JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM

Name of the Project:

Utilization of Associated Petroleum Gas at the Sredne-Khulymsk Oil Field

Project Owner:
JSC «Russian Innovation Fuel-Energy Company »
(JSC «RITEK»)

Moscow, 2009

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Annexes

SECTION A. General description of the project

A.1. Title of the project:

Utilization of Associated petroleum gas (APG) at the Sredne-Khulymsk oil field, Western Siberia, Russia. PDD Version 3.3
Sectoral scope 1,10
Dated May 12, 2009.

A.2. Description of the project:

The project includes utilization of associated petroleum gas (APG) on two modern power stations with the total installed capacity 15 MW located on Sredne-Khulymsk oil field (owner- JSC "RITEK"), Nadym district of Yamal-Nenets Okrug, Tumen region, Russian Federation (Figure 1a). Ten Cummins QSV 91G generating units of 1.5 MW of nominal electrical capacity each are installed at the plant. Power plant is design for APG utilization. Generated energy ensures operation of all complex of the basic and supporting equipment on the oil wells.

Power plant also supplied with four heat exchangers Alfa-Laval for heat utilization. Installed capacity 0,4 Gcal/h.

APG at the Sredne-Khulymsk oil field is obtained during the separation process at the booster pump station located next to the new power plant. The APG utilized within the Project was previously flared as shown in Figure 1b. Within the Project, part of the APG (approximately 19,4 million m^3 per year) is used by the power plant with the remaining APG flared as usual at the stack of the booster pump station.

History of the Project & Baseline Scenario. RITEK has started development of Sredne-Khulymsk oil fields in the end of 90th. Electric power for the oil production needs of the project owner was initially supplied by the so called PE-6M powertrains (mobile generating facilities consuming oil as a basic fuel) with emergency needs provided by diesel generators.

Within the Baseline Scenario the growth of power consumption at the oilfield was supposed to be covered by additional powertrains – roughly 15 trains of 1 MW capacity each. This scenario constituted the cheapest solution, with total cost of 15 additional power trains not exceeding 2 mln. Euro.

Figure 1. Project Gas Power Plant (GPP), (a), and the associated petroleum gas flaring at Sredne-Khulymsk oil field (b)
(a) (b)

Still the Project Owner opted for other ways of APG utilization that were analyzed and assessed within 2003-2004. Partly the refusal from the baseline scenario can be attributed to the innovation profile of the project owner - JSC RITEK within its mother Group LUKOIL. RITEK has been chosen as a testing ground for advanced technological and environmental solutions within the Group, that presupposed additional costs that were spent often regardless of the profitability considerations.

The key phases of the history of the project included:

- corporate decision on the exploring alternative solutions for APG utilization including those involving the Kyoto market mechanisms, taken on the meeting of the RITEK Technical Board on 25.09.2003
- commissioning of the related feasibility study by the project owner to the NIPIGazpererabotka research institute (Krasnodar, Russian Federation), contract concluded on 29.09.2003. The preliminary report of this study was issued in December 2003, the final report was ready by May 2004. The project alternatives examined by the Institute combined solution of the problem of APG utilization and electricity generation. The option chosen by the project owner presumed construction of GPP.
- Commissioning of the full-cycle work on the first block of the power station in Sredny Khulim to JSC Zvezda-Energetika (Saint Petersburg, Russian Federation), contract concluded on 22.06.2004. The job was to be executed on turnkey basis and presumed design, manufacturing of equipment, construction, assembly and launching into operation of the first block of the power station (GPP-1), based on the Cummins reciprocating engines.
- First block (GPP-1) officially launched into operation on 29.10.2005
- Commissioning of the full-cycle work on the second block of the power station in Sredny Khulim to JSC Zvezda-Energetika (Saint Petersburg, Russian Federation), contract concluded on 25.12.2006. The job was to be executed on the turnkey basis for the second block of the power station (GPP-2), based on the Cummins reciprocating engines.
- Second block (GPP-2) officially launched into operation on 28.12.2007

With the costs considerably risen within the new options for APG utilization-based power generation the issue of financial viability of the project have been raised on the corporate level. One of the possible ways to ease the financial burden was to use the opportunities of the Kyoto protocol market mechanisms, namely the Joint Implementation within the Article 6. The related perspective of the Russian participation in the JI mechanism became clear in September 2003 as long as the Russian Government Climate Change Commission initially approved the first version of the JI National Regulations fro the Russian Federation. This was a clear signal for the business stakeholders concerned and the project owner has chosen the Kyoto market opportunities to ease the APG utilization costs. The related income was taken into consideration within the corporate financial decision making arrangements on the project implementation.

Carbon revenues expected in the frameworks of the JI format are supposed to compensate substantially the expenses and will make the project as a whole profitable. Social responsibility of the Project Owner – the oil company, first of all from the environmental point of view, was the key driver for the project implementation. Within the Baseline Scenario in the absence of the project the power would have been generated by the oil-powered trains whilst the APG would have been flared.

In addition to the GHG emission reductions, the Project contributes to sustainable development of the host country by promoting the utilization of wasted APG which can be a valuable energy resource. The Project also leads to the reduction of local pollutants such as CH_4, CO, NO_x, through reduced gas flaring and more efficient combustion of the APG by the environmentally friendly low-emission gas engines.

The supplier of APG to the GPP and the purchaser of electric power produced is Project Owner – joint stock company RITEK. The quantities of APG within the oil field in its exploitation are defined by license of the Russian State Committee for Reserves (GKZ). The order of its utilization is regulated (also) by the license. It guarantees the perspective of gas generation, correct treatment and monitoring.

The electricity users are mainly groups of pumping stations, which are maintaining oil reservoir pressure by pumping water into the reservoirs 24 hours a day, other facilities ensuring oil production and transportation at the oil field, and heating devices. This requires the GPP generating units to operate 24 hours per day to meet the demand. Delivery of electric energy to the external grids is not reasonable from the technical point of view (as the oil field is located far from the nearest Transforming Station (PS), which makes unprofitable any possible construction of a grid for sales of insignificant volumes of additional energy). Besides, in Russia there is no legal mechanism to support the alternative power generation, and the tariff for electric power in a grid (in case if it approved by the regional power commission - REK) is calculated on the base of return of investment within 10 years. With the above factors taken into consideration, the power stations are meant to operate in an autonomous regime.

The basic operating mode for the Stations presumes that four units are operating at each station (at an average of 0,8 of total capacity). Two units are kept as a reserve capacity. The annual general electric energy production, taking into account the electric power consumed by GPP for own needs, makes 32,9 and 33,3 GWh accordingly. Station's own power consumption is regulated in accordance with Russian National norms (SNIPs), as 20 kWh per every MWh of energy produced. The general own power consumption, thus, makes – 2 GWh per year.

Main part of electric power is deliveries to the transformer substation ZRU-6 kWA and further to transformer facilities of the consumers at voltage 6/0,4 kV. The total installed capacity is 17,5 MW the energy-requiring equipment. Average rate of operation is ≈0,5 of the total capacity.

The Project will contribute to sustainable development of the host country by promoting the utilization of wasted APG which is a valuable energy resource and will reduce CO_2 and CH_4 emissions in two ways.

- Utilization of the APG in the efficient power generating facilities - gas engines, instead of their flaring,
- Substitution of crude-oil combustion in power generation by APG which has a smaller CO_2 – emission factor.

Estimated total reductions of GHG emissions will be around 105,223 tonnes of CO_2- equivalent (tCO_2e) per year and respectively 526,114 tCO_2e within the 2008-2012 crediting period.

JSC «RITEK» - project owner (investor) and power station operator.

According to the license agreement JSC "RITEK" is the owner of associated petroleum gas.

JSC «RITEK» is responsible for Joint Implementation Project and for implementation of the monitoring plan

A.3. Project participants:

Table 1: Project participants

Party involved	**Legal entity project participant (as applicable)**	**Please indicate if the Party wishes to be considered as project participant (Yes/No)**
Russian Federation (Host party)	JSC "RITEK"	**No**
Not indicated	-	-

A.4. Technical description of the project:

The project consists of two Gas Power Plants (GPP) with total installed capacity of 15 MW (7,5 MW each Plant), and necessary facilities for APG pre-treatment and transportation. Necessary electrical equipment is used for electricity delivery to the consumers. First GPP is also equipment with heat exchangers for wasted heat utilization.

A list of key project components is provided in Section A.4.2.

A.4.1. Location of the project:

The project is located 120 km south from the Nadym-city in the Yamalo-Nenetzky autonomous okrug (YaNAO), Tumen oblast, 2,500 km from Moscow (see fig. 2).

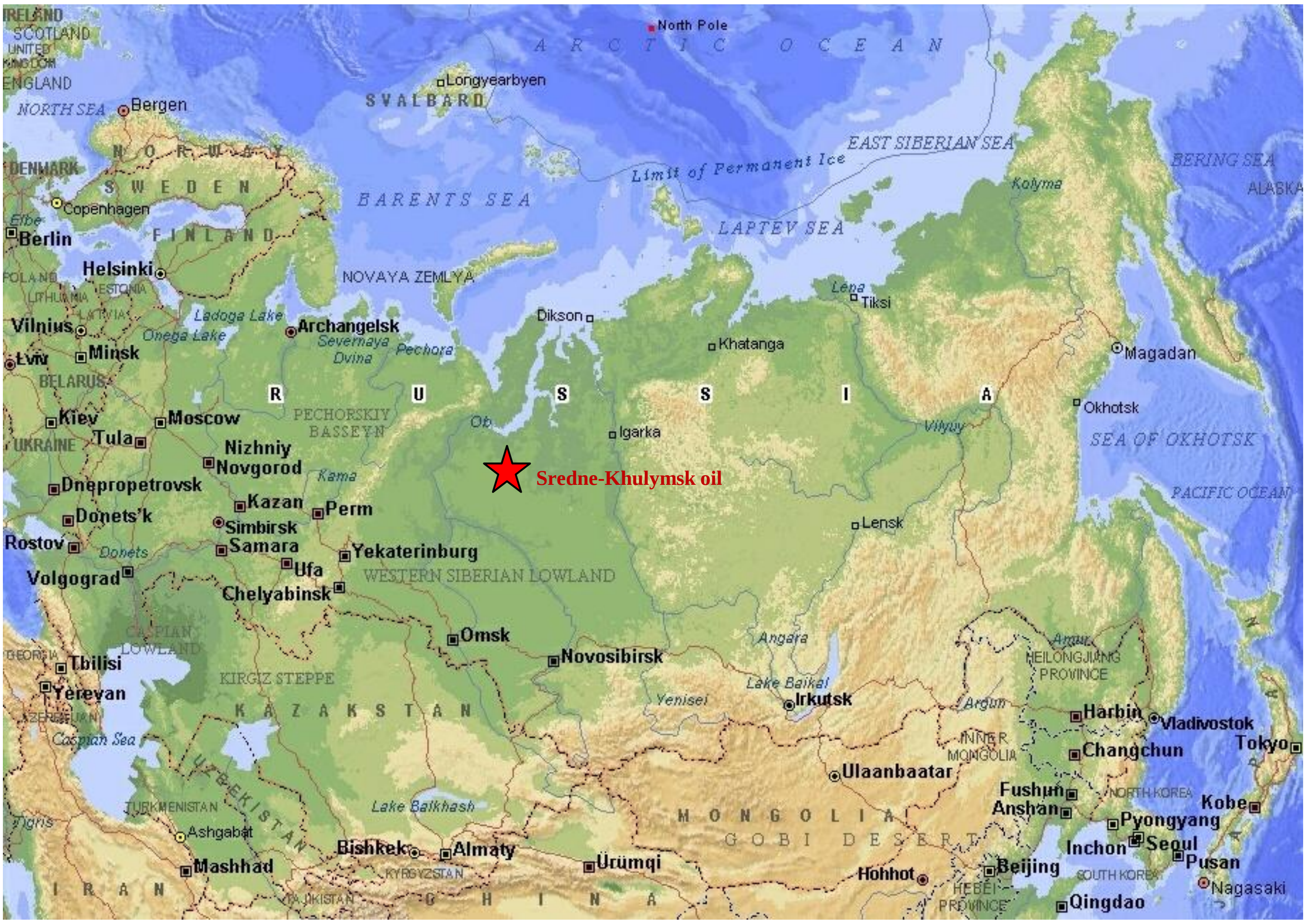
Site latitude - 64°31'34". Site longitude - 71°13'50". Sredne-Khulymsk oil field located between rivers Levaya Khetta & Hegiyaha in boggy district.

Figure 2.

General view

Of oil field

Figure. 3. **The location of Project**



A.4.1.1. Host Party(ies):

Russian Federation

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

Yamalo-Nenetzky autonomous okrug (YaNAO) located in the central part of Russian Federation. It occupies a part of territory of West-Siberian plain. The capital of the region is the city of Salekhard. YaNAO is a sparsely inhabited area with a population density of 0.7 persons per square km. The total population 538,000 people, that is spread across 750,3 thousands sq.km. Approximately 90% of the region's population lives in 8 cities.

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

Nadym is a city in the Russian Federation, administrative centre of the district - Nadymsky, YaNAO, Tumen region, third in size in YaNAO after Novyy Urengoy and Noyabrsk, one of very few Russian cities that are bigger then the regional capital (Salekhard), both in terms of population and industrial potential.

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

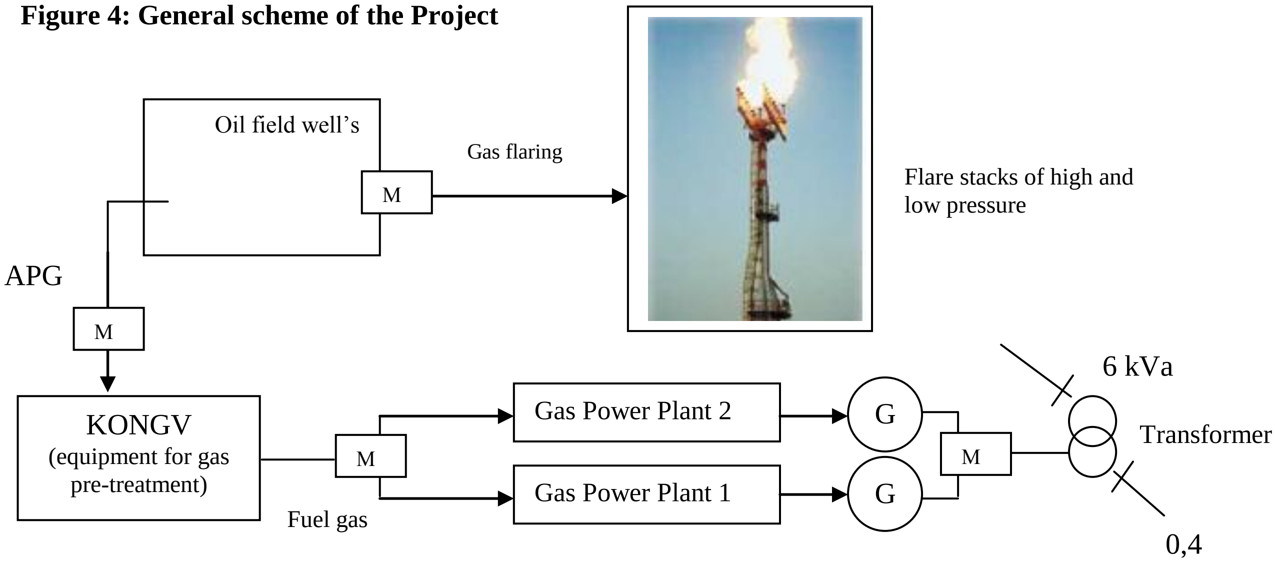
The Nadym district occupies the central part of the Western-Siberian plain and covers a river basin Nadym and the western part of Tazovsky peninsula. The western border of area passes through the watershed of the rivers Nadym and Poluj basins. In the south and the southwest the area borders with Khanty-Mansijsk autonomous region. From the east the border passes through the watershed of rivers Nadyms and Nyda basins on the one hand and a river basin of Pur — on another. In the north-east part of Tazovsky peninsula, the area borders with Tazovsky district. Northern border passes through the water areas Obsky and Taz bay. The total area makes 110 thousand square kilometers. The territory is covered by a number of lakes and more than is half boggy. Besides the largest river Nadym, the rivers Pravaya Hetta, Levaya Hetta and others flow through the area territory. The large part of the land in the district is permafrost ground.

The climate of Nadym district — subarctic continental with long severe winters, and relatively cool enough short summers. Cold air masses from the north move through its flat lands freely, reaching southern borders of area, and also the hot winds of Central Asia and Kazakhstan move from the south to north. All this leads to sharp and unexpected temperature changes, which annual amplitude of fluctuations makes 95 degrees by Celsius scale. Average temperature of the coldest month - January – 23,5 degree below zero, and the warmest — July — nearby 15 degree, average annual temperature is 6,5 degree below zero. An absolute minimum —62 degrees below zero, an absolute maximum — 35 degrees above zero.

The basic riches of Nadym area are the natural gas and oil; other minerals in its territory include sand, clay and peat. All the amounts of oil and gas produced in the district are mined in the triangle between rivers Nadym, Pur, Taz.

The oldest and largest (of the country) gas fields are located in Nadym district; they are operated here for 35 years and provide the cheapest in the world hydrocarbon fuel not only for Russia, but also for many countries of Europe. More than 170 billion cubic meter of the high-quality gas is produced here annually containing basically — methane. The new 40 oil/gas/condensate deposits are discovered and operating in the region, including the giant ones like Medvejye, Jamburgskoye, Urengojskoye, North Urengojskoye, Pestsovoe, North Komsomol, Sugmutskoye, Jurharovskoye. Mining of hydrocarbons in territory of Nadym area is conducted on 18 fields. Twenty fuel/energy companies work on the territory of Nadym area, from them nine enterprises are engaged only in investigation and exploration of the oil and gas fields. In YaNAO as a whole, Nadym's area share in mining is: natural gas = 30,4 %; Oil = 11,5 %, gas condensate = 24,2 %.

Figure 4: General scheme of the Project



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

The 15 MW of installed capacity of the Project consists of 10 * 1,538 MW gas-fired reciprocating engines (Cummins QSV 91G). The gas engines are connected with LSA54 XL10 electric generators manufactured by Stamford HV824C.

The major components of the Technological Solution within the Project design are summarized in Table 2.

Table 2: Project components (a)

Equipment type	Quantity	Parameters	Notes
Power-block			
GPP - QSV 91G Cummins, manufactured by JSC «Zvezda Energetika»	10	1,538 MW_e per unit. Efficiency, 38,2%, with heat 79% (1,668 MW/h), estimated expenditure of gas 293 cubes/MW	The gas-reciprocating engines are equipped with inner cooling .
Gas power plant automated control system (ACS)	1	ACS includes the control system of each generating unit, the synchronization system of the units and the GPP control system.	The GPP ACS ensures: 1- Operational control of the GPP by automated workstation and monitoring of technological processes at the power generating units, switch gears (6 kV, 0,4 kV, inhouse transformer); 2- Retrospective evaluation of GPP's operation mode; 3- Timely detection of emergency situations with precise indication of the damaged areas.
Transformers 6/0,4 kV	49	6 kVA, capacity 160-1000 kWA.	For electricity consumption and for delivery to fiders
Fire fighting and alarm System	2		The Project is implemented in compliance with the existing norms and standards for explosion and fire fighting requirements and ensures operation safety

Communications	1		Radio relay equipment is applied
Pre-treatment Block			
Oil-gas separator 1-stage NGS 1,0-2,400-2	1	P=1,0 MPa, V=50m^3, Gfl=7200m^3/d	The APG treatment plant includes 2 gas separators, 2 pump separators, 2 flare separators, drainage, and the gas pressure control unit
Finite separator NGS1 -1,0-2000-2I	2	P=1,0 MPa, V=25m^3, Gfl=3600m^3/d	
Gas separator GS 1-2,5-600-2-I	1	P=2,5 MPa, V=0,8 m^3, Gfl=7200m^3/cd	
Gas separator NGS 1-1,0-2000-2-I	1	P=1,0 MPa, V=25m^3,	
Flare separator	2	P=1,0 MPa, V=10m^3,	
Tank for condensate collection ON-100-10MB	2	P=1,0 MPa, V=100m^3,	
Buffered tank 1-50-1,6-3	2	P=1,6 MPa, V=50m^3,	
Via gas-heater	1	Qn=2350t/s; Po=6,4 MPa; Qt=1,86 MW	
Heater-Treater manufactured by Hanover Maloney Inc.	2	V_1=100m^3, P_1=0,5 MPa, V_2=100m^3, P_2=0,4 MPa, t=93°C; $Q_{\text{Н}}$=1200t/d; $Q_{\text{В}}$=1200 m^3/d	
Drainage tank with pump NV 50/50	1	V=12,5m^3, Q-105 m^3/h, H=490 m	
Glicoles block for gas drying	1	Q =40000 m3/d	
Centrifugal pump multisenctional CNS 105/490	3	Q=105 m^3/h, H=490 m	
Centrifugal pump multisenctional CNS 105/490	4	Q=38 m^3/h, H=66 m	
Modal pumping station (ANT-150)	3	Q=30 65 m^3/h	
Flare stack of low pressure UBMG 200	1	Ø=200mm	
Flare stack of high pressure UBMG 300	1	Ø=300mm	
Tank for diesel fuel	2	V=5000m^3	

Table 2. (b) Implementation schedules

#		2003		2004				2005				2006				2007			
				Quarters				Quarters				Quarters				Quarters			
1	Corporate decision on feasibility study preparing 25.09.2003																		
2	Business planning phase																		
3	Corporate approval																		
4	Design project																		
5	GPP-1 installation (4un.)																		
6	GPP-1 commissioning																		
7	GPP-2 installation																		
8	GPP-2 commissioning																		
9	GPP-1 additional unit																		
10	Project commissioning																		

A.4.2.1. Characteristics of the GPP's basic components

The main components of the GPP are:

- QSV 91G Cummins gas-reciprocating engines produced by *JSC Zvezda Energetika*,
- Stamford HV824C
- 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 is APG that is separated at the Sredne-Khulymsk booster pumping station. Minimal CH_4 index without decreasing power is 52 %. APG after separation is divided 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.

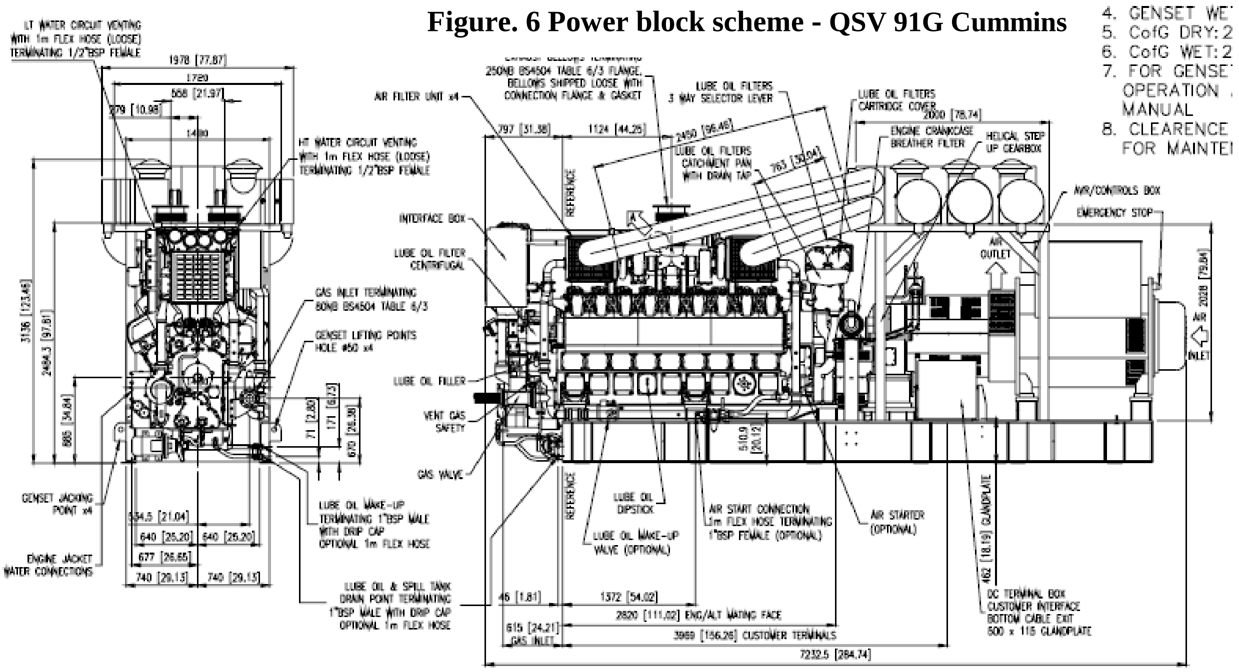
Figure. 5 Block of QSV 91G Cummins

Electrical Interconnection Systems

The GPP includes the following electrical equipment:

- 10 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)

Figure. 6 Power block scheme - QSV 91G Cummins



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 64,2 GWh/year. Own power consumption of the stations is approximately 2 GWh/year. Power supply for own needs is provided from external feeders on voltage 380 V. Delivery of the electric power is carried out by 6 kV cables to the related transformers and facilities. In case of emergency switch-off of a gas supply system, or in other cases of absence of gas in APG processing facilities the power plants use emergency diesel fuel. Transition to emergency operation of work on 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.

As electric power transfer occurs on low voltage grid, it assumes rather high level of losses. The existing national norms (that may be considered obsolete) presume 2% losses for high voltage grids, and 9% losses for low-voltage grids in Russia, regardless of the distance for power transmission. Energy auditing and metrology is necessary for an estimation of practical losses. At the state level works on metrology have started in 2005, and will be possibly finished in 2016. Therefore using the existing norms for the assessment of losses may seem to be the only legitimate way for their estimation.

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 interconnection with external networks.

A.4.2.2. Technological flow diagram

Figure 7 represents technological scheme and monitoring point locations for the Project facilities. The description of the monitoring points is provided in Table 3 following the diagram.

Figure 7: Technological flow diagram

Oil field wells

Gas flaring

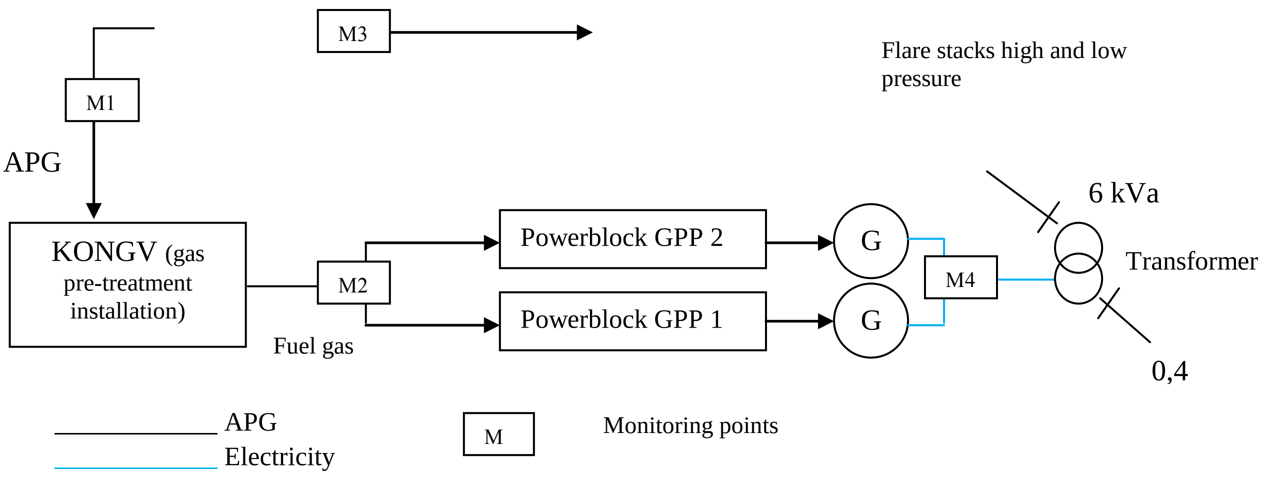


Table 3: Description of monitoring points

Monitoring Point	Location	Parameters to monitor	Quantity | year	Metering equipment
M1	KONGV station (enter)	Gas volume explicated in normal cubic meters	More than 19,4 mln cubic meters	Flowmeter
M2	KONGV station (exit)	Gas volume explicated in normal cubic meters	Not more than 19,4 mln cubic meters	Flowmeter Dymetic 9421, IRVIS-RS4
M3	Flare stack	Flaring on a stack superfluous gas volume and pressure	Actual volumes	Flowmeter IRVIS - RS4,
M4	Fiders on GPP	Electricity delivery	66,2 GWh	Electricity counter SET 4TM

Specific training on the monitoring procedures and techniques is not required due to the high professional level of expertise of the personnel of the Project Owner at the production site.

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

In the baseline scenario, 19,4 million m^3 of APG will continue to be flared annually at the Sredne-Khulymsk booster pumping station. In the Project scenario, this volume of APG is captured and burns in the installed gas engines to supply 66,2 GWh of electricity per year to support pumping requirements for the Sredne-Khulymsk oil field. In the baseline scenario, an equal amount of electricity will be generated by the power trains which are fuelled by crude oil from oil field.

GHG emission reductions, that will be included in the calculation of the emission reductions due to the Project, will occur in two locations (see table 4):

- Reductions at the Srende-Khulymsk field will occur because the captured APG that was previously flared will be combusted in the gas engines with much higher efficiency than it is in the local flare. This will generate the emission reductions due to the combustion of the unburned fraction of the APG that was previously directly directly escaping into the atmosphere from flare stack.

• Reductions will also occur since the crude oil combustion in powertrains for power generation will be changed to combustion of APG that has lower GHG emission factor.

Table 4: Ex ante emission reduction estimates

	Items	Units	Baseline Emissions (index b)	Project Emissions (index p)
A	APG flared/combusted	1000 m^3	19,400	19,400
B	Complete combustion of APG	tCO_2	46757	59363
C	Unburned APG in terms of tCH_4	tCH_4	1573	-
D	Unburned APG in terms of tCO_{2e}	tCO_2	33052	-
E	Total local emissions	tCO_2	79809	59363
F	Net fuel consumption (tons equivalent fuel)	Tuf	39455	-
G	Power trains emissions	tCO_2	84776	-
	Total emissions	tCO_{2e}	164586	59363

Flare combustion is less efficient than more tightly controlled combustion in gas engines. However, there are no international standardized methods of precisely calculating such emissions from readily available data. Therefore, calculations of the methane emissions from flaring of APG captured and utilized by the Project is based on 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 St-Petersburg Institute for the Air Protection of the of Rosgidromet (Russian National Service of Hydrometeorology and Environmental Monitoring). This methodology has been approved and endorsed by the Decree of the State Committee for Environmental Protection – GosKomEcologiya (# 199 of 08.04.1998) and adopted from 01.01.1998 as the appropriate basis for reporting hazardous emissions from flaring of APG.

Rosgidromet methodology is the most widely accepted approach used by the Russian oil and gas industry. It provides all relevant parameters, algorithms and measurement requirements to calculate the emissions of hazardous substances (including methane emissions) that are accounted in the project baseline as a result of the incomplete combustion of the APG. The calculation of methane emissions is based on the following parameters:

• Technical parameters of the stack and characteristics of APG (flow rate, composition, density) and of the APG components (density, molecular mass, adiabatic index, carbon mass content, etc).

• The mode of APG combustion (subject to non-black firing test). The non-black firing test is implemented to determine the quantity of methane emissions vented into atmosphere due to low combustion efficiency of the flare (so-called under-firing). Black-firing mode refers to under-firing to a degree that flare emissions contain significant soot and under-fired hydrocarbon emissions, including methane. The methodology provides default factors for the emission rates for both non-black firing and black-firing combustion. These factors are the integral part of the approved methodology and were established on the basis of the program of on-field measurements for the industrial flare stacks in Russian oil and gas industry.

Current national policies provide minimal incentives to oil producers in Russia to use APG more efficiently or to reduce flaring. The main obstacles for APG flaring reduction projects in Russia are as follows (see also the Section B.1 of the PDD):

• Regulated prices for APG at the entry of gas processing plants are too low to encourage development of new APG transport and processing facilities. These prices remained non-revised from their 2001 level until now at the range of 2.8 to 17 USD/1000 m^3 depending on liquids content. The Russian Federal Tariff Regulation Office drafted new marginal wholesale prices on APG for 2007. According to this draft, minimal marginal tariffs range within 5-29 USD/1000 m^3, and maximal marginal tariffs are within 6-39 USD/1000 m^3 depending on liquids content. However, these new prices are not applicable yet.

Hence, the Project, even within the most favorable circumstances (maximal world oil prices, low APG prices), cannot be assessed as commercially viable; according to the calculations of its commercial profitability below, it generates net operational losses due to the difference in investments payback time between the baseline (roughly 5 years). Calculations for this period show additional annual costs for the project line of 2.098 thousand euro compared with the baseline, that can be treated as operational losses (from the baseline viewpoint). For the whole period of 5 years these losses reach 10.090 thousand euro. With this in mind we may conclude that the Project is financially unattractive for the Owner.

- High investment costs and inadequate returns of APG utilization projects compared to other highly profitable alternatives for the oil companies. The facilities for the utilization of the APG were usually not integrated in the oil field production schemes and may imply a construction of the new infrastructure for collection, treatment, and transport of the APG. These investments tend to be uneconomic for remote oil fields with limited local energy needs and long distances to the gas processing facilities or consumption markets. The oil companies also face structural barriers such as limited access to the existing gas transmission infrastructure and low prices for the APG negotiated with the transmission companies or gas processing facilities.
- Low environmental fees for the emissions of polluting substances during APG flaring. According to Amendments to the Governmental Decree of 12.06.2003 # 344, issued on July 2005, the fee rate for methane emissions contained in APG flared by stationary sources is 250 rubles (about 10 US dollars) per ton of methane equivalent. Mentioned fee rate was applied for basic investment analysis. This level of environmental payments does not imply any significant impact on the investment decisions of the oil companies. Since January 1, 2009 fee rate was increased by the RF Government Ordinance #59, dated 09.02.2008. In accordance with Ordinance fee rate at 2011 will grow up in 113 times (≈€ 660/tn CH_4) for every ton exceeding 5% limit (approximately 1000 US dollars) of APG flaring.

Taking all this into account, including local specifics, e.g.: absence of GPP operating experience by the Project owner, high investment costs of the project, relatively high operation costs, the Project cannot be considered as economically attractive for the Owner. Therefore its implementation in the mode described above can be explained only by its environmental importance, including intentions to reduce the emissions of GHG.

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

The crediting period for this project is from 2008 through 2012. Estimated emission reductions during the crediting period are 105,223 tCO_2e per year or 526,114 tCO_2e in total (Table 5).

Table 5: Ex ante estimates of emission reductions by year

Length of the crediting period	**5 years**
Year	**Estimate of annual emission reductions in tonnes of CO_2 equivalent**
2008	105223
2009	105223
2010	105223
2011	105223
2012	105223
Total estimated emission reductions over the crediting period (tonnes of CO2 equivalent)	526114
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	105223

A.5. Project approval by the Parties involved:

All necessary approvals will be obtained later in accordance with Decree #332 from May 22, 2007.

SECTION B. Baseline

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

This section defines and justifies the selected baseline scenario following the Annex B of the JI Guidelines and the JISC "Guidance on criteria for baseline setting and monitoring". The baseline is established on a project-specific basis using two main steps:

- By identifying and listing alternatives to the project activity on the basis of conservative assumptions and taking into account uncertainties;
- By identifying the most plausible alternatives considering relevant sectoral policies and circumstances and other key factors that may affect a baseline. The screening of the alternatives is based on analysis of the technological and economic considerations, as well as on the prevailing practices.

Step # 1. List alternatives to the project activity that can be a baseline scenario.

The decision making context of the Project includes two entities:

- Project owner, which operates the Sredne-Khulymsk oil field, has flares the APG before the Project.
- the GPP-1 and GPP-2, receiving gas from KONGV (gas pre-treatment unit), generate electricity for own consumption of the oil field.

Since the project is carried out on the oil field situated far from main networks (gas, power) which could change a number of Project – related issues, the Owner of the project can be determined as a monopolist, who doesn't have alternatives in the mode of the project implementation; therefore it appears appropriate to consider given parameters and figures as average (similar) for the region.

The APG produced at the Sredne-Khulymsk oil field can be treated in the following possible ways by Owner or with involvement of a third party:

1. Continuation of APG flaring at with power generation provided by the powertrains. This is the business-as-usual scenario, used by the overwhelming majority of the oil and gas companies in the situation similar to the Project owner's one.
2. The proposed Project - reduction of APG flaring installation of the GPP and electricity generation for the local needs using the APG.
3. The GPP Project could be developed on the base of gas turbine technology instead of four-stroke reciprocating engines.
4. The GPP Project could be of a smaller or larger scale in case if it could be commercially viable.
5. Reduction of APG flaring and re-injection of APG into oil wells.
6. Reduction of APG flaring and delivery of APG by the Project owner to the gas processing plants for conversion to dry gas, LPG, or condensate for downstream utilization, or delivery of the APG to the gas transmission pipelines.
7. APG combustion by existing powertrains for electric power generation

These options cover all of the alternatives for baseline identification that are listed in CDM methodology AM0009, for example. The comparison of AM0009 alternatives and the list above is as follows:

Table 6: The comparison of AM0009 alternatives and the possible alternatives to the Project activity

AM0009 Alternatives	Options considered as possible alternatives to the Project activity

Release of APG to atmosphere (Venting)	Not considered
Flaring at the Project site	Option 1
On-site APG utilization	Options 2 through 4
Injection into oil reservoir	Option 5
Transportation, processing, distribution to end users	Option 6

Venting is not an acceptable option for this project because it is not legal under Russian regulations. Therefore, this is not a plausible future scenario.

Options 3 and 4 test technical Project variants to provide robust assessment of which options are the most plausible future developments that involve on-site electric generation.

Re-injection and downstream processing are the alternatives available to the RITEK as owner of the APG without the project, and complete the list of possible options to be considered.

Step # 2. Identifying of the most plausible alternatives considering relevant sectoral policies and other key factors that may affect a baseline.

<u>1. Continuation of APG flaring at the oil field and supply of the power needed for local facilities by the powertrains</u>.

The specific feature of the oil field is the proximity of the APG sources and the oil field facilities to the GPP. All customers also (pumping and other facilities) are located within 5 km from GPP. At the same time the nearest high voltage grid – LEP - situated far from oil-field, and that makes energy consumption from external distributors unprofitable. Above this, technical connection to external networks presents a serious problem and involves high additional costs (200-400 $ per 1 kW of power capacity).

Since 2003, (after adoption of the new State Law on Energy Sector Reform) the country is experiencing fast growth of prices for power that gave an additional reason for the Owner to develop in-house generation facilities.

Currently, economic incentives are insufficient to attract most oil companies to efficiently use APG. No tax for APG flaring is imposed on oil companies. The only payments oil companies are required to make are the environmental fees for emissions of the polluting substances (i.e. methane) into the atmosphere. These fees are extremely modest compared to the investment costs required to productively utilize the APG. The current methane fees for flared APG per barrel of oil produced are less than 1.0% of the sales price of a barrel of oil. Thus, methane fees for flaring will have no perceptible influence on decisions regarding oil production and related APG output. The only argument that can be suitable in present situation – step-by-step enhancement of control growth under the basic conditions of license agreement – requirement of APG utilization. Last thing will probably become such a motive in a distant future.

In this context, from 53- 55 billion m^3 of APG produced annually in Russia, about 45% is purchased by gas processing plants, 26% is utilized at the oil fields, and more than 25% is flared. A similarly low rate of utilization of the APG is observed in the YaNAO.

Oil producers in this region can earn very high returns on investment, expanding oil production and are much more likely to allocate funds to production rather than to less financially attractive APG utilization facilities. According to the head of the Gas and Natural Resources Department of neighboring Khanty-Mansiysk Autonomous Okrug, the payback on investment in oil production tends to be less than one year. No APG utilization projects are likely to offer a similar return.

In addition to the overall sectoral circumstances, the following project-specific arguments suggest that continued flaring at the Sredne-Khulymsk field is a highly probable future scenario through 2012 and beyond as long as current economic and regulatory conditions prevail:

- Traditionally problem of power supply on this oil field was effectively solved by powertrains, combusting crude-oil as fuel, since it was and continues to be the cheapest solution.
- There are no gas processing plants or APG delivery networks available in the immediate vicinity to the Sredne-Khulymsk oil field. No plans exist to construct them in future. Thus, considerable additional investments would be required to transport and process APG for downstream utilization, that don`t have a commercial perspective, given the volumes of the APG at the oil field.

- The technological solution in oil mining at the Sredne-Khulymsk oil field presumes use of water to maintain pressure for oil extraction. Additional investments are needed to replace water with APG for injection; this option was considered by the Project Owner on the business planning phase (2003-2004) as the remote perspective, going beyond the Project timeframe. Thus, possibility of further APG flaring exists, and can be considered as an alternative to the Project.

<u>2. Proposed Project presuming the reduction of APG flaring, construction of the GPP and power generation for the local needs using the APG, that is currently implemented by the Project Owner.</u>

It should be noted that the Project Owner already possesses the experience of on-site electric generation at some oil fields. However, in this case the choice has been made, taking into account the local specifics, namely the absence of access to external grids. In this case the Power plant operates in an independent mode, and power supply of each well is provided by the cable-lines that are connected with power distribution facilities of the GPP.

Within the investment analysis approach and cost assessment provided in Section B.2 (Investment analysis sub-section), the total Project cost for the Project Owner is estimated at 15 million Euro. This estimation is based on a conservative assumption of after-tax rate of return of 14%. Thus, annualized Project investment costs for Owner can be estimated at 3,8 mln. Euro. The investment costs recovery of the Project equals 9 years (at the standard full amortization of the generating equipment equals 7 years). The project at existing costs is below the threshold of profitability existing for the first class borrowers for crediting period - project planning (7 years for a full recovery at 14 % annual). This clearly demonstrates that the project is not economically attractive to the Initiating party. The possibility exists for the Initiating party to compensate a part of the Project costs by using the Kyoto mechanisms, namely the Joint Implementation. This opportunity was considered at a stage of business planning of the Project.

Due to revenues from sales of GHG emissions reduction for roughly 4,2 million Euro during 2008-2012 the economic parameters of the project improve. Its profitability increases above the level of 14 %, and the time of recovery of investments is reduced approximately to 6,4 years. Thus, taking into account carbon revenues the project reaches the minimal level of the profitability acceptable in Russia for large corporations – the first class borrowers, though it remains still below the average level of profitability for investments in the oil & gas industry.

At the same time using powertrains according to baseline scenario would mean total investment costs around 2 million euro for the same generating capacities, and a time of recovery of investments - approximately 2 years, with annual operational expenses of 970 thousand euro. Beside this, installation of power trains does not require considerable time for design, and for the project implementation as a whole. The project of power station on the basis of PE-6M is a typical certified technological solution, requiring no additional environmental assessment & expertise. It is necessary to mention also that the project planning phase within the corporate decision making procedure within the Project Owner took place in 2003-2004 when the prices for crude-oil were below the level 30$ barrel and therefore, the potential revenues from the additional volumes of oil were considered to be lower the level needed to compensate the costs of the Project. All this gives ample ground for conclusion, that the Project Owner did not have sufficient economic reasons to investments in the Project, and Project implementation was not considered to be economically efficient alternative.

<u>3. The installation of gas turbines instead of gas engines for power generation using APG.</u>

This alternative was not considered by the Project Owner as technologically realistic, though the turbine solution had some advantages, including smaller size and smaller costs for MW installed. Still, the Project Owner explored this option and rejected the gas turbine technology for the following reasons:

- The efficiency for gas turbines (GT) is (usually) not higher than 32%, compared to 38-40% for Cummins engines operating at full load. Steam-gas cycle (that can raise total efficiency) is appropriate when the GPP has possibility to deliver power to external networks. But since it is not so, and internal consumption is characterized by significant fluctuation in demand, the gas turbines seems to be not inappropriate for this.
- The climate of Western Siberia is harsh with severe winters and warm summers. The temperature varies from - 40°C through + 20-25°C, and these changes do affect the GT efficiency that drops by 15-20%. At the temperature higher than + 30°C, the GT efficiency is even lower. On the contrary, Cummins has a high degree of resistance against the temperature changes, keeping its efficiency parameters high and steady.
- A Cummins engine can be started up and halted without limitation. Starts and halts do not affect the length of service of the engine. As for the GT, the situation is different; 100 starts of the GT reduce its service life by 500 hours.

• The service life until the overhaul for a GT is 20,000 - 30,000 hours, whereas for a Cummins engine it is 60,000 hours.
• Specific equipment costs, fuel consumption rates and O&M expenses for GT in this size range are higher than those for a Cummins.

Based on these findings, development of the Project with gas turbines replacing the gas engines is not more attractive than the Project as proposed. If the Project, as proposed, does not offer competitive returns, the gas turbine variant will certainly not be attractive. The GT alternative is not a plausible future scenario for the Project since the Cummins option proves to be more efficient and reliable.

4. Construction of larger GPP with increase in quantity of utilized APG and sales of a part of the electric power to external consumers/ construction of a smaller size GPP.

The larger size option presumes competition with local power networks that appears to be not realistic. The key power company Tumenenergo is the transit grid system connecting the West and the East of the Russian Federation, because of this any admission of alternative power producers and power suppliers (even, despite the lack of capacities) is extremely complicated. Russia is operating a two-level power network system, in which low voltage grids (less than 220 kV), are subordinate to the federal grids – FSK UES (220 kV and more). Connection to high voltage grids are possible, however it is this possibility exists in reality only for «big power plants» (200 MW and over). Connection to local distributive networks is inconvenient, since they are overloaded and operating mode of power station will be complicated in these frameworks, since it will be defined by regional dispatching management (RDU), and the generating equipment will therefore operate in an unstable regime, delivering low-quality power.

Besides that, the expenses needed to construct interconnecting cable lines are considerable and comparable to expenses for the GPP itself. The mechanism of compensating these costs does not exist in Russia. Until 2007 the ownership of networks constructed by independent power suppliers, was bound to be that of the local grid company, that assumed the property rights (free of charge) shortly after the construction of each related line. It should be also acknowledged that power production of the GPP depends on stability or instability of APG-production, and stability of APG quality; since both cannot be totally guaranteed, the GPP as an independent power producer cannot provide guaranteed quantities and quality of power, and this unreliability can cause penal sanctions from the grid operator.

The first case of establishing national regulations targeted to support investment projects in the field of power generation presumed introduction of in addition investment extra charge to the power tariffs. However, currently this mechanism has been approved exclusively for the Kaliningrad region (“Yantarenergo” power company) for TEC#2. This case is unique due to the region’s isolated location. There were no other cases of introduction of similar policies in Russia so far. Therefore the Project is based on independent (autonomous) generation mode. For this purpose taking due note of the relevant state requirements for generating capacities, two GPP stations were constructed, each one duplicating the other.

Total generating capacities within the Project have been divided between two stations (that has solved a problem of obligatory capacity reservation). Within the limits of the Project generation capacities are destined to the existing demands. Investment costs for the Project do not depend linearly on the Stations’ sizes. In general, the average expenses per 1 MW decrease as long as the station’s size grows. The chosen variant with 6 engines in constant operation, 2 peak and 2 reserve ones is optimal, as long as smaller GPP couldn’t satisfy the peak demands, which is definitely one of the key requirements for a new power generating facility. This clearly demonstrates that construction of a smaller size GPP can not offer an environmentally friendly and technologically reliable option for the Project.

5. Reduction of APG flaring and re-injection into the oil reservoirs.

Re-injection of associated petroleum gas into oil reservoirs is one of the methods to increase oil extraction, as it helps maintain reservoir pressure. The technological solution in oil mining at the Sredne-Khulymsk oil field presumes use of water to maintain pressure for oil extraction. APG injection as an option was considered by the Project Owner on the business planning phase (2003-2004) as the remote perspective, going beyond the Project timeframe. At the Sredne-Khulymsk water injection system is operating efficiently; this system includes a group of pumping stations that are constantly pumping the water into the oil reservoirs. These stations consume the power delivered by the GPP within the Project.

Given the considerable costs invested by the Project Owner in water injection infrastructure, taking into account local hydrology, climate and the low cost of water used for this purpose, the APG re-injection can not be considered as economically attractive alternative for the Project Owner. Still, possibility of re-injection of APG in reservoir is now being considering by Project’s owner (as a technological experiment), but perspective of commercial use of this technology is distant and is definitely outside the Project timeframe.

Therefore, this option can not be considered as a plausible future scenario.

6. Delivery of APG to gas processing plants or to a gas transporting pipeline.

Implementation of this scenario is an unlikely due to following reasons:

- APG delivery to the nearest gas processing plant located in the city of Noyabrsk at a distance of 400 km from Sredne-Khulymsk oil field requires huge investments, of many millions. For example construction of 1 km of the gas pipeline could cost 1,0-1,5 million €. Thus the total cost of the gas pipeline would require an investment of 400 to 600 million €. The volumes of AP gas available at the oil field are definitely not enough to guarantee a pay-off of such a project.
- Construction of a new gas processing plant at this site would also be excessively expensive. Based on available data, we can assume that construction of a gas processing plant for a comparable volume of APG would cost 28-40 million euros. The Sredne-Khulymsk APG has an attractive composition due to significant fraction of gas liquids. This fraction (20% of APG volume) can be effectively sold on the market. But remaining part of APG - methane - can be transported from the oil field only in the liquefied form. However there is no necessary infrastructure for liquefied gas transportation in Russia. The necessary national technical regulation (TU) for this type of gas transporting is not developed yet, and this presents an additional problem, especially taking into the related hazard effects of methane. Thus, the economic benefits of such option are not obvious.
- There is a gas pipeline nearby to oil field location that belongs to JSC "Gazprom". However access to them and perspective of their use for APG sales, are not clear due a number of constraints. Sredne-Khulymsk APG can not be delivered to gas transporting pipelines without preprocessing needed to change it in accordance with pipeline transportation standards - GOST for natural gas. Even with this done, the supply to the gas transmission pipelines of Gazprom could face barriers due to the risk of facing limited access to the gas transmission infrastructure, taking into account the lack of free capacities in Gazprom system. In addition, Gazprom generally accepts to pay a low price for the APG that may not be enough to cover the costs needed to develop the related infrastructure for gas collection, treatment and transportation. And above all, additional gas volumes from an outside producer being injected in the Gazprom transport system at the Gazprom key gas producing region, actually means decrease of revenues of state monopoly. All this reduces chances of this similar scenario of APG treatment practically to zero.

7. APG utilization by the existing powertrains.

This variant, being more expensive, than baseline one and is less environmentally friendly, than the project scenario. Its implementation would lead not to reduction of fuel consumption, but to its growth. Numerous generation capacities create, being unified, a certain complexity both technical and organizational. Absence of a local-external power supply grid would result in increased losses of the electric power, no-result work of generators. All this would result in general an additional growth of fuel consumption up to 15 - 25 percent. Besides, all existing schemes of powertrain fueling are based not on pure APG, but on using either pure oil, or a combination of oil with APG. Thereby the goal - APG utilization, presumed by the project, would not be reached completely in terms of volume. At the same time, with the efficiency of power trains PE-6M averaging 66-70% of the efficiency of GPP "Cummins", the fuel consumption for electric power generation at project level was essentially more in this option than within the Project. Besides, the given variant would provide development of expensive system of APG pre-treatment which is absent in the base scenario. Thereby, it is possible to define that the given variant cannot be considered as a real alternative to the project from the environmental point of view and cannot be considered as realistic alternative to the baseline scenario from the economic point of view.

Conclusion:

Based on above considerations, the only option can be regarded as plausible and credible candidate for the baseline scenario at this site:

- Option 1: Continuation of APG flaring at the Sredne-Khulymsk oil field with power needed by the Project Owner generated by the powertrains.

The key information and data used to establish the baseline (variables, parameters, data sources etc.) in tabular form:

Data/Parameter	$V_{F,y}$
Data unit	Nm^3
Description	Volume of the total recovered gas measured at point M2, after pretreatment, during the period *y*
Time of determination/monitoring	Monthly
Source of data (to be) used	Flow meter
Value of data applied (for ex ante calculations/determination)	19400000
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 and GPP's exploiting company (Zvezda Energetika).
QA/QC procedures (to be) applied	Volume of gas 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	Vi
Data unit	(%)
Description	Composition, of recovered gas measured at point M2, after pretreatment, during the period *y*
Time of determination/monitoring	Two times a year (winter, summer)
Source of data (to be) used	Measurement providing by authorized company
Value of data applied (for ex ante calculations/determination)	Vi (shown below)
Justification of the choice of data or description of the measurement methods and procedures to be applied	Basic figures for calculations meters by authorized company on its chromatograph, at the junction point and at exit from KONGV pre-treatment. Annual figures will be the APG volume weighted averages of two-times a year figures.
QA/QC procedures (to be) applied	**QA**: measurements from the flow 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 (once in five years) calibration of the meters by the regional representatives of State Office for Metrology and Standardization
Any comment	-
Data/Parameter	Gen El.
Data unit	MWh
Description	Electricity supply to consumers at Sredne-Khulymsk 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
Value of data applied (for ex ante calculations/determination)	66200 GWh
Justification of the choice of data or description of the measurement	Electric meters are installed at the 6 kV (0,4 kV) in-door switch gears, data will be archived electronically and in monitoring workbook.

methods and procedures to be applied	
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 (once a year) calibration of the chromatograph by the regional representatives of the State Office for Metrology and Standardization
Any comment	-
Data/Parameter	Voil
Data unit	Tuf (tonnes of unified fuel)
Description	Volume of crude oil to be combust in accordance with baseline to provide current electricity generation.
Time of determination/monitoring	Annually
Source of data (to be) used	Total electricity generation multiplied on coefficient 0,596 (tuf per MWh)
Value of data applied (for ex ante calculations/determination)	39,455 tuf
Justification of the choice of data or description of the measurement methods and procedures to be applied	Procedure using for estimation of total fuel consumption by powertrains. Average coefficient based on results of official audit carried out in 2006.
QA/QC procedures (to be) applied	Typical procedure in national power generation sector. Calculations providing by trained specialists of the Project owner.
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 JI project:

To demonstrate that the proposed JI project will reduce the GHG emissions below those that would have occurred in the absence of the project, two steps are implemented:

- Step #1: Investment analysis of the Project based on the comparison of the annualized investment costs and annual net revenues.
- Step#2: Comparison of the GHG emissions that would occur due to the project activity and in the baseline scenario.

Step #1. Investment analysis of project without carbon revenues

The investment analysis is performed to assess the additionality of the Project. This analysis compares the annualized Project costs and annual revenues from the Project and is based on the following assumptions and elements (see formula below and table 7)

- *Annualized Project costs* is a sum of the annualized investment costs, annual non-fuel costs.
- *Annualized investment costs* are calculated as the initial investment cost multiplied by the capital recovery (return) factor which is defined as:

$$CRF = \frac{i*(1+i)^n}{(1+i)^n - 1}$$

Where:
CRF – capital recovery factor

i - the before-tax rate of return. The before-tax rate of return for the project has been calculated as the after tax hurdle rate divided by (1-0.24) where 24% represents the corporate income tax rate in Russia.
n - the lifecycle for equipment (investment) which is 20 years for the GPP.

The after–tax hurdle rate of return for the present project had been defined at the rate 14 %. This rate corresponds to return of investments within seven years. This rate is the one that existed for the first class borrowers (large reliable corporations) with the key Russian banks during the Project decision making phase (2003-2004). The same terms apply to and equipment leasing provisions in Russia at the same period. Longer terms of financing are possible only for the companies with the state involvement. This chosen rate of profitability can be determined as market-average.

- *Annual revenues* for Sredne-Khulymsk oil field are calculated on the base of operational expenses for power generation on powertrains. For the sake of conservative assessment, it should be mentioned, that the annual revenues are calculated, taking into account the estimated annual increase of electricity and APG prices. Over 65% of the tariff on power is the costs of transmission and distribution that in case of the given Project is much less. This gives grounds to believe that in long-term perspective power generated on oil-field will be cheaper, than the one possibly available from the external grid. But on the other side, it is necessary to notice that total Project investments are considerably higher per unit of power since one station de facto duplicates the other.
- *Annual costs* for RITEK in the baseline scenario are calculated on the basis of operational costs for power generation (including the missed benefits from unsold oil and ecological payments for methane emissions) by the power trains (as it is calculated in table 7, index *D,E*). For conservativeness reasons, the annual revenues are calculated on a median of growth of operational expenses vs. existing prices.

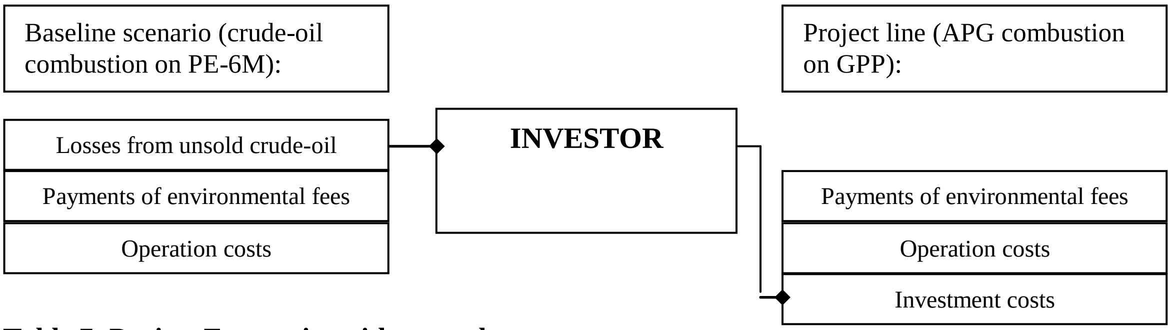


Table 7: Project Economics without carbon revenues

№	Item	Units	Price/item		Total cost
			Rubles/item	Euros/item	Euro (000)
Project Economics for RITEK					
Project Cost (costs according to the project line)					
A	**Annualized Investment Cost (After Tax ROI hurdle rate 14% (for rubles)**	-	-	-	**3040,2**
B	**Operational costs***	-	-	-	**760,1**
C	**Total annualized costs**	-	-	-	**3800,3**
Revenues (comparison with baseline chargers)					
D	**Annualized Investment Cost (the same terms as for GPP) ****	-	-	-	**430,3**
E	**Operational costs**	-	-	-	**970,4**
F	**Payments on environmental fees**	**1574tCH_4**	**250/tCH_4**	**6,85 / tCH_4**	**10,8**
G	**Volumes of saved crude-oil in form of net income per ton in € equivalent*****	**24199**	**420r/tn**	**12 €/tn**	**290,4**

H	**Absolute difference in annual repayments on investments within baseline (in comparison with Project line)**	**-**	**-**	**-**	**2098,4**

* Costs on associated petroleum gas pre-treatment are not mentioned, as they are included in the main balance of producing enterprise.
** Including losses from unsold oil
*** Maximum achievable income with prices 30$ per barrel crude-oil.

Table 8: Project Economics with carbon revenues (sales of emissions reduction units)

№	**Item**	**Units**	**Price/item**		**Total cost**
			Rubles/item	**Euros/item**	**Euro (000)**
Project Economics for RITEK					
Project Cost (costs according to the project line)					
A	**Annualized Investment Cost (After Tax ROI hurdle rate 14% (for rubles)**	**-**	**-**	**-**	**3040,2**
B	**Operational costs***	**-**	**-**	**-**	**760,1**
C	**Total annualized costs**	**-**	**-**	**-**	**3800,3**
D	**Revenues from ERU sales**	**105223**	**-**	**10**	**1052,2**
E	**Annualized repayments on investments within the project line without ERU**	**-**	**-**	**-**	**3800,3**
F	**Annualized repayments on investments within the project line with ERU**	**-**	**-**	**-**	**2748,0**

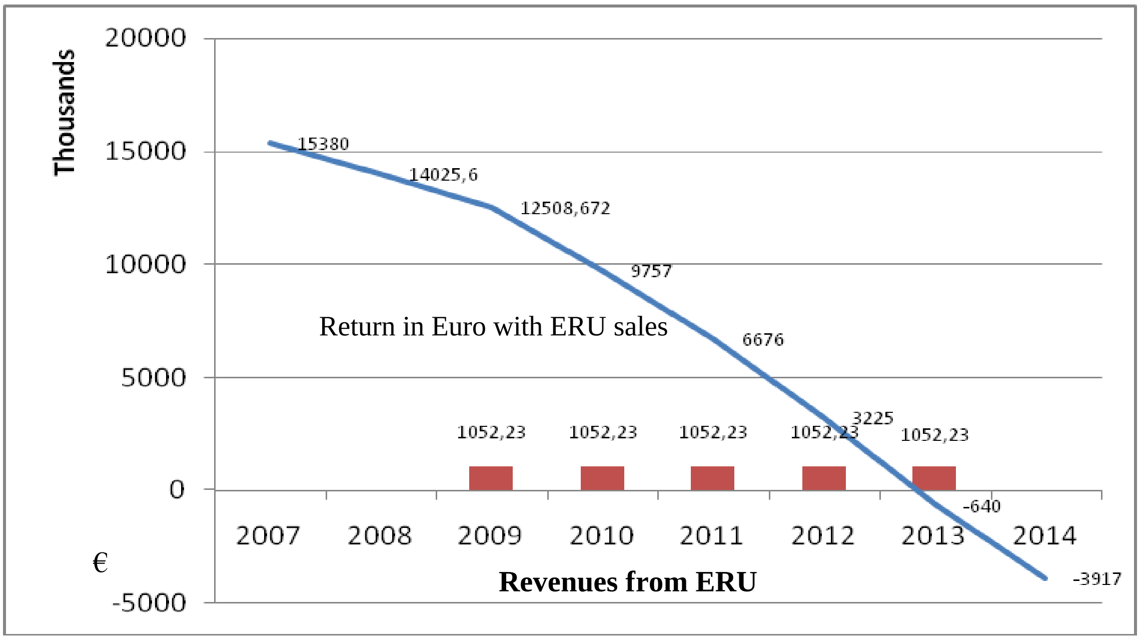


Figure 8. Project scenario for investments return with carbon revenues

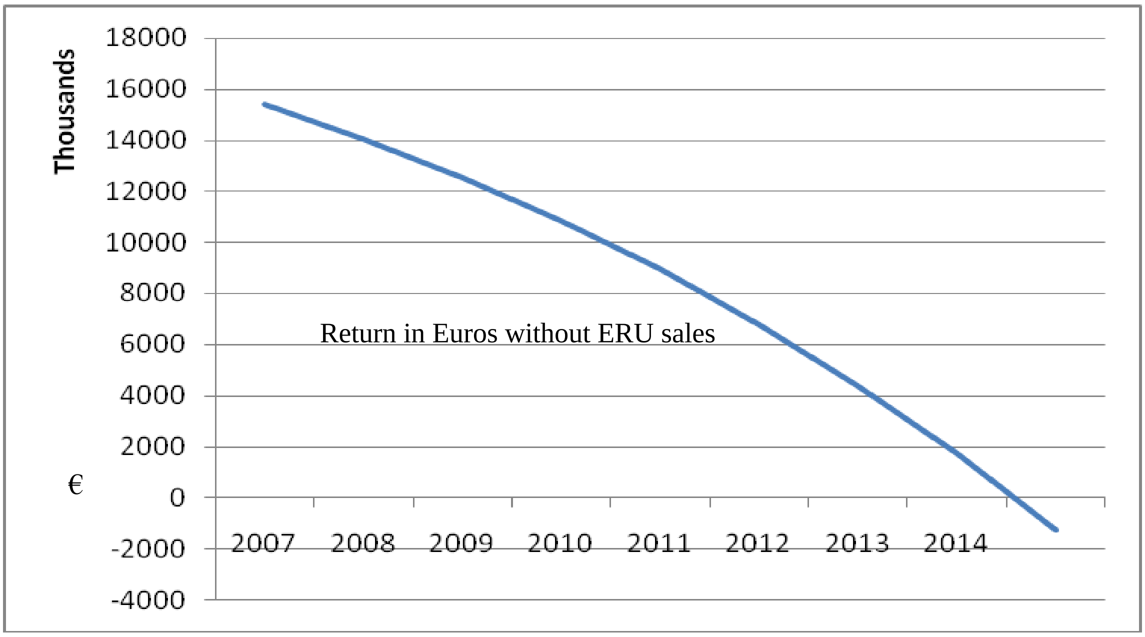


Figure 9. Project scenario of investments recovery without carbon revenues

The project at existing costs is below the threshold of profitability existing for the first class borrowers at the period of project planning (7 years for a full recovery at 14 % annual). This clearly demonstrates that the project is not economically attractive to the Initiating party. Even being on peak of attractiveness (the maximum world prices for oil, low cost price for APG), the pure result of economic activities within the Project (Table 7, **H**) is negative - 2098 thousand euro p/a. In this connection the project can be described as economically unreasonable for the Owner.

Emissions reduction (ERU) sales within the Project can add considerably to its attractiveness in terms of return on investments within the Project line; a possibility also exists to increase incomes of the company by revenues from ERU sales in the post-Kyoto period, after 2012. Additional incomes from ERU sales can help to overcome financial barriers of the Project. It is worth noticing, that incomes from the sales of reductions will raise attractiveness of the Project for the Owner and will create a precedent which can be further repeated by the other oil companies in YaNAO.

The Project is one of the first in the region, directed to utilization of associated petroleum gas for power generation. Besides it is the first project connected with replacement of existing generation – powertrains - by modern generating equipment, more environmentally friendly in terms of hazardous emissions into the atmosphere.

Nowadays, as the State is shaping its strategy in APG treatment the Project can be assessed as one conforming with best environmental standards and approaches, that can be reflected in this strategy as an effective way to minimize the anthropogenous pressure on environment in the oil-producing regions.

Step #2. Comparison of the GHG emissions that would occur due to the project activity and in the baseline scenario

The previous section demonstrates that the most probable option in the absence of the JI project is the continued flaring of 19,4 million m^3 of APG that the JI project would have used for electric generation. Given this baseline scenario, baseline and project emissions of GHG can be compared as follows:

Table 9: Baseline and project scenario emissions

Comparative Item	Units	Baseline scenario	Project scenario
APG flared/combusted	1000 m^3	19,400	19,400
Complete combustion of APG	tCO_2	46757	59363
Unburned APG in terms of tCH4	tCH_4	1573	-
Unburned APG in terms of tCO2e, *(c*21)*	tCO_2	33052	-
Total Local Emissions	tCO_2	79809	59363
Power (electricity consumption) consumption	GWh	66,2	66,2
Power trains emissions	tCO_2	84776	
Total emissions CO_{2eq}	tCO2	164586	59363

Calculations based on representative historical data show that the Sredne-Khulymsk flaring is performed in black-firing mode and that the APG produced here is ≈74% methane (by volume). The detailed Rosgidromet calculation methodology then indicates that flaring of 19,4 million m^3 per year of APG at oil field will lead to emissions of 1573 tCH_4 due to under-firing and 46,757 tCO_2. Conversion of CH_4 to CO_2e using an IPCC global warming potential factor of 21 then indicates baseline local emissions due to flaring of 79,809 tCO_2e.

The Project supplies 66,2 GWh of electricity and supply p/a for local consumption on the Sredne-Khulymsk oil field. As power supply within the baseline and the Project is meant to be carried out in an independent (autonomous) mode, the internal losses of 9%, are taking into account within the actual amount of power produced and consumed. In this case the annual electric power generated is calculated brutto and in the baseline it is assessed as consumed.

The baseline scenario supposes the electric power for the Sredne-Khulymsk oil field to be generated by the PE-6M powertrains with standard capacity of 1050 kW (See Fig. 11). This solution combined with local power grids is the most widespread type of power supply in the oil fields of the region. For a number of remote locations in Russia powertrains (in a few cases – diesel power stations) are the only available source of power supply.

Figure.11. Powertrain PE-6M

The gross power generation required within baseline is equal to 66,2 GWh p/a. The key parameter needed for baseline calculation is the actual fuel use by the powertrains for generation; it is estimated at 0.596 t of unified fuel equivalent per 1 MWh. Fuel consumption for this amount of power within the baseline is estimated as 39,455 tonnes of unified fuel equivalent per year. Typical fuel average efficiency of PE-6M engines is 30,3 % (according to warranties of company-supplier).
Such fuel consumption makes total energy use at 1156037GJ (39455t*29300 MJ/tuf – calorific value of unified fuel). Available default carbon content for crude oil according to 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Vol.2 Energy. Chapter 1) is 20kg/GJ. Thus total carbon emissions equals 23120747 kg (1156037GJ*20kg/GJ). Last step estimation of CO2 emissions. 23120747 kg*44/12/1000 makes emissions at 84776 tCO_2e.

With this in consideration the overall baseline emissions from power generation are equal to 84,776 CO_2e tons p/a.

Total baseline emissions are then 79,809 + 84,776 = 164,586 tCO_2e per year.

Combustion of APG in the gas engines is much more efficient than in flare. The project uses the approach from the previously approved CDM methodology AM0009 version 2 and assumes full oxidization.

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

Where:
Vy – volume of APG to be flared
Py – density of APG

Thus, 21068,4 (tAPG) * 0,768 (cAPG) * 44/12 = 59363 tCO_2
Total project emissions, equals – 59363 tCO_2e

The estimate of annual reductions in GHG emissions is then 164,586 – 59,363= 105,223 tCO_2e.

While the Rosgidromet methodology for calculating flare emissions is widely recognized as the standard for the Russian oil and gas industry, it relies centrally on the chemical composition of the APG being burned and on continued operation of the flare in black-firing mode. Since the gas engines within the Project have been specifically designed for the APG of Sredne-Khulymsk, the long term purchase contract includes clear specifications of fuel composition and GPP staff regularly monitors compliance with these specifications. No significant variations in fuel composition are anticipated during the period from 2008 to 2012 (Project crediting period) although this will be monitored monthly and emission reductions will be tied to composition of the fuel actually received.

As discussed in the Annex 4, the black-firing test depends on the physical dimensions of the flare stack, the volume, adiabatic index, molecular mass and temperature of the APG being flared, and the discharge velocity of the flared gas. Since the flaring will continue within the Project, the necessary data for this test will be provided on a regular basis. However, some significant changes in the mode of operation of GPP may require reconstruction of the stacks. Since there is no significant motivation for RITEK to change the mode of operation of the flare or to invest in reconstruction, it is assumed that black-firing mode will continue. GPP will provide monthly dated photographs of the flare as evidence that no major reconstruction has occurred. In that case, the assumption of continued black-firing is appropriate. If significant reconstruction does occur, GPP will request the necessary data from the Project Owner to determine whether black-firing is still the appropriate. Future flare reconstruction is considered highly improbable.

The Project reroutes APG that flows to the flare in the baseline through the gas treatment plant, the gas engines and ultimately through the gas engine stacks. Obviously this Project routing offers some opportunities for emissions due to leakages and/or accidents in the delivery, cleaning and combustion of APG. However, the project APG pipeline is only 0,5 km. It was built according to the modern standards, including those for insulation. Therefore, leaks have been ignored to assure that emission reduction estimates are on a conservative basis.

Similar activities to the proposed project activity that have been implemented previously or are currently underway are reasonably selected according to the following similarity criteria:

- similarity of the equipment type and capacity;
- comparable environment and geographical location

Several projects implemented or on-going in Russia do comply with the above criteria, namely:

- Yarainer GPP, 5 Cummins engines of 6575 KW total capacity, operating on APG, Project Owner – Sibneft; launched – November 2003
- Kharampur GPP, 5 Cummins engines of 7500 KW total capacity, operating on APG, Project Owner – Rosneft; launched – ……
- Kisso-Katyn GPP, 8 Cummins engines of 12000 KW total capacity, operating on APG, Project Owner – Bashneft; launched – September 2007
- Zapadno-Krapivinsk GPP, Wakesha engines, 1.2 MW total capacity, operating on APG, Project Owner – Sibneft; launched – October 2006
- Vakhitov GPP, operating on APG, Project Owner – TNK-BP; launched – February 2005
- Vostochno-Yelovoye & Talakan GPP, operating on APG, Project Owner – Surgutneftegaz; under development

The said activities were implemented in following cases:
-financial viability of the project;
-corporate environmental reasons in case of unprofitable project

Cases of financial viability of the project are normally those with an expensive baseline, that is attributed to two basic circumstances:

- the project with AGP generation substituting expensive power acquired by the Project Owner previously from the local power generating company. In some cases the prices charged by the local power operator exceed those that can be obtained by the Project Owner at his own facilities (cases of Surgutneftegaz projects, Vakhitov project of TNK-BP, Kisso-Katyn project of Bashneft)
- the project with AGP generation substituting expensive power previously generated with diesel engines, with the costs of transporting the diesel fuel to the generating facilities considered by the Project Owner as unreasonably high (cases of Zapadno-Krapivinsk and Yarainer projects of Sibneft)

In some cases financially unviable projects are still implemented due to the considerations of the corporate environmental policy. These considerations are particularly true for the Russian National oil leaders – Rosneft and LUKOIL, that are following the Western standards of the corporate environmental responsibility and operating within their own sustainability strategies.

In case of the Rosneft this company normally opts for Kyoto JI mechanisms to cover the losses within the projects initiated for environmental reasons, the way it has been with the Khasirey project, that has been developed as a JI project and therefore not included into the above list; this gives a reason to expect that Kharampur project implemented by the Rosneft has a strong chances to be developed as a JI project in due course of time.

In the case of the LUKOIL Group it should be specially noted that JSC RITEK occupies a special position of an advanced innovative facility, used as a testing ground for technological and environmental solutions to be later followed by other companies of the Group.

This explains the evident financial disadvantages for RITEK within the Project that could be partly covered by the carbon revenues. The difference between this Project and other similar projects was that while the other, financially sound ones, were initially developed as power generating businesses this Project as an innovative one was initially developed as a GHG abatement project and planned within the Kyoto protocol framework. This gives a clue to the serious expenses that were undertaken by the Project Owner regardless of the existence of a cheap baseline option of generating the power on powertrains.

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Summarizing the additionality considerations, it should be repeated that in the Project scenario, electric power for the local needs of the Sredne-Khulymsk oil field would be provided by gas-fired power plants. APG flaring at the Sredne-Khulymsk oil field would be considerably reduced. The new GPP combustion process is much more environmentally friendly than flaring and reduces the methane emissions into the air. As shown by the economic efficiency analysis, the Project itself is not the most attractive option for the Project Owner from the financial point of view; threshold of profitability within the Project is reached only with the perspective of respective incomes from ERU sales within the Project (that was considered at the business planning stage of the Project). Additional effect of the Project is the raise in energy efficiency, resulting in extra emissions reductions, due to substitution of the powertrains by more efficient GPPs. Therefore, it may be stated that the Project corresponds to the additionality requirements, since it is definitely not a part of the baseline scenario and reduces the GHG emissions below those that would have occurred in the absence of the project.

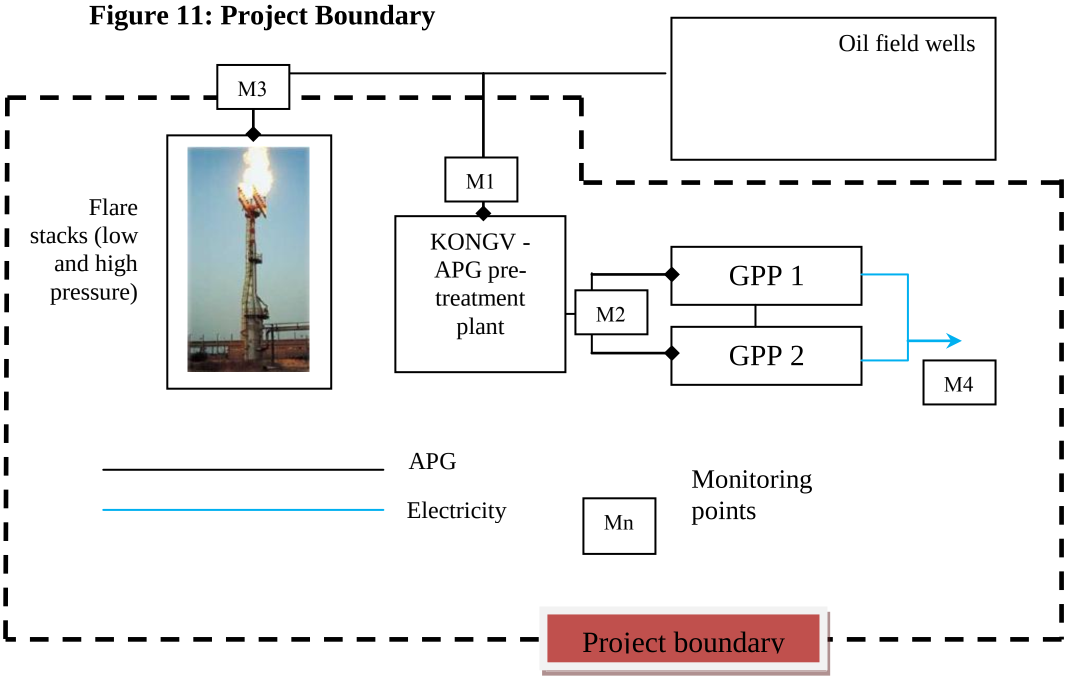
B.3. Description of how the definition of the project boundary is applied to the project:

The project boundary encompasses the following Project components (see figure 11):

- 2 GPPs (GPP-1 and GPP-2) including auxiliary facilities such as the electrical cables, etc;
- 2 flare stacks (high and low pressure) at the Sredne-Khulymsk booster pumping stations;
- Local grid (low voltage) - distribution system, transforming station;
- The APG treatment plant (providing fuel-Gas) and the emergency diesel generator;
- Equipment for APG transmission onto GPP (gas pipeline and pumping stations);
- Complex of metering equipment;

All components are directly under control Project owner (operator). Access to metering equipment (including certification, exploitation and calibration) is enjoyed solely by the Operator with the exception for the relevant state authorities.

Figure 11: Project Boundary



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

Date of the baseline study 01/09/2008- 12/12/2008
Date of the baseline setting 24/04/2009

Name of person(s)/entities determining the baseline:

LLC «Mejdunarodnaya Gruppa «Sigma»

Moscow, Russian Federation

Tel. +7 (495) 7753232
Fax +7 (495) 7753232

e-mail: sigma@effort.ru

LLC «Mejdunarodnaya Gruppa «Sigma» is not Project participant

The baseline was determined under the guidance of approved methodology CDM AM0009

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

September 25, 2003

C.2. Expected operational lifetime of the project:

20 years (240 months)

C.3. Length of the crediting period:

5 years (60 months) from January 1, 2008 till December 31, 2012

SECTION D. Monitoring plan

D.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 CH_4 emissions due to more complete APG combustion in gas engines relative to APG flaring;
- Substitution of power generation from the powertrains to power from GPP with more efficient engine and reduced GHG emissions.

At present, no approved CDM monitoring methodology that would allow estimating CH_4 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 CO_2 reductions due to the displacement of electricity generation from the powertrains uses the elements of the Approved CDM Methodology - AM0009.

Data/Parameter	Gen
Data unit	MWh
Description	Electricity supply to consumers at Sredne-Khulymsk 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
Value of data applied (for ex ante calculations/determination)	66200 GWh
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 (once a year) calibration of the chromatograph by the regional representatives of the State Office for Metrology and Standardization

Any comment	-
Data/Parameter	EmGen
Data unit	MWh
Description	Generation on emergency diesel generator that will lead to additional emissions based on diesel combustion
Time of determination/monitoring	Monthly
Source of data (to be) used	Electric meters
Value of data applied (for ex ante calculations/determination)	0 MWh
Justification of the choice of data or description of the measurement methods and procedures to be applied	Electric meters installed at the 6 kV 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 (once a year) calibration of the chromatograph by the regional representatives of the State Office for Metrology and Standardization
Any comment	In a case of emergency situation on GPP, diesel generator provide electricity for the most important needs.
Data/Parameter	Vi
Data unit	%
Description	Composition of recovered gas measured at point M2, after pretreatment, during the period *y*
Time of determination/monitoring	Two times a year (winter, summer)
Source of data (to be) used	Measurement providing by authorized company
Value of data applied (for ex ante calculations/determination)	Vi shown below Table 11.
Justification of the choice of data or description of the measurement methods and procedures to be applied	Authorized company on its chromatograph, at the junction point and at exit from KONGV pre-treatment. Annual figures will be the APG volume weighted averages of two-times a year figures.
QA/QC procedures (to be) applied	**QA**: measurements from the chromatograph 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 (once a year) calibration of the chromatograph by the regional representatives of the State

	Office for Metrology and Standardization
Any comment	M APG and density calculating on the base of available APG composition.
Data/Parameter	$V_{F,y}$
Data unit	Nm^3
Description	Volume of the total recovered gas measured at point M2, after pretreatment, during the period *y*
Time of determination/monitoring	Monthly
Source of data (to be) used	Flow-meters with corrector
Value of data applied (for ex ante calculations/determination)	19400000
Justification of the choice of data or description of the measurement methods and procedures to be applied	Flow-metering equipment installed at the junction point and at the exit from KONGV measures volumes of APG automatically, archived electronically and in monitoring workbook.
QA/QC procedures (to be) applied	**QA**: measurements from the flow 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 (once in five years) calibration of the meters by the regional representatives of State Office for Metrology and Standardization
Any comment	-

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

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

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable as the data was indicated in D.1.

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

The equations used to calculate Project emissions are summarized in Table 10 below.
The project uses the approach from the previously approved CDM methodology AM0009 version 2 and assumes full oxidization.

$PE_{,y} = (Vy*Py) * W_{carbon,A,y} *44/12$

where:
PE,y - the baseline emissions during the period y in tons of CO2 equivalents.
Vy - volume of gas recovered from the oil field during the period *y*, explicated in (000) ncm.
Py - density of APG, kg/ncm.
Wcarbon,A,y - the average content of carbon in the gas recovered during the period y.
The methane content in the gas W*carbon,A,y* is determined from Table 11, 1.

Table 10: 1. Project emissions calculation equations

PE1	1 From BE3	2 From BE2	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 CH4	Total CO2 emissions project
	M APG	*σ c_APG*		*μ CO2*	$\mu\ CH_4$	*ECO2_combustion project*
Units	t	% mass	Scalar	kgCO2/mole	Kg CH4/kg mole	tCO2
	21068,4	76,8441	0,01	44	16	59363

2- Emissions from emergency diesel generator

PE2	1	2 IPCC Factor	3=1*2
	Electricity by emergency diesel generator	Emissions factor for electricity by diesel generator	Total emissions_emergency diesel generator
	Emgen_fuel	*Diesel fuel EF*	*Emgn_CO2*

Units	MWh	tCO2/MW	tCO2
	0	0,2626	0

3- Total Project emissions

PE3	1 from BE5	2 from PE2	3=2+1
	Total emissions from APG_project	Total emissions _ emergency diesel generator	Total emissions project
	ECO2e_APG_project	*Emgn_CO2*	*ECO2e_total_project*
Units	tCO2e	tCO2	tCO2
	59363	0	59363

Thus, total project emissions 59,363 tCO2e per year.

As explained in 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.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable as the data was indicated in D.1.

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Baseline emissions at the Sredne-Khulymsk flare are calculated using equations *BE2* through *BE6* below in combination with *BE1* as shown in Table 11.

Color coding distinguishes inputs which will be monitored each year (yellow); inputs that will be stipulated upfront as constants (green) and calculated values (blue).

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 Sredne-Khulymsk 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 *BE5)*, the density of that APG and the volumetric composition of the APG.

Table 11: 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/miCH$_4$
Unit	index	*Vi*	*pi*	*Mi*	*μi*	*Ki*	*σc-i*	*σi*	*k APG*	*σc_APG*	*σ CH4*
		Volume fraction, weighted average of monitored monthly data	Density of hydrocarbons and elements	Molecular mass of components	Molecular mass of icomponent in APG	Adiabatic index of icomponent of APG	mass content of carbon of icomponent in APG	Molar ratio	Adiabatic index of APG	Mass fraction of Carbon in APG	Hydrocarbons in CH4 equivalent
	component	%	kg/m3	kg/mole	kg/mole		% mass	%		% mass	%
	CH_4	74,35	0,716	16,043	11,92797	1,31	74,87	0,4902	0,9740	36,7005	0,4902
	C_2H_6	4,21	1,342	32,07	1,350147	1,21	79,98	0,0520	0,0509	4,1609	0,103996
	C_3H_8	10,01	1,969	44,097	4,41411	1,13	81,71	0,1815	0,1131	14,8295	0,498854
	C_4H_{10}	6,72	2,595	58,124	3,905933	1,1	82,66	0,1606	0,0739	13,2731	0,581764
	C_5H_{12}	1,90	3,221	72,151	1,370869	1,08	83,24	0,0564	0,0205	4,6908	0,253438
	C_6H_{14}	0,71	3,842	86,066	0,611069	1,07	83,73	0,0251	0,0076	2,1031	0,134751
	C_7H_{16}	0,22	4,468	100,08	0,220176	1,06	84,01	0,0091	0,0023	0,7604	0,056463
	C_8H_{18}	0,06	3,8	114,23	0,068538	1,05	84,21	0,0021	0,0006	0,1768	0,014949
	CO_2	0,30	1,977	44,011	0,132033	1,3	27,29	0,0055	0,0039	0,1490	

	N_2	1,52	1,251	28,016	0,425843	1,04			0,0158		
	Total	100,00			24,42669			0,9824	1,2627	76,8441	
			1,086						Total σCH_4 equivalent		2,134405

2- Quantity of carbon atoms in molecular formula of APG

	1	2	3	4	5=(1*3/4)*2
	Mass fraction of Carbon in APG	Molecular mass of APG		Molecular mass of carbon	Quan. Of carbon atoms in molecular APG
BE2	*σ c_APG*	*μ APG*		*μ c*	*Kc*
Units	% mass	kg/mole	Scalar	kg/mole	carbon atoms
	76,8441	24,426688	0,01	12	1,564

3- CH_4 emission factor for APG flaring

	1	2	3=1*2
	Ku/f (bf)	*σ CH_4*	*e CH4_baseline*
BE3	Under firing coefficient	Total hydrocarbons in CH_4 equivalent	CH4 emission factor_baseline
Units	Scalar	% mass	Kg CH4/kg APG
	0,035	2,134405	0,0747

4- CO_2 emission factor for APG flaring

BE4	1	2	3	4	5	6	7	8=2/3	9=4/5	10=6/7	11=1*(8-9-10)
Units	Molecular mass of CO2	Qu of carbons in APG formula	Molecular mass of APG	CH4 emission factor _ baseline	Molecular mass of CH4	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*

	kgCO2/mole	Carbon atoms	kg APG/mole	Kg CH4/kg APG	Kg CH4/kg mole	Kg CO/kg APG	kgCO/mole		Kg CH4/mole APG	Kg CO/mole APG	Kg CO2/kg APG
	44	1,564	24,42669	0,0747	16	0,25	28	0,0640	0,0047	0,0089	2,2193

5- Mass amount of APG flared

BE5	1	2	3=1*2
units	Annual volumetric flow of APG to be flared	Density of APG	Mass amount of APG flared
	V APG	*ρ APG*	*M APG*
	ncm (1000)	kg/nCM	T
	19400	1,086	21068,4

6- Total emissions from APG flare

BE6	1	2	3	4	5=1*2	6=1*3*4	7=5+6
Units	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*
	T	Kg CO2/kg APG	Kg CH4/kg APG	scalar	tCO2e	tCO2	tCO2
	21068,4	2,2193	0,0747	21	46757,6	33051,8	79809,4

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 within the Project. Table 12 shows equation *BE7*, *BE8* 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 Sredne-Khulymsk oil field 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.

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 (NGDU "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). 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).

The Table 12 combines local and power-trains fuel consumption and emissions to calculate the total annual *ex-ante* estimate of baseline emissions.

Table 12: Baseline powertrains emission (A) equations electricity generation, and total baseline emission (B)

(A) Electricity generation (GPP-1 and GPP-2)

BE7	1	2	3=2*1
	Electricity (net) generation	Consumption tons equivalent fuel per MW	Total fuel consumption
	Elec_gen	*EF_CM*	*Tuf_tr*
Units	MWh	T*uf*/MWh	T*uf*
	66200	0,596	39455

BE8	1	2	3=1*2	4	5=3*4	6=5*44/12
	Total fuel consumption	Energy per ton of unified fuel	Total energy consumption	Default carbon content	Total carbon content	Trains CO2 emission
	Tuf_tr	*Energy_Tuf*	*total_energy*	*carbon_factor*	*total_carbon*	*trains_CO2*
Unit	T*uf*	MJ/tuf	MJ	kg/GJ	kg	tCO_2
	39455	29300	1156037360	20	23120747	84776

1. For purposes of present sector of PDD 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).

(B) Total baseline emissions

BE9	1	2	3=1+2
	Total CO2 emissions from APG flaring	Trains CO2 emissions	Total baseline emissions
	E CO2e flaring baseline	*trains_CO2*	*ECO2e_total_baseline*
Units	tCO_2	tCO_2	tCO_2
	79809	84776	164586

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

Option is not used.

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

Not applicable as the data was indicated in D.1.

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

Not used

D.1.3. 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.

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable as the data was indicated in D.1.

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

No formulae used to estimate leakage (please see Section D.1.3).

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Ex ante estimates of the total annual emission reductions for the Project have been derived in equation *ER1* as a difference between the total baseline emissions estimated by equation *BE9* in Table 12 total Project emissions estimated by equation *PE3* in Table 10.

$$ER = BE - PE$$

Table 13: Annual emission reductions

ER1	1 (from BE9)	2 (from PE3)	3=1-2
	Total baseline emissions	Total emissions project	Total emissions reduction
	ECO2e_total_baseline	*ECO2e_total_project*	*ER CO2e_total*
Units	tCO2	tCO2	tCO2e
	164586	59363	105223

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

A four level system for the monitoring of environmental impacts has been established at the 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 are equipped with the *LENOX* controlling system, which automatically monitors CH_4 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, etc). 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).

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1. VAPG (M1,M2)	Low (in accuracy of measurements 0,2%)	**QA**: measurements from the flow meters are 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 (once in five years) calibration of the meters by the regional representatives of State Office for Metrology and Standardization
2. V% (M1,M2)	Low (Instrumental error 1%)	**QA**: measurements from the flow meters are 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 (once a year) calibration of the meters by the regional representatives of the State Office for Metrology and Standardization
3. ElecDel 6 kV (M4)	Low (Instrumental error 0,2%)	**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 (once a year) calibration of the meters by the regional representatives of the State Office for Metrology and Standardization
4. ElecDel 0,4 kV (M4)	Low (Instrumental error 0,2%)	**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 (once a year) calibration of the meters by the regional representatives of the State Office for Metrology and Standardization
5. EFCO2_diesel _fuel	Low	**QA:** the CO_2 emissions factor of the diesel fuel is taken from the Appendix B of the simplified modalities and procedures for small CDM project activities (IPCC factor); **QC:** periodic (once a year) check of this data
6. Gross_ cons	Low	**QA**: the total electricity of oil field will be taken from an official corporate report. Data on equipment loading based on technical parameters from technical passport. **QC**: periodic (once a year) check of this data

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

The Project's operational and management structure will be totally in compliance with that of existing at the GPP. Majority of variables are monitored under normal day-to-day routine practice. Data on GPP performance indicators, including APG deliveries and electricity supplied to RITEK and also self consumption. Based on that, the monitoring structure will be as follows:

At the GPP level, the shift operators will be responsible, on day-to-day basis for monitoring the variables indicated above in subchapter D.1.1.1. and D.1.1.3., including taking the readings from electricity meters, APG flow meters, chromatograph 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. Composition and density of APG, specifies two times a year (in winter and in summer), by authorized organization. Emission reductions will be automatically determined, as a Microsoft Excel program will make the necessary calculations with the use of formulas described in the subchapters D.1.1.2 and D.1.4. and the tables provided in the Monitoring Workbook. All this information will be documented and stored in paper and electronically with the operator. The necessary instruction with regard to monitoring of emission reductions will be provided to GPP operators.

Every month, the data used to calculate emission reductions received will be summed up and be reported to the GPP's chief manager, who will transfer them via the internet to the head office of RITEK in Moscow. The manager of RITEK responsible for the Project will provide general supervision of the technical performance of GPP including verification of data storage. To provide the verification of emission reductions generated by the Project, the archiving of data will be extended until 2014.

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

LLC «Mejdunarodnaya Gruppa «Sigma»

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Fax +7 (495) 7753232
e-mail: sigma@effort.ru

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Ex-ante Project emission estimates have been developed on a basis of actual GPP performance data available on June of 2007. By that month the GPP reached projected power capacity and APG utilization level in compliance with the targets set in present PDD. Further operation of Sredne-Khulymsk GPP has been characterized by similar parameters without any significant deviation.
Therefore, *ex-ante* estimates provided in this section are assumed to be representative for each year of Project implementation (although the actual figures will vary based on ex post data).
Ex-ante Project emission estimates have been developed using the 3 equations shown in table 10 (see Section D.1.1.2.). Table 14 provides the *ex-ante* illustrative calculation of annual Project emission from APG combustion excluding possible emissions from emergency diesel generator at 59,363 tCO_2e.

Table 14: Project emissions from APG combustion at the GPP

APG combustion in Project gas power plant (GPP)			
M_APG	Mass amount of APG flared	T	21068,4
σ c_APG	Carbon mass fraction in APG	%	76,844
μ CO2	Molecular mass of CO2	kgCO2/mole	44
μ C	Molecular mass of carbon	kgC/Mole	12
ECO2_combustion project	Total CO_2 emissions project	tCO_2	59363

The *ex-ante* estimates of emissions from the emergency diesel generator are estimated in Table 15.

Table 15: Project emissions from emergency generator

Emgen_fuel	Electricity by emergency diesel generator	MWh	0
Diesel fuel EF	Emissions factor for electricity by diesel generator	tCO2/MW	0,2626
Emgn_CO2	Total emissions _ emergency diesel generator	tCO2	0

Total Project emissions from all sources are then summarized for all relevant years in Table 16. *Ex-ante* estimates for 2008 through 2012 are equal to the *ex-ante* illustrative estimates shown.

Table 16: Total project emissions by year

year	APG combustion engines	Carbon mass fraction in APG		Molecular mass of CO2	Molecular mass of carbon	Total emissions project
		σ c_APG	*Scalar*	*μ CO2*	*μ C*	*ECO2e_total project*
	tAPG	%		kgCO2/mole	kgC/Mole	*tCO2e*
Ex-ante illustration	21068	76,844	0,01	44	12	59363
2008	21068	76,844	0,01	44	12	59363
2009	21068	76,844	0,01	44	12	59363
2010	21068	76,844	0,01	44	12	59363

2011	21068	76,844	0,01	44	12	59363
2012	21068	76,844	0,01	44	12	59363

E.2. Estimated leakage:

Not identified.

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

Since quantified leakage estimates have been excluded, the total Project emissions are estimated as 59,363 tCO_2e per year and 296,813 tCO_2e for the period 2008-2012 (see table 16).

E.4. Estimated baseline emissions:

The estimations of the baseline emissions apply the equations demonstrated in the table 11 and 12. These estimations and are based on the measurements of the APG characteristics, available data on the Sredne-Khulymsk flare stack for 2007 and on the available data on powertrain operation. Future characteristics of the Sredne-Khulymsk APG flare and of the power consumption are not expected to change significantly (although the actual figures will vary based on ex post data). Therefore, *ex-ante* estimates provided in this section are assumed to be reasonably representative for each year of Project implementation.

The baseline emissions include 2 main sources:
- Annual emissions due to flaring of the amount of APG equal to the annual APG to be utilized within the Project by GPP (see table 16);
- Substitution of power generated by powertrains combusting crude-oil with low efficiency and high emissions factor, by GPP.

Table 17: Local baseline emissions from flaring APG to be used within the Project

Step 1. Determining mass amount of APG flared, kg			Ex-ante illustration
Index	Parameter	Units	Value
V APG	Annual volumetric flow of APG to be flared	Ncm (000)	19400
ρ APG	Density of APG	kg/nCM	1,086
M APG	Mass amount of APG flared	t	21068,4
Step 2. Calculation of APG molecular mass			
Index	Parameter	Units	Value
μ APG	Molecular mass of APG	kg APG/mole	24,42669
Step 3. Determining physical-chemical parameters			
Index	Parameter	Units	Value
k APG	Adiabatic index of APG	-	1,26
σc_APG	Mass fraction of carbon in APG	%	76,84
Kc	Quan. Of carbon atoms in molecular APG	carbon atoms	1,56
Step 4.	Non-black flaring test: Discharge jet flow > 0,2 Sound velocity in APG flared		
Index	Parameter	Units	Value
U flow	APG`s discharge jet flow velocity	m/s	

U sound	Sound velocity in APG flared	m/s	
	Result of the test		black firing

Step 5. CH4 emissions due to incomplete burning			
Index	Parameter	Units	Value
k u/f	Under firing coefficient	-	0,035
σ CH4	hydrocarbons in CH4e	% mass	2,1344
e CH4_baseline	CH4 emission factor _ baseline	kgCH4/kgAPG	0,0747
MAPG	APG flared per year	kgAPG	21068400
E CH4_bl	Total CH4 emissions _ baseline	tCH4	1574
E CO2_bl		tCO2e	33052
Step 6. Total CO2 emissions from APG flaring			
Index	Parameter	Units	Value
μ CO2	Molecular mass of CO2	kg CO2/mole	44
Kc	Quan. of carbon atoms in molecular APG	carbon atoms	1,564
μ APG	Molecular mass of APG	kg/mole	24,43
e CH4_baseline	CH4 emission factor baseline	kgCH4/kgAPG	0,0747
μ CH4	Molecular mass of CH4	Kg CH4/kg mole	16
e CO_baseline	CO emission factor _ baseline	kgCO/kgAPG	0,25
μ CO	Molecular mass of CO	kgCO2/mole	28
e CO2	CO2 emission factor _ baseline	kgCO2/kgAPG	2,2193
M APG	APG flared per year	kgAPG	21068400
E CO2 complete baseline	CO2 emissions from complete burning	tCO2e	46758
ECO2e_flaring_baseline	Total CO2e emissions from APG flaring	tCO2e	79809

The Rosgidromet methodology has been applied in this analysis as detailed in section D.1.1.4. (see table 11). The most critical inputs to these calculations are the parameters defining the composition of the APG that is used in the GPP. Step 4 of the calculation of baseline emissions from APG flaring also provides the calculation that is used to determine that the Sredne-Khulymsk flare is operating in black-firing mode.

The usual historic mode of operation of this flare which is more than 8 years old has been black-firing mode and RITEK has little, if any, incentive to reconstruct the flare or change its operation in any fundamental way. The Project sponsors do not have guaranteed access to the specific data that would be required to calculate this test at routine intervals in the future. However, it is believed that any change sufficient to move away from black-firing mode would necessarily involve substantial reconstruction of the flare that would be clearly visible. Thus, photo documentation that the flare has not been fundamentally rebuilt is proposed as the appropriate monitoring method to establish that the black-firing parameters are appropriate for use in future calculations. If significant observable reconstruction occurs, the Project sponsor will request the data needed to recalculate the black-firing test.

Local baseline emissions from the APG flare are estimated to be 79,809 tCO2e per year.

In the baseline scenario, RITEK would continue to consume 66,2 MWh per year of electricity from the powertrains. This amount of electricity is supplied by the GPP and the emergency diesel generator in the Project scenario. The *ex-ante* estimates of the annual baseline powertrains emissions related to this supply are equal to 84,776 tCO_2e (see table 12A). Monthly and annual power deliveries to RITEK will be monitored due to confirmed metering devices on feeders. The powertrains fuel use factor based on the elements of the

AM0009 is equal to 0.596 t of equivalent of unified fuel/MWh, according to the data based on five year record of operating experience.

Local and powertrains baseline emissions taken together as shown in Table 18 to make the total annual *ex-ante* estimate of 164,586 tCO_2e. The *ex-ante* estimates for years 2008 through 2012 are assumed to be identical to the illustrative case shown, thus the total baseline emissions for the period 2008-2012 are estimated at 822,928 tCO_2e.

Table 18: Total baseline emissions

Year	Total CO2e emissions from APG flaring	Total CO2 emissions from powertrains	Total baseline emissions
	ECO2e_flaring_baseline	*ECO2_total*	*E CO2e_total_baseline*
	tCO2e	tCO2e	tCO2e
ex-Ante Illustration	79809	84776	164586
2008	79809	84776	164586
2009	79809	84776	164586
2010	79809	84776	164586
2011	79809	84776	164586
2012	79809	84776	164586
Total for 2008-2012	399047	423880	822,928

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

The *ex-ante* emission reduction estimate is shown in Table 19 below. *Ex*-ante estimates are the same for future years although the actual figures will vary based on *ex-post* data on the APG used, the composition and characteristics of that APG, and the electricity delivered from the GPP and the emergency diesel generator. Estimated emission reductions are 105,223 tCO_2e per year and 526,114 tCO_2e for the period 2008-2012.

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

The estimations for the Project emissions are provided in the tables 14, 15 and 16 in the section E.1. and the estimations for the baseline emissions are provided in the tables 17,18. As shown in the table 19, for the period 2008-2012, the total project emissions reductions due to the Project are estimated *ex-ante* at 526,114 tCO_2e as a difference between the project emissions (296,813 tCO_2e) and baseline emissions (822,928 tCO_2e).

Table 19: Ex-ante emission reduction estimates

Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emissions reductions (tonnes of CO2 equivalent)
2008	59363	0	164586	105223
2009	59363	0	164586	105223
2010	59363	0	164586	105223
2011	59363	0	164586	105223
2012	59363	0	164586	105223
Total (tonnes of CO2 equivalent)	296813	0	822928	526114

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:

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 clause on assessment of environmental impact.

On assignment with *RITEK*, a scientific research institute, *JSC NIPIGasPererabotka*, has elaborated the environmental impact assessment (EIA) ("Feasibility study on rational APG utilization on exploiting oil fields" from 2003. Contract #2003.30) for the Project.

EIA consists of the following chapters:

- general part;
- physical-geographical characteristics of the Project site;
- characteristics of the Project GPP as a polluting source;
- water disposal and water usage;
- waste management;
- impact on atmospheric air;
- protection and sound management of land;
- scope of environmental protection works;

With regard to the impact to atmospheric air, the emissions of polluting substances during Project construction and operation periods are represented in the tables 20, 21 and 22.

Table 20: Polluting emissions during operation period

Location	Source	Quantity	Polluting emissions		
			type	g/sec	tonnes/year
GPP	Gas engine flue pipe	2	Carbon oxide, CO	2,12682	33,788364
			Nitrogen dioxide, NO_2	2,17518	34,556650
			Saturated hydrocarbons C1-C5	0,55238	8,775566
			Soot	0,08057	1,279936
			Sulphur dioxide	1,148883	18,25207444
			Formaldehyde	0,022978	0,365047
			Benzpyrene	0,000000252	4,003474E-06
			Nitrogen Oxide, NO	0,351991	5,592011

Table 21: Polluting emissions from machinery during construction period (12 months)

Location	Source	Quantity	Polluting emissions		
			type	g/sec	tonnes/year
Project site	Construction machinery	15	Carbon oxide, CO	0,1670	11,28673
			Nitrogen dioxide, NO_2	0,1718	10,1884
			Kerosene	0,0484	3,6654
			Soot	0,0356	2,5012
			Sulphur dioxide	0,0216	1,5124
			Nitrogen Oxide, NO	0,351991	8,7743

Table 22: Polluting emissions from welding during construction period

Location	Source	Quantity	Polluting emissions		
			type	g/sec	tonnes/year
Project site	welding		Ferrous oxide	0,007722	0,03791
			Manganese	0,000605	0,00291
			Dust SiO_2	0,000556	0,00277
			Fluorides	0,000516	0,002447
			Carbon Oxide, CO	0,00738	0,03559
			Nitrogen Oxide, NO	0,001500	0,00742

As shown in the table 20, the estimated climate effect will be limited to emissions of saturated hydrocarbons (C_1-C_5) in the amount of 8.755 tonnes a year (on a basis of a one gas engine).

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

The environmental impact assessment (EIA) documentation with regard to this Project has undergone public environmental examination. The YaNAO Environment Protection Office (Nadym district) has issued a conclusion stating that the Sredne-Khulymsk GPP complies with the requirements of the environmental legislation, normative and technical design documentation.

SECTION G. Stakeholders' comments

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

This project has not been controversial since the site is within the leasehold area that RITEK has long used for oil development and the emissions from the GPP are less significant than those from the flare. No significant comments were received during the preparation of the EIA.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Country:	
Phone:	
Fax:	
E-mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last Name:	

Middle Name:	
First Name:	
Department:	
Phone (direct):	
Fax (direct):	
Mobile:	
Personal e-mail:	

Annex 2

BASELINE INFORMATION

Detailed baseline information was given in Sector B.

Annex 3

MONITORING PLAN

1. OVERVIEW

1.1. Objective of the monitoring plan

The objective of the monitoring plan is to ensure that the Associated Petroleum Gas Flaring Reduction Project at the Sredne-Khulymsk Oil Field, Western Siberia, Russia ("the Project") meets requirements for the collection, processing and auditing/verification of data to fulfill the requirements for the issuance of Emission Reduction Units (ERUs) pertaining to Article 6 of the Kyoto Protocol.

APG at the Sredne-Khulymsk oil field is obtained during the separation process at the booster pump station located next to the new power plant. Previously, the APG used by the Project was flared as shown in Figure 1b. In the Project, part of the APG (approximately 19,4 million m^3 per year) is used in the power plant with the remaining APG flared as usual in the stack of the booster pump station. Power producing for self consumption was provided by so called – powertrains PE-6M.

1.2. The Project

The project assumes recycling of associated petroleum gas (APG) which will be burnt on two modern power stations with the general installed capacity 15 MW installed on Sredne-Khulymsk oil field (that belongs to JSC "RITEK"), Nadym area of Yamal-Nenets Okrug, Tumen region, Russian Federation (Figure 1a). Ten Cummins QSV 91G, generating units of 1.5 MW of nominal electrical capacity each are installed in the plant. Power plant designed with specificity of APG's utilization. Generated energy ensures functioning of all complex of the basic and providing equipment on the oil-well, and self-consumption of settlement and GPP. In baseline scenario energy generation was provided by powertrains.

Project was realized by company JSC "RITEK". Volumes of associated petroleum gas, to be combusted confirmed juridical by license agreement on exploiting oil field. Parameters of last one, reconfirmed only in a case of any significant modification in extracting equipment or conditions of work. Gas technically provided by 0,5 km pipeline from booster station up to pre-treatment facility.

The project is located 120 km south from the town called Nadym in the Yamalo-Nenetsky autonomous okrug (YaNAO), Tumen oblast, Western Siberia. Nadym is approximately 2500 km from Moscow.

Currently, the GPP operates at 15 MW average load using 10 units. Two of them usually stay in reserve to cover forced or maintenance outages. Given the expected operation of ten full-time equivalent generating units, the GPP will consume annually 19,400,000 m^3 of APG and will generate 66,2 GWh of electricity (gross generation). The GPP's own use is 2 GWh with the remaining 64,2 GWh delivered to local users - booster stations located on a distance 2-10 km.

The Project will reduce CO_2 and CH_4 emissions in two ways:

- Local emissions of CO_2 and CH_4 will be reduced due to increased combustion efficiency in the gas engines compared to the Sredne-Khulymsk flare,
- Emissions of CO_2 from crude-oil combustion reduced on APG gas which has smaller CO_2 – emission factor.

Estimated total reductions of GHG emissions will be about 105,223 tonnes of CO_2 equivalent (tCO_2e) per year and 526,114 tCO_2e in the 2008-2012 crediting period.

1.3. Monitoring points

The key points to monitor the Project's input and output flows are indicated in Figure 1. The description of the monitoring points is provided in Table 1 following the diagram.

Figure 1: Monitoring points of the Project

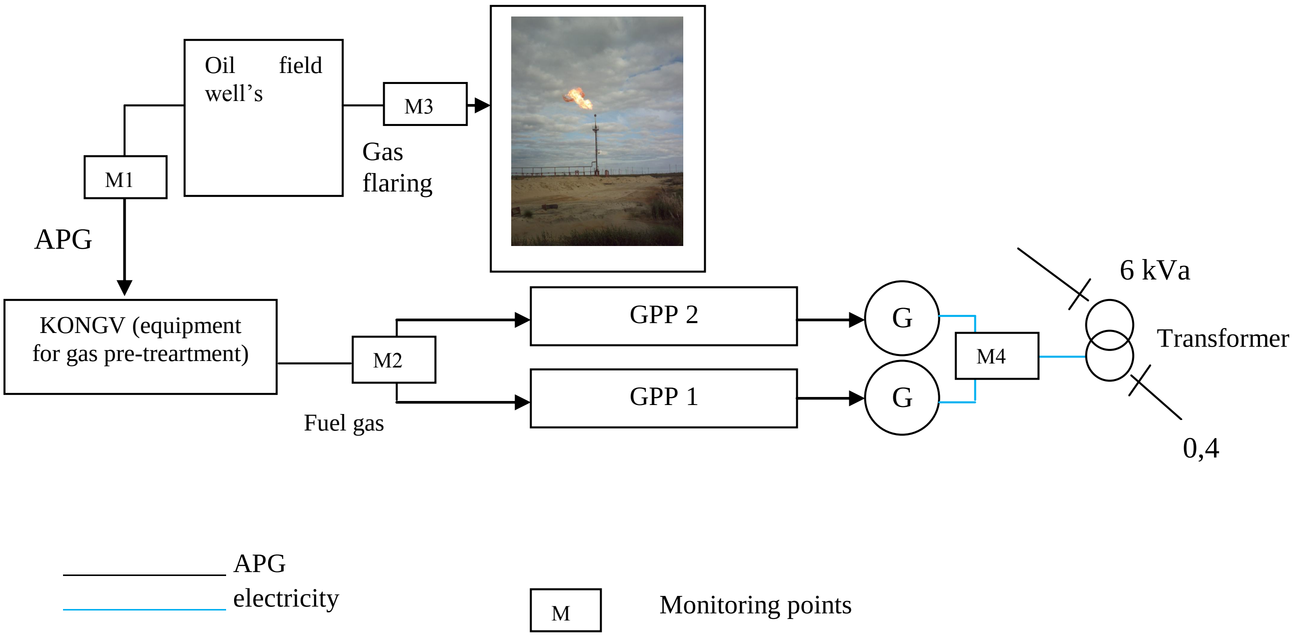

Table 1: Description of monitoring points

Monitoring Point	Location	Parameters to monitor	Quantity | year	Metering equipment
M1	KONGV station (enter)	Gas volume explicated in normal cubic meters	More than 19,4 mln cubic meters	Flowmeter
M2	KONGV station (exit)	Gas volume explicated in normal cubic meters	Not more than 19,4 mln cubic meters	Flowmeter Dymetic 9421, IRVIS-RS4
M3	Flare stack	Flaring on a stack superfluous gas volume and pressure	By fact	Flowmeter IRVIS - RS4,
M4	Fiders on GPP	Electricity delivery	66,2	Electricity counter SET 4TM

Project sales of electricity to outside consumers are monitored at the sale points which are located at the GPP's switch gears of 6 kV and 0,4 kV accordingly, where technical metering of power output is provided. Calculation of self consumption can also be provided in accordance with present standards of electricity consumption by power stations. Such data are usually rather stable.

The volume of APG delivered to GPP and its physical and chemical characteristics (such as the chemical composition and the density) are monitored at the APG treatment plant - KONGV.

Monitoring of electricity consumption is not very critical in local closed network, as it has no any other facilities for power generation, and can be effectively organized on the base of information about actual loudness of electricity-consuming equipment. That also concerns social infrastructure of oil field settlement, having approximately 8% in total consumption.

2. CALCULATIONS AND ASSUMPTIONS

Outline of GHG reduction calculation

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 CH_4 emissions due to more complete APG combustion in gas engines relative to APG flaring in the Sredne-Khulymsk stack;
- Displacement of electricity generation from the powertrains and related reductions in GHG emissions.

At present, no approved CDM monitoring methodology that would allow estimating CH_4 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 and endorsed by State Committee for Environmental Protection - GosKomEkologiya, (FGUP "NII Atmosphera", Rosgidromet) is designed for practical usage when estimating such emissions during APG flaring.

Estimation of CO_2 reduction due to the displacement of electricity generation from the powertrains uses the elements of the Approved CDM Methodology, AM0009.

Available data from well #5, still combusting crude-oil on powertrains, was mentioned as an approved example for baseline scenario estimations, and can be additionally used in monitoring frames.

Calculations will be carried out in accordance with Table 10 (Project emissions calculation equations) – for Project line, and Table 11 (Equations for local baseline emissions at the APG flare), Table 12 (Baseline powertrains emission equations (A) for Baseline) shown above.
Equation for annual emission reductions showed in Table 13.

3. MONITORING RESPONSIBILITY

As a beneficiary of ERU transfer, the Project Company will have the primary responsibility for collection and reporting of all data necessary for monitoring project performance according to this Monitoring Plan. The following table defines the responsibilities of the involved parties in the monitoring of the Project.

Table 2: Responsibilities of the involved parties

Item	RITEK, Project Company	Emissions Reduction Investor - ______________
Monitoring system	♉ Review of the Monitoring Plan (MP) and suggest adjustments if necessary ♉ Establish and maintain monitoring system and implement MP ♉ Prepare for initial verification and project Commissioning	♉ Arrange for initial verification
Data collection	♉ Establish and maintain data measurement and collection systems for all MP indicators ♉ Check data quality and collection procedures regularly	
Data computation	♉ Enter data in MP workbooks ♉ Use MP workbooks to calculate emission	

	Reduction	
Data storage system	♉ Store and maintain records ♉ Implement approval system for completed worksheets ♉ Forward annual worksheet outputs to ERI	♉ Receive copies of key records and reports ♉ Maintain ERI records
Performance, monitoring and reporting	♉ Analyze data and compare project performance with project targets ♉ Analyze system problems and recommended improvements (performance management) ♉ Prepare and forward annual reports	
MP training and capacity building	♉ Ensure that operational staff is trained and enabled to meet the needs of this MP	
Quality assurance, audit and Verification	♉ Establishment and maintain and internal approval system with a view to allowing for audits and verification ♉ Prepare for, facilitate and coordinate audits and verification process	♉ Arrange for periodic verification audits as needed

The monitoring data will be reported annually to support payments for reduction achieved. The data of submission shall be decided according to agreement between RITEK and the Emissions reduction's Investor.

To protect the interests of all stakeholders in the carbon purchase agreement, it is essential that a system of report auditing and verification be established.

First, ERI representatives will do the first level review of the Annual GHG Reduction Report.

Second, all emission reductions generated by the project shall be subject to verification by an independent entity. Emissions reduction's Investor (ERI) shall instruct the independent entity to undertake verification of the emission reductions generated by the project within a reasonable time after receipt of the Monitoring Report. ERI may choose to waive its right to arrange for verification in any year. However, when ERI requests that the Annual GHG Reduction Report is to be verified in a year following a year where no verification report was produced, then verification should verify all GHG Reductions generated over the years constituting the entire period since the last verification.

JSC "RITEK" shall be fully cooperative with ERI and the verifier in accordance with the requirements of this Monitoring Plan. JSC "RITEK" will make available, upon request, all data required by this Monitoring Plan and will also provide the verifier with:

- The names and titles of individuals responsible for preparation of the data in the annual monitoring reports.
- Meter readings and invoices to support the electricity delivered to Project consumers and the APG received for GPP operation.
- Any other supporting documentation.

"RITEK" shall keep all data until the end of the Project's life-span in 2020.

4. MONITORING PLAN WORKBOOK TEMPLATES

The monitoring plan can be carried out according to the spreadsheet workbook. A brief explanation of each table is provided below. Throughout the workbook, color coding has been used to distinguish inputs that will be monitored throughout the crediting period (yellow); inputs that are stipulated to remain constant throughout the crediting period (green); and calculated results (blue). All entries in the workbook are to be documented by initials for the individual responsible for preparation, checking and approval.

The workbook contains the derivation of ex ante estimates of input data and emission reductions as a benchmark for comparison for future inputs and results. The layout also will accommodate actual data for 2007 to allow for testing of the monitoring procedures. This is optional but highly recommended as useful training and debugging exercise prior to completion of the required analyses for the crediting period.

Table 3 documents the monthly meter readings at both the 6kV and 0,4kV delivery to determine the total displacement by month and year.

Table 3 Total Electric Deliveries, on fiders 6 kV and 0,4 kV necessary for estimation of energy substitution monthly and annually

Note	MWh sales data reported here must match monthly according to meter readings
Coding	Inputs
	Calculated
	Stipulated Constant

Meter reads						Hypothetical Illustration	Optional	Required
							2007 2007	2008 2008
6 kV Delivery Point			Report responsibilities					
Bill Period Start			Prepared by	Checked by	Approved by	Data reading	Data reading	Data reading
	Jan							
	Feb							
	Mar							
	Apr							
	May							
	Jun							
	Jul							
	Aug							
	Sep							
	Oct							
	Nov							
	Dec							
Bill period end			Prepared by	Checked by	Approved by	Data reading	Data reading	Data reading
	Jan							
	Feb							
	Mar							
	Apr							
	May							
	Jun							
	Jul							
	Aug							
	Sep							
	Oct							
	Nov							
	Dec							

MWh Delivered To 6kV System

						Hypothetical Illustration					
	Month	Variable		Meter calibration factor			MWh		MWh		MWh

Jan		31				5622				
Feb		28				5078				
Mar		31				5622				
Apr		30				5441				
May		31				5622				
Jun		30				5441				
Jul		31				5622				
Aug		31				5622				
Sep		30				5441				
Oct		31				5622				
Nov		30				5441				
Dec		31				5622				
						66200				

Tables 4 and 5 documents the MWh produced by the emergency diesel generator and the fuel used for this generation. The efficiency check should easily detect and out of range entries.

Table 4 Electric Production by Emergency Diesel Generator (MWh)

Note: This output can be metered or estimated based on measured fuel consumption and a stipulated efficiency.

QA/QC		Prepared by	Checked by	Approved by	Hypotetical illustration			2007		2008
Jan										
Feb										
Mar										
Apr										
May										
Jun										
Jul										
Aug										
Sep										
Oct										
Nov										
Dec										
Total	*Emgen*									

Table 5 Annual Fuel Consumption by Diesel Generator (MWh)

Items		Prepared by	Checked by	Approved by	Units	Illustration		2007		2008
Use					Litres					
Calorific value					Mj/litre					
Fuel input					MW					
Efficiency check					%					

Table 6 summarizes the total electric deliveries from the GPP which equal the total deliveries less the production of the emergency generator.

Table 7 records the monthly deliveries of APG expressed in terms of thousand standard cubic meters (TCM). APG density, calorific value and molecular mass are also shown here. These APG characteristics have tight tolerances specified by contract and have thus been stipulated as fixed throughout the future at their expected average values. These parameters are monitored continuously and could be reported on an ongoing basis but that adds unnecessary complexity to the calculations. The technical tolerances are 5% for density and 3% for calorific value and molecular mass. Since the ex ante expected value for molecular mass was 24.43 kg/mole, that value has been used for all ex ante calculations in the PDD. Operating experience shows approximately the same figures. Therefore, the lower value has now been used as the stipulated figure.

Table 6 Monthly Deliveries from GPP

			Units	Illustration		2007		2008
Jan			MWh	5622				
Feb			MWh	5078				
Mar			MWh	5622				
Apr			MWh	5441				
May			MWh	5622				
Jun			MWh	5441				
Jul			MWh	5622				
Aug			MWh	5622				
Sep			MWh	5441				
Oct			MWh	5622				
Nov			MWh	5441				
Dec			MWh	5622				
Total	*ElecDelTotal*							

Table 7 Monthly GPP Use of APG

Month	Variable name	Prepared by	Checked by	Approved by	Units	illustration		2007		2008
Jan					TCM	1647				
Feb					TCM	1488				
Mar					TCM	1647				
Apr					TCM	1595				
May					TCM	1647				
Jun					TCM	1595				
Jul					TCM	1647				
Aug					TCM	1647				
Sep					TCM	1595				
Oct					TCM	1647				
Nov					TCM	1595				
Dec					TCM	1647				
Total APG Input	*V APG*				TCM	19400				
APG Density	*ρ APG*				kg/SCM	1,086		1,086		1,086
Total APG	*tAPG*				t APG	21,068				

input								
Calorific Value	*LHV APG*		MWh/SCM	0,0102		0,0102		0,0102
Total fuel Input	*APG MWh*		MWh					
Net efficiency Check	*GPP effnet*		%	39,7				
Molecular mass of APG	*μ APG*		kg/mole	24,43		24,43		24,43

Table 8 accommodates entry of the composition data of the APG at the monthly level and the calculation of the volume-weighted annual composition figures to be used for project emission estimates.

Table 8 APG Monthly Composition Table

This table displays the monthly APG volume composition with input based on data gathered on the second Tuesday of each month. The values entered will be the volume-weighted hourly averages for those days

Prepared by:
Checked by
Approved by

	1	2	3	4	5	6	7	8	9	10	11	12	
Percent APG use	1647	1488	1647	1595	1647	1595	1647	1647	1595	1647	1595	1647	
Hydro carbon	Jan % vol	Feb % vol	Mar % vol	Apr % vol	May % vol	Jun % vol	Jul % vol	Aug % vol	Sep % vol	Oct % vol	Nov % vol	Dec % vol	Annual
CH_4	74,35	74,35	74,35	74,35	74,35	74,35	74,35	74,35	74,35	74,35	74,35	74,35	74,35
C_2H_6	4,21	4,21	4,21	4,21	4,21	4,21	4,21	4,21	4,21	4,21	4,21	4,21	4,21
C_3H_8	10,01	10,01	10,01	10,01	10,01	10,01	10,01	10,01	10,01	10,01	10,01	10,01	10,01
C_4H_{10}	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72	6,72
C_5H_{12}	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9
C_6H_{14}	0,71	0,71	0,71	0,71	0,71	0,71	0,71	0,71	0,71	0,71	0,71	0,71	0,71
C_7H_{16}	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22	0,22
C_8H_{18}	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,06
CO_2	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
N_2	1,52	1,52	1,52	1,52	1,52	1,52	1,52	1,52	1,52	1,52	1,52	1,52	1,52
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 9 contains key calculations of APG properties based on the volume composition data derived in Table 7. The temperature figure shown is calculated based on 5 degrees C for October to April and 10 degree C for May through September. Alternate parameters are shown to capture the mode of operation of the Sredne-Khulymsk flare. Calculations of the black-firing test using the Rosgidromet methodology and typical flare volumes show that the Sredne-Khulymsk flare has operated in black-firing mode for at least the past decade. An increase in the volume of APG flared of more than 10% would be required to move the flare out of black firing mode unless the flare stack were substantially reconstructed. For these reasons, continued operation of the Sredne-Khulymsk flare in black-firing mode has been assumed throughout the crediting period. Photographs will be taken of the flare stack on the second Tuesday of each month to verify whether significant reconstruction has taken place. If not, continued operation in black-firing mode will be assumed.

Table 9 Annual APG Analysis

Index	parameter	Unit	Value
ρAPG	density	kg/nm3	1,086
LHV ApG	Low heating value	Kcal/nm3	8731
		MWh/nm3	0,0102
t	temperature	Celcium	7,1

Index		Units	Value
D	Stack diameter	m	0,2
GWP CH4			21

Index	Vi	ρI	mi	μi	ki	∂c-i	∂i		kAPG	∂c-APG	∂CH4
Component	Volume fraction weighted average or monitor	Density of hydrocarbons	Molecular mass of components	Molecular mass of i-components	Adiabatic index of i-components	Mss content of carbon of i-component	Mass fraction of i-component		Adiabatic index of APG	Mass fraction of i-component in APG	Hydro carbons in CH4e
	% vol	kg/m3	kg/mole	kg/mole		% mass	%			%	%
CH_4	74,35	0,716	16	11,896	1,31	74,87	0,4902		0,9740	36,7005	0,490190
C_2H_6	4,21	1,342	32	1,3472	1,21	79,98	0,0520		0,0509	4,1609	0,103996
C_3H_8	10,01	1,969	44	4,4044	1,13	81,71	0,1815		0,1131	14,8295	0,498854
C_4H_{10}	6,72	2,595	58	3,8976	1,1	82,66	0,1606		0,0739	13,2731	0,581764
C_5H_{12}	1,9	3,221	72	1,368	1,08	83,24	0,0564		0,0205	4,6908	0,253438
C_6H_{14}	0,71	3,842	86	0,6106	1,07	83,73	0,0251		0,0076	2,1031	0,134751
C_7H_{16}	0,22	4,468	100	0,22	1,06	84,01	0,0091		0,0023	0,7604	0,056463
C_8H_{18}	0,06	3,8	114	0,0684	1,05	84,21	0,0021		0,0006	0,1768	0,014949
CO_2	0,3	1,977	44	0,132	1,3	27,29	0,0055		0,0039	0,1490	0,490190
N_2	1,52	1,251	28	0,4256	1,04		0,0175		0,0158		
Total	100			24,3698			1,073	Total	1,2627	76,8441	2,134405
								CH4 mass share			

Specific emissions of CO, kg CO/kgAPG	non black-firing	0,02	RosG	Molecular mass of CO	Kg/mole	21
	black-firing	0,25	RosG			

Underfiring coefficient	non black-firing	0,0006	RosG			
	black-firing	0,035	RosG			

Table 10 requires no additional inputs. Rather, the entire table calculates the baseline emissions at the Sredne-Khulymsk flare using the Rosgidromet methodology.

Table 10: Baseline Emissions at Sredne-Khulymsk APG flaring

Step 1	Determining mass amount of APG flared, kg		Ex-ante illustration
Index	Parameter	Units	Value
V APG	Annual volumetric flow of APG to be flared	ncm (1000)	
ρ APG	Density of APG	kg/nCM	
M APG	Mass amount of APG flared	t	
Step 2	Calculation of APG molecular mass		
Index	Parameter	Units	Value
μ APG	Molecular mass of APG	kg APG/mole	
Step 3	Determining physical-chemical characteristics of APG		
Index	Parameter	Units	Value
K APG	adiabatic index of APG		
σ c_APG	Mass fraction of i-comp in APG	% mass	
Kc	Quan. Of carbon atoms in molecular APG	carbon atoms	
Step 4	Non-black flaring test: Discharge jet flow > 0,2 Sound velocity in APG flared		
Index	Parameter	Units	Value
U flow	APG`s discharge jet flow velocity	m/s	
U sound	Sound velocity in APG flared	m/s	
	Result of the test		black firing

Step 5. CH4 emissions due to incomplete burning			
Index	Parameter	Units	Value
k u/f	Under-firing coefficient	-	
σ CH4	CH4 mass fraction	% mass	
e CH4_baseline	CH4 emission factor _ baseline	kgCH4/kgAPG	
MAPG	APG flared per year	kgAPG	
E CH4_baseline	Total CH4 emissions _ baseline	tCH4	
		tCO2e	
Step 6. Total CO2 emissions from APG flaring			

Index	Parameter	Units	Value
μ CO2	Molecular mass of CO2	kg CO2/mole	
Kc	Quan. of carbon atoms in molecular APG	carbon atoms	
μ APG	Molecular mass of APG	kg/mole	
e CH4_baseline	CH4 emission factor baseline	kgCH4/kgAPG	
μ CH4	Molecular mass of CH4	Kg CH4/kg mole	
e CO_baseline	CO emission factor _ baseline	kgCO/kgAPG	
μ CO	Molecular mass of CO	kgCO2/mole	
e CO2	CO2 emission factor _ baseline	kgCO2/kgAPG	
M APG	APG flared per year	kgAPG	
E CO2 complete baseline	CO2 emissions from complete burning	tCO2e	

Table 11 simply provides reporting of the results from Table 10 throughout the trial period and then throughout the crediting period.

Table 11: Baseline total CO_2e emissions from APG flaring

year	APG combustion engines	CO2 emission factor flaring	CH4 emission factor _ baseline	CO2 emissions from complete burning	Total CH4 emissions in terms of tCO2e	Total baseline emissions
		eCO2_baseline	*e CH4_baseline*	*E_{CO2} complete baseline*	*E CH_4 baseline*	*ECO2e_total baseline*
	tAPG	tCO2/tAPG	Kg CH4 / kg APG	tCO2e	tCO2	tCO2e
Ex-ante illustration	21068	2,2193	0,0747	46757,6	33051,8	79809
2008	21068	2,2193	0,0747	46757,6	33051,8	79809
2009	21068	2,2193	0,0747	46757,6	33051,8	79809
2010	21068	2,2193	0,0747	46757,6	33051,8	79809
2011	21068	2,2193	0,0747	46757,6	33051,8	79809
2012	21068	2,2193	0,0747	46757,6	33051,8	79809

Table 12 develops the estimated baseline emissions at powertrains that are displaced by the Project generation of electricity for local use at Sredne-Khulymsk. Specific data on electric quantities explants entering are not available in the frame of Project. From the other side losses on the local grid (6 kV) can be estimated in comparison electricity on GPP fiders and total local consumption. Such losses can be determined as absolute due to an autonomous status of grid. Besides it is evident, that energy consumption will grow (because of decreasing pressure in well and increasing energy costs for oil extraction). But in a view of conservative emission's estimation conception – consumption defined as a stable till the end of 2012.

Table 12 also converts power generation to gross CO2 emissions. Finally, Table 10 introduces the powertrains emission factor that has been quantified using elements of AM0009.

Table 12 Baseline CO2 Emissions at the Powertrains

Index	*ElecDel Total*	*EF*	*TUF*	*total_energy*	*carbon_factor*	*total_carbon*	*trains_CO2*
Year	Total Electricity Delivered to GPP feeders	Emission factor	Total fuel consumption	Energy per ton of unified fuel	Default carbon content	Total C content	CO2 emission
	MWh	tuf/MWh	Tuf	MJ/t	kg/GJ	kg	tCO_2
Ex-ante illustration	66,200	0,596	39,455	29300	20	23120747	84776
2008	0	0,596	0	29300	20	0	0
2009	0	0,596	0	29300	20	0	0
2010	0	0,596	0	29300	20	0	0
2011	0	0,596	0	29300	20	0	0
2012	0	0,596	0	29300	20	0	0

Table 13 then collects the annual results in summary form for all years of the crediting period.

Table 13 Total Baseline Emissions

Index	*ECO2 flaring_baseline*	*ECO2_total*	*ECO2e_total_baseline*
Year	Total CO2 emissions from APG flaring	Total CO2 emissions from trains	Total baseline emissions
	tCO2e	tCO2e	tCO2e
Ex-ante illustration	79809	84776	**164586**
2008	#DIV/0!	0	#DIV/0!
2009	#DIV/0!	0	#DIV/0!
2010	#DIV/0!	0	#DIV/0!
2011	#DIV/0!	0	#DIV/0!
2012	#DIV/0!	0	#DIV/0!

Table 14 relies on a single input which equals the net capacity per gas engine which is stipulated. The net capacity is used to calculate the number of full time equivalent engines that are operative in a year. This step was necessary to allow use of the EIA method of calculating gas engine emissions which were developed on a per engine basis. It should be noted that the Project includes sophisticated instrumentation and control systems that allow careful control and measurement of emissions from the GPP and that experience to date has shown that emissions of GHG are negligible. Thus, the use of the EIA methodology is demonstrably conservative.

Table 14: Project CO2 Emissions Calculation			Ex ante		Optional	
			illustration		2007	2008
APG combustion in Project gas power plant (GPP)						
M_APG	Mass amount of APG flared	t	21068,4			
σ c_APG	Carbon mass fraction in APG	%	76,844			
μ CO2	Molecular mass of CO2	kgCO2/mole	44			
μ C	Molecular mass of carbon	kgC/Mole	12			
ECO2_combustion project	Total CO_2 emissions project	tCO_2	59363			

Table 15 provides a simple calculation of the emissions from the emergency diesel generator in the event that it should operate during the year. To date, this generator has not been utilized since back-up generation has always been provided from the reserve gas engines.

Table 15	**Emissions From Emergency Generator**				2007 optional	2008
Emgen_fuel	Electricity by emergency diesel generator	MWh	0		0	0
Diesel fuel EF	Emissions factor for electricity by diesel generator	tCO2/MW	0,2626		0,2626	0,2626
Emgn_CO2	Total emissions_emergency diesel generator	tCO2	0		0	0

Table 16 provides calculation of the total annual Project emissions as a sum of the CO_2e emissions from gas engines and CO_2 emissions from emergency diesel generator if applicable.

Table 16 Total Project Emissions

Year	APG combustion engines	Carbon mass fraction in APG	Molecular mass of CO2	Molecular mass of carbon	Total emissions project
		σ c_APG	*μ CO2*	*μ C*	*ECO2e_total project*
	tAPG	%	kgCO2/mole	kgC/Mole	*tCO2e*
Ex-ante illustration	21068	76,844	44	12	59363
2008	21068	76,844	44	12	59363
2009	21068	76,844	44	12	59363
2010	21068	76,844	44	12	59363
2011	21068	76,844	44	12	59363
2012	21068	76,844	44	12	59363

Finally, Table 17 combines the annual baseline and project emission estimates to derive the emission reductions for each year in the crediting period.

		Prepared by:	
		Checked by:	
		Approved by:	
Table 17 Total Emission Reductions			
Year	Total baseline emissions	Total project emissions	Total emission reductions
	tCO2	tCO2	tCO2
Ex Ante Illustration	164586	59363	105223
2008	#DIV/0!	#DIV/0!	#DIV/0!
2009	#DIV/0!	#DIV/0!	#DIV/0!

2010	#DIV/0!	#DIV/0!	#DIV/0!
2011	#DIV/0!	#DIV/0!	#DIV/0!
2012	#DIV/0!	#DIV/0!	#DIV/0!

Annex 4

MAIN ELEMENTS OF THE METHODOLOGY OF CALCULATION OF EMISSIONS OF HAZARDOUS SUBSTANCES INTO THE ATMOSPHERE DUE TO THE FLARING OF THE ASSOCIATED PETROLEUM GAS AT FLARING STACKS

Data on flaring conditions and key characteristics of APG necessary for calculations of emissions of hazardous substances into the atmosphere due to the flaring of the associated petroleum gas at flaring stacks:

Indicator	Unit	Comments
V_{APG}	Nm3	Annual volumetric flow of APG to be flared
t	°C	Temperature of APG before flaring
D	m	Stack' pipe diameter
V_{APG}	% vol	Volumetric composition of APG
V_i	% vol	Volumetric concentration *i*-component in APG
ρ_{APG} ρ_i	Kg/m3	Density of APG and its components
m_i	Kg/mole	Molar mass of *i*-component in APG
k_i	Scalar	Adiabatic index of *i*-component in APG
σ_{C-i}	% mass	Mass content of carbon of *i*-components in APG

Step 1. Determining of mass amount of APG flared, kg

$$M_{APG} = V_{APG} * \rho_{APG}$$

Step 2. Calculation of APG molecular mass

$$\mu_{APG} = \Sigma\ 0.01*V_i* m_i;$$

Step 3. Determining physical-chemical characteristics of APG

3.1. Adiabatic index of APG (K_{APG}):

$$K_{APG} = \Sigma\ 0.01* V_i * k_i;$$

3.2. Mass fraction of i-component in APG (σ_i):

$$\sigma_i = 0.01*Vi * \rho_i/\rho_{APG}$$

3.3. Mass fraction of carbon in APG (σ_C):

$$\sigma_{C\_APG} = \Sigma\ \sigma_i * \sigma_{C-i}$$

3.4. Quantity of carbon atoms in molecular formula of APG (Kc):

$$Kc = 0.01*(\sigma_{C\_APG}/\mu_c)* \mu_{APG}$$

μ_c - molecular mass of carbon equals to 12.

Step 4. Non-black firing test

This test determines combustion efficiency of the APG flaring. The formulae used:

4.1. The condition of non-black firing:

$if\ U_{flow} > 0,2\ U_{sound}$

then the soot does not discharges from the stack's pipe, the APG burning is complete.

$if\ U_{flow} < 0.2\ U_{sound}$,

the soot discharges that demonstrating incomplete burning of APG. In this case, under-firing coefficient equal to 0,035 must be taken into account in further calculations:

4.2. APG's discharge flow velocity, m/sec (U_{flow}):

$$U_{flow} = 4*W_v / (\pi *d_2)$$

W_v – APG volumetric flow, m_3/s;
d – Sredne-Khulymsk oil field stacks diameter is equal to 0,2 m and 0,3 m;

4.3. Sound velocity in APG flared, m/sec (U_{sound}):

$$U_{sound}=91.5*(K*(T_{APG}+273)/\mu_{APG})_{0.5}$$

K_{APG} - adiabatic index of APG
$K_{APG} = \Sigma\ 0.01* V_i * k_i;$
Vi, - volumetric concentration i-component in APG, % vol;
ki – adiabatic index of i-component in APG;
T_{APG} – temperature of APG, °C;
μ_{APG} – molecular mass of APG, kg/mole.

Step 5. Determining CH_4 emissions due to incomplete burning

5.1. CH_4 emission factor, kg CH_4/kg APG (e_{CH4})

$$e_{CH4} = 0.01*\ under\text{-}firing\ ratio * \sigma_{CH4}$$

σ_{CH4} – CH_4 mass fraction, %.

5.2. CH_4 emissions, tonnes of CH_4 (E_{CH4})

$$E_{CH4} = 0.01 *e_{CH4} * M_{APG;}$$

Step 6. Determining CO_2 emissions, taking into account the incomplete burning

6.1. CO_2 emission factor, kg CO_2/kg APG (e_{CO2})

$$e_{CO2} = \mu_{CO2}\,(k_C/\mu_{APG} - e_{CH4}/\mu_{CH4} - e_{CO}/\mu_{CO})$$

e_{CO} – CO emission factor, kg CO/kg APG; equals to 0,25

μ_{CO_2} – molecular mass of CO_2, equals to 44;

μ_{CH_4} – molecular mass of CH_4, equals to 16;

μ_{CO} – molecular mass of CO, equals to 28

6.2. CO_2 emissions, taking into account the incomplete burning, tCO_2 (E_{CO2})

$$E_{CO2} = e_{CO2} * M_{APG}$$

Step 7. Determining total CO_2 equivalent emissions

$$E_{CO2e\_flaring} = E_{CO2} + E_{CH4} * GWP_{CH4}$$

GWP_{CH4} - Global Warming Potential, equals to 21 for methane.