The chief engineer
JSC "RITEK"

________________ **/A.A. Maslanov/**

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JOINT IMPLEMENTATION PROJECT

4th MONITORING REPORT

Name of the Project:

"Utilization of Associated Petroleum Gas (APG) at the Vostochno-Perevalnoye Oil Field, Western Siberia, Russia"

Monitoring period: 1 January 2011 to 31 October 2012

Version 2.eng
26 November, 2012

4th Monitoring report:

Prepared by chief of department of an oil and gas recovery JSC "RITEK" –

A.O. Kulakov ________________

Checked by:

The head of department of an oil and gas recovery JSC "RITEK" –

S.V. Shishkin ________________

Internal audit was executed by head of department of corporate supervision JSC "RITEK"

A.V. Kotov ________________

Moscow, 2012

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Introduction

The purpose of this monitoring report is to calculate Greenhouse gas (GHG) emission reductions achieved by the Joint Implementation (JI) project Utilization of Associated petroleum gas (APG) at the Vostochno-Perevalnoye oil field, Western Siberia, Russia during the period from 1 January 2012 to 31 October 2012. 4th monitoring report have been developed by specialists of JI working group, confirmed by internal order of JSC RITEK #73 from 05 june 2009. All functions and responsibilities of the JI working group are stated in the "Plan of action of JSC RITEK JI working group" (Annex #4).

1. General project activity information

1.1. Title of the project activity

"Utilization of Associated petroleum gas (APG) at the Vostochno-Perevalnoye oil field, Western Siberia, Russia".

1.2. Short description of the project

The aim of the project is utilization of associated petroleum gas (APG) on the modern power station with gas piston power generation units Cummins QSV 91G with the total installed capacity 7,5 MW and on heating station consisting of three furnaces KVG 0,63 MW with capacity 1,89 MW located on Vostochno-Perevalnoye oil field with the purpose to supply electric and heat energy for own needs of the oil field.

Figure 1. Project Gas Power Plant (GPP).

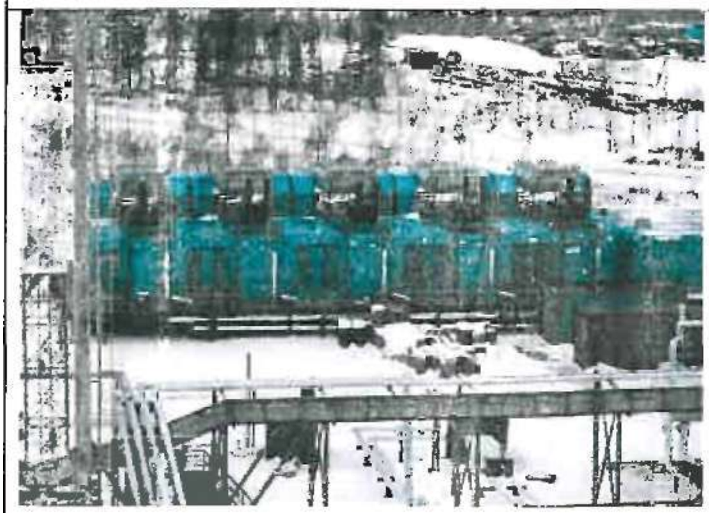


Figure 2. The location of Project.

The main components of the GPP are:

- QSV 91G Cummins gas-reciprocating engines produced by *JSC Zvezda Energetika* (fig.3);
- Stamford HV824C generators;
- Fuel gas supply system.

Ten -18 cylinders, four stroke, high speed gas engines with electric spark ignition have been chosen, in part, because of their tolerance for lower quality APG-fuel and because of low pollutant emissions in the exhaust gas. The fuel gas supply system of the GPP, including gas pipelines (isolated for leakage minimization) and the APG treatment plant, is designed to support normal operation of the power generating units using APG. Each unit is equipped with a device that switches off fuel supply sources in emergency cases. The fuel gas flow rate at 100% load is 293 nm^3/MW per hour. The fuel gas (APG) is taken from the gas pipeline of the APG treatment plant into the engine's gas mixer where air is added. The mix is then transported by pipe into the turbo-blower. Then, the compressed gas-air mixture goes through the cooler into the fuel suction line that distributes the mixture among the engine's cylinders. Design pressure at the fuel supply inlet is 3.5 Bars with temperatures from 10 to 20 degrees Celsius. The fuel used at the GPP and HS is APG that is separated at the Vostochno-Perevalnoye booster pumping station. Minimal CH_4 index without decreasing power is 52 %. APG after separation is devided in two flows with one part directed to the GPP and the other flared at the existing stack of the booster pumping station.

Before use in gas-engines, APG must be processed at the treatment plant by:

- □Drying from dropping liquids while being heated up from +10 to +20°C,
- □Reducing pressure from 0,5 MPa to 0,35-0,4 MPa,
- □Gas filtration.

No incremental electric use is needed for gas treatment and transport due to the Project. The pressure at which gas comes into the APG treatment plant is sufficient to push it through the system. Heating of the gas is fully covered through use of waste heat from the gas engines.

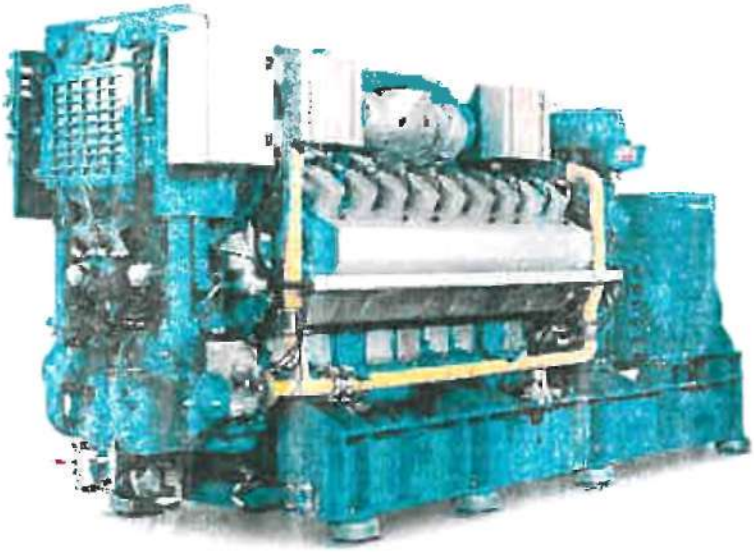


Figure 3. Block of QSV 91G Cummins

Electrical Interconnection Systems

The GPP includes the following electrical equipment:

- 5 generators;
- 6 & 0,4 kV gears;
- 6/0,4 kV transformers;

- in-house transformer substation with 0.4 kV distributor switch gear (for self consumption)

Delivery of the electricity to power consumers is provided from transforming station, voltage 6 kV. Total annual consumption from the given substation is estimated as 34,1 GWh/year. Own power consumption of the station is approximately 0,7 GWh/year. Power supply for own needs is provided from external feeders on voltage 380 V. Electric power is delivered to the ZRU-6kV distribution installation and further on by 6 kV cables to the related transformers and facilities. The average distance to consumers 2,5 km. In case of emergency switch-off of a gas supply system, or in other cases of absence of gas in APG processing facilities, consumers will be supplied from diesel-generator. Transition to emergency operation of work in GPP occurs in case of critical pressure drop in the gas pipeline.

In case of GPP transition to work the emergency diesel fuel the emissions are calculated according to the actual expense of fuel and nameplate data on received emissions.

Electric power delivery in external grids, and also stabilization of voltage due to interconnection to high-voltage transformers in foreseeable prospect is impossible, because of very high expenses (exceeding cost of the power station), and difficult procedure of the coordination of generating object inclusion into external networks.

Heating station (figure 4) is transportable boiler, consisted of three steel furnaces KVG 0,63 MW (0,54 Gcal) each. Expenditure of gas per 1 Gcal (while heating from 70°C to 90°C) –129,5 nm cub (0,155 tons of fuel equivalent; efficiency - 92%). Every furnace equipped with automatic gas-burner providing necessary graphic of fuel injection. HS needs no operating personnel.

Figure 4. Heating station at Vostochno - Perevalnoye oilfield.

Significant advantage of HS – is easy to assemble on site. Such heating stations are usually installed nearby consumers and because of this there is no necessity of excessive investments in pipelines (for district heating).

Delivery of the heat to consumers in well-exploitation settlement is provided by pipes insulated with poly-urethane foam. Losses are insignificantly small due to very short distances, and also due to good present condition of equipment. Because of heat controller's absence at consumers' present losses can be estimated as 2%.

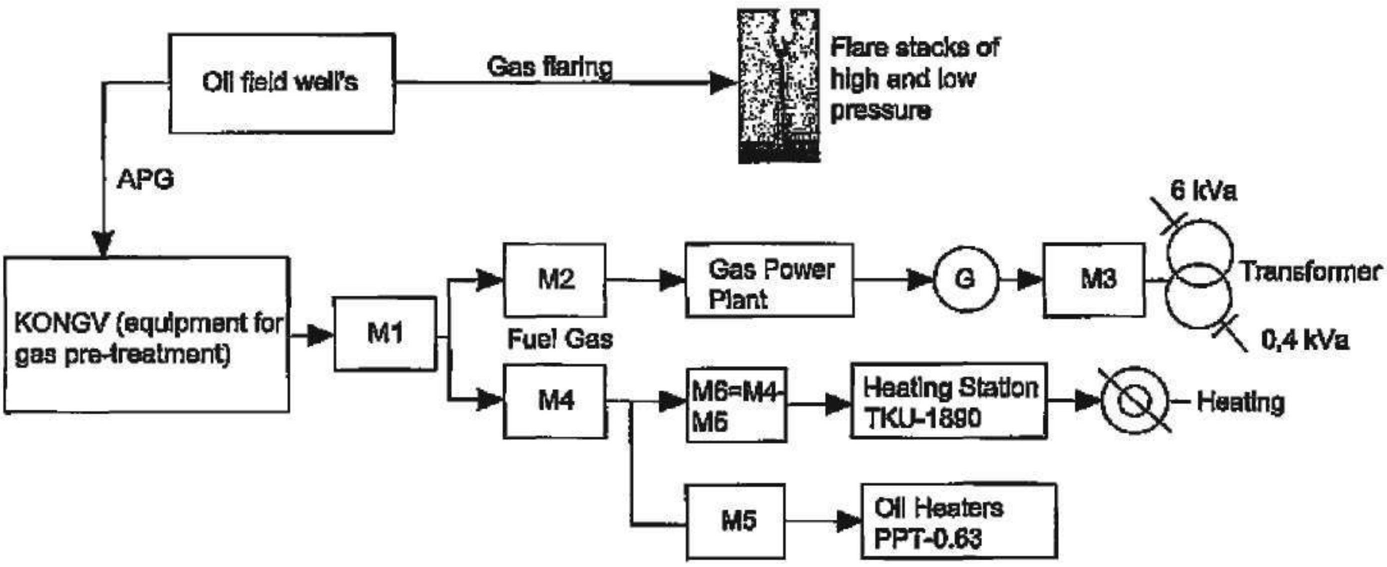
In the absence of the project, the whole volume of the utilized APG would be flared (10,7 mln Nm3 per year, Figure 5) and the oil field energy needs would be covered by electric energy produced by firing crude oil at wagon-type power units ПЭ-6М (27 thousand tonnes of reference fuel with LHV of 29,3 MJ/kg per year, Figure 6).

Figure 5. Associated petroleum gas flaring at Vostochno-Perevalnoye oil field.	Figure 6. Wagon-type power units PE-6M.
	

The termination of oil firing and utilization of APG will result in the GHG emissions reduction during the crediting period in volume of 62,322 tCO2e per year.

Actual investments in the project amounted 7,3 mln euros.

1.3. General scheme of the Project.



1.4. Monitoring period

1 January 2012 – 31 October 2012

1.5. Implementation of the project

Table 1. Main milestones in project implementation

Milestone	Date
UNFCCC JI procedures:	
Project Design Document submitted to Accredited Independent Entity	25 May, 2009
Determination of Project Design Document by Accredited Independent Entity	02 September, 2009
Letter of Approval from the Ministry for Economic development of the Russian Federation as a legal and authorised representative of the Government of RF	30 July, 2010
Final determination of the JI project	11 August, 2010
Construction and operation of gas power station and heat station	
Heat station starts operating	1 January, 2008
Gas power station starts operating	1 September, 2008

1.6. JI Project and Monitoring report designers

JI Project Utilization of APG at the Vostochno-Perevalnoye Oil Field is developed by:

LLC «Mejdunarodnaya Gruppa «Sigma»
Moscow, Russian Federation
Tel. +7 (495) 7753232
Fax +7 (495) 7753232
e-mail: sigma@effort.ru

Monitoring report prepared, checked and confirmed by:

JSC «Russian Innovative Fuel-Energy Company» (JSC «RITEK»)
Chief of department of an oil and gas recovery – A.O. Kulakov
The head of department of oil and gas recovery – S.V. Shishkin
Chief engineer JSC RITEK – A.A. Maslanov
Address: Russian Federation, 628486, Tumensky region, Kogalym, Noyabrskaya str. 7
Tel: +7(495) 665-76-89
Fax: +7(495) 424-77-15
Email: info@ritek.ru

2. Monitoring activities implemented

2.1. Description of monitoring plan chosen

The Project will contribute to sustainable development of the host country by promoting the utilization of a wasted energy resource and will achieve two goals:

- Reducing CH4 emissions due to more complete APG combustion in gas engines relative to APG flaring;
- Substitution of power generation from the power trains to power from GPP with more efficient engine and reduced GHG emissions.

At present, no approved CDM monitoring methodology that would allow estimating CH4 emissions mitigation from APG flaring reduction projects is available. On the other hand, the

"Methodology of calculation of emissions of hazardous substances into the atmosphere due to the flaring of the associated petroleum gas at flaring stacks" developed by the Saint-Petersburg Scientific Research Institute for Protection of Atmosphere of Rosgidromet, (Rosgidromet) endorsed by State Committee for Environmental Protection – GosKomEcologiya, is designed for practical usage when estimating such emissions during APG flaring. This methodology is widely used by Russian oil and gas sector in calculations of hazardous atmospheric emissions. Therefore, modalities relating to CH_4 emission reductions estimation contained in the Rosgidromet methodology are used in the monitoring plan of this Project.

Estimation of CO2 reductions due to the displacement of electricity generation from the power trains uses the elements of the Approved CDM Methodology - AM0009.

2.2. Monitoring of environmental impacts of the project.

According to the Order of the State Committee of the Russian Federation for Environmental protection as of 15.05.2000 # 372 "On the approval of the regulations on the assessment of the impact of the planned economic and other activity on the environment of the Russian Federation" the project developers must include in the project documentation the special assessment of environmental impact.

On assignment with *RITEK*, a scientific research institute, JSC Giprotyumenneftegaz, has elaborated the environmental impact assessment (EIA) for the Project, within the Project documentation.

EIA consists of the following chapters:

- general part;
- physical-geographical characteristics of the Project site;
- land protection measures ;
- water disposal and water usage;
- waste management;
- impact on atmospheric air;
- recommendations on environmental monitoring;
- assessment of the impact on the components of the environmental system;
- socio – economic impact assessment.

The environmental impact assessment (EIA) documentation with regard to this Project has undergone public environmental examination. The Project including the Assessment of environmental impact has received an official approval of the local Khanty-Mansy Branch of the Russian State Expertise (granted on April 28, 2008, # 157-08/ХМЭ-0165/2), with attached detailed analysis of the environmental impact, confirming the basic considerations and conclusions of the Assessment of environmental impact provided by the Giprotyumenneftegaz project documentation. Upon the launching of the GPP into operation the due permission was obtained by the Project Owner from the local branch of the Russian Technical Supervisory Service (Rostechnadzor) for related emissions of substances emitted by the Project facilities (#501 on 22 july, 2008).

A four level system for the monitoring of environmental impacts has been established at the GPP. Data from HS also reflect in monitoring plan of GPP. This system allows monitoring, reporting and controlling of the maximum concentrations of the hazardous substances emissions such as CH_4, NO_x, and CO:

1. First, the gas contamination sensors that monitor CH_4 concentrations relative to maximum permissible emissions (MPE) limits are installed at the APG treatment plant and at condensate collection tanks.

2. Second, the generating units at the power hall (GPP) are equipped with the *LENOX* controlling system, which automatically monitors CH4 concentrations in the engines.

3. Third, the mobile mechanized plant, *TESTO*, monitors concentration of the hazardous waste in the exhaust gases at any desired measuring point (engine, power hall, furnaces, etc. in GPP and heating station). The emissions measurement may be taken in any required place. Once the data is measured, the shift operator inputs it in his log book.

4. Fourth, the shift operator is periodically on a beat monitoring the situation with gas emissions.

In case of exceeding the established MPE maximum limits, the signals from sensors will come in GPP's automated control system (ACS) that will adjust working parameters of the equipment to an optimized safe operation level. The shift operator inputs the measurements (in case of exceeding the maximum limits) in the log book. All shift log books will be numbered, tied together and archived for 5 years.

In frameworks of National Environmental Regulation of host party – maximum permitted emissions (MPE) determined according to GOST 17.2.3.02-78 (regulation standards of harmful substance's emissions for Industry). GOST's using during estimation of environmental impact in frames of project documentation, simultaneously with established by Ministry of Health USSR in 1978 maximum permitted concentrations (MPC).

2.3. Deviation from the Monitoring Plan.

2.3.1. Coefficient, considering own needs of PE-6M.

Monitoring plan, stated in section D PDD "Utilization of Associated petroleum gas (APG) at the Vostochno-Perevalnoye oil field", doesn't contain the coefficient, considering own needs of PE-6M.

The electricity supplied by GPP to the consumers at Vostochno-Perevalnoye oilfield from 1 Junuary 2012 till 31 October 2012 is 29 394,220 MWh. Accordingly to annex №6, own needs of GPP in period of 2012 year have made 1 487,181 MWh, or 4,82% from the total amount of produced energy on GPP – 30 881,401 MWh.

Own needs for power trains PE-6M includes a power consumption on heating of oil, on oil treatment object and maintenance of necessary temperature in diesel engines for instant start for reserve. The factor of energy consumption for PE-6M own needs has made 11,22 % in 2010 (accordingly to the previous MR 2008-2010).

2.3.2. Monitoring plan, stated in section D PDD "Utilization of Associated petroleum gas (APG) at the Vostochno-Perevalnoye oilfield", defines the frequency of APG sampling as twelve times a year.

In 2008 year JSC RITEK planned to purchase own chromatograph to make componental analysis of APG at the own laboratory of Vostochno-Perevalnoye oilfield.

In the second half of 2008 year because of the world economic crisis JSC RITEK decided to postpone these purchase. APG componental structure analyses were carried out by the means of JSC BING once-time a year and once-time by means of Sergino laboratory (see table 4). As addition for the proof of stability of structure of APG in Table 4 cited the data of structure of APG for 2010 and 2011 years.

The calculations of ERU's were carried out with six figures of componental structure of APG (2010, 2011 and 2012) and given to the verifier. For the present Monitoring Report we use the most conservative result.

2.3.3. APG consumption by HS is defined as a difference between the measured APG volume at the inlet of heat consumer group (point M3) and APG volume at the inlet of oil heaters (point M5). The actual General Scheme of the Project is presented at p. 1.3.

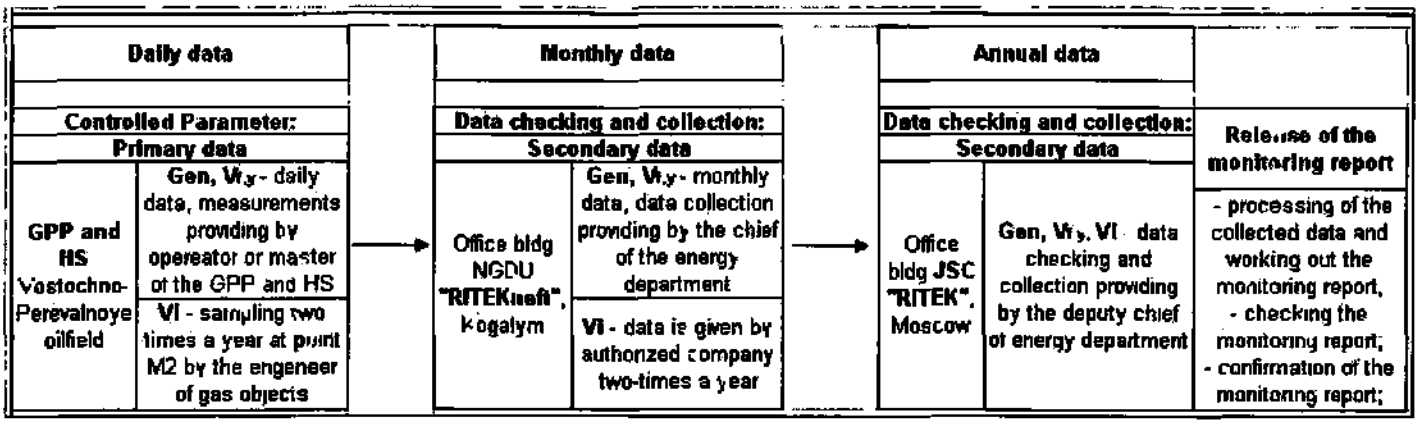
The volume of APG, measured at point M3 and M5 are stated in Annex №1. APG consumption by HS is defined as a difference between measurements at points M3 and M5.

2.3.4. Parameter $\sigma CH4$ (total hydrocarbons in CH4 equivalent) was used for calculation for ERU's in PDD table 11, BE3. This parameter was calculated by means of APG, including the whole number gas hydrocarbons (from methane to octane). Using the sum of hydrocarbons gases equivalent isn't correct, because only methane is GHG. The equation was corrected with adjusted for methane in MR. Final calculation of ERU's based on corrected equation.

2.3.5. Accordingly to the Volume 1, Chapter 7, box 7.2 page 7.6 "2006 IPCC Guidelines for National Greenhouse Gas Inventories" Calculating CO2 inputs to the atmosphere from emissions of carbon-containing compounds (carbon monoxide CO) emissions will eventually be oxidised to CO2 in the atmosphere. These CO2 inputs could be included in national inventories. They can be calculated from emissions of CO. Thus, this specification to be reflected in calculation in equation BE4 positions 6 and 10. Value of positions 6 and 10 goes to zero. Final calculation of ERU's based on corrected BE4 equation.

2.4. Data collection

2.4.1. Algorithm of data collection



2.4.2. Fixed values

Table 1.

Parameter	Default value	Description
EFcm	596,4 grUF/kWh	The actual fuel equivalent use by the powertrains for electricity generation
EF_{HS}	0,155 tUF/Gcal	The actual fuel equivalent use by the heating station for heat generation

Factor of unified fuel equivalent use for generation (Tuf/MWh) was taken into account as stable parameters within due to 5 years of operating the powertrains. For monitoring plan it was considered appropriate to use determined by auditor ("EnergoPerspektiva" Ltd.) data from well Group #1 (TPP "RITEKNadymneft"), exploited powertrains until GPP commissioning. The average consumption in 2006 was 596,4 grUF/kWh in accordance with official report from 18.01.2007,Contract #17/23 (Annex №5). Modification (theoretical) of quality of fuel, that can additionally reduce emissions, compensates by decreasing efficiency of consuming equipment due to their physical amortization, and accordingly growth of energy consumption (and fuel reduction in frameworks of project line).

2.4.3. Data for calculation

All measurements are executed automatically by means of the checked devices according to the Monitoring plan, stated in section D PDD "Utilization of Associated petroleum gas (APG) at the Vostochno-Perevalnoye oil field".

Collecting and archiving of all measurements are executed by qualified personal of TPP "RITEKKogalymneft" according to the internal order about appointment of responsible persons in directions (Annex №3).

All data is presented in an electronic and paper kind on object GPP and HS Vostochno-Perevalnoye oilfield, and also in office building TPP "RITEKKogalymneft" (Kogalym).

2.4.4. Using the IT technology at the data collection

At the GPP and HS level, the shift operators will be responsible, on day-to-day basis for monitoring the variables, including taking the readings from electricity meters, APG flow meters and the fuel tank contents and deliveries. The monitoring and reporting of most of these data (volume, capacity and electricity flows) has been already adopted under the routine operation regime of the GPP and HS.

On the basis of the received daily data from the electricity meters of GPP and HS operators enters figures to the spreadsheets in the Microsoft Excel program. The operator will transfer them via the internet to the Energy Department in the office bldg TPP "RITEKKogalymneft".

At the TPP "RITEKKogalymneft" the head of the energy department checks and processes the daily data received from operator of GPP and HS of Vostochno-Perevalnoye oilfield to the monthly and annual reports. These reports are:

- saved on the computers at the Energy department;
- printed and archived in paper kind at the Energy department, GPP and HS of Vostochno-Perevalnoye oilfield:
- sent by internal e-mail with the protected channel to the head office of JSC RITEK in the Energy Department.

At the head office of JSC RITEK all received reports take place in limited access at the public directory. All interested persons have access, protected by password, for reports to check and verify it. Verified reports will be saved at the server of JSC RITEK until 2015 year.

After the internal verification of received reports, annual data is entered into the program for calculation ERU's. This program is developed on base of Monitoring plan (PDD section D). Microsoft Excel program will make the necessary calculations with the use of formulas.

Table 2. Information on key parameter monitored

Data/Parameter	Gen
Data unit	MWh
Description	Electricity supply to consumers, measured at point M3, at Vostochno-Perevalnoye oil-field on voltage 6 kV, and electricity supplied for self consumption 0,4 kV.
Time of determination/monitoring	Monthly
Source of data (to be) used	Electric meters «СЭТ 4ТМ», Uncertainty level of data – 0,2%
Value of data applied (for ex ante calculations/determination)	MWh, shown below in Table 3
Justification of the choice of data or description of the measurement methods and procedures to be applied	Electric meters are installed at the 6 kV (0,4 kV) in-door switch gears, data will be archived electronically and in monitoring workbook.

QA/QC procedures (to be) applied	**QA**: measurements from the electricity meters is screened on monitors at the operator's desk; readings are taken by the trained staff according to the requirements of the technical specifications; **QC**: periodic calibration by the regional representatives of the State Office for Metrology and Standardization
Any comment	-
Data/Parameter	Vi
Data unit	%
Description	Composition of APG measured at point M1, after pretreatment, during the period *y. The componental structure of APG, flared for GPP and HS needs,is identical.*
Time of determination/monitoring	Twelve times a year by authorized company (table 4 below)
Source of data (to be) used	Measurement providing by authorized company with the license for the given kind of activity. Uncertainty level of data – 0,5%
Value of data applied (for ex ante calculations/determination)	Vi shown below in Table 4
Justification of the choice of data or description of the measurement methods and procedures to be applied	By authorized company at the junction point and at exit from KONGV pre-treatment Twelve times a year by authorized company figures. The structure of APG will be used for calculation, that will allow to receive the most conservative result.
QA/QC procedures (to be) applied	**QA**: measurements are taken by the trained staff according to the requirements of the technical specifications; **QC**: periodic calibration by the regional representatives of State Office for Metrology and Standardization
Any comment	M APG and density calculating on the base of available APG composition.
Data/Parameter	$V_{F,y}$ at point M2
Data unit	Nm^3
Description	Volume of APG consumption for power generation at points M2, during the period *y*
Time of determination/monitoring	Monthly (table 5 below)
Source of data (to be) used	Flow-meters DYMETIC 9421, Uncertainty level of data – 5%
Value of data applied (for ex ante calculations/determination)	Nm3, shown below in Table 5
Justification of the choice of data or description of the measurement methods and procedures to be applied	Measurements effectively show volume of APG that would be flared in frames of baseline. It is typical procedure using for settlements between Project's owner GPP's exploiting company (Zvezda Energetika).
QA/QC procedures (to be) applied	Volume of APG will be completely metered with regular calibration of metering equipment. The measured volume should be converted to the volume at normal temperature and pressure using the temperature and pressure at the time to measurement.
Any comment	-
Data/Parameter	Vf,y at point M6
Data unit	Nm3
Description	Volume of the total recovered gas measured at point M6 as a difference between measurements at points M4 and M5, during the period y
Time of determination/monitoring	On-line (with monthly summarizing).
Source of data (to be) used	Flow-meters ДРГ.М-160, Uncertainty level of data – 5%
Value of data applied (for ex ante calculations/determination)	Nm3, shown below in Table 6
Justification of the choice of data or description of the measurement methods and procedures to be applied	Measurements effectively show volume of APG that would be flared in frames of baseline. It is typical procedure using for settlements between Project's owner (HS).

QA/QC procedures (to be) applied	Volume of APG at points M4 and M5 will be completely metered with regular calibration of metering equipment. The measured volume should be converted to the volume at normal temperature and pressure using the temperature and pressure at the time to measurement.
Any comment	-

Table 3. Data on electricity supplied (with EmGen) by GPP to the consumers at Vostochno-Perevalnoye oil-field in 2012:

Month	Electricity supply to consumers at *Vostochno-Perevalnoye* oil-field, MWh
January	2 795,550
February	2 744,650
March	3 254,410
April	2 973,520
May	3 045,930
June	2 794,860
July	2 908,060
August	2 839,410
September	2 927,700
October	3 110,130
Total over the monitoring period	**29 394,220**

Table 4. The componental structure of APG, used for electricity development at GPP Vostochno-Perevalnoye Oil Field

Component	*№12-3 from 19.03.10*	*№ 12-7 from 17.06.10*	*№ 382 from 18.12.2011*	*№ 7 from 23.06.11*	*№ 3515 from 23.06.12*	*№ 569 from 12.09.12*	***Value used in calculation****
N_2	2,62	2,40	1,67	0,64	1,131	1,051	**1,131**
CO_2	1,25	1,48	1,24	1,15	1,602	2,743	**1,602**
CH_4	78,37	78,19	81,11	79,08	65,501	76,72	**65,501**
C_2H_6	4,93	5,18	5,56	6,09	7,659	7,589	**7,659**
C_3H_8	6,96	7,10	6,55	7,79	14,002	8,108	**14,002**
nC_4H_{10}	2,23	2,34	1,97	2,29	4,834	2,130	**4,834**
iC_4H_{10}	0,96	0,96	0,87	0,97	2,251	0,7424	**2,251**

nC_5H_{12}	0,57	0,61	0,41	0,56	1,048	0,3786	**1,048**
iC_5H_{12}	0,49	0,52	0,35	0,49	0,995	0,2919	**0,995**
C_6H_{14}	0,82	0,69	0,20	0,58	0,668	0,1875	**0,668**
C_7H_{16}	0,59	0,37	0,06	0,27	0,159	0,04866	**0,159**
C_8H_{18}	0,21	0,16	0,01	0,09	0,058	0,009973	**0,058**
Calculation of GHG emissions	48 662	48 686	48 902	48 837	48 348	48 726	**48 348**

* - The calculation with the measurement № 3515 from 23.06.12 allow to receive the result of GHG emissions in the amount of 48 348 tonnes of CO2-equivavlent.

The results of calculations with measurements № 12-7 (17.06.10); № 382 (18.12.2011); № 7 (23.06.2011); № 12-3 (19.03.10) and 569 (12.09.12) are: 48 686; 48 902; 48 837; 48 662 and 48 726 tonnes of CO2-equivavlent.

All calculations have been executed and given to the verifier.

Difference between all calculations makes 554 tonnes CO2-e or 1,13%. For the present Monitoring Report we are going to use most conservative result.

Accordingly to the PDD measurements of componental structure of APG should be executed 12 times a year (monthly) by the means of authorized company. In 2012 year measurements have been executed once a-times a year by the means JSC "BING" and once a-time by the means of Sergino chemical laboratory.

Table 5. Volume of APG consumption for power generation, after pretreatment, during the monitoring period.

Month	*Volume of the total recovered APG, mln. Nm3*
January	0,796
February	0,775
March	0,929
April	0,844
May	1,071
June	0,818
July	0,829
August	0,816
September	0,838
October	0,893
Total over the monitoring period	**8,611**

Table 6. Volume of APG consumption for heat generation, after pretreatment, during the monitoring period.

Month	*Volume of the total recovered APG, mln. Nm3*
January	0,05
February	0,047
March	0,063
April	0,031
May	0,029
June	0,001
July	0,000
August	0,000
September	0,026
October	0,032
Total over the monitoring period	**0,278**

2.4.5. Description of formulae used to estimate heat energy, produced by heating station TKU-1890

The calculation of heat energy, produced by heating station TKU-1890 consisting of three furnaces KVG 0,63 MW with capacity 1,89 MW will be estimate with using of following parameters:

- *Volume of APG consumption for heat generation, after pretreatment, during the monitoring period): 0,397 mln.nm3;*

- *The componental structure of APG, used for heat development at HS Vostochno-Perelnoye OilField.*

- *Expenditure of gas per 1 Gcal (while heating from 70°C to 90°C) –129,5 nm cub of natural gas (0,155 tons of fuel equivalent/Gcal; efficiency - 92%). (data from the technical passport of TKU-1890).*

1. The equation to calculate Lower Heating Value LHV of APG (H) is:

H = ∑ (H1*V1+H2*V2+…+Hi*Vi) = 10 198,25 Kcal/kg

- Hi and Vi – LHV (Kcal/kg) and Volume (%) of i-component in APG.

2. The density of APG (ρ):

ρ = ∑(ρ1*V1 + ρ2*V2 + … + ρi*Vi) = 1,180 kg/m3,

- ρi and Vi – density (kg/m3) and volume (%) of i-component in APG.

3. Mass amount of APG flared in HS (Mt, tonnes):

M = ρ * V = 327,7 tonnes.

4. Heat energy, produced by heating station TKU-1890:

Heat_gen2 = M * H * eff = 3074,3 Gcal (or 3575,4 MWh)

2.4.6. Description of formulae used to estimate project emissions

The equations used to calculate Project emissions are summarized in Table 7 below.

The project uses the approach from the previously approved CDM methodology AM0009 version 3 and assumes full oxidization.

$PE,y = (Vy*Py) * Wcarbon,A,y *44/12$ (PE2)

where: *PE,y* - the baseline emissions during the period y in tons of CO_2 equivalents.

Vy - volume of gas recovered from the oil field during the period *y*, explicated in (000) nm3.

Py - density of APG, kg/ncm.

Wcarbon,A,y - the average content of carbon in the gas recovered during the period y.

The carbon content in the gas W*carbon,A,y* is determined from Table 8, 1.

Table 7:

1. **Mass amount of APG flared**

PE1	1	2 form 2, BE1	3=1*2
	Annual volumetric flow of APG to be flared	Density of APG	Mass amount of APG flared
	V APG	*ρ APG*	*M APG*
units	ncm (1000)	kg/nCM	t
GPP	8 610,54	1,18	10 162,95
HS	277,67	1,18	327,73
	8 888,21		10 490,68

2. **Project emissions calculation equations**

PE2	1	2 from 9, BE1	3	4	5	6=1*2*3*4/5
	Mass amount of APG flared	Carbon mass fraction in APG		Molecular mass of CO2	Molecular mass of C	Total CO2 emissions project
	M APG	σ c_APG	scalar	μ CO2	*μ C*	*ECO2_combustion project*
unit	t	% mass		kgCO2/mole	Kg C/kg mole	tCO2e
GPP	10 162,95	76,621	0,01	44,011	12,011	28 533
HS	327,73	76,621	0,01	44,011	12,011	920
	10 490,68					29 453

Thus, total project emissions 29 453 tCO2e/(01.01.2012 – 31.10.2012).

As explained in PDD Section B.2, emissions based on leakages and/or accidents are likely to be greater in the baseline delivery of APG to the flare than they will be in the operation of the new GPP.

Therefore, potential leaks and accident emissions in the Project scenario have been ignored to assure that the emission reduction estimates are based on conservative assumptions.

2.4.7. Description of formulae used to estimate baseline

Baseline emissions at the Vostochno-Perevalnoye flare are calculated using equations *BE2* through *BE5* below in combination with *BE1* as shown in Table 8.

Columns (6) in equation *BE4* and column (1) in equation *BE3* are parameters that are specified in the Rosgidromet methodology for calculating emissions from flaring of APG in Russia. The factors shown assume that the Vostochno-Perevalnoye flare will continue to operate in black-firing mode. The monitoring plan addresses the photo evidence that will support this assumption going forward. The key input parameters for future years will be the volume of APG used by the GPP (column (1) in equation PE1, the density of that APG and the volumetric composition of the APG.

Table 8: Equations for local baseline emissions at the APG flare

1. **Calculation of mass fraction of APG components**

BE1		1	2	3	4	5	6	7	8=1*5/100	9=6*7	10=7*3/miCH4	11	12=11*7
		Vi	pi	mi	μi	ki	σc-i	σi	k APG	σc_APG	σ CH4	σн-i	σн_APG
	index	Volume fraction, weighted average of monitored	Density if hydrocarbons and elements	Molecular mass of components	Molecular mass of i-compnent in APG	Adiabatic index of i-component of APG	Mass content of carbon of i-compnent in APG	Mass ratio	Adiabatic index of APG	Mass fraction of Carbon in APG	Hydrocarbons in CH4 equivalent	Mass content of Hydrogen of i-component in APG	Mass fraction of Hydrogen in APG
unit		%	pi	Mi	kg/mole	μi	% масс	%				% масс	
	CH_4	65,501	0,716	16,043	10,508	1,31	74,87	0,3973	0,8581	29,7495	0,397348	25,13	9,9854
	C_2H_6	7,659	1,342	30,07	2,303	1,21	79,89	0,0871	0,0927	6,9571	0,163224	20,11	1,7512
	C_3H_8	14,002	1,969	44,097	6,174	1,13	81,71	0,2336	0,1582	19,0863	0,642051	18,29	4,2723
	nC_4H_{10}	4,834	2,595	58,124	2,810	1,1	82,66	0,1063	0,0532	8,7852	0,385056	17,34	1,8429
	iC_4H_{10}	2,251	2,595	58,124	1,308	1,1	82,66	0,0495	0,0248	4,0909	0,179305	17,34	0,8582
	nC_5H_{12}	1,048	3,221	72,151	0,756	1,08	83,24	0,0286	0,0113	2,3806	0,128623	16,76	0,4793
	iC_5H_{12}	0,995	3,221	72,151	0,718	1,08	83,24	0,0272	0,0107	2,2602	0,122118	16,76	0,4551
	C_6H_{14}	0,668	3,842	86,066	0,575	1,07	83,73	0,0217	0,0071	1,8206	0,116651	16,27	0,3538
	C_7H_{16}	0,159	4,468	100,08	0,159	1,06	84,01	0,0060	0,0017	0,5057	0,037548	15,99	0,0962
	C_8H_{18}	0,058	6,230	114,23	0,066	1,05	84,12	0,0031	0,0006	0,2575	0,021798	15,88	0,0486
	CO_2	1,602	1,965	44,011	0,705	1,3	27,29	0,0267	0,0208	0,7278	2,193724	0	0,0000
	N_2	1,223	1,251	28,016	0,343	1,4			0,0171			0	0,0000
	Total	100,000			26,426			0,9870	1,2563	76,6215			20,1430
			1,180										

2. Quantity of carbon atoms in molecular formula of APG

	1 from 9, BE1	2 from 4, BE1	3	4	5=(1*3/4)*2
BE2	Mass fraction of Carbon in APG	Molecular mass of APG		Molecular mass of carbon	Quan. of carbon atoms in molecular APG
	σ c_APG	μ APG		μ c	Kc
units	% mass	kg/mole	Scalar	kg/mole	carbon atoms
	76,6215	26,426	0,01	12,0110	1,686

3. CH_4 emission factor for APG flaring

	1	2 from L17, BE1	3=1*2	4 from L6, BE1	5=1*4
BE3	Ku/f (bf)	σ CH4 $_{equivalent}$	e CH4_baseline	σ GHG CH_4	GHG CH4_baseline
	Under firing coefficient	Total hydrocarbons in CH4 equivalent	CH4 equivalent emission factor_baseline	Total hydrocarbons in GHG CH4	CH4 equivalent emission factor_baseline
units	scalar	% mass	Kg CH4/kg APG	% mass	Kg CH4/kg APG
	0,035	2,194	0,0768	0,397	0,0139

4. CO_2 emission factor for APG flaring

	1	2 form 5, BE2	3 from 4, BE1	4 from 3, BE3	5	6	7	8=2/3	9=4/5	10=6/7	11=1*(8-9-10)
BE4	Molecular mass of CO2	Quan. of carbon atoms in molecular APG	Molecular mass of APG	CH4 emission factor_baseline	Molecular mass of CO2	CO emission factor_baseline (black firing)	Molecular mass of CO	C emission factor_baseline	Molecular mass of CH4	Molecular mass of CO in APG	CO2 emission factor
	μ CO2	Kc	μ APG	e CH4_baseline	μ CH_4	e CO_baseline	μ CO	e C_baseline			e CO2
Units	kgCO2/mole	Carbon atoms	kg APG/mole	Kg CH4/kg APG	Kg CH4/kg mole	Kg CO/kg APG	kgCO2/mole		Kg CH4/mole APG	Kg CH4 / mole APG	Kg CO2/kg APG
	44,011	1,686	26,426	0,0768	16,043	0	28	0,0638	0,0048	0,0000	2,5970

5. **Total emissions from APG flare**

BE5	1 from 3, BE5	2 from 11, BE4	3 from 3, BE3	4	5=1*2	6=1*3*4	7=5+6
	Mass amount of APG flared	CO2 emission factor_baseline	CH4 emission factor_baseline	CH4 global warming potential	CO2 emissions from complete burning	Total CH4 emissions in terms of tCO2e	Total CO2 emissions from APG flaring
	M APG	*e CO2_baseline*	*e CH4_baseline*	*GWP CH4*	*E_{co2} complete baseline*	*E_{CH_4} baseline*	*E_{co2e} flaring baseline*
Units	t	Kg CO2/kg APG	Kg CH4/kg APG	scalar	tCO2e	tCO2	tCO2
	10490,681	2,5970	0,0139	21	27243,8	3064	30308

The second major component of baseline emissions is the GHG to be released by powertrains in course of generating power equal to the power amount to be generated by the GPP and HS within the Project. Table 9 shows equation *PE3, PE4* that used to calculate baseline emissions from powertrains.

Total power deliveries to consumers will be metered and confirmed by data from ACS, meter equipment reflecting actual load, forming current regime of GPP work. Algorithm of ACS management is:

Growth of loads (consumption) → decrease of voltage → additional (power) engines started → increasing generation→ increasing gas consumption.

So in comparison with GPP working with external network, GPP on Vostochno-Perevalnoye oilfield actual consumption and actual delivery have more objective data, suitable for monitoring plan. All losses in local grid will be calculated as the difference between power generated and derivative of installed equipment capacity and hours of operation.

The Table 8 combines local and power-trains fuel consumption and emissions to calculate the total annual *ex-ante* estimate of baseline emissions.

Table 9: Baseline powertrains emission equations electricity generation, and total baseline emission

1. **Electricity and Heat generation (GPP and HS)**

	1	2	3	5 = 2 / (3*4)	6 = 1 + 5
PE3	Electricity supplied by GPP to the consumers of oilfield	Heat energy supplied by HS to the consumers of oilfield	Electricity network losses	Heat energy consumption from PE-6M in baseline	Electric and Heat enegry supplied by GPP and HS
	Elec_gen1	*Heat_gen2*	*Net_losses*	Heat_gen3	*Total_gen*
Units	MWh	MWh		MWh	MWh
	29 394,2	3 575,4	0,91	3929,0	33 323,2

2. **Electricity and Heat generation by PE-6M**

	1 (from 6, PE2)	2	3	4	5=3*4
PE4	Electric and Heat enegry supplied by GPP and HS to the consumers of oilfield	Coeficient of own needs of PE-6M	Electricity supplied on PE-6M with own needs	Consumption tons equivalent fuel per MWh	Total fuel consumption
	Total_gen	*Own needs_coef*	*Elec_gen2*	*EF CM*	*t_ufuel*
Units	MWh		MWh	tuf/MWh	t
	33 323,2	0,1122	37 062,1	0,5964	22 103,8

3. **Baseline powertrains emission equations electricity generation**

	1 (from 3, PE3)	2	3=1*2	4	5=3*4	6=5*44/12
PE5	Total fuel consumption	Energy per ton of unified fuel	Total energy conumption	Default carbon content	Total carbon content	Trains CO2 emission
	t_ufuel	*Energy_coef*	*total_energy*	*carbon_factor*	*total_carbon*	*trains_CO2*
Units	t	MJ/tuf	MJ	kg/GJ	kg	tCO2
	22104	29300	647642099,4	20	12952842	47494

1. For purposes of present sector of Monitoring Report emission factor CH_4 and N_2O was not defined due to it's extremely inferiority (< 1% from total emissions);

2. Default carbon content factor (rate for crude oil) was considered, as the most corresponding to specific of oil-field exploitation. (According to Table 1-3 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2, "Energy", Chapter 1).

4. Total baseline emissions

	1	2	3=1+2
PE6	Total CO2 emissions from APG flaring	Trains CO2 emissions	Total baseline emissions
	E CO2e flaring baseline	*trains_CO2*	*ECO2e_total_baseline*
Units	tCO2	t	t
	30 308	47 494	77801

2.4.8. Treatment of leakage in the monitoring plan:

No leakages were identified that correspond to net changes of emissions which occur outside the project boundary and are measurable and attributable to the Project activity. The emissions related to the supply of fuel for the emergency diesel unit and the emissions from installing the new equipment will not be significant. Much greater emissions could be associated with delivery of gas to grid power plants situated in region, which does not occur in the Project that presumes local on-site power generation and consumption. Therefore, the exclusion of leakages from the Project will assure conservatism in the estimation of emission reductions within the Project.

2.4.9. Description of formulae used to estimate emission reductions for the project.

Ex ante estimates of the total annual emission reductions for the Project have been derived in equation *PE7* as a difference between the total baseline emissions estimated by equation *PE6* in Table 9 and total Project emissions estimated by equation *PE2* in Table 7.

Table 9: Annual emission reductions

	1 from 3, PE6	2 from 6, PE1	3=1-2
PE7	Total baseline emissions	Total CO2 emissions project	Total emissions reduction
	ECO2e_total_baseline	*ECO2_combustion project*	*ER CO2e_total*
Units	t	tCO2e	tCO2e
	77 801	29 453	48348

Thus, the termination of oil firing and utilization of APG will result in the GHG emissions reduction during the monitoring period in volume of 48 348 tonnes of CO2-equivavlent.