions, tonnes CO_2e
2008	41 666
2009	43 513
2010	29 493
2011	–
2012	–
2013	38 224
2014	38 224
2015	38 224
2016	38 224
2017	38 224
2018	38 224
2019	38 224
2020	38 224
Total	**420 464**

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2008	82 849	0	124 515	41 666
2009	79 682	0	123 195	43 513
2010	56 645	0	86 138	29 493
2011	–	–	–	–
2012	–	–	–	–
Subtotal over the period of 2008-2012 (tonnes of CO_2 equivalent)	**219 176**	**0**	**333 848**	**114 672**
2013	73 059	0	111 283	38 224
2014	73 059	0	111 283	38 224
2015	73 059	0	111 283	38 224
2016	73 059	0	111 283	38 224
2017	73 059	0	111 283	38 224
2018	73 059	0	111 283	38 224
2019	73 059	0	111 283	38 224
2020	73 059	0	111 283	38 224
Subtotal over the period of 2013-2020 (tonnes of CO_2 equivalent)	**584 472**	**0**	**890 264**	**305 792**
Total over the period of 2008-2020 (tonnes of CO_2 equivalent)	**803 648**	**0**	**1 224 112**	**420 464**

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:

The project will have positive impact on the environment due to reduction of organic fuel combustion in the furnaces of AVD unit.

The proposed joint implementation project will lead to more efficient utilization of organic fuel for oil refining and lowering atmospheric air pollution.

The sources of harmful emissions to the atmosphere of the AVD unit are chimneys of the furnaces and partly leakages of the technological equipment.

Residual fuel oil, one of the most significant fuel by the primary oil refining is the biggest source of emissions. Owing to the operation of the AVD unit the following polluting substances are emitted in the atmosphere:

- Hydrocarbons limiting C1-C5 (37% of the emitted pollutants);
- Benzene (0.04%);
- Toluene (0.02%);
- Xylene (0.01%);
- Hydrogen sulphide (0.03%);
- Carbon oxide (39%);
- Nitrogen oxides (7%);
- Methane (13%);
- Sulphurous and sulphur anhydride (3.6%);
- And other solid and gaseous products of incomplete combustion of gases.

Mentioned polluting substances are affecting the ecosystems of the region and human health. Decrease of fuel consumption as a result of operation efficiency improvements at Odessa Refinery will lead to improvements of ecological situation in the region.

The project does not have significant impact on biotic and water mediums as well as any transboundary environmental impact. In general, project realization will have positive environmental impact.

Reduction of greenhouse gases emissions during the period 2008-2012 will reach 114 672 tonnes CO_{2e} and during the period 2008-2020 greenhouse gases emissions will be reduced by 420 464 tonnes of CO_{2e}.

Project activity is in consistence with all mandatory laws and regulations. The Odessa Refinery operation is in line with the following regulations: Law of Ukraine 'On atmospheric air protection', Sanitary Regulations and Norms 4946-89 'Sanitary regulations on atmospheric air protection', etc.

The Ministry of Environmental protection of Ukraine has issued an Allowance for emissions of polluting substances into the atmospheric air by stationary sources at 24.06.2009, which will remain valid till 24.06.2014 and foresees amounts and pollutants emitted within the project boundaries.

Environmental impact assessment regarding the modernization of the AVD unit and its furnaces replacement has been prepared by the Company Ecotechnika and approved by LUKOIL responsible bodies on 05.09.2006[14].

[14] Reconstruction of the CDU-AVD unit. Environmental impact assessment (EIA). Volume 8. Odessa – 2006.

Statement of environmental effects of the activity has been published in environmental impact assessment of the project (volume 8, pp. 99-111) dated 15.09.2006. Positive conclusion #1815/03-06-09 of the state environmental expertise of the detailed design of the project has been approved by the State environmental administration in Odessa region on 22.05.2007.

There is an environmental management systems ISO 9001:2008 “Quality management system” and ISO 14001:2004 “Environmental management system” introduced at the enterprise. They are certified by independent authority and theirs proper operation is confirmed by the certification body. Thus, the environmental policy and objectives which take into account legal requirements and other requirements as well as information about significant environmental aspects is established and functioning at the enterprise.

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

Total environmental impacts of project scenario in comparison with baseline scenario will be positive.

Environmental impacts of the project are controlled within general environmental reporting procedures according to national legislation using the following statistical forms:

- 2-tp (air) *Data on protection of atmospheric air*, which contains information on amounts of trapped and neutralized atmospheric pollutants, itemized emissions of specific pollutants, number of emission sources, measures on reduction of emissions into the atmosphere, emissions from particular groups of pollution sources;

- 2-tp (water resources) *Data on water use*, which presents information on consumption of water from natural sources, discharge of waste water, and content of pollutants in it, capacity of treatment facilities, etc.;

- 2-tp (waste) *Data on formation, use, neutralization, transportation and placement of industrial and household waste*, which presents the annual balance of waste flow, by waste types and hazard classes.

SECTION G. Stakeholders' comments

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

No stakeholder consultation process for the JI projects is required by the Host Party. Stakeholders' comments will be collected during the time of this PDD publication during the determination procedure.

Positive conclusion of the state environmental expertise of the detailed design of the project of the AVD reconstruction has been approved by the State environmental administration in Odessa region on 22.05.2007.

Annex 1

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Annex 2
FINANCIAL PLAN

The information on project financing plan is provided in the table below.

Table 1. Project investment (UAH without VAT)

Year	2003	2004	2005	2006	2007	2008	Total
Total investment	5 886 363	18 873 230	17 635 577	21 773 123	65 706 316	348 649	130 223 257

The project investments have been provided by the credit recourses described in table below.

Table 2. Project funding sources (UAH without VAT)

Modernization activity	Credit resources, UAH	Interest rate, %	Crediting period, years
Credit agreement #1	5 886 363	18% in UAH	1
Credit agreement #2	29 373 230	18% in UAH	2
Credit agreement #3	94 963 661	Libor +4	5