JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

CONTENTS

SECTION A. General description of the project

A.1. Title of the project:

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Reduction of PFC emissions at RUSAL Novokuznetskiy Aluminium Smelter

Sectoral scope: Metal production
Version: 02
Date: 15.04.2012

A.2. Description of the project:

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Novokuznetsk Aluminium Smelter (abbreviated name: RUSAL-NkAZ is one of the largest and oldest aluminium smelters in Siberia and in the Russian Federation. It is located in the industrial area of the town of Novokuznetsk, Kemerovo region. The smelter belongs to UC RUSAL.

The smelter was founded in 1943. It belongs to UC RUSAL.

NkAZ total production volume of aluminium was 318 694 tonnes in 2008.

NkAZ's production facilities include 10 potrooms, 4 of which use horizontal stud Soderberg without alumina point feeder (HSS), the 6 remaining potrooms use the vertical stud Soederberg without alumina point feeder (VSS). The smelter does not have any of its own power facilities, all of its power supply comes from local power generating systems.

Project objectives:

The objective of this project is to reduce perfluorocarbon emissions by decreasing the frequency and duration of anode effects (AEF/AED) as the result of implementing various engineering and organisational measures (implement a process control system at the obsolete BT potline horizontal stud Soderbergs (HSS)) to be specially provided for this purpose within the implementation at Novokuznetsk aluminium smelter since the beginning of 2003, as well as of a number of organisational measures regarding the Spotline in 2010, 2011 aimed at reducing both the duration and frequency of the anode effect (AE).

The project will not lead to an increase of aluminium output. The production capacity will remain the same as it was prior to the project implementation and it will remain the same after the project implementation.

The implementation of this project is based on the principles of sustainability, i.e. make our production process more environmentally-friendly. As a result of (AE) reduction with the same aluminium output the perfluorocarbon (CF_4 and C_2F_6) and soot emissions will reduce, which contributes to the reduction in greenhouse effect and improvement in difficult environmental conditions in Novokuznetsk and Kemerovo Region.

Situation prior to project activities

Prior to the implementation of the project measures in 2003 and 2001, as well as in 2010, the smelter produced primary aluminium according to the Soederberg process when keeping the current production capacity without taking any measures aimed at the AEF/AED reduction and additional environmental measures. AE amounts were at a high level prior to the project implementation in the main potrooms, however it is a usual practice of the HSS operation without alumina point feeder.

At Russian smelters, the anode effect has always been considered as a measure for normal cell operation because it is considered that the bath temperature, cell cavity configuration, metal production and current efficiency are key indicators for effective cell functioning. If the anode effect has not occurred in natural way during a certain period of time, it has been created artificially, as a rule. Moreover, the AEF/AED reduction does not influence greatly upon electric power consumption, aluminium production or quality, as well as labour cost. Therefore, this reduction does not bring about any significant profit because of this the smelter management has never considered this a priority. Moreover, current Russian laws regarding greenhouse gas emissions allow very high levels of perfluorocarbon emissions and do not encourage the smelter's management to make any changes in regards to their policies on greenhouse gas emissions.

Project

The project is aimed at reducing perfluorocarbon (PFC) levels by means of a frequency/duration (AEF/AED) reduction by implementing the following measures:

1. The project measures related to the BT potline from 2003 are aimed at installing a dedicated Troll process control system that allows one to forecast anode effects more reliably.

2. Project measures related to the S potline from 2001 and 2010 are aimed at making operational improvements by means of bringing out some equipment from outsourcing, which will allow making it more accessible for the reduction department personnel. In addition, changes in the cell maintenance manual have been introduced. These changes influence the AE quenching time and prevent downtime during AE. For the S8 potline, the same approach is used: operation with cell voltage specified and anode plant foremen work (since 2010). This will bring AE frequency down to 0.5.

Pre-project Statistics (beginning of the year2002):

Description	Unit	2001	2001	2001	2001
		BT-82	BT-88	S-2.3	S-8BM
Alumina	kg/tonne	1,932.0	1,932.0	1,911.5	1,911.5
Cryolite	kg/tonne	21.7	21.1	38.1	39.5
Aluminium fluoride	kg/tonne	21.8	22.8	32.5	32.1
Anode paste	kg/tonne	499.0	498.1	532.7	525.8
Calcium fluoride	kg/tonne	2.3	2.1	3.0	3.2
Process power	kW·h	15,160.1	14,994.0	15,540.4	15,642.4
Electrolytic aluminium	tonne	15,768	73,538	117,330	73,725
Current	A	81,494	87,444	139,597	157,403
Average voltage	V	4.453	4.473	4.632	4.697
Current efficiency	%	87.42	88.79	88.70	89.38
AEF	day^{-1}	1.12	1.02	1.32	0.99
AED	min	1.71	1.67	2.13	2.40

Overall, performance is satisfactory, however higher anode effect frequency and duration are quite unjustified.

Project objectives:

- the anode effect frequency reduction for all the cell types down to less than 0.9 day^{-1}

- AE reduction by cell type:

-BT-82, BT-88: no more than 1.7 min

-C-2, C-3, S-8BM: no more than 1.9 min

Performance achieved in 2011 (for BT82 for the year 2008, the last year of operation)

Description	Unit	2008	2011	2011	2011
		BT-82	BT-88	S-2.3	S-8БМ
Alumina	kg/tonne	1,951.8	1,950.4	1,941.7	1,941.7
Cryolite	kg/tonne	16.9	8.5	11.8	8.9
Aluminium fluoride	kg/tonne	30.8	34.8	41.2	37.2
Anode paste	kg/tonne	507.3	507.4	525.6	527.8
Calcium fluoride	kg/tonne	0.77	0.94	1.31	1.45
Process power	kW•h	15,260.1	15,422.0	15,470.4	15,624.2
Electrolytic aluminium	tonne	17,428	72,412	130,393	80,558

Description	Unit	2008	2011	2011	2011
		BT-82	BT-88	S-2.3	S-8БМ
Current	A	88309	101225	142843	171549
Average voltage	B	4.549	4.596	4.633	4.681
Current efficiency	%	88.72	88.69	89.14	89.17
AEF	day^{-1}	0.67	0.63	0.89	0.87
AED	min	1.60	1.50	1.77	1.90

Thus, with the introduction of this project the main engineering-and-economic performance has not deteriorated and the project objectives have been achieved, i.e. the anode effect duration and frequency have reduced significantly.

Regarding their activities, RUSAL NkAZ have been guided by the principles of sustainability and responsibility related to environmental, industrial and social component of their activities over the years of the company's existence.

Therefore, with the development of this Joint Implementation Project, the following objectives have been set:

-reduction in anthropogenic impact on nature in Kemerovo Region and Novokuznetsk;

-quality and environmental friendly aluminium production

-reduction of greenhouse gas emissions in the atmosphere by reducing PFC during aluminium production

- improvement in labour conditions for workers involved in reduction department.

- an opportunity of its implementation within the context of the Kyoto Protocol mechanisms in order to minimise costs for the reconstruction, automatic control required and operational measures, as well as to attract additional financing for the subsequent refinancing of other similar activities aimed at the improvement of environmental situation meeting the highest world standards; thus, the company, when discussing the project at meetings, took into consideration the chances of attracting investments due to the emission reduction sales and made a positive decision regarding its implementation according to Art. 6 of the Kyoto Protocol

- following the principles of sustainability and best practice; this will reduce contaminant emissions significantly in the region and greatly improve the health and quality of life of inhabitants of Novokuznetsk.

The project implementation was connected with overcoming a number of serious economic difficulties. However, RUSAL-NkAZ hopes to obtain an additional revenue due to sales of the Emission Reduction Units (ERU) generated within the context of the Project will help to overcome these difficulties when implementing and approving the Joint Implementation Project (JI).

Kyoto Protocol component of this Project (Project history):

-December 25th, 2001: a decision was made to bring out a part of equipment to outsourcing and replace the process instructions for the S potline in order to reduce AE to adhere to Art. 6 of Kyoto Protocol
-February, 1st, 2003: a decision was made to reduce AE for the BT potline by means of commissioning on Troll automatic control in the reduction department to adhere to Art. 6 of Kyoto Protocol
-In below table the information on measures that were provided at NkAZ to secure JI status of the project is presented.

Year	Description
2001/2002 (management decision)	Action: Intention to adopt the acidic bath technology for reducing anode effect within the framework of Article 6 of the Kyoto Protocol. Evidence:Decision of Technical Council. Minutes of discussion of Technical Council of 25.12.2001 Justification of the evidence: That was a management decision to start the project as a JI activity.
2003	Action: decision on the start of monitoring of national legislation on Kyoto Protocol ratification and JI-procedure establishment Evidence: See Minutes of discussion of 01.02.2003 Justification of the evidence: PDD was supposed to be elaborated after KP ratification and establishment of JI-procedure. To know that these conditions are in place the monitoring regarding the legislation onKP-related issues was established. From this point that was a real action to secure a JI status.
2004	Action: Monitoring of KP ratification status Evidence: Minutes of discussion of 11.04.2004 Justification of the evidence: Keeping adherence to commitment to develop the project under JI-mechanism after KP ratification and establishment of JI approval procedure the NKAZ smelter were proceeding with the monitoring of status of laws on adoption of these documents. That is why this is a real action to provide a JI status for the project.
2005	Action: Monitoring of KP ratification status and PIN elaboration Evidence: Minutes of discussion of 15.03.2005 and PIN Justification of the evidence: Keeping adherence to commitment to develop the project under JI-mechanism after KP ratification and establishment of JI approval procedure the NKAZ smelter were proceeding with the monitoring of status of laws on adoption of these documents.
2006	Action: Monitoring of KP ratification status and observation of national legislative documents on realization of KP mechanism in Russia. Evidence: Minutes of discussion of 28.03.2006 Justification of the evidence:

	Keeping adherence to commitment to develop the project under JI-mechanism after KP ratification and establishment of JI approval procedure the NKAZ smelter were proceeding with the monitoring of status of laws on adoption of these documents.

A year later NkAZ merged with RUSAL Company and further the management of the JI project has been carried out on RUSAL level. The below table contains information on measures to secure JI status on RUSAL level.

2006	UC RUSAL Action: Setting the goals. Goal 2 is to secure interests of Company in sphere of GHG regulation and emission reduction circulation. Evidence: Environmental strategy accepted on 25/09/06.Presentation in PPT-format. Justification of the evidence: Due to a merger of assets and the establishment of a united company RUSAL the management of JI projects moved to a RUSAL central head office in Moscow. Initially, to start the management of a corporate JI project portfolio RUSAL accepted Environmental strategy, which, among others, set a goal on GHG regulation and emission reduction circulation. From that point this was a real action that initiated the development of JI projects of above smelters on a RUSAL level.
2007	UC RUSAL Action: Setting the goals on reduction of CO2 emissions at Company's smelters/getting additional income from ERU sales and on realization of 6 Company's projects as JI Evidence: Passport of corporate project "Kyoto Protocol" accepted. Presentations of passport of project "Kyoto protocol" and Kyoto project realization. Justification of the evidence: By establishing a corporate project "Kyoto protocol" UC RUSAL set timeframes and estimated budgets for realization of the projects as JI. That was a further RUSAL real action to secure JI status of the smelter's project.
2008	UC RUSAL Action 1: Evaluation of all potential JI projects realized in Company's smelters in 2000-2007. Evidence 1: Discussion of all potential JI projects in RUSAL carbon portfolio. Minutes of discussion on evaluation, checking and preparation of JI projects of 28/06/2008. Justification of the evidence 1: By this action RUSAL proceeded with actualizing the goals set in Environmental strategy and the project "Kyoto Protocol". Concrete assignment to evaluate potential JI projects realized in the smelters in 2000-2007 was provided. Action 2: Start of cooperation with a consulting company on JI project preparation for IrkAZ, SAZ, NkAZ projects. Evidence 2: Discussion of the cooperation with a consulting company (NOPPPU). Minutes of discussion # 1 of 24/09/2008. Justification of the evidence 2: This document can be considered as a real action because a certain consulting company was named and intentions stipulated for providing assessment of carbon potential of JI projects for attracting carbon investments. Action 3: Monitoring of PFC emissions in 2008 at IrkAZ, BrAZ, SAZ, NkAZ . Evidence3: see file XLS-file 2008-2011 "Meeting emission obligation" Justification of the evidence: This is a direct real action to provide JI status of the smelters' projects as the monitoring for the project emissions was established and provided.
2009	UC RUSAL Action 1: Postponing ofconsultancy services due toRUSAL difficult economic situation in

	the markets. Evidence 1: Discussion of the issue with participation of RUSAL and NOPPPU representatives. Minutes of discussion of 19/03/2009. Justification of the evidence 1: Despite postponing the development of JI projects was not terminated. Parties stuck with an intention to go back to the projects after improving financial health of RUSAL. Consistency of real actions provided on previous steps was not broken. Action 2: Monitoring of PFC emissions in 2009 at IrkAZ, BrAZ, SAZ, NkAZ . Evidence2: see file XLS-file 2008-2011 "Meeting emission obligation" Justification of the evidence: This is a direct real action to provide JI status of the smelters' projects as the monitoring for the project emissions was provided.
2010	UC RUSAL Action 1: Denial of approach proposed by former PDD developer (Poyry Energy) for KrAZ and BrAZ projects and intentions to enter into co-operation with NOPPPU on PDD development. Evidence 1:Discussion of approach proposed by NOPPPU. Minutes of discussion of 02.04.2010 Justification of the evidence 1: That is the evidence that RUSAL and NOPPPY (a third party consultant) were working closely on one of smelters' projects and were to sign a cooperation agreement for PDD development on IrkAZ, SAZ and NkAZ projects. Action 2: Monitoring of PFC emissions in 2010 at IrkAZ, BrAZ, SAZ, NkAZ. Evidence2: see file XLS-file 2008-2011 "Meeting emission obligation" Justification of the evidence 2: This is a direct real action to provide JI status of the smelters' projects as the monitoring for the project emissions was provided.
2011	UC RUSAL Action 1: Development ofpreliminary versions of PDD Evidence 1: Preliminary PDDs Justification of the evidence 1: That is a self-explanatory action. Action 2: Monitoring of PFC emissions in 2011 at IrkAZ, BrAZ, SAZ, NkAZ . Evidence 2: see file XLS-file 2008-2011 "Meeting emission obligation" Justification of the evidence 2: This is a direct real action to provide JI status of the smelters' projects as the monitoring for the project emissions was provided.
2012	UC RUSAL Action: Approval ofpreliminary versions of PDD with RUSAL Evidence: Submission of PDDs for determination.Letter of consultant to Tuev-Nord representative # ЮН-58/12 of 29/03/12. Justification of the evidence: That is a self-explanatory action.

Baseline scenario

According to the baseline scenario, primary aluminium would still be produced in the 1-10 VSS and HSS potrooms while keeping the current production capacities and not taking any measures aimed to reduce AEF and any additional environmental measures. This was possible due to the current smelter operation practice which has ensured a flawless production process year after year. The Soederberg process has been studied thoroughly, it is stable and used all across the world, in addition, the main large Russian smelters use it. No measures, apart from the similar ones or operational and engineering measures aimed particularly at the AE reduction could influence AE because AE is a factor of normal cell operation.

Thus, the following factors support the idea of maintaining more conventional production practices:

- Lack of sufficient stimuli for the Project implementation: the anode effect has always been considered a benchmark for normal cell operation at Russian smelters. Moreover, AEF reduction does not really have an influence upon power consumption, aluminium output or quality, as well as labour costs, i.e. main production performance. Therefore, reduction does not bring any significant profit; because of this the smelter management have never considered this reduction a priority. Moreover, current Russian laws regarding greenhouse gas emissions allow for a very high level of perfluorocarbon emissions and do not encourage the smelter's management to make any changes in regards to their policies on greenhouse gas emissions

- Lack of investment attractiveness of such projects: without the Joint Implementation Mechanism to be proposed by Kyoto Protocol, the company would not start implementing this Project, because it does not bring any significant profit apart from the PFC emission reduction.

Emission reduction

As the result of the project activities the following will take place:

- significant improvement in work conditions for workers involved in the reduction department

- reduction in perfluorocarbon (CF_4 and C_2F_6) emissions from aluminium production by 204,814 tonnes annually or 1,024,071 tonnes for 2008-2012.

A.3. Project participants:

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Party involved	**Legal entity project participants (as applicable)**	**Please indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Party A - Russian Federation (Host party)	"RUSAL NkAZ" Joint Stock Company	No
Party B – No	To be determined further	-

JSC "RUSAL NkAZ" is one of producers of primary aluminium in the Russian Federation. It belongs to the United Company RUSAL and includes one of the world biggest smelter of primary aluminium.

A.4. Technical description of the project:

A.4.1. Location of the project:

A.4.1.1. Host Party(ies):

>>
Russian Federation

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

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The project will be implemented at the NkAZ premises in Novokuznetsk, Kemerovo Region.

Figure 4.1.2 Kemerovo region on the map of the RF

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

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Kemerovo Region

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

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City of Novokuznetsk.

Novokuznetsk is the largest city of Kemerovo Region of regional subordination (Novokuznetsk city district); it is the administrative centre of Novokuznetsk District of Kemerovo Region of Russia. The city is located on the left hand and right banks of the Tom River.

The Project will be implemented at the Novokuznetsk aluminium smelter at 10 reduction department shops. It is located in an industrial zone of Novokuznetsk, Kemerovo Region.

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

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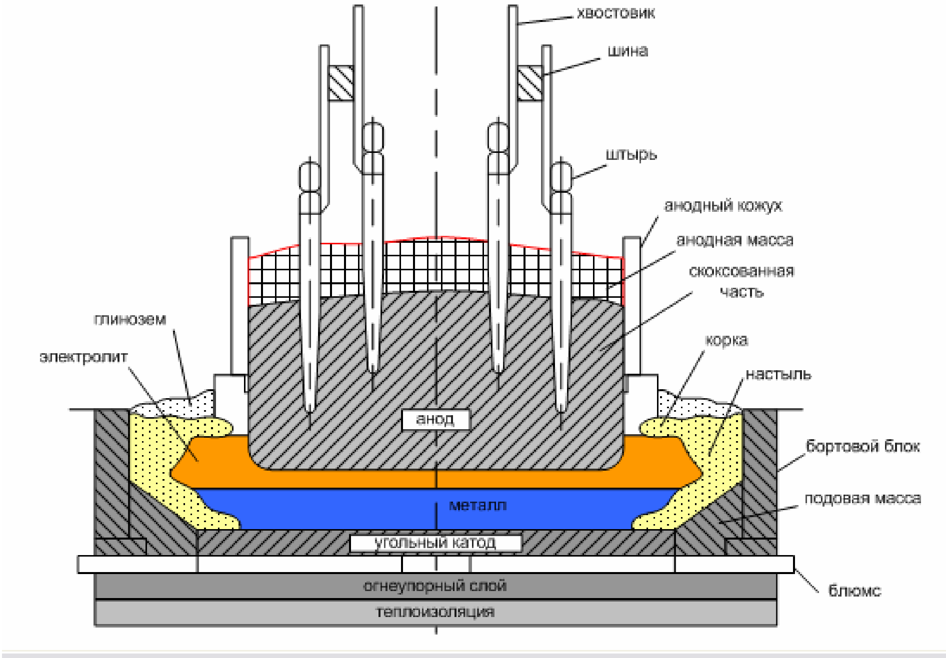
Process system description

Electrolytic aluminium production is based on electrolytic reduction of aluminium oxide (Al_2O_3) solved in cryolite melt in electrolyte pot at a temperature of 950-970°C. The electrolyte pot is a pot lined with carbon blocks serving as the cathode (the bottom). Molten aluminium is located on the bottom, because it is denser (its specific gravity is 2.7 g/cm^3 at 960 ^{0}C) than electrolyte (its specific gravity being 2.1 g/cm^3). Aluminium is pumped away with vacuum to vacuum ladles. Steel beams conduct electric current through fireproof siding brick away from the carbon cathode in the electrolyte pot footing. Anode is plunged in electrolyte from above, moving along steel guides. The anode carbon is consumed in the course of reduction. When prebaked anodes process is applied, carbon anodes are used, which burn in the atmosphere of oxygen produced from aluminium oxide producing carbon oxide (CO) and carbon dioxide (CO_2).



Two types of anodes are used in aluminium production:

a) Self-baking Soederberg anodes that consist of anode paste (calcinated coke mixed with coal tar or petroleum pitch) placed in a steel shell. Under high temperatures, the anode paste is calcinated (baked). There are two types of Soederberg cells: horizontal stud Soederber (HSS) and vertical stud Soederberg (VSS). NkAZ uses both HSS and VSS. Alumina is fed manually by means of an alumina side feeder having a manual control (SF VSS standard process)

b) More advanced baked anode procedure uses preliminary baked anodes from large carbon blocks (e.g. 1900×600×500 mm with a weight about 1.1 t) baked in special baking furnaces which are part of the refinery capacities.

Electrolyte pot operation procedure is regularly accompanied by the phenomenon called ‘anode effect’. Anode effect (‘flash’) is the result of anode polarisation at reduction. It takes place when alumina (Al_2O_3) concentration in electrolyte falls below the critical value (1.5 – 2%) (the so called ‘pot deficiency’) and is characterised by a dramatic growth of voltage due to worsened anode wetting with electrolyte, and due to increase of electrolytic resistance at the anode-electrolyte interface.

Two gaseous perfluorocarbons (PFC) are produced at anode effect – tetrafluoromethane (CF_4) and hexafluoroethane (C_2F_6) – gases covered by this project.

$4Na3AlF_6 + 3C \rightarrow 4Al + 12NaF + 3CF_4$

$4Na3AlF_6 + 4C \rightarrow 4Al + 12NaF + 2C_2F_6$

For feeding most of electrolyte pots, the side alumina loading method with crust breaking is used. In this case, the electrolyte crust is broken along the pot longitudinal wall and the alumina is manually loaded into the pot. This procedure is the standard and basic electrolytic pot feeding method. It is established that the basic cause of anode effect is fall of alumina concentration below the critical level between feeding cycles.

The purpose of the project is to change the electrolyte composition which will provide the pot with maximum stability to alumina feed fluctuations which is typical for electrolytic pots without APF. *Pre-project Statistics (beginning of the year 2002):*

Description	Unit	2001	2001	2001	2001
		BT-82	BT-88	S-2.3	S-8BM
Alumina	kg/tonne	1,932.0	1,932.0	1,911.5	1,911.5
Cryolite	kg/tonne	21.7	21.1	38.1	39.5
Aluminium fluoride	kg/tonne	21.8	22.8	32.5	32.1
Anode paste	kg/tonne	499.0	498.1	532.7	525.8
Calcium fluoride	kg/tonne	2.3	2.1	3.0	3.2
Process power	kW•h	15,160.1	14,994.0	15,540.4	15,642.4
Electrolytic metal	tonne	15,768	73,538	117,330	73,725
Current	A	81,494	87,444	139,597	157,403
Average voltage	B	4.453	4.473	4.632	4.697
Current efficiency	%	87.42	88.79	88.70	89.38
AEF	day-1	1.12	1.02	1.32	0.99
AED	мин	1.71	1.67	2.13	2.40

As a whole, the performance achieved is satisfactory, however a high the anode effect frequency and duration is quite unjustified.

Project objectives:

- the anode effect frequency reduction for all the cell types down to less than 0.9 day^{-1}
- AE reduction by cell type:

-BT-82, BT-88: no more than 1.7 min

-C-2, C-3, S-8BM: no more than 1.9 min

Performance achieved for the year 2011 (for BT-82: for the year 2008, the last year of operation)

Description	Unit	2008	2011	2011	2011
		BT-82	BT-88	S-2.3	S-8BM
Alumina	kg/tonne	1951.8	1950.4	1941.7	1941.7
Cryolite	kg/tonne	16.9	8.5	11.8	8.9
Aluminium fluoride	kg/tonne	30.8	34.8	41.2	37.2
Anode paste	kg/tonne	507.3	507.4	525.6	527.8
Calcium fluoride	kg/tonne	0.77	0.94	1.31	1.45
Process power	kW•h	15260.1	15422.0	15470.4	15624.2
Electrolytic metal	tonne	17428	72412	130393	80558
Current	A	88309	101225	142843	171549
Average voltage	V	4.549	4.596	4.633	4.681
Current Efficiency	%	88.72	88.69	89.14	89.17
AEF	day^{-1}	0.67	0.63	0.89	0.87
AED	min	1.60	1.50	1.77	1.90

Thus, with the introduction of this project the main engineering-and-economic performance has not deteriorated and the project objectives have been achieved, i.e. the anode effect duration and frequency have reduced significantly.

Production data after implementing the Project

Anode effect data	**Potline No.**									
	4		5		6		7		8	
	Potroom No.									
	3	4	5	6	7	8	9	10	11	12
Production process category	HSS	HSS	HSS	HSS	VSS	VSS	VSS	VSS	VSS	VSS
Electrolysis process	BT88	BT88	BT88	BT88	S2(3)	S2(3)	S2(3)	S2(3)	С8БМ	С8БМ

Anode effect data	**Potline No.**									
	4		5		6		7		8	
	Potroom No.									
	3	4	5	6	7	8	9	10	11	12
Feeding type	SF	SF	SF	SF	SF	SF	SF	SF	SF	SF

VSS: vertical stud Soederberg, PFPB: centre worked/point feeding prebaked anode cells, S: Soederberg process, SF – manual side feeding (worked) cell.

Project history:

-*December 25th, 2001: a decision was made on outsourcing some equipment and maintenance operationssand replacing process instructions for the S potline in order to reduce AE to adhere to Art. 6 of the Kyoto Protocol*

-*February, 1st, 2003: a decision was made to reduce AE for the BT potline by means of commissioning on Troll automatic control in the reduction department to adhere to Art. 6 of the Kyoto Protocol*

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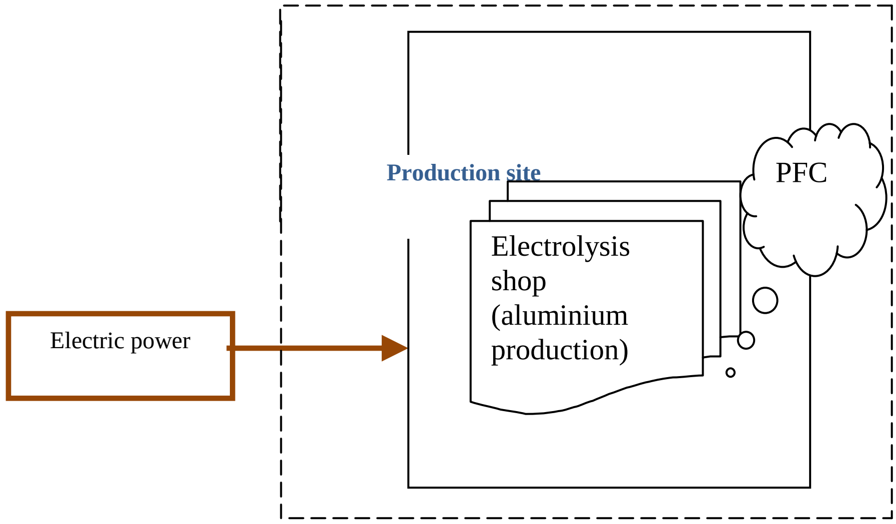
Figure. A.4.2. Layout of the project activity



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:

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The project is aimed at minimising AEF which is the main cause of PFC emission. They can only be minimised by technical means provided in the project or by performing operational actions.

The specialists of the aluminium of UC RUSAL have always believed that aluminium production process can be made more effective at gradual reduction of AEF. Such a vision was out of tune with the common opinion that the process applied at electrolyte pot is imbalanced if no anode effect occurs. At Russia industrial facilities anode effect has always been considered as evidence of normal operation of electrolyte pot. Moreover, reduction of AEF has no significant impact on electric power consumption, aluminium production or its quality, or at workers' labour consumption. Consequently, decrease in anode effect brings no significant profit, therefore the refinery managers have never treated such a decrease as a priority. Moreover, the existing Russian laws allow for very significant perfluorcarbon emissions and has no influence on the refinery managers' attitude to anode effect and associated emission of greenhouse gases.

Without this project activity it would be impossible to achieve the decrease, since normal operation practice would provide for no actions aimed at anode effect decrease, and consequently a high level of anode effect would exist, characteristic of this type of reduction, which would lead to higher greenhouse gas emissions and environment deterioration.

All the above facts as well as the reasons provided in Section B mean that RUSAL Novokuznetsk would not have started greenhouse gas emissions but for the support of Kyoto Protocol, and does so only within the framework of the joint implementation project.

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

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	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2equivalent
2008	188,342
2009	154,995
2010	181,410
2011	249,662
2012	249,662
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	1,024,071
Annual average of emission reductions over the crediting period (tonnes of CO_2 equivalent)	204,814

In case of extending the crediting period beyond 2012 the monitoring plan and calculation of emission reductions will remain unchanged, which will be determined according to formulas in D sections

	Years
Length of the second crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2equivalent
2013	249,662
2014	249,662
2015	249,662
2016	249,662
2017	249,662
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	1248310
Annual average of emission reductions over the crediting period (tonnes of CO_2 equivalent)	249,662

A.5. Project approval by the Parties involved:

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On September 15, 2011 the Chairman of the Russian Federation Government signed Resolution 780 “On measures for realization of Article 6 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change”. This document depicts a JI-project approval procedure in the Russian Federation.

According to item 4 of the Provision the approval of projects will be carried out by the Ministry of Economic Development of the Russian Federation based on consideration of submitted project proposals. Competitive selection of demands is carried out by the operator of carbon units (Sberbank of RF) according to the item 10 of the Government Decree of the Russian Federation № 780.
According to item 7 of the Provision the application structure includes «the positive expert opinion on the project design documentation prepared according to the international requirements by the accredited independent entity chosen by the applicant».

Thus, according to the legislation of the Russian Federation in the field of JI projects realization, the Project approval is possible after reception of the positive determination opinion from AIE.

SECTION B. Baseline

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

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The chosen baseline will be described and justified on the basis of the “Guidelines for users of the joint implementation project design document form” (Version 04) and in accordance with the “Guidance on criteria for baseline setting and monitoring” (Version 03) and Appendix B to Decision 9/CMP.1 using the following step-wise approach:

Step. 1. Indication and description of the approach chosen regarding the baseline setting.

Step. 2. Application of the approach chosen.

The following is a detailed presentation of approach including two steps:

Step. 1. Indication and Description of the Approach Chosen Regarding the Baseline Setting

The baseline is determined through considerations of various alternative scenarios with regard to the proposed project activity. As criteria for choosing the baseline scenario the key factors will be determined. All alternatives will be considered in terms of influence on them of these factors. The alternative scenario, which is the least negatively influenced by the key factors, will be chosen as the baseline.

Therefore, the following stages of determining the baseline scenarios are envisaged:

a) *Description of alternative scenarios.*
b) *Description of the key factors.*
c) *Analysis of influence of key factors on alternatives.*
d) *Choosing the most plausible alternative scenario.*

Step. 2. Application of the Scenario Chosen

As options for production of electrolytic aluminium at project facilities (shops), RUSAL Novokuznetsk discusses the following scenarios:

Scenario 1. Performing current activities of the smelter in accordance with the Soederberg process that is standard in Russia without measures specially aimed at reducing AE.

Scenario 2. Project implementation along with measures for engineering and operational activities aimed at AE reduction without its further development as a Joint Implementation Project.

Other scenarios are not considered because they are not plausible and are not used in the Russian Federation. All the smelters located in the Russian Federation have been built using VSS process.

Exceptions are such state-of-the-art smelters such as Sayanogorsk aluminium smelter and Khakassia aluminium smelter where prebaked anode process (PFPB) is used.

Compliance of chosen alternatives to current laws and regulations

From the regulatory document point of view, NkAZ is not required to reduce PFC emissions because they occur with AE, and AE is normal cell operation.

The implementation of any of two scenarios corresponds to environmental regulations because any scenario will not result in exceeding maximum environmental impact that is able to become a barrier preventing some scenario from being implemented.

Conclusion: Thus, none of the stated options is in contradiction with the currently effective laws and may be considered for further analysis.

Stage 2. Key factors review

This stage involves identifying the factors that could interfere with alternative scenarios identified in the previous stage and analysis of influence of these factors on the implementation of alternatives. In result of factors review the conclusion on feasibility of each scenario is made.

The result of the two above stages is to determine the most likely options not hindered by factors considered.

Identification of factors that could interfere with alternative scenarios

For purposes of this analysis of key factors an influence of *technological factors* on above options is considered. These factors include:

Technical feasibility. As part of this factor, is considered the feasibility of option realisation from a technical and economic point of view taking into account remoteness of the project site, value of capital investments, availability and development of infrastructure. Should this factor not be overcome by one of the above options, it is not considered for further analysis.

Analysis of impact of key factors on these options

The influence of the factor of technical feasibility

Scenario 1. The implementation of current smelter activities according to the Soederberg practice that is standard in Russia without measured that are specially aimed at reducing AE

AE frequency reduction is not to be expected because any high frequency with the Soederberg process is standard and reflects normal cell state, sometimes AE is provoked artificially, for the anode preventive maintenance and cleaning. Electrolytic aluminium would still be produced at the smelter in the obsolete potrooms with HSS and VSS.

The use of the current aluminium production process with a high AE level does not require a cost increase.

AE reduction itself is not foreseen, small variations are possible, either toward an increase or toward a decrease, due to various causes: alumina unstable composition, alumina (manual) feeding interruptions, poor anode sintering, etc.

This will result in:

- a small electric power saving
- minor metal slag reduction
- a slight reduction in contaminant emissions through the reduction department skylight exhaust without their treatment.

However, common metal production and power consumption depend on multiple factors because the results to be achieved due to unplanned (sure thing) AEF reduction cannot be assessed and measured. This is one of the reasons why no attempts have been made to reduce AEF at Russian smelters for such a long time. Elimination of measures for AEF reduction from this scenario is explained by certain hurdles that need to be overcome to implement such measures (financial, institutional, and pilot-industrial barriers).

Russian legislation for environment protection does not regulate greenhouse gases included in the Project, despite the fact that the safe level of their impact (ASLI) is specified by the GN at approximately 2.1.6.2309-07. In accordance with 2.1.6.2309-07, ASLI for CF_4 is 10 mg/m^3, that for C_2F_6 is 20 mg/m^3. The calculation of diffusion for the similar smelter (Krasnoyarsk aluminium smelter) having the similar PFC emission level shows that the maximum one-time concentration of contaminants on a sanitary area boundary is much lower than the maximum permissible concentration of such particles (in our case, that level is equal to ASLI). Therefore, according to the OND-86 requirements, such substances are not subjected to be reduced. Because of this, they are not included in the maximum permissible concentration standards and their emissions are not regulated.

Changes in law concerning greenhouse gas emissions are not foreseen. Small reductions in AE frequency during production process variations do not result in a significant reduction of contaminant emissions entering with AE into the atmosphere through the reduction department skylight exhaust without any treatment (solid and gaseous fluorides, alumina dust) and the smelter itself meets the environmental standards completely provided that the project is implemented. So the NkAZ management has no reasons for implementing any additional measures aimed at reducing AEF.

Scenario 2. Project implementation along with measures on engineering and operational activities aimed at reducing AE without its further development as a Joint Implementation Project

When implementing measures aimed at AEF/AED reduction, the smelter's management did not set any objective for obtaining any additional profit from economic effect connected with reducing AEF including electric power consumption reduction and metal slag. The main reason for this is that the effect being the result of these measures cannot be measured which under other circumstances could become a solid argument for the management in favour of continuation of work on AEF reduction.

The economic effect due to the AEF reduction as the result of the accompanying reduction in electric power consumption and metal slag cannot be measured to such an accuracy that would allow the management to objectively assess a decision on AEF reduction in order to reduce electric power consumption and increase aluminium production.

An accurate value of electric power saving as the result of the AEF reduction may be calculated only theoretically, and its quantitative measurement will be performed simply.

Let us suppose that the cell working voltage is 4.5 V, and the current is 100 kA during the operation with the current efficiency being equal to 88-90 %.

Faraday law is expressed by the following equation:

$m = k * I * \tau * CE$, kg

where:

k – aluminium electrochemical equivalent that is equal to 0.336 g/(A·h) (quantity of aluminium to be produced at the cell cathode during an hour after current that is equal to 1 A has passed)

I – current, kA

τ – time during which electric current passes through the cell, s

CE – current efficiency

The quantity of aluminium to be produced in a single cell is determined according to the Faraday law. A single cell will produce during 24 h:

m = 0,336 * 100 * 24 * 90 % =725.8 , kg

Electric power consumption will be:

$W = U * I * 24$ = 10,800 kW·h

The electric power consumption per one tonne of aluminium will be 10,800/0/7258= 14,880 kW·h.

Let us suppose that at a tension of 40 V and duration of 2 min is daily observed on the cell having operational parameters mentioned above. An additional power consumption due to will be

W =*U* * *I* * t*24 kW·h,

which corresponds to (40 -4.5)*100*(2 /(60*24))*24 = 118.3 kW·h or 118.3/0.7258 = 163 kW·h.

In case of AEF reduction from 1 down to 0.8 a day power consumption will reduce by the same 20 % and will be equal to 163*0.8=130 kW·h.

In actual practice, reduction in project additional consumption by 33 kWh (or 40/14,880 * 100 = 0.26%) is challenged by serious technical difficulties:

The project is not achieved energy savings by reducing the AE.

- at the majority of NkAZ potlines, the current measurement tolerance is 1-1.5 % which significantly exceeds the additional consumption value that is required to be reduced. Under such conditions, the measurement of very small values is pointless statistically.

Such theoretical measurement is not suitable for financial estimations not being supported by measurements or actual significant changes in electric power consumption. Such situation is with variations in cell capacities as the result of AEF reduction.

There are two product types in the electrolysis process: electrolytic aluminium (i.e. aluminium to be produced in a cell as the result of applying direct current) and raw aluminium to be extracted from a pot with vacuum ladle and to be transferred to the casthouse.

At first approximation, the volumes of both products may be considered as almost the same, however, that is not the case in practice.

If the amount of aluminium may be determined to an accuracy of ±20 kg using a balance, then it is difficult to accurately determine the quantity of aluminium that remains in the pot.

The cell design is such that a protective layer consisting of frozen bath remains on their sides. This protective layer protects the pot walls against corrosive fluid. The layer thickness and volume (as well as quantity of aluminium that remains permanently in the pot) cannot be determined to an accuracy of ±7 % using widespread methods without using radioactive isotopes or other expensive methods.

Now, there is no unique hypothesis regarding nature. Multiple researchers suppose that with the anode effect, aluminium ions stop emitting at the cathode. While others think that the anode effect means emission in the gaseous phase forming under the anode with insufficient bath volume on the pot bottom. Western literature does not contain consistent data that could support an assumption that the anode effect varies systematically current efficiency. If we suppose that the current efficiency with the anode effect drop by 5 %, then it should result in the total current efficiency reduction that would be equal to 5*2/(24*60)=0.7 %. In case of a daily AEF reduction by 0.2 the current efficiency drop should be reduced theoretically by 0.14 %.

To confirm that connection a long-term experiment with absolute stable initial parameters is required. I.e. current, raw material quantity, ambient temperature, etc. must strictly be at the same level during the whole experiment. Thereafter, a confirmation will be required that under such stable conditions a quantity of aluminium produced has been changed, e.g. by 0.14 %. So far, these experiments have not been performed due to impossibility of their organisation under industrial conditions.

All that mentioned above means it is impossible to determine the exact economic effect due to the aluminium loss reduction and electric power consumption reduction. No one has measured these parameters and no one is going to measure them in the future. Therefore, the only economic effect to be considered by the company's management when making a decision is a possible effect due to emission reduction unit sales.

To support such a theory suffice it to remember that all the Russian smelters were built in the sixties and they use the same production process. No effective plans for reducing AEF has been passed in the last decades because it would not provide an investment return. The fact that there are not any limitations of PFC emissions in Russian regulatory documents support this theory.

Thus one may say that significantly reducing AE occurs within the framework of the Project due to specific measures aimed just at this and decreasing high levels of PFC and carbon dioxide emissions.

However, within the context of this scenario, the case in question is private financing of measures that have environmental significance.

The implementation of the project for the development of a dedicated process control system and operational measures has required significant financial expenditure for:

- reequipping all shops with Troll control system;
- purchasing dedicated machines for beam transportation.

The company has implemented this project, costing 27.9 million roubles, at their own expense.

Taking into account this situation regarding the current understanding of AE and considering significant capital expenditures, one may affirm that this alternative would hardly be implemented without involvement of additional investments for it because about 28 million roubles have been invested which is incomparably higher than the option of Soederberg cell operation. Thus, an opportunity to implement this alternative scenario is improbable, nevertheless, it will be considered in the investment analysis.

Stage 3. Choosing the most plausible alternative scenario

Table B 1.1. Factor analysis

#	Factor	Scenario 1	Scenario 2
1.	Sectoral reform policies and legislation	Favors to implementation	Favors to implementation implementation
2.	Economic situation in aluminium production sector	Makes this scenario the most plausible candidate for baseline	Unfavorably effects on its realization
3.	Availability of capital	Provides implementation of the scenario as no investments are needed.	Represents a considerable investment barrier for this scenario

Based on the conducted analysis it is quite obvious that the key factors favor the implementation of Scenario 1 and affect negatively Scenario 2. Therefore, Scenario 1 is the **baseline scenario**.

Theoretical description of the baseline scenario

Baseline GHG emissions take place due to the occurrence of anode effects during the production of primary aluminium.

$$\mathbf{BE = MP * AEF_b * AED_b * S_{CF4} * (6500 + F_{C2F6}/_{CF4} * 9200)/1000} \qquad \mathbf{(1)}$$

Where:
MP – is the production of electrolysis aluminium, t/year; equals to a quantity of aluminium poured out the pots plus aluminium remained in pots as work-in-progress.

AEF_b – is the average frequency of anode effects under the baseline, times per pot-days; historical data from the database control system for BT series in period 2000-2002, for S series 200-2001, for C8 series 2000-2010 prior project implementation. Numeric value present in E section

AED_b –is the average duration of anode effect under the baseline, minutes, historical data from the database control system for BT series in period 2000-2002, for C8&S series 2000-2001 prior project implementation. Numeric value present in E section

S_{CF4} – is the slope coefficient for CF_4, (kg of CF_4 /tonne of aluminium)/(number of minutes of anode effect/pot per day) [1];

$F_{C2F6 / CF4}$ – is the weight fraction of C_2F_6/CF_4

6500 – Global Warming Potential for CF_4 [2]
9200 – Global Warming Potential for C_2F_6 [3]

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[1] Definition "pot-day" means the quantity of pots under operation multiplied by the quantity of working days (2006 IPCC, Volume 3, Chapter 4.4, page 4.55)

[2] http://unfccc.int/ghg_data/items/3825.php

[3] http://unfccc.int/ghg_data/items/3825.php

For calculation of the baseline PFC emissions the smelter provided a plausible estimate of the average frequency and average duration of anode effects which could happen in the absence of the project activity (please see the annex to PDD).
Applied values of the slope coefficient and weight fraction for appropriate technology are taken from 2006 IPCC, Chapter 4, p. 4.58, table 4.16.

The key information and data used to establish the baseline presented in the tables below:

Data/Parameter	MP
Data unit	tonnes
Description	Electrolytic aluminium poured out the pots
Time of determination/monitoring	constantly
Source of data (to be) used	Weight scale KGW-20 International Aluminium Institute form (IAI-PFC001)
Value of data applied (for ex-ante calculations/determinations)	2008: 318,694 2009: 228,256 2010: 268,798 2011: 283,363 2012: 283,363
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data in 2008-2011 are actual and obtained on certified equipment. Data for 2012 are assumed on 2011 year level, considering global boost in aluminium supply.
QC/QA procedures (to be) applied	All devices used in monitoring are regularly checked in accordance with Russian legislation by competent entities.
Any comment	-

Value of data applied for MP:

2008	318,694
2009	228,256
2010	268,798
2011	283,363
2012	283,363

Data/Parameter	AEDb
Data unit	Minutes
Description	Average duration of anode effect
Time of determination/monitoring	Constantly
Source of data (to be) used	Automatic process control system (APCS)
Value of data applied (for ex-ante calculations/determinations)	see table below
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Line trend based on historical data from the database control system for BT series in period 2000-2002, for C8&S series 2000-2001 prior project implementation. Numeric value present in E section

Value of data applied for AEDb:

	BT82	BT88	S2.3	C8БМ
2008	1.68	1.65	2.36	2.62
2009	1.68	1.65	2.36	2.62
2010	1.68	1.65	2.36	2.62
2011	1.68	1.65	2.36	2.62
2012	1.68	1.65	2.36	2.62

QC/QA procedures (to be) applied	All devices used in monitoring are regularly checked in accordance with Russian legislation by competent entities.
Any comment	-

Data/Parameter	AEFb
Data unit	Anode effects per pot day
Description	Average frequency of anode effects
Time of determination/monitoring	Constantly
Source of data (to be) used	Automatic process control system (APCS)
Value of data applied (for ex-ante calculations/determinations)	see table below
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Line trend based on historical data from the database control system for BT series in period 2000-2002, for S series 200-2001, for C8 series 2000-2010 prior project implementation. Numeric value present in E section
QC/QA procedures (to be) applied	All devices used in monitoring are regularly checked in accordance with Russian legislation by competent entities.
Any comment	-

	BT82	BT88	S2.3	C8БМ
2008	1.06	1.05	1.41	-
2009	1.06	1.05	1.41	-
2010	1.06	1.05	1.41	-
2011	1.06	1.05	1.41	1.09
2012	1.06	1.05	1.41	1.09

Data and parameters that are not monitored throughout the crediting period but determined only once (and thus remain fixed throughout the crediting period)

Data/Parameter	S_{CF4}
Data unit	(kg of CF_4 /tonne of aluminium)/(number of minutes of anode effect/pot day)
Description	Slope coefficient of CF_4
Time of determination/monitoring	Determined once (referenced value)
Source of data (to be) used	2006 IPCC, Volume 3, Chapter 4.4., page 4.55, table 4.16
Value of data applied (for ex-ante calculations/determinations)	see table below
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data that used in the absence of direct measurements. One value for each technology
QC/QA procedures (to be) applied	Reference data
Any comment	-

Technology	VSS	HSS
2008-2012	0,092	0,099

Data/Parameter	$F_{C2F6/CF4}$
Data unit	C_2F_6/CF_4
Description	Weight fraction
Time of determination/monitoring	Determined once (reference data)
Source of data (to be) used	2006 IPCC, Volume 3, Chapter 4.4., page 4.54, table 4.16
Value of data applied (for ex-ante calculations/determinations)	Technology: 2008-2012; VSS: 0,053; HSS: 0,085
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data that used in the absence of direct measurements. One value for each technology
QC/QA procedures (to be) applied	Reference data
Any comment	-

Technology	VSS	HSS
2008-2012	0,053	0,085

Data/Parameter	**6500**
Data unit	tCO_2/tCF_4
Description	Global Warming Potential for CF_4
Time of determination/monitoring	Determined once during PDD development
Source of data (to be) used	Decision 2/CP.3 **http://unfccc.int/resource/docs/cop3/07a01.pdf#page=31** Climate Change 1995, Climate Change Science: Conclusion for politicians and technical conclusion of Report of Expert Group I, p.22 http://unfccc.int/ghg_data/items/3825.php
Value of data applied (for ex-ante calculations/determinations)	6500
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Global Warming Potential is needed for calculation of CO_2 equivalent emissions
QC/QA procedures (to be) applied	Reference data
Any comment	-

Data/Parameter	**9200**
Data unit	tCO_2/tC_2F_6
Description	Global Warming Potential for C_2F_6
Time of determination/monitoring	Determined once during PDD development
Source of data (to be) used	Decision 2/CP.3 **http://unfccc.int/resource/docs/cop3/07a01.pdf#page=31**

	Climate Change 1995, Climate Change Science: Conclusion for politicians and technical conclusion of Report of Expert Group I, p.22 http://unfccc.int/ghg_data/items/3825.php
Value of data applied (for ex-ante calculations/determinations)	9200
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Global Warming Potential is needed for calculation of CO_2 equivalent emissions
QC/QA procedures (to be) applied	Reference data
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:

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Additionality was demonstrated according to the paragraph 2 (a) of the Annex I to the “Guidance on criteria for baseline setting and monitoring” version 03 by “Provision of traceable and transparent information showing that the baseline was identified on the basis of conservative assumptions, that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources or enhancements of net anthropogenic removals by sinks of GHGs”.

The analysis provided in subsection B.1. clearly demonstrates that the proposed project is not a baseline.

This section demonstrates that the project provides reductions in emissions by sources that are additional to any that would otherwise occur, using the following step-wise approach:

Step 1. Indication and description of the approach applied.

A JI-specific approach is chosen for justification of additionality. For this purpose provision a) is chosen defined in paragraph 2 of the annex I to the Guidance on criteria for baseline setting and monitoring version 02. 1, i.e: (a) Provision of traceable and transparent information showing that the baseline was identified on the basis of conservative assumptions, that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources or enhancements of net anthropogenic removals by sinks of GHGs.

Step 2. Application of the approach chosen.

The step includes consideration of three sub-steps:
Sub-step 2.1. Identification of alternative scenarios.

Sub-step 2.2. Investment analysis.

Sub-step 2.3. Common practice analysis.

For further analysis the alternatives identified in B1 Section are applied:

Sub-step 2.1. Identification of alternative scenarios.

Scenario 1. Performing current activities of the smelter in accordance with the Soederberg process that is standard in Russia without measures specially aimed at AE reduction.

Scenario 2. Project implementation along with measures for engineering and operational activities aimed at AE reduction without its further development as a Joint Implementation Project.

Sub-step 2.2. Investment analysis

It is determined on this sub-step:

- whether the Project is a most financially or economically attractive alternative;
- whether the Project is economically or financially viable without cash generated from ERU sales.

Sub-step 2.2a. Determination of appropriate analysis method

On this sub-step it is determined whether to apply simple cost analysis, investment comparison analysis or benchmark analysis. If the JI project activity generates no financial or economic benefits other than JI related income, then the simple cost analysis is applied.

The proposed JI project activity does not generate income from sales of electricity or additional quantity of aluminium or substantial economy of fuel, therefore the simple cost analysis is applied.

Sub-step 2.2b. Simple cost analysis

According to the baseline, primary aluminium would be still produced in the 1-10 VSS and HSS potrooms and when keeping the current production capacities not taking any measures aimed to reduce AEF/AED and any additional environmental measures. It was due to the current smelter operation practice year after year without any faults and production shutdown. The Soederberg process has been studied thoroughly, it is stable and widespread in the world practice, in addition, the main large Russian smelter use it. At the same time, an investing company would not invest any capital. Any repair either current or emergency repair may be in both scenario, so they are not taken into consideration. Such repair would be performed at the expense of means included in the annual production schedule as repair required to support the current capacity level.

The project scenario that proposes the implementation of measures aimed at the AE reduction at the expense of means of an investor cost practically 27.9 million roubles. The Joint Implementation Project to be proposed does not cause additional profit from the electricity sales and additional aluminium sales or substantial fuel saving due to the AE specification. Thus, the investor cannot obtain other profit from the project activities implementation apart from the emission reduction unit sales.

Expenditure comparison as per alternative 1 and 2:

	Alternative 1	Alternative 2 (project)

	Alternative 1	Alternative 2 (project)
Investment, million roubles	Nil since no additional expenses are required	27.9

The main parameters influencing the evaluation of electrolyze productions (and as a consequence of the current economy and aluminum) is:
-Cell operating voltage of 4.5 V
-Current amperage in the process is 100-150 kA (reference value for Soderbergh)
-Tolerance (error rate) measurements of the current amperage
-Tolerance of the measurement of weight of aluminum in the weights

All of the above options will be calculated on the basis of really logic and electrochemical laws, the amount of energy savings and the aluminium production in the AE reductions.
So, the explanation in Section B, indicate that reduction of electricity consumption this is a statistically small quantities are to be measured, because are located in the partings of errors involved in the monitoring.
To confirm that the auditors were presented passports instruments (scales and measuring channels of electrolyze process in Nkaz).
Passport error by scale = 20 kg weights.
The electrolyze channel error 1-1.5%
The remaining quantities, they are an advisory and standard options reflective of a process (electrolyze voltage and current). It can be found in the directory http://www.alfametal.ru/?id=hommadeall
The project is not achieved energy savings by reducing the AE.

But as already noted the theoretical benefit from energy savings can be calculated by multiplying reduction in project additional consumption by 33 kWh per tonne Aluminium with aluminium production (e.g. in 2002 it was approx. 300 Ths t) tonne with the tariff as of 2002. The theoretical savings would be approx. 1.9 Mio Rub (33kWh/t*300 ths.t *0.2 rub/kWh = 1.9 Mio rub)
The investment costs for implementing the project activity are 27,9 Mio Rub. As evident from this analysis even the theoretically estimated savings are significantly lower than the investment costs.

It is quite obvious that Alternative 2 requires considerable costs for its implementation whereas no expenses are needed for implementation of Alternative 1.

Sub-step 2.3. Common practice analysis
Aluminium business management strategy pay little attention to AEF reduction measures due to an impossibility of estimating economic advantages associated with them. As it is impossible to assess economy of electric power and increasing aluminium output due to AEF reduction, such measures are out of priority for the managers of the smelters. Therefore, such measures are not widespread. There is a AEF reduction project at another smelter, KrAZ, but it is realized under Article 6 of Kyoto Protocol, therefore it cannot be considered as a common practice. As RUSAL is an only company in Russia, which produces aluminium, it testifies to the fact that the proposed Project activity is a common practice.

Resume: Analysis conducted above clearly demonstrates that the Project activity is not an economically attractive alternative and is not a common practice. Therefore it is additional.

Step 3. Provision of additionality proofs.
Information provided as evidence of complementarity, the following documents:
-protocols for making decisions under Article 6 of the Kyoto Protocol

-financial documents for the project Capex

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

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The project boundary embraces GHG emission sources attributed to the project activity. It is only those sources are taken into account emissions from which are above (1%) in the overall quantity of GHG emissions. In the following table the emission sources and GHG types are considered as to including them in the baseline or project boundary.

Emission considered includes CF4 and C2F6 occurred due to the anode effect at all 10 electrolysis potrooms. The Project does not considers reduction of CO2 emissions due to a shift to 5th series as it is a not a considerable part of the Project and also is not designed for reduction of anode mass.

Table B 3.1. GHG emission sources

Scenario	**GHG source**	**GHG type**	**Include/do not include**	**Comments**
Baseline	PFC emissions during anode effect	CF_4 and C_2F_6	Include	Main emission source
		N_2O	Do not include	N_2O emissions does not occur
		CO_2 CH_4	Do not include	CO_2 и CH_4 are not considered to be conservative as emissions of these gases under the baseline are greater than that under the Project
Project activity	PFC emissions during anode effect	CF_4 and C_2F_6	Include	Main emission source
		N_2O	Do not include	N_2O emissions does not occur
		CO_2 CH_4	Do not include	Emissions of these gases are reduced during the Project. But Project participants decided not to consider them to simplify the monitoring.

Leakage assessment

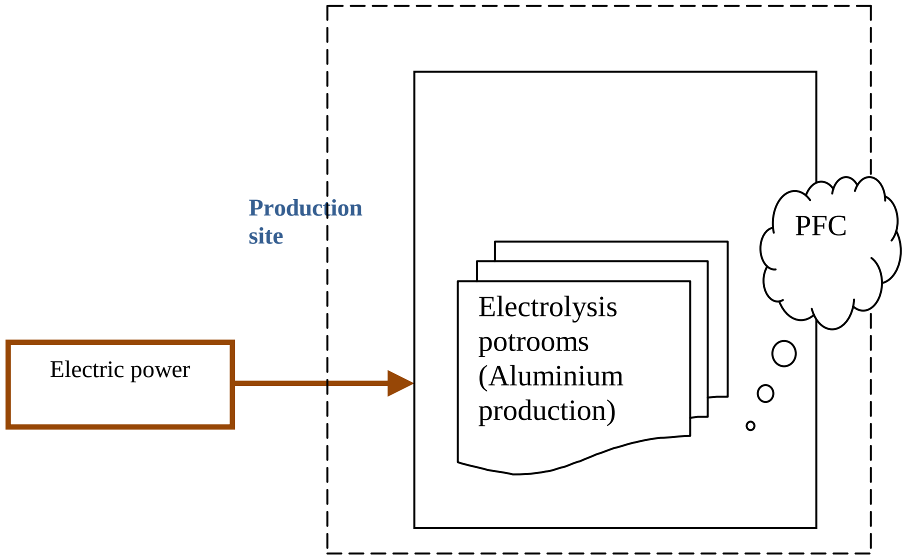
In accordance with “Guidance on criteria for baseline setting and monitoring” (Version 03) the leakage is determined as “the net change of anthropogenic emissions by sources and/or removals by sinks of GHGs which occurs outside the project boundary, and that can be measured and is directly attributable to the JI project.” In case the potential leakage is determined the project participants must undertake an assessment of the potential leakage of the proposed JI project and explain which sources of leakage are to be calculated, and which can be neglected.

Main potential leakages attributable to the Project activity are GHG emissions due to electric power generation in the grid.

Due to the Project activity the electric power consumption will be reduced. So will be the fuel consumption (and hence GHG emissions) at the grid power plants. However, for conservativeness sake these emissions will not be taken into account.

Project boundary includes all electrolysis potrooms at which aluminium is produced.

Fig B.3.1. 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:

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Date of baseline setting: 25.03.2012.

The baseline has been designed by:
National Carbon Sequestration Foundation – (NCSF, Moscow);

Contact person:
Timofey Besedovskiy,
Lead expert of Project Development Department;
Tel +7 499 788 78 35 ext. 108
Fax +7 499 788 78 35 ext. 107
E-mail: BesedovskiyTN@ncsf.ru

National Carbon Sequestration Foundation is not a participant of the Project.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

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The project launch date is 14/01/2002 .Outsourcing of a part of equipment influencing on AE

C.2. Expected operational lifetime of the project:

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Operational lifetime of the Project is 20 years or 240 months: from 14/01/2002 till 14/01/2022.

C.3. Length of the crediting period:

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Crediting period is determined within the first budget period of Kyoto Protocol from 01.01.2008 till 31 December 2012 and making 5 years or 60 months.

If the Russian Federation joins further extension of the budget period beyond 2012 the crediting period will be automatically prolonged.

The credit period of the project will not exceed the life of the project.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

>>

The monitoring plan is described throughout a section D in accordance with paragraph 30 of the Guidance on criteria for baseline setting and monitoring. Project developer applies its own methodology for monitoring plan (JI specific approach) in accordance with paragraph 9 (a) of the Guidance on criteria for baseline setting and monitoring (Version 03), and other applicable JI guidelines. The JI-approach includes consideration of the following steps:

Step 1. Indication and description of the approach chosen regarding monitoring.

Step 2. Application of the approach chosen.

Below the approach is presented in more detail.

Step 1. Indication and description of the approach chosen regarding monitoring.

The electrolysis potshops 1-10 will participate in the monitoring at the smelter.

Description of monitoring points

M1i	M2i	M3i
Production of electrolysis aluminium, t	Average frequency of anode effect, anode effects per pot day	Average duration of anode effect, min

Key emission parameters

The emission parameters needed for determining of PFC emissions (including baseline and project emissions) are defined in accordance with the existing practice of measuring such emissions and fixing technical-economic indicators NkAZ.

Resently NkAZ smelter underwent through the process of modernization of the monitoring system, all data on aluminium production, AEF and AED are under control, stored in the electronic database and are updated on-line. The terminals are installed in the control rooms at each electrolysis potroom where reliable data are gathered.

Control for the Project implementation does not require changing in the existing system of data collection and registration system.

Technologies and formulas for defining emissions are described in the last version of 2006 Aluminium Sector Greenhouse Gas Protocol developed by International Aluminium Institute. The provisions of the Protocol are included in 2006 IPCC, Chapter 4.4 “Primary Aluminium Production”.

According to the technology the Tier 2 method should applied for the emission calculation of the proposed project activity. Under the Tier 2, the actual data on anode effect, on aluminium production and standardized production factors are used in calculation.

According to 2006 IPCC the PFC emissions will be determined according to the formula:

$$\mathbf{ER_{CO2} = MP * AEF * AED * S_{CF4} * (6500 + F_{C2F6}/_{CF4} * 9200)/1000}$$

MP – is the production of electrolysis aluminium, t/year; equals to a quantity of aluminium poured out the pots plus aluminium remained in pots as work-in-progress.

AEF_b – is the average frequency of anode effects under the baseline, times per pot-days;

AED_b –is the average duration of anode effect under the baseline, minutes

S_{CF4} – is the slope coefficient for CF_4, (kg of CF_4 /tonne of aluminium)/(number of minutes of anode effect/pot per day) [4];

$F_{C2F6 / CF4}$ – is the weight fraction of C_2F_6/CF_4

6500 – Global Warming Potential for CF_4[5]
9200 – Global Warming Potential for C_2F_6[6]
For defining the slope coefficient for CF_4 and the weight fraction $F_{C2F6/CF4}$ there is no need in measurements as the reference data from 2006 IPCC are used.

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[4] Definition “pot-day” means the quantity of pots under operation multiplied by the quantity of working days (2006 IPCC, Volume 3, Chapter 4.4, p. 4.55)

[5] http://unfccc.int/ghg_data/items/3825.php

[6] http://unfccc.int/ghg_data/items/3825.php

Technology	**Slope coefficient [(kg CF4/tonne Al) / (minutes of AE / Pot-day]**		**Weight fraction C_2/F_6**	
	S_{CF4}	Uncertainty (±%)	$F_{C2F6/CF4}$	Uncertainty (±%)
VSS	0,092	17	0,053	15
HSS	0.099	44	0.085	48

Step 2. Application of the approach chosen.

See below

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

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
D.1.1.1.1.	*MP Electrolytic aluminium production*	*Each potroom*	*tonnes*	*m*	*monthly*	*100%*	*Paper and electronically*	*Data stored in automated process control system (APCS)*
D.1.1.1.2.	*AED Average duration of anode effect*	*Each potroom*	*minutes*	*m*	*constantly*	*100%*	*Paper and electronically*	*Data stored in APCS*
D.1.1.1.3.	*AEF Average frequency of anode effects*	*Each potroom*	*Anode effects per pot day*	*m*	*constantly*	*100%*	*Paper and electronically*	*Data stored in APCS*

D.1.1.1.4	*S_{CF4} Slope coefficient of CF_4*	*Reference data in 2006 IPCC*	*(kg of CF_4 /tonne of aluminium)/(number of minutes of anode effect/pot day)*	*e*	*Constantly*	*100%*	*Paper and electronically*	-
D.1.1.1.5	*C_2F_6/CF_4*	*Reference data in 2006 IPCC*	-	*e*	*Constantly*	*100%*	*Paper and electronically*	-

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

>>

GHG project emissions will take place due to the occurrence of anode effect during production of the primary aluminium:

1. $$PE_{pCO2_e} = MP * AEF_p * AED_p * S_{CF4} * (6500 + F_{C2F6}/_{CF4} * 9200)/1000$$

MP – is the production of electrolysis aluminium, t/year;

AEF_p – is the average frequency of anode effects under the project, aluminium effects per pot-days;

AED_p –is the average duration of anode effect under the project, minutes

S_{CF4} – is the slope coefficient for CF_4, (kg of CF_4 /tonne of aluminium)/(number of minutes of anode effect/pot per day) [7];

$F_{C2F6 / CF4}$ – is the weight fraction of C_2F_6/CF_4

6500 – Global Warming Potential for CF_4[8]
9200 – Global Warming Potential for C_2F_6[9]

---

[7] Definition "pot-day" means the quantity of pots under operation multiplied by the quantity of working days (2006 IPCC, Volume 3, Chapter 4.4, page 4.55)

[8] http://unfccc.int/ghg_data/items/3825.php

[9] http://unfccc.int/ghg_data/items/3825.php

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
D.1.1.3.1.	*MP Electrolytic aluminium production*	*Each potroom*	*tonnes*	*m*	*monthly*	*100%*	*Paper and electronically*	*Data stored in automated process control system (APCS)*
D.1.1.3.2.	*AED Average duration of anode effect*	*Each potroom*	*minutes*	*m*	*constantly*	*100%*	*Paper and electronically*	*Data stored in APCS based on database control system for BT series in period 2000-2002, for C8&S series 2000-2001 prior project implementation. Numeric value present in E section*

D.1.1.3.3.	*AEF* *Average frequency of anode effects*	*Each potroom*	*Anode effects per pot day*	*m*	*constantly*	*100%*	*Paper and electronically*	*Data stored in APCS based on historical data from the database control system for BT series in period 2000-2002, for S series 200-2001, for C8 series 2000-2010 prior project implementation. Numeric value present in E section*
D.1.1.3.4	S_{CF4} *Slope coefficient of* CF_4	*Reference data in 2006 IPCC*	*(kg of* CF_4 */tonne of aluminium)/(number of minutes of anode effect/pot day)*	*e*	*Constantly*	*100%*	*Paper and electronically*	-
D.1.1.3.5	C_2F_6/CF_4	*Reference data in 2006 IPCC*	-	*e*	*Constantly*	*100%*	*Paper and electronically*	-

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

>>

GHG baseline emissions will take place due to the occurrence of anode effect during production of the primary aluminium:

2. $$BE_{bCO2_e} = MP * AEF_b * AED_b * S_{CF4} * (6500 + F_{C2F6}/_{CF4} * 9200)/1000$$

MP – is the production of electrolysis aluminium, t/year;

AEF_p – is the average frequency of anode effects under the baseline, aluminium effects per pot-days;

AED_p –is the average duration of anode effect under the baseline, minutes

S_{CF4} – is the slope coefficient for CF_4, (kg of CF_4 /tonne of aluminium)/(number of minutes of anode effect/pot per day);

$F_{C2F6 / CF4}$ – is the weight fraction of C_2F_6/CF_4

6500 – Global Warming Potential for CF_4
9200 – Global Warming Potential for C_2F_6

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

This option is not applicable.

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

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

>>
This option is not applicable.

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

No leakage emissions identified due to implementation of this 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 *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

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

>>

Not applicable.

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):

>>

3. $$ER_{CO_{2e}} = BEb_{CO_{2e}} - PEp_{CO_{2e}}$$

$ER_{CO_{2e}}$ – reduction of PFC emissions due to the project implementation, tCO_2e/year;
$BEb_{CO_{2e}}$ – PFC baseline emissions, tCO_2e/year;
$PEp_{CO_{2e}}$ – PFC project emissions, tCO_2e/year.

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:

>>

In accordance with the legislation in the field of environmental protection, the company must control emissions, wastewater discharges, organize and ensure the management of waste production and consumption, established to provide accountability in public authorities (Federal Service for Ecological, Technological and Atomic Supervision).

During anode effect direct emissions of perfluorocarbons, solid and gaseous fluorides, carbon monoxide and carbon dioxide, sulfur dioxide, inorganic dust, etc are produced.

The main data sources to monitor polluting emissions into the atmosphere are:

- Technological reports by type of production (anode, electrolysis);
- Health and environmental monitoring data (gas cleaning and sealing pots);
- Primary data on the materials used.

Monitoring of emissions is based on a special control schemes, including standards, metering, operators, control periods, measuring methods and parameters. The calculation of emissions of harmful substances carried out by specialists of environmental department in accordance with the methodology for analyzing the composition and volume of emissions in the production of electrolytic aluminum, approved by the Federal Service for Ecological, Technological and Atomic Supervision in accordance with the Decree № 182 of March 31, 2005.

Data on qualitative characteristics of the raw materials used in the production are provided by technical control experts over the results of laboratory tests conducted in the central laboratory accredited in the system of analytical laboratories of the Federal Agency for Technical Regulation and Metrology.

A list of certified methods to determine the quality characteristics of raw materials.

#	Raw material	Component to determine	Normative document on analytical method	Range measurements, $\%_{масс.}$	Error of analysis, $\%_{абс}$
1	Aluminum fluoride (AlF_3)	F	GOST 19181-78 «Aluminium fluoride technical. Technical conditions», item.4.4	from 10 to 65 incl.	1,30
2	Aluminum fluoride (AlF_3)	SO_4	GOST 19181-78 «Aluminium fluoride technical. Technical conditions», item.4.1	from 0,1 to 0,7 inclusive	0,09
3	Calcium fluoride (CaF_2)	CaF_2	GOST 7619.3-81 «Fluor spar. Method of determination of calcium fluoride»	from 70 to 90 incl. s 90	0,95 1,14
4	Calcium fluoride (CaF_2)	S	GOST 7619.3-81 «Fluor spar. Method of determination of total sulfur»	from 0,1 to 0,3 incl.	0,038
5	Coke	S	GOST 8606-93 «Solid mineral fuel. Determination of total sulfur. Method of	from 0,5 to 5,0	0,043

			Eshka»		

Sanitary and environmental parameters (data on gas cleaning and sealing of the electrolytic bath) is performed by specialists of sanitary and industrial laboratory (SIL). SIL is certified for the appropriate technology and is registered in the State Register. CIL is checked annually by Certification Service for technological competence.

Internal inspection is conducted on a regular basis in each department of environmental control in order to verify the accounting procedures, receiving and storing data, and calibration procedures, testing equipment and procedures for staff training in accordance with the Regulations "Internal Audit". Calibration of measuring instruments for monitoring environmental parameters used is carried out in accordance with the Regulation "Monitoring and control units of account".

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.

D.1.1.1.1., D.1.1.3.1.	*Low*	*The volume of production of electrolytic aluminum by potrooms for the year is determined by summing the mass of the metal, determined by weighing buckets with metal from the electrolysis, and determine the mass of aluminum in liquid form, located in electrolyzers as a work in progress.* *1. Weighing of bucket with aluminum is produced on scales «KGW-20" by DF staff (Directorate foundry) in accordance with instructions for use "Scales Crane type KGW». Scales are included in the "List of measuring equipment," and every year according to the "Schedule of verification and calibration of measuring instruments' are calibrated by specialists of contractor in accordance with GOST 8.453-82," Scales for statistical weighting. Methods and means of verification. "* *The maximum permissible error: ± 20 kg with a range of weighing 5000-20000kg.* *Entries for the weighing buckets with metal stored in electronic form in the "ARM weightting" of at least 5 years.* *2. Amount of aluminum in liquid form in electrolyzers is determined by "Method for determination of liquid aluminum in electrolysis cells," according to the instructions of TRP 00.01.02-04 "Electrolysis production. Determination of liquid goods in process of the electrolysis of aluminum is carried out by the indicator method "once a quarter.* *The method of definition is as follows: Number of molten metal in the body of a pot is determined by multiplying the average level of the metal in a pot by the average mass per centimeter of the metal and the number of existing electrolyzers.* *The level of metal line is measured in accordance with the KPVO 440.01.01.15.02-2008 "Measurement of the metal and an electrolyte."* *The average weight of one centimeter of the liquid metal set at least once a year with the metal-indicator method by GOST 3221-85. The method is based on determining the difference between the mass fraction of copper in aluminum for a certain period of time, measuring the metal level in the cell and the subsequent calculation of the formula. The measurements produce at 10% of electrolyzers. In the analysis of the metal the conditions are followed set by the normative documents of the means of measurement.* *Based on the foregoing, it can be assumed that the uncertainty of data consists of 0.1% error of the weights (based on the mass of the bucket with a weight of metal 10t) and not more than 10% of the accounting work in progress based on the fact that the measurement is made on 10% of pots with a view errors of the means of measurement and implementation of indirect measurements, but due to the fact that the volume of work in progress is less than 1% of the annual volume of electrolytic aluminum, the overall accuracy of this index will not exceed 0.1%.*

D.1.1.2., D.1.1.3.2., D.1.1.1.3., D.1.1.3.3		*AEF of the corps of electrolysis for the year, AEF /pot -day and the duration of the AE potrooms per year, min./pot day is carried out by an automated process control system of electrolysis aluminum).* *One of the functions of process control is the control of AE on the voltage measurement channel in the area anode-cathode (Ua-k) for a five-minute averaging interval. In excess of the increase a certain threshold, such as 8 mV for 5 minutes is declared the prediction of AE. It is prohibited to automatically move down the anode. By reducing the voltage gain up to 6 mV, a sign of the forecast AE removed. The basic error of the channel ± 0,2%. The measuring channel is regularly calibrated according to procedure "METODICAL GUIDANCE SYSTEM FOR MEASURING ALUMINUM ELECTROLYSIS PROCESS. CONTROL METHODS OF CALIBRATION." Specialists of contractor carry out calibration in accordance with the Rules of calibration of measuring instruments."* *Entries for the AEF and AED stored in electronic form at least 5 years.* *Based on the data accumulated during the operation control system, the percentage of lost information on the number and duration of anode effects due to the failure of the control system is approximately 2%, so the uncertainty is low and the sum of the percent error of the channel and control system performance of APCS.*

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

>>

Necessary to calculate the emission reductions of greenhouse gas emissions information is collected as is usually done at the Novokuznetsk aluminum smelter, so monitoring does not require any other additional information as compared with the already collected.

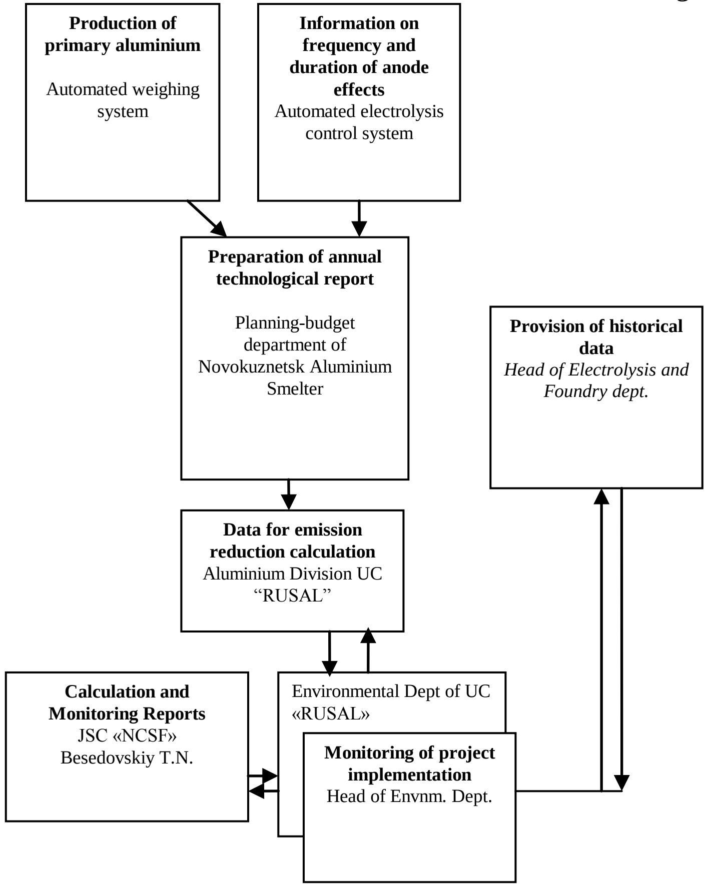
Measuring the output of electrolytic aluminum, frequency and duration of anode effects is carried out electronically without human intervention. Thus, the Novokuznetsk aluminum smelter is the high-tech enterprise, with a fully automated accounting system operating parameters. The human factor is minimized.

The calculation of emission reductions at the end of each year of the crediting period is performed based on data that are provided by Aluminium Division of UC "RUSAL" for annual environmental reporting regulations (PFC Form 001) in the International Aluminium Institute (IAI). Calculation of GHG emission reductions is based on the annual technical reports of the Novokuznetsk Aluminium Smelter. The baseline was calculated as a result of expert judgment of specialists of Novokuznetsk aluminium smelter based on historical data.Below is a schematic diagram of the organization of monitoring reductions in greenhouse gases by JSC "RUSAL Novokuznetsk."

If the monitored data are not available because of a failure of the instruments, it closes a gap similar to the average data for the same period at this site.

The data on the emission reductions achieved, and the original data will be available for project participants 2 years after the last transfer of ERUs.

Figure D.1.1 scheme of monitoring at the smelter.



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

>>

The monitoring plan has been established by:
National Carbon Sequestration Foundation – (NCSF, Moscow);

Contact person:
Timofey Besedovskiy,
Lead expert of Project Development Department;
Tel +7 499 788 78 35 ext. 108
Fax +7 499 788 78 35 ext. 107
E-mail: BesedovskiyTN@ncsf.ru

National Carbon Sequestration Foundation is not a participant of the Project.

SECTION E. Estimation of greenhouse gas emission reductions

In assessing the greenhouse gas emissions resulting from implementation of project activities and baseline the emissions are determined by the formulas given in Section D.

Production data to calculate of emission reductions.

Potrom	Technology	Type of electrolyze	Year	Production of aluminium	FAE		DAE	
					project	Baseline	project	Baseline
2	BT-82	HSS	2008	17 428,0	0,67	1,06	1,60	1,68
3	BT-88	HSS	2008	23 175,0	0,63	1,05	1,72	1,65
4	BT-88	HSS	2008	23 128,0	0,56	1,05	1,73	1,65
5	BT-88	HSS	2008	21 761,0	0,58	1,05	1,66	1,65
6	BT-88	HSS	2008	21 836,0	0,42	1,05	1,81	1,65
7	S-2	VSS	2008	31 095,0	1,17	1,41	1,89	2,36
8	S-2	VSS	2008	31 100,0	1,14	1,41	1,93	2,36
9	S-3	VSS	2008	31 103,0	1,32	1,41	1,94	2,36
10	S-3	VSS	2008	36 600,0	1,16	1,41	1,91	2,36
11	S-8BM	VSS	2008	40 701,0	1,20	1,20	1,96	2,62
12	S-8BM	VSS	2008	40 767,0	1,18	1,18	1,94	2,62
All			2008	318 694,0				

Potrom	Technology	Type of electrolyze	Year	Production of aluminium	FAE		DAE	
					project	Baseline	project	Baseline
2	BT-82	HSS	2009	4 384,6	0,7	1,06	1,64	1,68
3	BT-88	HSS	2009	5 015,0	0,7	1,05	1,63	1,65
4	BT-88	HSS	2009	4 752,5	0,6	1,05	1,64	1,65
5	BT-88	HSS	2009	5 561,2	0,6	1,05	1,80	1,65
6	BT-88	HSS	2009	5 592,8	0,4	1,05	1,89	1,65
7	S-2	VSS	2009	30 095,4	1,1	1,41	1,84	2,36
8	S-2	VSS	2009	30 245,4	1,1	1,41	1,83	2,36
9	S-3	VSS	2009	30 283,7	1,2	1,41	1,86	2,36
10	S-3	VSS	2009	35 397,6	1,3	1,41	1,86	2,36
11	S-8BM	VSS	2009	38 308,8	1,5	1,54	1,96	2,62
12	S-8BM	VSS	2009	38 619,2	1,5	1,49	1,98	2,62
All			2009	228 256,1				

Potrom	Technology	Type of electrolyze	Year	Production of aluminium	FAE		DAE	
					project	Baseline	project	Baseline
2	BT-82	HSS	2010		0,00	0,00	0,00	0,00
3	BT-88	HSS	2010	14 219,1	0,7	1,05	1,81	1,65
4	BT-88	HSS	2010	14 413,5	0,6	1,05	1,74	1,65

5	BT-88	HSS	2010	16 338,4	0,7	1,05	1,77	1,65
6	BT-88	HSS	2010	15 235,7	0,8	1,05	1,80	1,65
7	S-2	VSS	2010	30 867,0	1,1	1,41	1,77	2,36
8	S-2	VSS	2010	30 935,0	0,9	1,41	1,78	2,36
9	S-3	VSS	2010	30 947,6	1,1	1,41	1,80	2,36
10	S-3	VSS	2010	36 367,0	1,2	1,41	1,81	2,36
11	S-8BM	VSS	2010	39 721,3	1,2	1,20	1,91	2,62
12	S-8BM	VSS	2010	39 753,0	1,4	1,35	1,93	2,62
All			2010	268 797,6				

Potrom	Technology	Type of electrolyze	Year	Production of aluminium	FAE		DAE	
					project	Baseline	project	Baseline
2	BT-82	HSS	2011	0,0	0,00	0,00	0,00	0,00
3	BT-88	HSS	2011	18 655,2	0,7	1,05	1,47	1,65
4	BT-88	HSS	2011	17 231,0	0,6	1,05	1,48	1,65
5	BT-88	HSS	2011	18 369,0	0,6	1,05	1,53	1,65
6	BT-88	HSS	2011	18 156,9	0,6	1,05	1,55	1,65
7	S-2	VSS	2011	31 238,0	0,9	1,41	1,77	2,36
8	S-2	VSS	2011	31 184,0	0,9	1,41	1,76	2,36
9	S-3	VSS	2011	31 259,0	0,9	1,41	1,79	2,36
10	S-3	VSS	2011	36 711,6	1,0	1,41	1,77	2,36
11	S-8BM	VSS	2011	40 344,0	0,8	1,09	1,90	2,62
12	S-8BM	VSS	2011	40 213,8	0,9	1,09	1,90	2,62
All			2011	283 362,5				

Potrom	Technology	Type of electrolyze	Year	Production of aluminium	FAE		DAE	
					project	Baseline	project	Baseline
2	BT-82	HSS	2012	0,0	0,00	0,00	0,00	0,00
3	BT-88	HSS	2012	18 655,2	0,7	1,05	1,47	1,65
4	BT-88	HSS	2012	17 231,0	0,6	1,05	1,48	1,65
5	BT-88	HSS	2012	18 369,0	0,6	1,05	1,53	1,65
6	BT-88	HSS	2012	18 156,9	0,6	1,05	1,55	1,65
7	S-2	VSS	2012	31 238,0	0,9	1,41	1,77	2,36
8	S-2	VSS	2012	31 184,0	0,9	1,41	1,76	2,36
9	S-3	VSS	2012	31 259,0	0,9	1,41	1,79	2,36
10	S-3	VSS	2012	36 711,6	1,0	1,41	1,77	2,36
11	S-8BM	VSS	2012	40 344,0	0,8	1,09	1,90	2,62
12	S-8BM	VSS	2012	40 213,8	0,9	1,09	1,90	2,62
All			2012	283 362,5				

E.1. Estimated project emissions:

>>

Table E.1.1. GHG project emissions in 2008-2012

Year	GHG project emissions
2008	388,236
2009	342,496
2010	340,763
2011	267,749
2012	267,749
Total (tCO_2e)	1,606,993

E.2. Estimated leakage:

>>

To be conservative leakage emissions are not taken into account.

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

>>

Not applicable. Please see the table E.1.1.

E.4. Estimated baseline emissions:

>>

Table E.1.1. GHG baseline emissions in 2008-2012

Year	GHG baseline emissions (tCO_2e)
2008	576,578
2009	497,491
2010	522,173
2011	517,411
2012	517,411
Total ($t\ CO_2e$)	2,631,063

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

>>

Emission reductions are calculated according to the formula D.3 in the section D.1.3. folmulae 3

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

>>

Years	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
2008	388,236	-	576,578	188,342
2009	342,496	-	497,491	154,995

2010	340,763	-	522,173	181,410
2011	267,749	-	517,411	249,662
2012	267,749	-	517,411	249,662
Total (tonnes of CO2 equivalent	1,606,993	-	2,631,063	1,024,071

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:

>>

Changes to the functional component of the production process does not fall under the "Regulations for the assessment of environmental impacts (planned commercial and other activities in the Russian Federation", approved by order of the State Commission for the Protection of the Environment of the Russian Federation № 372 of May 16, 2000. So within the framework of the objectives of the project was carried out internal assessment of the impact on the environment. main goal of the project is voluntary reduction of PFC emissions from the electrolysis potrooms by reducing the anode effect frequency, which means that the project cannot harm the environment and, on the contrary, it helps to reduce emissions pollutants associated with the process of electrolysis.

To eliminate the anode effects in the current technology of aluminum, one must enter a wooden pillar in order to destroy the scum on the walls of the anodic bath and add a fraction of alumina in the bath to melt. In this connection, the destruction of approximately one-third scale bath is extremely necessary procedure. Thus, the direct emissions of perfluorocarbon in the anode effect accompanied by the release of additional electrolysis gases, such as solid and gaseous fluorides, carbon monoxide and carbon dioxide, sulfur dioxide, inorganic dust, etc. This means that the reduction of anode effect frequency assumes no negative impact on the environment.

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 project activity does not adversely impact on the environment, as aimed at reducing emissions of PFCs. This leads to significant reductions in CO2 emissions in an amount of 1,024,071tCO2e in the period 2008 - 2012.

SECTION G. Stakeholders' comments

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

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Consultations with stakeholders on the project activity have not been carried out because this is not a requirement of the Russian legislation.The project activity improves the ecological environment, since it reduces the implementation of pollution by harmful substances.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	Open Joint Stock Company "Rusal Novokuznetsk"
Street/P.O.Box:	Ferroalloy Avenue
Building:	7
City:	Novokuznetsk
State/Region:	Kemerovo region
Postal code:	654000
Country:	Russia
Phone:	+7 (3843) 39-73-22
Fax:	+7 (3843) 39-73-22
E-mail:	nkaz@rusal.com
URL:	www.rusal.ru
Represented by:	General director – Victor Gjirnakov
Title:	mr
Salutation:	-
Last name:	Gjirnakov
Middle name:	-
First name:	Victor
Department:	-
Phone (direct):	-
Fax (direct):	-
Mobile:	-
Personal e-mail:	-

Annex 2

BASELINE INFORMATION

The key information and data used to establish the baseline presented in the tables below:

Data/Parameter	MP
Data unit	tonnes
Description	Electrolytic aluminium poured out the pots
Time of determination/monitoring	constantly
Source of data (to be) used	Weight scale KGW-20 International Aluminium Institute form (IAI-PFC001)
Value of data applied (for ex-ante calculations/determinations)	2008: 318,694 2009: 228,256 2010: 268,798 2011: 283,363 2012: 283,363
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data in 2008-2011 are actual and obtained on certified equipment. Data for 2012 are assumed on 2011 year level, considering global boost in aluminium supply.
QC/QA procedures (to be) applied	All devices used in monitoring are regularly checked in accordance with Russian legislation by competent entities.
Any comment	-

Data/Parameter	AEDb
Data unit	Minutes
Description	Average duration of anode effect
Time of determination/monitoring	Constantly
Source of data (to be) used	Automatic process control system (APCS)
Value of data applied (for ex-ante calculations/determinations)	see table below
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Line trend based on historical data from the database control system for BT series in period 2000-2002, for C8&S series 2000-2001 prior project implementation. Numeric value present in E section
QC/QA procedures (to be) applied	All devices used in monitoring are regularly checked in accordance with Russian legislation by competent entities.

	BT82	BT88	S2.3	C8БМ
2008	1.68	1.65	2.36	2.62
2009	1.68	1.65	2.36	2.62
2010	1.68	1.65	2.36	2.62
2011	1.68	1.65	2.36	2.62
2012	1.68	1.65	2.36	2.62

Any comment	-

Data/Parameter	AEFb
Data unit	Anode effects per pot day
Description	Average frequency of anode effects
Time of determination/monitoring	Constantly
Source of data (to be) used	Automatic process control system (APCS)
Value of data applied (for ex-ante calculations/determinations)	see table below
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Line trend based on historical data from the database control system for BT series in period 2000-2002, for S series 200-2001, for C8 series 2000-2010 prior project implementation. Numeric value present in E section
QC/QA procedures (to be) applied	All devices used in monitoring are regularly checked in accordance with Russian legislation by competent entities.
Any comment	-

	BT82	BT88	S2.3	C8БМ
2008	1.06	1.05	1.41	-
2009	1.06	1.05	1.41	-
2010	1.06	1.05	1.41	-
2011	1.06	1.05	1.41	1.09
2012	1.06	1.05	1.41	1.09

Data and parameters that are not monitored throughout the crediting period but determined only once (and thus remain fixed throughout the crediting period)

Data/Parameter	S_{CF4}
Data unit	(kg of CF_4 /tonne of aluminium)/(number of minutes of anode effect/pot day)
Description	Slope coefficient of CF_4
Time of determination/monitoring	Determined once (referenced value)
Source of data (to be) used	2006 IPCC, Volume 3, Chapter 4.4., page 4.55, table 4.16
Value of data applied (for ex-ante calculations/determinations)	see table below
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data that used in the absence of direct measurements. One value for each technology
QC/QA procedures (to be) applied	Reference data
Any comment	-

Technology	VSS	HSS
2008-2012	0,092	0,099

Data/Parameter	$F_{C2F6/CF4}$
Data unit	C_2F_6/CF_4

Description	Weight fraction
Time of determination/monitoring	Determined once (reference data)
Source of data (to be) used	2006 IPCC, Volume 3, Chapter 4.4., page 4.54, table 4.16
Value of data applied (for ex-ante calculations/determinations)	Technology: 2008-2012; VSS: 0,053; HSS: 0,085
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data that used in the absence of direct measurements. One value for each technology
QC/QA procedures (to be) applied	Reference data
Any comment	-

Data/Parameter	**6500**
Data unit	tCO_2/tCF_4
Description	Global Warming Potential for CF_4
Time of determination/monitoring	Determined once during PDD development
Source of data (to be) used	Decision 2/CP.3 **http://unfccc.int/resource/docs/cop3/07a01.pdf#page=31** Climate Change 1995, Climate Change Science: Conclusion for politicians and technical conclusion of Report of Expert Group I, p.22 http://unfccc.int/ghg_data/items/3825.php
Value of data applied (for ex-ante calculations/determinations)	6500
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Global Warming Potential is needed for calculation of CO_2 equivalent emissions
QC/QA procedures (to be) applied	Reference data
Any comment	-

Data/Parameter	**9200**
Data unit	tCO_2/tC_2F_6
Description	Global Warming Potential for C_2F_6
Time of determination/monitoring	Determined once during PDD development
Source of data (to be) used	Decision 2/CP.3 **http://unfccc.int/resource/docs/cop3/07a01.pdf#page=31** Climate Change 1995, Climate Change Science: Conclusion for politicians and technical conclusion of Report of Expert Group I, p.22

	http://unfccc.int/ghg_data/items/3825.php
Value of data applied (for ex-ante calculations/determinations)	9200
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Global Warming Potential is needed for calculation of CO_2 equivalent emissions
QC/QA procedures (to be) applied	Reference data
Any comment	-

BASELINE INFORMATION (data of the aluminum produced by JSC "RUSAL NkAZ")

Duration of anode effect (DAE)

AED depend on how fast the AE stops. The AE is stopped manually using wooden rods at all the potrooms at Novokuznetsk aluminium smelter.

Since changes in the AE quenching technique have not been supposed and no actions on stimulation of AE quenching time reduction have been provided, an actually achieved value prior to the project measure implementation in 2003 and 2001 has been assumed as a basic value.

The project measures regarding the BT potline, in 2003, are focused on the commissioning of the dedicated Troll process control system that allows forecasting anode effects more reliably.

The project measures relative to the S potline, in 2001, are focused on the operational improvements by means of outsourcing of a part of equipment that influences the quenching time, which will allow making it more accessible for the reduction department personnel. In addition, changes have been introduced in the cell maintenance manual, these changes influence the AE quenching time reduction and elimination of downtime during the AE.

It should be noted that the AED does not depend on the KO values, but only directly depends on frequency and quenching time limits set.

Variations in any direction may occur, they are caused by various factors: alumina quality, fluoride additive quality, maintenance quality and time, etc. However, such variations would take place with any scenario, so assuming an average value as a base prior to the implementation of the project measures with invariability of production process and manuals reflects the plausible practice.

AED data for smelter for BT and S potlines

BT-82	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AED, min.	1.62	1.71	1.71	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
BT-88	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AED, min.	1.65	1.67	1.63	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
C-2,3	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AED, min..	2.59	2.13	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36	2.36
S-8BM	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AED, min.	2.84	2.40	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62

Anode effect frequency (AEF)

The AEF may be assumed as a constant for each process type. In 2003, at NkAZ, a project within the context of Kyoto Protocol for electrolysis control using the dedicated Troll process control system for BT potline was implemented. For the S potline, operational improvements were made, and changes in the production process instructions were introduced, which allowed to quench the AE more operatively and to forecast it more responsibly. It allowed reducing the AEF due to more competent maintenance and forecasting of the AE itself and further elimination of the AE. To estimate the baseline a value that is equal to the average AEF has been assumed from a digit (prior to the transfer to the dedicated process control system in 2003). It should be noted that to estimate the basic frequency a conservative scenario has been assumed, with which the average performance for 2000-2002 has been taken, despite of the AE level 1 that is inherent for the process due to lack of any intellectual system and forecasting system. In 2002, a small positive dynamic in the AE growth was noted. Variations in any direction may occur, they are connected with multiple causes: alumina quality, fluoride additive quality, maintenance quality and time, etc. However, such variations would take place with any scenario, so assuming an average value as a base prior to the implementation of the project measures with invariability of production process and manuals reflects the plausible practice.

For the S8 potline, the same approach is used based on the previous and following performance that has been actually achieved at a time of the implementation of the dedicated control: actualisation of work with electrolysis voltage specified and work of anode plant foremen (since 2010). It will allow reducing the AEF down to less than 0.5.

Basic AEF values for BT, C and C8 potlines are presented since 2000

BT-82	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AEF, day^{-1}	0.93	1.12	1.14	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
BT-88	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AEF, day^{-1}	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

	1	2	3	5	5	5	5	5	5	5	5	5	5
C-2,3	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AEF, day^{-1}	1.50	1.32	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
S-8BM	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AEF,day^{-1}	1.03	0.99	0.94	0.88	0.91	1.01	1.15	1.10	1.19	1.51	1.27	1.09	1.09

Baseline angular coefficient values for CF_4 and C_2F_6.

Baseline angular coefficient values for CF_4 и C_2F_6 have not changed for years since the Class 2 calculation method was first applied. They are show in IPCC2006 recommendations.

Aluminium output

It is supposed that the aluminium output produced is equal to one that is announced in the project. The planned capacity will be shown in annual business plans of a smelter and in the internal document “RUSAL NkAZ objectives based on the target performance approved in the Aluminium Division.”

To calculate project emissions and baseline emissions the quantity of electrolytic aluminium is used. Electrolytic aluminium is aluminium that actually is produced during the year including aluminium in process. Annual decrease of electrolytic aluminium output cannot be calculated for each month, since the quantity of aluminium in process is not determined monthly.

Thus, an amount of unprocessed aluminium is used. (Planned output for 2006-2012 is also determined in tonnes of unprocessed aluminium). Unprocessed aluminium is aluminium that actually is tapped from a cell (not taking into account material in process).

Theoretically these values must be equal, but due to the fact that aluminium tapped from a cell is fluid, they differ in practice. The longer the period, the less is the difference between the values. The difference to be observed during several days is usually less than 1 % and, thus, taking into account the fact that material in process is to be determined once a quarter it is admitted that these values are equal.

Project substantiation

State by the project launch (beginning of the year 2002):

Description	Unit	2001	2001	2001	2001
		BT-82	BT-88	S-2.3	S-8BM
Alumina	kg/tonne	1,932.0	1,932.0	1,911.5	1,911.5
Cryolite	kg/tonne	21.7	21.1	38.1	39.5
Aluminium fluoride	kg/tonne	21.8	22.8	32.5	32.1

Anode paste	kg/tonne	499.0	498.1	532.7	525.8
Calcium fluoride	kg/tonne	2.3	2.1	3.0	3.2
Process power	kW•h	15,160.1	14,994.0	15,540.4	15,642.4
Electrolytic metal	tonne	15,768	73,538	117,330	73,725
Current	A	81,494	87,444	139,597	157,403
Average voltage	B	4.453	4.473	4.632	4.697
Current efficiency	%	87.42	88.79	88.70	89.38
AEF	day-1	1.12	1.02	1.32	0.99
AED	min	1.71	1.67	2.13	2.40

The performance achieved is satisfactory on the whole, however high anode effect frequency and duration are quite unjustified.

Project objectives:

- the anode effect frequency reduction for all the cell types down to less than 0.9 day^{-1}

- AE reduction by cell type:

-BT-82, BT-88: no more than 1.7 min

-C-2, C-3, S-8BM: no more than 1.9 min

Performance achieved in 2011 (for BT82 for the year 2008, the last year of operation)

Description	Unit	2008	2011	2011	2011
		BT-82	BT-88	S-2.3	S-8BM
Alumina	kg/tonne	1,951.8	1,950.4	1,941.7	1,941.7
Cryolite	kg/tonne	16.9	8.5	11.8	8.9
Aluminium fluoride	kg/tonne	30.8	34.8	41.2	37.2
Anode paste	kg/tonne	507.3	507.4	525.6	527.8
Calcium fluoride	kg/tonne	0.77	0.94	1.31	1.45
Process power	kW•h	15,260.1	15,422.0	15,470.4	15,624.2
Electrolytic metal	т	17428	72412	130393	80558
Current	A	88,309	101,225	142,843	171,549
Average voltage	B	4.549	4.596	4.633	4.681
Current efficiency	%	88.72	88.69	89.14	89.17
AEF	day-1	0.67	0.63	0.89	0.87
AED	мin	1.60	1.50	1.77	1.90

Thus, within the project implementation, the main engineering-and-economic performance is not deteriorated, but the project objectives have been achieved, i.e. the anode effect duration and frequency are reduced significantly.

Performance actually achieved by the end of the year 2011

BT-82	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AEF, day^{-1}	0.93	1.12	1.14	0.86	0.87	0.72	0.74	0.80	0.67	0.71	-	-	-
AED, min.	1.62	1.71	1.71	1.65	1.59	1.59	1.62	1.59	1.60	1.64	-	-	-
BT-88	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AEF, day^{-1}	1.11	1.02	1.03	0.84	0.80	0.74	0.66	0.64	0.55	0.57	0.68	0.63	-
AED, min.	1.65	1.67	1.63	1.62	1.68	1.70	1.65	1.68	1.72	1.73	1.78	1.50	-
C-2,3	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AEF, day^{-1}	1.50	1.32	1.16	1.10	0.95	1.02	1.21	1.11	1.19	1.18	1.10	0.89	-
AED, min.	2.59	2.13	1.91	1.95	1.94	1.94	1.98	1.93	1.92	1.85	1.79	1.77	-
S-8BM	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
AEF, day^{-1}	1.03	0.99	0.94	0.88	0.91	1.01	1.15	1.10	1.19	1.51	1.27	0.87	-
AED, min.	2.84	2.40	1.94	1.90	1.95	1.99	2.01	2.00	1.95	1.97	1.92	1.90	-

Department Director of

RUSAL Novokuznetsk A. Gribanov

Annex 3

MONITORING PLAN

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