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ЗАВОД

MONITORING REPORT

ON JOINT IMPLEMENTATION PROJECT
«Reduction of PFC emission from RUSAL Krasnoyarsk Aluminium Smelter»

REGISTRATION NUMBER of Joint Implementation Project Design Document: ***0111***

PERIOD OF MONITORING: from 1 January 2008 to 31 December 2009

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Section A. General information on the project activity

A.1. Introduction

The data presented in this monitoring report has been collected in line with the PDD for the JI project Reduction of PFC emissions from RUSAL Krasnoyarsk Aluminium Smelter (version 3.0 of 27th October 2008, the positive determination opinion of DNV is received, report № 2008-1624) over the period 1st January 2008 – 31th December 2009.

The purpose of this project is to reduce emissions of perfluorocarbons (PFCs) through the reduction of anode effect frequency (AEF) and anode effect duration (AED), by implementing a number of organizational and technical measures at the 24 potrooms of RUSAL Krasnoyarsk Aluminium Smelter (KrAZ), located in the city of Krasnoyarsk, Russian Federation. Twenty one of these potrooms use vertical stud Søderberg process with point feeders (PFVSS), the remaining – prebake anode process with point feeders (PFPB). The project is limited to CF_4 and C_2F_6 emissions.

The project uses own methodology for calculation of baseline and project line emissions based on the 3-rd version of the methodology "The Aluminium Sector Greenhouse Gas Protocol" (Addendum to the WRI/WBCSD Greenhouse Gas Protocol) 2006, which has been approved and included in 2006 IPCC Guidelines for National Greenhouse Gas Inventories. According to the IPCC methods, PFCs emissions are influenced by four parameters, which depended on the specific aluminium production: overall production of electrolytic aluminium, frequency and duration of anode effects and slope coefficient for CF_4 and C_2F_6 emissions.

The Tier 3 slope coefficients used for calculation of PFCs emissions were measured in September 2007 by Jerry Marks – consultant of International Aluminium Institute, and remain valid 3 years in past and in future (that is can be used for calculation PFC emission since beginning of the project and up to September 2010) in accordance to his recommendations. On June 2010 it is planned to perform new series of measurements for specification of slope coefficients for the next 3 years. The measurements will be again done under control of Jerry Marks.

Project started in 1st January 2006. The implementation of the project that is expressed in achievement of the annual targets for reduction of frequency and duration of anode effects will be held at least until 31st December 2012, however OJSC "RUSAL Krasnoyarks" has also the long-term aim for anode effects until 2015. For 2009 the target on AEF for PFPB technology was 0.2 anode effects per pot-day and for PFVSS technology the target was 0.45 anode effect per pot-day.

A.2. Technology employed

The project has been realized at 21 potrooms with VSS pots (1878 pots) and at 3 potrooms with the point feeders prebaked anodes technology (PFPB) (279 pots). During the project implementation point feeders (PF) has been installed at all VSS potrooms till the end of 2007.

The project also covers pots newly installed within the frameworks of the smelter modernization project (total 76 pots are added to existing 1878 ones; in potrooms 9 to 23, installation of 4 additional pots was made in each room. In potroom 1 and 4, 8 additional pots in each are installed). Including new pots into the project boundary is explained by the fact that their installation is implied by the baseline scenario, and the implementation of individual measures aimed at reduction of AEF for the new VSS pots separately without considering the existing pots in the corresponding potrooms will be inappropriate and even impossible, because there are groups of pots serviced by a team of pot operators. And otherwise, excluding them from the activities aimed at reducing AEF is also inappropriate for the same reason.

Therefore in the project boundary are 2233 electrolytic cells of PFVSS and PFBP technology.

In accordance with PDD the electrolytic cells for production of high-purity aluminium (74 pots in potroom 25) are outside the project boundary because these pots have been designed for aluminium refinement by three-layer method instead of its initial generation. During such electrolysis the anode is situated underneath in the layer of the metal and PFCs are not evolved due to the absence of anode effects.

A.3. Emission reduction for monitoring period

Project has generated 169 731 tones CO_{2eq} of emission reduction units (ERU) in 2008 that is slightly less than estimated in PDD (189 390 tones CO_{2eq}). The cause of nonconformity is the technological issues with prebaked technology and use of point feeders that led to missing of the target for frequency of anode effects. However that deviation was somehow compensated by better performance of PFVSS technology.

Analyzing the reasons for AEF deviations connected to prebaked technology OJSC "RUSAL Krasnoyarsk" had implemented some corrective actions during 2008 that gave a comprehensive effect in 2009. For example the smelter has developed and implemented the techniques for technological treatment of the cells partially without anode effect. Besides the duration of anode effects has decreased significantly throughout the smelter. As a result the actual ERUs amount in 2009 (294 789 tones CO_{2eq}) has exceeded the value estimated in the PDD (207 445 tones CO_{2eq}).

For period from 1^{st} of January 2008 to 31^{st} of December 2009 there have been generated **464 520 tons of CO_{2eq}** of Emission Reduction Units.

A.4. Contact information

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Section B. Description of the project monitoring system

B.1. Monitored data

The following table highlights the data monitored during the project activity (See also B.2).

Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	Comment
MP	Tone	m/c	monthly	100%	Overall production of electrolytic aluminium for Baseline and Project
AEFp	times/ pot-day	m	constantly	100%	Actual average frequency of anode effects
AEDp	minutes	m	constantly	100%	Actual average duration of anode effects

S_{CF_4}	(kg of PFC/ tonne of aluminium)/ (number of minutes of anode effect/ pot per day)	m	Once in three years, or once changing pot type/ considerable change in technology	No less than 15 anode effects per each reduction technology type (VSS, PFPB)	Tier 3 Slope coefficient for CF_4 measured in accordance to last version of Protocol for Measurement of Tetrafluoromethane (CF_4) and Hexafluoroethane (C_2F_6) Emissions from Primary Aluminium Production, US EPA and IAI
Weight fraction of C_2F_6/CF_4	Unit fraction	m	Once in three years, or once changing pot type/ considerable change in technology	No less than 15 anode effects per each reduction technology type (VSS, PFPB)	Tier 3 Slope coefficient for CF_4 measured in accordance to last version of Protocol for Measurement of Tetrafluoromethane (CF_4) and Hexafluoroethane (C_2F_6) Emissions from Primary Aluminium Production, US EPA and IAI
Average weight of 1 cm of metal in the pot	Kg	c	Once per year for each potroom	10% of pots in the potroom	The method is based on estimation of the difference between mass fraction of the copper and aluminium during 24 hours, measurement if the level of metal in pot and following calculation by formula. The parameter is used for estimation of amount of liquid aluminium in process.

a) *Overall production of electrolytic aluminium per year by potrooms*

Overall production of electrolytic aluminium per potroom for reporting period (month) is defined by addition of weight of raw aluminium determined by weighting of ladles with metal taken from potroom and weight of aluminium in progress (AIP) that consists of liquid aluminium being in pots at the end of the month, and small amount of solid aluminium. These separation and methods for estimation are prescribed in "Regulation for estimation of cost-performance characteristics of electrolytic production at the smelters of aluminium division of RUSAL company". It should be noted that amount of metal-in-progress consist of less than 1% of the annual electrolytic aluminium production.

Weighting of ladles is performed applying the scales "Scalex-1000" by the quality control department personnel according to the "Areal-type scales "Scalex-1000" User's Manual. The scales are included into the "List of measuring tools subject to control", and annually checked according to "Measuring tools check-up schedule" by the specialists of the Federal State Facility "Krasnoyarskiy TsSM" with issuing calibration certificates.

Permissible maximum accuracy is ±20 kg within the range of 5,000 to 20,000 kg. (GOST 8.453-82 Scales for statistical weighting. Methods and means of verification).

Records on weighting of the ladles with metal are input by "Weighting workstation" terminal and stored in electronic form in Information and Technological System (ITS) database at Oracle. The time of data storage is limited only by volume of free disk space which is periodically enlarged.

Mass of liquid aluminium in pots is determined monthly according to valid standard: instruction I 10.03-2002 "Methodology of accounting of the stock of raw materials, goods and metal in progress in electrolysis potrooms" and "Standard methodology for inventory of working remains and goods-in-progress at smelters of OJSC "Russian Aluminium".

The method of estimation is following: the quantity of liquid metal is calculated by multiplication of average level (height) of metal in pot to the average weight of one centimeter of the metal, and to the number of pots in progress. The measurements are done daily for formation of the day plan for pouring out of the metal from pots and planning of other operations. Data on the last day of the month is compared with same data for last day of the previous month and provides a basis for estimation of metal in progress.

A level of metal is measured by the ruler which is a non-standard tool for measurement fabricated on drawing. In accordance with instruction I 8-21-2001 «Order of performance of the measurements at electrolytic cells with top current feed" a gauge for measurement of the level of metal and electrolyte are subject for Quality Department Control during issuance from fabrication line and by technological staff during exploitation. During fabrication a producer company OJSC "Siberian instrument and repair factory" performs an initial calibration with issuance of the certificate on calibration. In process of exploitation the personnel performing the measurements observe the state of the ruler by comparison with calibrated ruler and visual inspection to check the defacement of the bottom part of the ruler and its mechanic damage. Thereby the ability for further application of the ruler is done. The calibration of the ruler is 1 cm, according to work standard RS 211.010.2008 (Measurement of level of metal and electrolyte) the level of metal is measured with accuracy of ±1 cm.

An average weight of one centimeter of the liquid metal is defined not less than once per year with metal indicator. The method is based on estimation of the difference between mass fraction of the copper in aluminium during 24 hours, measurement of the level of metal and further calculation by formula. Measurement is done at 10% of the pots installed in the potroom according to instruction I 10.03.2002 "Methodology of accounting of the stock of raw materials, goods and metal in progress in electrolysis potrooms", item 5.11. The copper is weighted with accuracy of 0.1 g.

Records on quantity of aluminium in electrolytic cells are documented by "Act of definition of metal-in-progress in electrolytic cells of "OJSC "RUSAL Krasnoyarsk" and stored not less than 5 years in the archive of Group of planning and analysis of electrolytic production according to current practice. A quantity of solid aluminium is estimated by multiplication of volume of the metal to its density and documented in acts for inventory of working remains. The acts are stored in Group of planning and analysis of electrolytic production for 5 years. For proper reporting on the considered Joint Implemented project the additional copying of these documents is provided for the aim of their guaranteed storage during 10 years.

Since all potrooms with VSS technology are equipped with alumina point feeders a slope coefficient for all VSS pots is the same. A slope coefficient for PFPB technology is different from VSS with point feeders. The electrolytic aluminium data are recorded in monthly technical reports. December report which is prepared in the middle of January next year has information for aluminum production by each potrooms. To get more accurate results annual project emission calculations have been done for each potroom.

b) *Average frequency and duration of anode effects*

Average anode effect frequency by potrooms per year, times/pot per day and anode effect duration by potrooms per year, min/ pot per day is measured by the aluminum electrolysis process automatic control system (ACS) SAAT-1. The responsibilities and work sequence of ACS operator is outlined in "SAAT-1 Operator's Manual". The process computer control SAAT-1 has a hierarchical two-level structure. The upper level is based on SUN server station (host computer). Information is achieved in electronic database of Information and Technological System (ITS) based on Oracle. Access to the date of frequency and duration of anode effects is provided through workstation ARM SMIT. A duration of the storage of these data is limited by free disk space only which is periodically enlarged. Therefore the data on frequency and duration of anode effects happened during the crediting period will be kept not less than 10 years.

To provide the maintenance and process personnel with information, the server station is connected via Ethernet 10Base-T to the control station operator workstation, to chief foremen workstations and to workstations of foremen of the anode facility. The data concentrator provides the data exchange between the host computer and the controllers of the control boxes of pots (lower level controllers). Both the data concentrator and the operator workstation are located in the control station of the potroom. Operation of the pot control system is based on the principle of generation (elaboration) of control actions on the actuating mechanisms of pots by means of mathematical processing of information on the electrolysis process, logical processing of signals about control positioning and actuating mechanisms condition.

One of the functions of the process control system is to control anode effects on the voltage measure channel on the anode and cathode (Ua-k) section. The operational voltage on the pot is 4.5 Volts in average. When it raises above 9 Volts the system fixes a start of anode effect and generate the corresponding sound and light information for the potroom staff shift. The average voltage of anode effect is 45 Volts in average. When the voltage drops down to 3.5 Volts (which happens after anode effect quenching measures have taken effect) the system fixes the duration of anode effect and it is counted as quenched. Thereby the information on frequency and duration of each anode effect is stored at the smelter.

The channel's basic accuracy is ±0.2 %. The measuring channel is calibrated once per two years according to the "Guidelines for the measuring system process control system for electrolytic reduction of aluminium calibration procedure". Calibration is performed by specialists of a contracted organization according to the Regulations for "check-up/calibration of measuring tools".

Based on the data accumulated during the process automatic control system operation, the percentage of lost information on frequency and duration of AE due to process automatic control system failure is approximately equal to 2%, therefore the degree of uncertainty is low, and it is composed of the channel accuracy and availability of the process control system.

c) *Slope factor for CF_4 and weight fraction C_2F_6/CF_4*

Slope coefficients have been obtained during PFC measurements, carried out by Mr. Jerry Marks (IAI consultant) in September 2007.

According to the data collected by Mr. Jerry Marks (IAI consultant), presented in the report on perfluorocarbon emission measurements, the main sources of uncertainty during continuous measuring are:

- spectrometer calibration uncertainty,
- the effectiveness of the analytical method in calculating the CF_4 and C_2F_6 concentrations from the measured spectrum,
- the measurement of the flow rate of exhaust gases in the collection ducts.

Another source of uncertainty in the Krasnoyarsk VSS measurements is the estimation of exhaust gas collection fraction and the short term variability of the collection fraction during anode effects.

The table below summarizes sources of uncertainty in the PFC measurement and estimates the magnitudes of each uncertainty source. Using IPCC Tier 3 guidelines (see IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Section 6.3.2, http://www.ipcc-nggip.iges.or.jp/public/gp/pdf/6_Uncertainty.pdf) for estimating uncertainty, the overall combined uncertainty from all sources is expected to give a result that is ± 12% of the actual value. The calculation methodology is based on the combined variances of all the major sources of uncertainty and is calculated as the square root of the sum of the squares of the individual uncertainties.

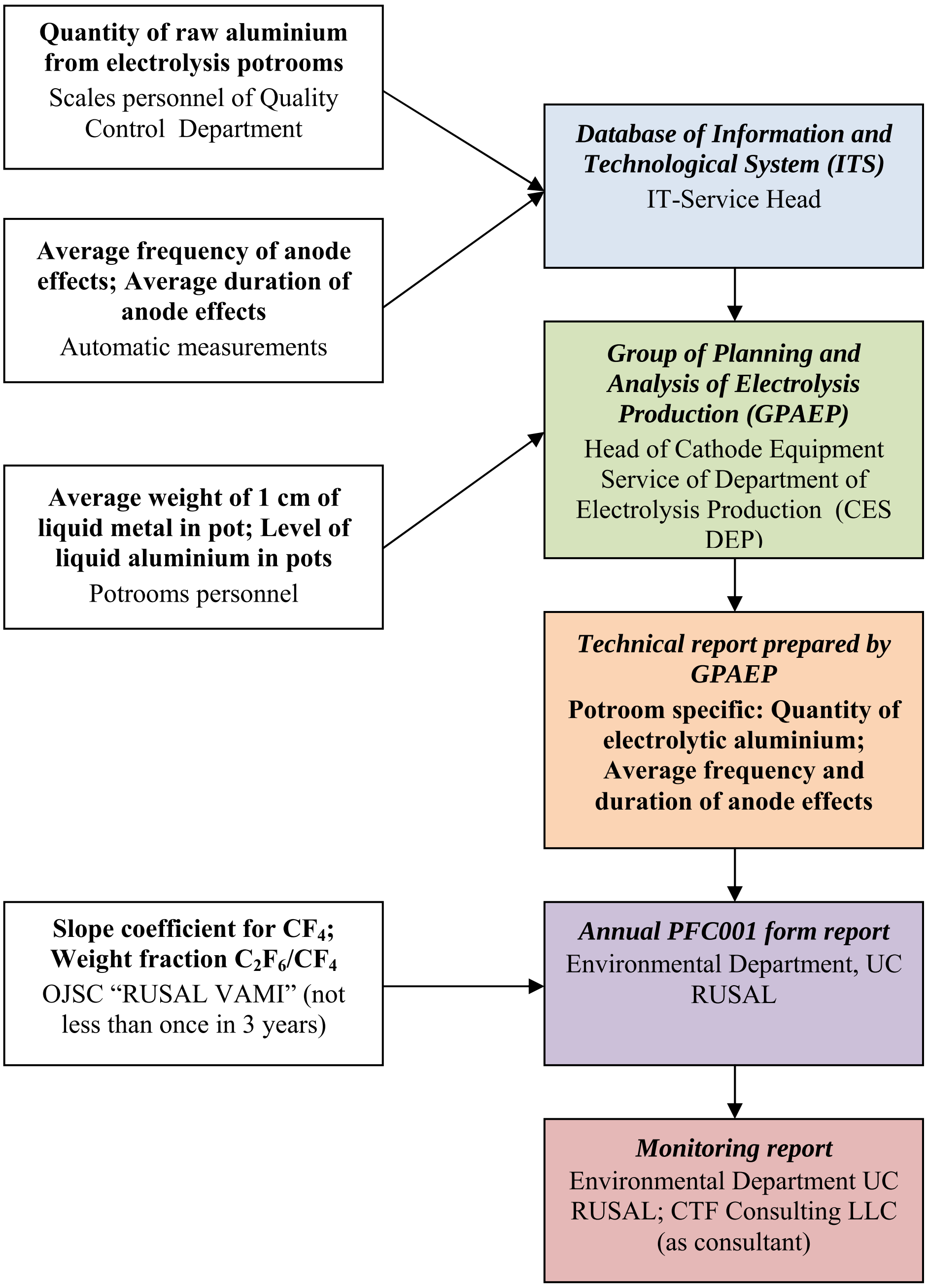
Summary table of sources and values of uncertainty

Uncertainty Source	Estimated Uncertainty
Spectrometer calibration	< ± 2%
Calculations performed with spectrometer	< ± 10%
Exhaust Stack Flow Measurement	< ± 5%
Collection Fraction Uncertainty	< ± 5%
Overall combined Uncertainty	< ± 12%

Thus, Uncertainty of slope coefficients is ±12%.

B.2 Accounting, registration and storage of data. Scheme of data flow

№	Data variable	Unit	Volume of data	Periodicity	Form of data	Way of storage (electronic / paper)	Place of storage	Storage duration	Responsibility	
									for data validity	for data retention
1	Quantity of raw aluminium from electrolysis potrooms	tones	100%	Each ladle	Information of database	Electronic form	Database of Information and Technological System (ITS)	Not less than 10 yr	Head of Quality Control Department (QCD)	IT-Service Head
2	Quantity of electrolytic aluminium produced	tones	Each potroom/ 100%	Monthly, annually	Technical report	Paper form	Group of Planning and Analysis of Electrolysis Production (GPAEP)	Not less than 10 yr	Head of Cathode Equipment Service of Department of Electrolysis Production (CES DEP)	Head of CES DEP
3	Average frequency of anode effects	times / pot / day	Each potroom	Monthly, annually	Technical report	Paper form	GPAEP	Not less than 10 yr	Head of CES DEP	Head of CES DEP
			100%	Daily	Information of database	Electronic form	Database of ITS	Not less than 10 yr	Head of CES DEP	IT-Service Head
4	Average duration of anode effects	minutes	Each potroom	Monthly, annually	Technical report	Paper form	GPAEP	Not less than 10 yr	Head of CES DEP	Head of CES DEP
			100%	Daily	Information of database	Electronic form	Database of ITS	Not less than 10 yr	Head of CES DEP	IT-Service Head
5	Slope coefficient for CF_4	kg of PFC/ tonne of aluminium)/ (number of minutes of anode effect/ pot per day	No less than 15 anode effects per each reduction technology type	Once per three years	Measurements report	Paper form	Environmental Department of UC "RUSAL"	Not less than 10 yr	OJSC "RUSAL VAMI"	Environmental Department of UC "RUSAL"
6	Weight fraction C_2F_6/CF_4	Unit fraction								
7	PFC emissions	t CO_{2eq}	Each potroom/ smelter	Annually	Report on PFC emissions	Paper form	Environmental Department of UC "RUSAL"	Not less than 10 yr	Environmental Department of UC "RUSAL"	Environmental Department of UC "RUSAL"
8	Average weight of 1 cm of liquid metal in pot	kg	Each potroom	Annually	Technical report	Paper form	GPAEP	Not less than 10 yr	Head of CES DEP	Head of CES DEP



B.3. Environmental monitoring

The project participants do not expect any negative environmental impact resulting from implementation of activities within the frameworks of this project, and the Russian governmental bodies do not require any surveys regarding environmental impact of the project.

B.4. Management system

KrAZ has and certified integral management system in accordance to ISO 9001, 14001 и OHSAS 18001. And all equipment related to electrolysis production and the project is covered by calibration procedures of plant. The equipment of VAMI used for PFC measurements are calibrated in accordance to technical requirements for measurement equipment maintenance.

B.5. Revisions of the monitoring plan in accordance with paragraph 40 of the Guidance on criteria for baseline setting and monitoring (version 02)

The monitoring plan has been implemented in accordance with PDD. No revisions were made during the monitoring period.

To improve transparency of the monitoring plan in accordance with recommendations of accredited independent entity Bureau Veritas received during the initial verification the monitoring plan was added with data variable “Average weight of 1 cm of liquid metal in pot”, which is applied for estimation of mass of liquid aluminium in progress. Information on the value of this parameter is in the monthly and annual technical report of the smelter.

Section C. Emission reduction calculation

C.1. Emission reductions generated

In line with the PDD for the project activity the total number of ERUs (tCO_{2eq}) is calculated from the following equation:

$$R_{CO_{2E}} = Eb_{CO_{2E}} - Ep_{CO_{2E}}$$ Formula (1)

where,

$R_{CO_{2Э}}$ – Emission reduction, tonnes of CO_{2eq}

$Eb_{CO_{2Э}}$ – Baseline emissions, tonnes of CO_{2eq}

$Ep_{CO_{2Э}}$ – Project emissions, tonnes of CO_{2eq}

C.2. Baseline emissions

$$Eb_{CO_{2E}} = MP \times AEFb \times AEDb \times S_{CF_4} \times \left(\frac{6500 + F_{C_2F_6/CF_4} \times 9200}{1000} \right)$$ Formula (2)

where:

MP	Metal overall production, tonnes of aluminium per year
AEFb	Estimate average frequency of anode effects for the chosen project scenario
AEDb	Estimate average duration of anode effects for the chosen project scenario
S_{CF_4}	Slope coefficient for CF_4, kg of CF_4 per tonne of aluminium times the number of minutes of anode effect / pot per day
$F_{C_2F_6/CF_4}$	Weight fraction of C_2F_6/CF_4
6500	Global warming potential for CF_4
9200	Global warming potential for C_2F_6

For estimation of PFCs emissions in the absence of the project activity (baseline scenario), the smelter has been provided with a sound estimate of AEF and AED values, that would have been in the case of absence of the project (see Annex 2) of PDD.

C.3. *Project emissions*

$$Ep_{CO_{2E}} = MP \times AEFp \times AEDp \times S_{CF_4} \times \left(\frac{6500 + F_{C_2F_6/CF_4} \times 9200}{1000} \right)$$ Formula (3)

where:

MP	Metal overall production, tonnes of aluminium per year
AEFp	Estimate average frequency of anode effects for the chosen project scenario
AEDp	Estimate average duration of anode effects for the chosen project scenario

S_{CF_4}	Slope coefficient for CF_4, kg of CF_4 per tonne of aluminium multiplied by the number of minutes of anode effect / pot per day
$F_{C_2F_6/CF_4}$	Weight fraction of C_2F_6/CF_4
6,500	Global warming potential for CF_4
9,200	Global warming potential for C_2F_6

Specific coefficients for VSS with alumina point feeders and PFPB technologies are to be used as the slope factors for CF_4 (S_{CF_4}) and weight fraction of C_2F_6/CF_4 ($F_{C_2F_6/CF_4}$). These specific coefficients have been obtained as a result of perfluorocarbon emission measurements in September 2007 performed by Jerry Marks.

C.4 Calculation of emission reductions

Calculation of emissions reduction is done in accordance to Formula 1.

Slope coefficient for CF_4 (kg of CF4 per tonne of aluminium times the number of minutes of anode effect / pot per day) is set as 0,032 for VSS and 0,133 for PFPB.

The emission reduction is the difference between emissions calculated in the baseline and project that are attached in the Excel file. The tables with calculations are below.

Table C.1. Calculation of the actual PFC emissions and ERUs for potrooms in 2008

Potroom	Technology of electrolysis	Year	Electrolytic aluminium production, tones	AEF, times anode effect per pot-day		AED, mins		Slope coefficient CF_4	Weight fraction C_2F_6/CF_4	PFC emissions, t CO2eq		Emission Reduction Units, t CO2eq
				Project	Baseline	Project	Baseline			Project	Baseline	
1	PFVSS	2008	41 822	0,42	0,76	2,59	2,50	0,032	0,044	10 052	17 557	7 505
2	PFVSS	2008	38 522	0,41	0,76	2,57	2,50	0,032	0,044	8 969	16 172	7 203
3	PFVSS	2008	38 628	0,41	0,76	2,78	2,50	0,032	0,044	9 728	16 216	6 488
4	PFVSS	2008	42 074	0,41	0,76	2,88	2,50	0,032	0,044	10 977	17 663	6 686
5	PFVSS	2008	30 358	0,29	0,76	2,61	2,50	0,032	0,044	5 077	12 745	7 668
5ou	PFVSS	2008	9 126	0,76	0,76	2,54	2,50	0,032	0,044	3 893	3 831	-61
6	PFVSS	2008	39 280	0,41	0,76	2,83	2,50	0,032	0,044	10 070	16 490	6 420
7	PFPB	2008	45 905	0,44	0,71	2,76	2,09	0,133	0,05	51 604	63 056	11 452
8	PFPB	2008	43 060	0,36	0,71	2,66	2,09	0,133	0,05	38 170	59 148	20 978
9	PFVSS	2008	40 365	0,49	0,76	2,97	2,50	0,032	0,044	12 980	16 946	3 966
10	PFVSS	2008	43 265	0,55	0,76	3,31	2,50	0,032	0,044	17 403	18 163	760
11	PFVSS	2008	41 650	0,43	0,76	2,71	2,50	0,032	0,044	10 724	17 485	6 761
12	PFVSS	2008	41 517	0,44	0,76	2,59	2,50	0,032	0,044	10 454	17 429	6 975
13	PFVSS	2008	41 627	0,39	0,76	2,85	2,50	0,032	0,044	10 223	17 476	7 252
14	PFVSS	2008	41 507	0,36	0,76	2,97	2,50	0,032	0,044	9 806	17 425	7 619
15	PFVSS	2008	41 949	0,39	0,76	3,01	2,50	0,032	0,044	10 881	17 611	6 730
16	PFVSS	2008	41 421	0,40	0,76	3,01	2,50	0,032	0,044	11 019	17 389	6 370
17	PFVSS	2008	44 828	0,44	0,76	2,72	2,50	0,032	0,044	11 854	18 819	6 965
18	PFVSS	2008	44 868	0,49	0,76	2,77	2,50	0,032	0,044	13 456	18 836	5 380
19	PFVSS	2008	44 520	0,63	0,76	2,88	2,50	0,032	0,044	17 848	18 690	842
20	PFVSS	2008	44 435	0,57	0,76	2,94	2,50	0,032	0,044	16 453	18 654	2 201
21	PFVSS	2008	43 929	0,52	0,76	3,11	2,50	0,032	0,044	15 697	18 442	2 745
22	PFVSS	2008	44 162	0,52	0,76	2,88	2,50	0,032	0,044	14 613	18 540	3 926
23	PFVSS	2008	45 665	0,44	0,76	2,83	2,50	0,032	0,044	12 564	19 171	6 607
26	PFPB	2008	25 187	0,26	0,71	2,36	2,09	0,133	0,05	14 306	34 597	20 291
Totally for the smelter		2008	999 669							358 820	528 551	**169 731**

Table C.2. Calculation of the actual PFC emissions and ERUs for potrooms in 2009

Potroom	Technology of electrolysis	Year	Electrolytic aluminium production, tones	AEF, times anode effect per pot-day		AED, mins		Slope coefficient CF_4	Weight fraction C_2F_6/CF_4	PFC emissions, t CO2eq		Emission Reduction Units, t CO2eq
				Project	Baseline	Project	Baseline			Project	Baseline	
1	PFVSS	2009	40 956	0,28	0,73	1,78	2,55	0,032	0,044	4 559	16 846	12 287
2	PFVSS	2009	36 231	0,25	0,73	1,62	2,55	0,032	0,044	3 294	14 902	11 608
3	PFVSS	2009	36 693	0,32	0,73	1,71	2,55	0,032	0,044	4 464	15 092	10 628
4	PFVSS	2009	40 704	0,33	0,73	1,76	2,55	0,032	0,044	5 160	16 742	11 582
5	PFVSS	2009	28 742	0,38	0,73	1,93	2,55	0,032	0,044	4 609	11 822	7 213
50	PFVSS	2009	7 885	0,70	0,73	1,73	2,55	0,032	0,044	2 122	3 243	1 121
6	PFVSS	2009	37 819	0,32	0,73	1,85	2,55	0,032	0,044	4 901	15 555	10 655
7	PFPB	2009	46 299	0,35	0,67	1,85	2,11	0,133	0,05	27 354	60 588	33 234
8	PFPB	2009	44 133	0,32	0,67	1,75	2,11	0,133	0,05	22 663	57 754	35 091
9	PFVSS	2009	38 663	0,31	0,73	1,83	2,55	0,032	0,044	4 878	15 902	11 025
10	PFVSS	2009	40 162	0,38	0,73	1,85	2,55	0,032	0,044	6 288	16 519	10 231
11	PFVSS	2009	39 809	0,29	0,73	1,92	2,55	0,032	0,044	4 864	16 374	11 510
12	PFVSS	2009	38 873	0,28	0,73	1,90	2,55	0,032	0,044	4 586	15 989	11 403
13	PFVSS	2009	38 983	0,26	0,73	1,95	2,55	0,032	0,044	4 384	16 034	11 650
14	PFVSS	2009	38 931	0,30	0,73	1,99	2,55	0,032	0,044	5 084	16 013	10 929
15	PFVSS	2009	39 382	0,46	0,73	1,91	2,55	0,032	0,044	7 645	16 198	8 553
16	PFVSS	2009	38 354	0,40	0,73	2,01	2,55	0,032	0,044	6 762	15 775	9 013
17	PFVSS	2009	42 631	0,36	0,73	1,93	2,55	0,032	0,044	6 508	17 534	11 026
18	PFVSS	2009	41 735	0,50	0,73	1,91	2,55	0,032	0,044	8 877	17 166	8 289
19	PFVSS	2009	42 033	0,68	0,73	1,95	2,55	0,032	0,044	12 387	17 288	4 901
20	PFVSS	2009	42 415	0,43	0,73	1,92	2,55	0,032	0,044	7 809	17 445	9 636
21	PFVSS	2009	41 901	0,56	0,73	2,02	2,55	0,032	0,044	10 529	17 234	6 705
22	PFVSS	2009	42 208	0,50	0,73	1,95	2,55	0,032	0,044	9 148	17 361	8 213
23	PFVSS	2009	44 334	0,45	0,73	1,81	2,55	0,032	0,044	7 979	18 235	10 256
26	PFPB	2009	22 970	0,32	0,67	1,79	2,11	0,133	0,05	12 027	30 059	18 032
Totally for the smelter		2009	952 845							198 879	493 668	**294 789**
Totally ERUs for 2008-2009												**464 520**