CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

>> **Line 5 & 6 - PFC emission reduction at DUBAL**
Version: 04
Date: 02/06/2011

PDD version	Complete date	Remarks
1	11/02/2010	For global stakeholder consultation and validation
2	16/12/2010	Revision based on validation findings mainly on section B of the PDD
3	13/01/2011	Revision after technical review
4	02/06/2011	Revision after UNFCCC request for review

A.2. Description of the project activity:

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Dubai Aluminium Company Ltd (DUBAL) is located in Emirate of Dubai, United Arab Emirates. It commenced operation in 1979 with three pot line having capacity of 135,000 tonnes of aluminium per annum. As on today the plant consists of 8 pot lines with 1,573 electrolytic cells. The plant is having production capacity of more than 950,000 MT per annum.

The total aluminium production in year 2008 was 891,723 tonnes with the electricity consumption of 14,274,273 MWh. The electricity requirement of the process is fulfilled by internal combined cycle gas based power generators.

The objective of this project is to reduce PFC emission from anode effect mitigation from line 5 & 6 through the installation of a new algorithm in the Automatic Control System (ACS) in 480 pots (pot lines 5 and 6). Two per fluorocarbons (PFCs), tetrafluoromethane (CF4) and hexafluoroethane (C2F6) are produced intermittently during brief process upset periods known as anode effect. The implementation of the new logic is reducing the anode effect and thus reducing of PFC emissions.

Pre project scenario:
In pre project activity the line 5 and 6 were operating at 4.5 Volt voltages and 230 kAmp current. In the lines the feeding of alumina is frequent in small quantities. The pot lines were operating (alumina concentration) very close to anode effect threshold limits and therefore generating the higher anode effect in the baseline.

Project activity:

In the project activity logic of alumina feeding is changed and tried at pilot scale. After one unsuccessful trial the project were stopped for some time. Dubal has upgraded the logic and tried it again at pilot scale. After successful trials the new feeding logic is introduced in line 5 & 6. The new logic is reducing the anode effect to a great extent. The project has the capacity to produce around 271,790 tonnes of CO_2 equivalent emission reductions over a 10-year time frame.

Contribution to sustainable development:

Project proponent has selected eco-friendly technical improvement to establish new paradigms from an environmental perspective while also being committed towards development of the community. Thus the project's contribution towards sustainable development has been addressed based on the following pillars of sustainable development:

Social:

The project activity is environmental friendly and will reduce the PFC emissions. This in turn will be having the better effect on the local climate and health of the workers.

Economic well being

The project activity will generate the CDM revenue. Some of the revenues will be used for research and development of PFC reduction. This may generate the employment opportunities for analysts and research scholars.

Environmental well being

The project activity would be reducing considerable amount of GHG emission which would have taken place in the pre project scenario. The project activity apart from reducing greenhouse gas emissions will be contributing towards better quality environment for the employees and the nearby communities mainly due to lowering of harmful pollutants.

Sustainable Development Indicators – UAE

Criteria	**Indicator**	**Impact of project**
Environmental		
Environmental sustainability	In line with national SD policy	Yes
	Complying with existing land use	Not applicable

	planning	
Respect of quality of resources	Not exceeding the threshold of existing national, local and environmental standards	Yes
	Not causing air pollution	Reducing the air pollution
	Not causing water pollution	Not applicable
	Not causing soil pollution	Not applicable
Respect of biodiversity	Maintain sustainability of local ecological functions	Yes
Economic		
Technology transfer & know how	Enhancing the capacity and utilization of local technology	Yes
	Enhancing the capacity and utilization of local resources	Yes
	Not using experimental or obsolete technologies	Yes
	Not causing dependencies on foreign parties in knowledge and appliance operation (know-how transfer)	No, The project is developed with in-house resources
Contribution to GDP growth and diversification	Improved GDP growth rate	Yes, Very marginal impact
	Support government's economic diversification strategy	Not applicable
	Enhancing the capacity and utilization of local human resources (education/training)	Yes
Employment	Contribution to increased employment	Not applicable
Social		
Local community health & safety	Not imposing any health risk	Yes
	Complying with occupational health & safety regulation	Yes

Local culture	Respect of local culture and traditions	Yes

A.3. Project participants:

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Name of Party involved (host) indicates a host Party	Private and/or public entity (ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
United Arab Emirates (UAE)	Abu Dhabi Future Energy Company PJSC (Private entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>
United Arab Emirates (U.A.E)

A.4.1.1. Host Party(ies):

>>
Dubai

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

>>
Jebel Ali

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

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DUBAL plant is located near Jebel Ali port which is proximate to Dubai city. The aluminium smelter has a jetty/port for unloading fuel and other raw materials required for smelting business. Abu Dhabi-Dubai motorway is adjacent to the plant and is well connected to the project site.

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

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Mean sea level:	16 m above sea level
Latitude:	25˚ 02’35’’N
Longitude:	55˚.07’ 15” E

	
Location of Dubai in UAE	**DUBAL PLANT**

A.4.2. Category(ies) of project activity:

>> The project activity belongs to Sectoral Scope Number 9: Metal production as per the sectoral scope of the project activities

A.4.3. Technology to be employed by the project activity:

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The objective of this project is to reduce PFC emission from anode effect mitigation through the installation of a new alumina feeding algorithm in the Automatic Control System (ACS) in 480 pots (pot lines 5 and 6).
The technology of these pots is point feed pre-bake cell technology (PFPB). The algorithm is a new over feed control procedure developed by the DUBAL technical team. This algorithm will permit a reduction of over-voltage of the anode effect.

Before the implementation of the project activity DUBAL was working on the following Resistance control logic for the feed control

The Resistance Control Logic

Smooth resistance is the calculated pot resistance after applying filters, to minimize the over-reaction due to sudden increase or decrease in pot resistance. It is compared with the resistance control set-point at regular intervals. If the smooth resistance is found to be outside the applicable dead-band limit, a resistance control action will be taken. Each feed window has its own set of dead-band parameters.

The smooth resistance is calculated every 6 seconds. It is used in controlling the pot resistance. Two values are calculated to measure the change in cell resistance and are used to define the end of the search: Delta-R and Slope.

Delta-R (ΔR) is the recorded increase in the smooth resistance referenced to the minimum smooth resistance value observed during the search.
The Delta-R is calculated every 6 seconds.

Slope (dR/dt) is the recorded rate of increase in the smooth resistance during the search. Slope is calculated every minute.

For a search to be successful, one of the following criteria must be met:

1. Actual ΔR (Delta-R) must exceed the search ΔR trigger
2. Actual dR/dt (slope) must exceed the search dR/dt trigger
3. ΔR (Delta-R) must exceed the critical ΔR trigger (independent of slope value)

Under normal conditions, an anode effect is manifested by a sudden increase in voltage. The factors which provoke it are as follows:

1. The amperage creep over the years has pushed the critical current density to higher alumina content. This appears to be the main cause of an AE during an anode setting operation.

2. In point feed pots, where alumina dosage is frequent but small, cells are operating close to AE threshold limit for alumina concentration. Modification to demand feed logic and strategy is desired to cater to higher amperage operation.

Logic was developed to kill an incipient anode effect. It was programmed and originally tried out on pilot scale on two cells before expanding it a bigger group and eventually rolling it out to 480 cells across pot lines 5 and 6.

The program works on the following logic:

a. Following a Successful Search and/or track: If Raw Volts – EOS Volts >= 100 mv (a parameter), Anode quench cycle should be activated without administering anode effect dumps b. Alumina Dumps: If condition 1 stated above occurs, provide eight alumina dumps (a parameter) simultaneously c. Feed Rate and Feed Windows: No change is proposed at this stage

d. Conditions: Above activity (No 1 + 2) should be applicable if following conditions are met on a pot:

1. Pot age is greater than 28 days(a parameter)
2. Demand Feed is active
3. Pot is on computer control
4. Starve logic is not active
5. No lock outs are not set on the pot

The technology implemented is in house development and environment friendly.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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Year	Annual Estimation of Emission Reductions (tCO_2e)
June 2011 – May 2012	27179
June 2012 – May 2013	27179
June 2013 – May 2014	27179
June 2014 – May 2015	27179
June 2015 – May 2016	27179
June 2016 – May 2017	27179
June 2017 – May 2018	27179
June 2018 – May 2019	27179
June 2019 – May 2020	27179
June 2020 – May 2021	27179
Total Emission reduction (tCO_2e)	**271790**
Total no. of Crediting Years	10
Annual average over the crediting period of estimated reductions (tCO_2e)	**27179**

A.4.5. Public funding of the project activity:

>> No development aid funds from the Annex 1 countries are involved in the project activity

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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Title: "PFC emission reductions from anode effect mitigation at primary aluminium smelting facilities"
AM0030 ver03
Reference:
http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_CRTQJTBCE4L4M2MBDZE44JOCZNB5HG

Other the methodology the following tools will be used for the project activity:-

1. Tool for the demonstration and assessment of additionality (ver 05.2)

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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The project activity is meeting the applicability criteria of approved methodology in following manner:

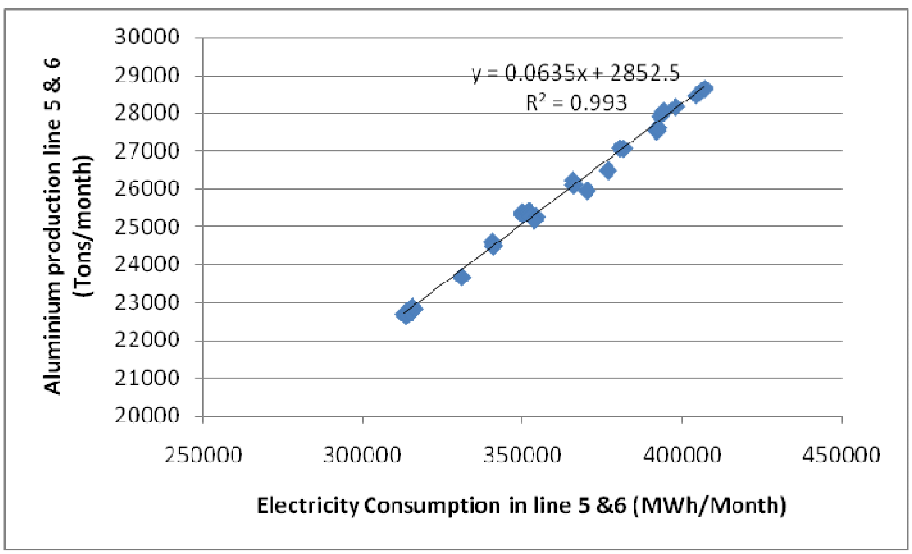
Applicability Criteria	Justification with respect to project activity
Primarily aimed at measures that reduce the PFC emissions in Aluminium smelting facilities that use center work pre-bake cell technology with bar brake (CWPB) or point feeder systems (PFPB).	DUBAL is implementing the project to reduce the PFC emissions only and using the PFPB technology.
At Aluminium smelting facilities that started operations before 31 December 2002	DUBAL started operations in year 1979. The line 5 has started operation in September 1996 and line 6 has started operation in May 1999[1].
Where at least three years of historical data are available regarding current efficiency, anode effect and Aluminium production of the industrial facility from 31 December 2002 onwards or, in case of project activities with a starting date before 31 December 2005, from 3 years prior to the implementation of the project activity onwards, until the starting date of the project activity;	DUBAL has daily historical data related to current efficiency, aluminium production, and anode effect performance from the last three years, and more, prior to project implementation.
At facilities where the existing number of pot lines and pots within the system boundary is not increased during	The existing number of pot lines and pots within the project boundary will not be

[1] 'Dubal facts and figures- Available in www.dubal.ae

the crediting period. The methodology is only applicable up to the end of the lifetime of existing pot lines if this is shorter than the crediting period;	increased during the 10-year crediting period, and their remaining lifetime is following: Line 5: 16 years Line 6: 19 years.
Where it is demonstrated that, due to historical improvements carried out, the facility achieved an "operational stability associated to a PFC emissions level" that allows increasing the Aluminium production by simply increasing the electric current in the pots". This can be demonstrated for example by providing results of pilot tests carried out by the company.	It can be demonstrated that, due to historical improvements carried out by the company, the facility achieved an "operational stability associated to a PFC emissions level" that allows increasing the aluminium production by simply increasing the electric current in the pots. More details are presented below in this PDD.

Operational stability:

Data from July 2005 to June 2008 is presented in the graph below. The graph has been plotted between the production and the electricity consumption in line 5 & 6 and it is clear from the graph's trend line and R square value that the electricity consumption is following the production. In other words production can be increased by increasing the electricity in the pots.



It is clear from the above table that the project activity is meeting all the applicability criteria of the methodology applied and therefore the methodology is applicable for the project activity.

B.3. Description of the sources and gases included in the project boundary:

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For this particular project activity, the project boundary includes the physical site of the 480 pots at the DUBAL pot line 5 & 6.

The emission sources included in the project boundary are listed in Table 3 below.

	Source	Gas	Included?	Justification/Explanation
Baseline	Anode effects in Pots	CF_4	Yes	According to the methodology AM0030, only PFC emissions from anode effects are included in the project boundary.
		C_2F_6	Yes	
	Carbon anode reaction	CO_2	No	These additional GHG emissions are not included in the methodology.
	Use of Na_2CO_3	CO_2	No	
	Use of cover gas	SF_6	NO	
	Internal transport	CO_2	NO	
		CH_4	NO	
		N_2O	NO	
	Electricity consumption	CO_2	NO	Electricity consumption is typically reduced to some extent, but it is not the trigger of this type of project activities. Thus, the emissions related to electricity consumption are excluded from further considerations, as a conservative assumption.
		CH_4	NO	
		N_2O	NO	
Project Activity	Anode effects in Pots	CF_4	Yes	According to the methodology AM0030, only PFC emissions from anode effects are included in the project boundary.
		C_2F_6	Yes	
	Carbon anode reaction	CO_2	No	These additional GHG emissions are not included in the methodology.
	Use of Na_2CO_3	CO_2	No	
	Use of cover gas	SF_6	NO	
	Internal transport	CO_2	NO	
		CH_4	NO	
		N_2O	NO	
	Electricity consumption	CO_2	NO	Electricity consumption is typically reduced to some extent but it is not the trigger of this type of project activities. Thus, the emissions
		CH_4	NO	
		N_2O	NO	

				related to electricity consumption are excluded from further considerations, as a conservative assumption.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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The baseline scenario is determined using the tool proposed in the methodology AM0030 that is supported on the *"Tool for the demonstration and assessment of additionality"*.

Step 1: Identification of baseline scenario candidates

According to the methodology, the baseline scenario candidates can be the following:

1. The proposed project activity not undertaken as a CDM project activity.

2. All other plausible and credible anode effect mitigation alternatives to the project activity that deliver outputs with comparable quality, properties, and application areas:

- Control measures (automatic and manual control system improvements);
- Quality measures (changing the type of alumina).

3. No implementation of any anode effect mitigation measure.

Sub-step 1a: Define alternatives to the project activity

Scenario 1: The proposed project activity not undertaken as a CDM project activity

The implementation of the proposed project activity without CDM is a feasible baseline candidate as it provides the same output with the same quality as the project activity. Dubal looks back on several technical improvements in the past years which have aimed to maximize production capacity by decreasing energy consumption, to improve operational flexibility by increasing possible operational amperage range. All technical improvements implemented so far were attractive without CDM revenues and have also been implemented without such. The alternative is discussed in the additionality section B.5 of this document.

This scenario will be having two alternatives:

Alternative 1: Implementation of project activity (algorithm) without CDM financing keeping the aluminium production at pre project production levels and with the benefit of the electricity consumption reductions that the implementation of algorithm implies

Alternative 2: Implementation of project activity (algorithm) without CDM financing but increasing the aluminium production by the correspondent amount, calculated according to the pre-project operational stability, to the electricity consumption reduction by algorithm implementation.

<u>Scenario 2: Other plausible and credible anode effect mitigation alternatives to the project activity that deliver outputs with comparable quality, properties, and application areas</u>

This scenario can be divided into two alternatives:

Alternative 3: Control measures (Automatic an manual control system improvements)
Alternative 4: Quality measures (Changing the type of alumina)
Dubal is continuously investing the technological changes and has developed new technology as well. The improvements made at each stage have been associated with clear financial benefits at the end of the operational period of each investment. All these investments were focused on the final objective of the aluminium company of increasing aluminium production. As a secondary objective, anode effects have been mitigated. Namely, the following upgrades have been implemented in the period before the project implementation:

• Improvements of the demand feed program: This project was implemented in 2006. A core technical group was formed which met on 7th march 2005 and implemented the project. The memorandum for 'summary of events on CIT-3095, AEF reduction in lines 5 & 6' dated 26th January 2006 has been submitted.

Dubal has kept on searching for further aluminium production improvements, which also further mitigate anode effects. Mitigating anode effects alone was not an option for Dubal as it results in no financial benefit. Manual control system improvements are not considered because they are disregarded since some operations would not be safe for the people involved in them. Changing the type of alumina processed also is not an alternative to the project participant. Buyers of Dubal's aluminium have very high quality specific requirements. Based on those requirements the purchased alumina has to comply with several quality criteria[2], such as; loss of ignition, angle of response, water content, SiO_2 content, Fe_2O_3 content, Na_2O content, particle size, etc.. Stricter requirements would not mitigate anode effect but rather increase the aluminium quality. The secured supply of such alumina is also questioned in this case, as it would be difficult for alumina providers to increase the already high quality of the alumina.
The only automatic control system improvement, which has not yet been addressed by aluminium production improvement measures, is the improvement of the computer process control system named as scenario 1. Another anode effect mitigation alternative would be the change from the existing technology to new more improved technology, requiring large investments. Considering the pot lines are new and having remaining life of more than 15 years and this would result in a loss of production, loss of revenue and loss of market share during the shutdown period; this is not a scenario for the project activity.

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[2] The quality criteria and last two years average data is submitted as a document name 'Quality specification'.

Overall, Dubal has already achieved low anode effect frequency and there is no additional incentive to continue improving further unless the improvement increases the aluminium production high enough to fully cover the investment costs.

Dubal concluded that renewing the computer process control logic (scenario 1) is, at the current stage, the only possible mitigation measure as all other alternatives have already been implemented or are not feasible. No other alternative anode effect mitigation measure can be implemented that delivers outputs with comparable quality, properties, and application areas. Hence scenario 2 is not a feasible baseline scenario considering the necessity of a major investment without having any savings or quality benefits or a significant production increase.

<u>Scenario 3: Increase in Aluminium Production without anode effect mitigation (Pre project Scenario)</u>

This scenario can be divided in two alternatives:

Alternative 5: The algorithm is not implemented but the aluminium production is increased, with respect to pre project production for the same amount that in alternative 2

Alternative 6: The continuation of current situation in which neither anode effect measures nor business strategy practices are undertaken in another feasible alternative as the current production process is stable providing required product quality.

The upgrades mentioned in scenario 2 led to lower anode effects but also led to better performance of the equipment and an increase in aluminium production. There are no measures, which could lead to the improvement of the performance of the equipment and/or an increase of the aluminium production without decreasing the anode effect. Only a pot technology switch towards better technology would significantly increase the performance of the equipment and the aluminium production as well as decrease the anode effect. For the reasons mentioned in scenario 2, the change of pot technology is currently not a feasible option.

The continuation of the current practice is a possible scenario as the process is stable and giving the desired production of aluminium with the expected quality.

Sub-step 1b. Consistency with mandatory laws and regulations

There are no regulations with or without GHG reduction objectives affecting the baseline scenarios.

Hence, all the baseline scenario candidates mentioned are neither required nor forbidden by any law or regulation. A voluntary agreement exists between government and industry in some countries, Dubal is part of that. International Aluminium Institute (IAI) set the initial voluntary objective to reduce emissions by 80% per ton between 1990 and 2010. IAI’s objective has already been met in the year 2006. Therefore, no mandatory laws or regulations affect the project activity or any alternative baseline scenarios.

Outcome of Sub-step 1a and Sub-step 1b:

From the above analysis it can be concluded that scenarios 1 and 3 are the only realistic and credible baseline scenario candidates. Therefore the two scenarios will be further analyzed.

Step 2: Identification of the baseline scenario

Particularly, Alternative 1 & 2 are not a feasible alternative for DUBAL because it is not an economically attractive option to the project participant. Additionally, this alternative faces prohibitive barriers that prevent its implementation. These barriers, as well as the economic assessment, are described below in Section B.5.

Additionally, as it is shown also in Section B.5, DUBAL may continue making future improvements so as to increase aluminium production, with the levels of anode effect obtained prior to the implementation of the project activity, and without having to implement any anode effect mitigation measure. Thus, DUBAL would have not implemented any anode effect mitigation measure without the incentive of the CDM related revenues. Without any motive to do otherwise, the baseline for DUBAL would be to continue using the current automatic control system without having to implement any anode effect mitigation measure. Thus, Alternative 5 or 6 results to be the baseline scenario.

Justification on the feasibility of baseline scenario: Alternative 5 (Increase in Aluminium Production without anode effect mitigation) was practically feasible in line 5 & 6 in the DUBAL. As it is proven that the aluminium production is directly proportional to the current during the stable conditions which has been proved in section B.2.

As the time of the project implementation the current in the pot lines were in the tune of 225-230 kA. As per the research paper and the actual plant information the current can be increased in the CD 20 technology without changing our parameters.

According to the international publication 'EVOLUTION OF CD20 REDUCTION CELL TECHNOLOGY TOWARDS HIGHER AMPERAGE PLAN AT DUBAL[3]' ……. increased amperage can be achieved in the CD20 and D20 technology while maintaining and even improving key operating parameters, such as current efficiency, specific energy and carbon consumption.

The other variable to increase in the production is the physical limitations. For line 5&6 physical limitations for the production increase are rectifiers. During the time of decision making the rectifiers were less loaded and were operating properly. Now the current is 241 kAmp[4] (2.5% more than pre-project scenario) and at this is the maximum level of rectifiers in the present conditions.

With this it is clear that the baseline alternative (0.026% increase in production) was feasible option at the time of decision making.

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[3] Published paper in Light metals 2009

[4] Minutes of meeting on rectifiers named 'PL-customer care01'

However scenario 3 is having two alternatives (5&6) and the alternative 6 is with the constant aluminium production. This is most unlikely that the plant will operate at constant aluminium production nevertheless this (alternative 6) will result is lower baseline emissions and therefore alternative 6 is the baseline scenario for the project activity.

The baseline regarded in this project considers the performance data from January 2007 to May 2008[5], prior to the installation of the project activity with the intention to reduce the emissions of PFC. In this period[6]:

a. The cells were in stable operative conditions;

b. The cells presented low values of Anode Effect Frequency;

c. The cells could increase the current (and the aluminium production) without stability problems.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

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DUBAL is environmental friendly organisation and consider environment before every decision making. The concept of the project started long back with CDM and DUBAL has signed the emission reduction purchase agreement with MUBADALA (Parent company of MASDAR) on July 23rd 2007. The brief chronology of project is discussed in the table below:

Table B.1: Chronology of the project

Sr No	Activity	Date	Supporting document
1	Signing of contract with MASDAR	23rd July 2007	Signed contract dated 23rd July 2007 – Emission Reduction Purchase Agreement
2	First trail for anode effect reduction	31/12/2007	PCR[7] 223/2007 (PCR requested on 31/12/2007 and implemented same day)
3	Reversal of trails	11/02/2008	PCR 013/2008 (PCR requested on 11th February and implemented on 14th February 2008)

[5] 'Operation summary' reports online available; Report code: RPM 002/POS1

[6] This has been explained in the baseline information annex 3 of PDD..

[7] PCR stands for process change request

4	Start of new trails with the different logic	18/05/2008	PCR 075/2008 (PCR requested on 18th May 2008 and implemented on 26th June 2008)
5	Successful completion of trails	26/06/2008	PCR 075/2008
6	**Implementation started to 15 pot**	**6/07/2008**	**PCR 091/2008 (PCR requested on 6th July 2008 and implemented on 10th July 2008)**
7	Implementation on 60 Pots	23/07/2008	PCR 097/2008 (PCR requested on 23rd July 2008 and implemented on 29th July 2008)
8	Implementation on 240 pots	25/08/2008	PCR 114/2008 (PCR requested on 25th August 2008 and implemented on 29th August 2008)
9	Full implementation	26/10/2008	PCR 160/2008 (PCR requested on 16th October 2008 and implemented on 21st October 2008)

CDM chronology:

Sr No	**Activity**	**Date**	**Supporting document**
1	Signing of Emission Reduction Purchase Agreement	23rd July 2007	Signed ERPA. This contract includes the development of CDM PDD and all other services related with the CDM registration.
2	**Start date of the project**	**06th July 2008**	**PCR 091/2008 (PCR requested on 6th July 2008 and implemented on 10th July 2008)**
3	Discussion with Masdar on project, data collection by Masdar and communication	30/09/2009	Masdar made site visits, presentation to Dubal and explained all the requirements. The formal mail has been sent on 30/09/2009.
4	Draft submission of PDD to Dubal	13/10/2009	Mail communication on 8th October 2009
5	Submission of final PDD to Dubal	18/11/2009	Mail communication dated 18th November 2009
6	Validation contract from TUV	19/11/2009	Email communication with the

	Middle east		contract attached
7	Stakeholder consultation	24/11/2009	Mail communication from CEO to all Dubal Employees
8	Finalisation of validator and signing of work order	7/12/2009	TUV middle east were signed; unfortunately they were not having sectoral scope
9	**Submission to DNA**	**23/12/2009**	**Mail communication dated 23/12/2009**
10	Submission to DNV	04/02/2010	Mail communication
11	Webhosting of PDD	February 2010 onwards	

As per the "GUIDELINES ON THE DEMONSTRATION AND ASSESSMENT OF PRIOR CONSIDERATION OF THE CDM" version 03 the project proponent is having less than 2 years gap between the project start date and signing of validator (Start date is July 2008 and validator were signed in Dec 2010). The project proponent has signed the emission reduction purchase agreement before the start date of project activity.

Start date of the project activity: According to CDM glossary of terms the starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins.
……For those project activities which do not require construction or significant pre-project implementation (e.g. light bulb replacement) the start date is to be considered the date when real action occurs. In the context of the above definition, pre-project planning is not considered "real action".

The project activity is of the same nature where the construction or significant pre project implementation is not required; therefore the real action date (starting date of implementation) is considered as start date of the project activity.
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It is clear from the above table that the project activity has been conceptualised only because of CDM revenues.

As mentioned above, the project additionality justification is carried out using Version 05.2 of the *"Tool for the demonstration and assessment of additionality"*.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to project activity

As described in Step 1 of Section B.4, the identified alternatives are the following:

Alternative 1: Implementation of project activity (algorithm) without CDM financing keeping the aluminium production at pre project production levels and with the benefit of the electricity consumption reductions that the implementation of algorithm implies

Alternative 2: Implementation of project activity (algorithm) without CDM financing but increasing the aluminium production by the correspondent amount, calculated according to the pre-project operational stability, to the electricity consumption reduction by algorithm implementation.

Alternative 3: Control measures (Automatic an manual control system improvements)

Alternative 4: Quality measures (Changing the type of alumina)

Alternative 5: The algorithm is not implemented but the aluminium production is increased, with respect to pre project production for the same amount that in alternative 2

Alternative 6: The continuation of current situation in which neither anode effect measures nor business strategy practices are undertaken in another feasible alternative as the current production process is stable providing required product quality.

As mentioned above, Alternative 3 &4 is not considered as a realistic and credible option for DUBAL. The alternative 6 is same as 5 without the aluminium production increase. Thus,

Alternative 1, 2 and 5 are compared in order to demonstrate the additionality of the project.

Sub-step 1b: Consistency with mandatory laws and regulations

There are no regulations on PFC emissions in UAE. Consequently, all the alternatives are neither required nor forbidden by any law or regulation.

Step 2: Investment analysis

In this step, the economical comparison analysis between the Alternatives 1 and 3 is carried out.

Sub-step 2a: Determine appropriate analysis method

Since the project activity could expect a slight benefit from energy efficiency, an investment comparison analysis (Option II) is applied in order to justify the project additionality.

Sub-step 2b – Option II: Apply investment comparison analysis

In this comparison analysis, three cases are considered as shown in Table B.2 below. While applying the investment comparison analysis the following input values used:

Explanation of Input values: As per the guidance from tool for demonstration and assessment of additionality ‘Input values used in all investment analysis should be valid and applicable at the time of the

investment decision taken by the project participant. All parameters used in the Financial Analysis where determined one year prior to the decision to proceed with the project activity (i.e. the start date of the project of 6 July 2008) and their validity at the moment of the of the investment decision has been have been further audited by third party qualified chattered accountants MCA in September 2010.

Economic analysis for PFC Reduction Project			
As per UNFCC Guidance on the Assessment of Investment Analysis: version2 dated 26/8/2008)			
			Data Source
Plant basic data			
Electricity consumption - line 5 & 6 (Average of last three years before the project activity)	4,280,678	MWh/yr	Data from process department – Monthly reports
Aluminium production - line 5 & 6 (480 pots) ((Average of last three years before the project activity))	306,001	t-Al/yr	Data from process department – Monthly reports
Aluminium production cost (non-electricity portion)	1,284	US$ / t-Al	Finance department report. Data for first 6 months of year 2007 (During time of decision making). Audited on 16.09.2010
Aluminium production cost (electricity portion)	344	US$ / t-Al	Finance department report. Data for first 6 months of year 2007 (During time of decision making). Audited on 16.09.2010
Aluminium sales price	2,917	US$ / t-Al	Finance department report. Data for first 6 months of year 2007 (During time of decision making). Audited on 16.09.2010
Electricity rate	28	US$ / MWh	Report from power department. Audited on 20.09.2010
Tax			
Corporate income tax rate	0%		No Tax in Dubai
Development cost for the algorithm			

Energy savings rate	0.026%		Data from Process department. Pre and post project comparison and savings. Audited on 20th September 2010.
Increase in aluminium production	71.97	Tons	Calculated based on the slope from the Aluminium production and Electricity consumption slope from last three years.. Production = 0.0635xElectricity
Research and development cost for the new system	19,798	US$	Data from Lab. Audited on 16/09/2010.
IT project costs	40,098	US$	Data from IT department. Audited on 16/09/2010.
System installation cost	0	US$	
O&M cost	3,753	US$ / yr	Data from operations department. Audited on 16.09.2010
Other assumptions			
Electricity rate escalation	5.00%	per year	http://www.indexmundi.com/commodities/?commodity=natural-gas&months=60
O&M cost escalation	3.00%	per year	Assumption
Aluminium price escalation	2.50%	per year	http://www.indexmundi.com/commodities/?commodity=natural-gas&months=60
Discount rate	9.00%	per year	Escalation and other assumptions pdf doc pg 3/11 (IMF report).
Life of the pot line	30	Years	From third party data. Qatar aluminium new smelter, the average life is 40 years. Conservatively 30 years is assumed.
Remaining life of pot line 5 (Sept 1996)	16	Years	Calculation
Remaining life of pot line 6 (May 1999)	19	Years	Calculation
Salvage value after 10 years	0		All investment is in R & D and software. Being conservatively 10 years equivalent benefits have been considered in the 10th year cash inflows.

Justification on discount rate: According to the ‘Tool for the demonstration and assessment of the additionality’ the discount factor can be any one of the following:

(a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data;

(b) Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project activity concerned), based on bankers views and private equity investors/funds’ required return on comparable projects;

(c) A company internal benchmark (weighted average capital cost of the company), only in the particular case referred to above in paragraph 5. The project developers shall demonstrate that this benchmark has been consistently used in the past i.e. the project activities under similar conditions developed by the same company used the same benchmark;

(d) Government/official approved benchmark where such benchmarks are used for investment decisions;

(e) Any other indicators, if the project participants can demonstrate that the above Options are not applicable and their indicator is appropriately justified.

For the project activity option b has been opted. According to this estimates of cost of financing and required rates of return can be a discount rate. . The cost of financing (commercial lending rate) has been considered as the discount rate. The 2006 and 2007 data has been used and the lowest is considered as the lending rate:

Quarter of year	**Commercial bank lending rate (%)**
Q1; 2006	10.42
Q2; 2006	10.4
Q3; 2006	11.04
Q4; 2006	10.37
Q1; 2007	9.05
Q2; 2007	9.2
Q3; 2007	10.3
Q4; 2007	10.2

The lowest of the above 9% has been considered in the calculation.

Table B.2: Comparison cases for the cost analysis

Cases	**Energy efficiency**	**Aluminium production**	**Remark**
Alternative 1	Up	No change	Introduction of the algorithm / energy efficiency only

Alternative 2[8]	Up	Up	Introduction of the algorithm / energy efficiency + production increase
Alternative 5	No change	Up	No introduction of the algorithm / production increase only
Alternative 6	No Change	No Change	No financial analysis is performed as it is having no additional investment or return

Alternative 1 and 2 correspond to the proposed project activity under two business approaches: alternative 1 related to save money from electricity savings, and alternative 2 related to take advantage of the electricity savings in order to increase aluminium production. Finally, alternative 5 corresponds to no implementation of any anode effect mitigation measure, and involves raising the electric current to increase the aluminium production in an amount comparable to that of alternative 2.

Specifically, alternative 1 is to first introduce the new algorithms whereas the production of aluminium stays the same and, as a result, an additional income from energy savings only could be expected. This is the typical case for an energy efficiency project.

On the other hand, alternative 2 corresponds to introduce the new algorithms, and to increase the aluminium production through the energy savings and also try to sell that to the market.

Finally, alternative 5 corresponds to simply increase the aluminium production by raising the current that circulates through the cell, providing additional income. The attractiveness for this case is that there is no need to change the current practice, which does not face any risk. The historical path (see Step 3) shows that this usually is the case in order to increase plant’s revenues.

Therefore, taking into account that no new investment is needed in alternative 5, the comparison analysis uses Net Present Value (NPV) as financial indicator, since other financial indicators, such as project or equity internal rate of return (IRR), are not applicable.

Sub-step 2c: Calculation and comparison of financial indicators

The spreadsheet attached to this PDD shows the assumed values of investment, basic operating and maintenance costs, aluminium prices in the international market, and taxes. Hypothesis to the ratio in projecting future costs or prices are given by applying certain percentage taken from official sources.

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[8] The pot lines are into stable conditions and the electricity increase is directly proposal to the production increase. The same has been demonstrated in section B.2 of the document. In this alternative the electricity saving with the project activity would be used to increase the production of aluminium; therefore the revenues from aluminium sell has been included in the financial analysis.

Additionally, the comparison analysis for the impact of the CDM registration and the corresponding CER revenues are also considered.
When the number for the CER rate is zero (0), the NPV can be compared when there are not CDM revenues.

Table B.3: Results obtained without considering CDM benefits

Results	**Alternative 1**	**Alternative 2**	**Alternative 5**
Investment amount (US$)	59,895	59,895	0
NPV before tax (US$)[9] at 9% discount rate	358,047	936,417	1,024,071

It could be seen from the results above that alternative 2 is a more attractive course of action than alternative 1, provided that the new algorithms are being introduced. But alternative 5 has a more attractive result for two reasons:

- The NPV, both before and after tax, is higher compared to the former 2 alternatives, which itself gives a reasonable reason.
- DUBAL would not need to take any risks involved in going through the implementation of new untested algorithms (avoiding the risks associated as a result of investing in it).

The table below gives the results obtained by considering the CDM related investment and costs: .

Table B.4: Results obtained with considering CDM benefits based in ex ante estimation of project emissions (Emission reduction 48367tCO_2eq/year)

Results	**Alternative 1**	**Alternative 2**	**Alternative 5**
Investment amount (US$)	109,895	109,895	0
NPV before tax (US$) at 9% discount rate	2,832,904	3,411,274	1,024,071

The impact of CDM is evident as it could be seen above: alternative 2 becomes more attractive, because it clearly provides the highest NPV, before and after taxes.

It is clear through the comparison between the two resulting tables that, without CDM benefits, DUBAL would not implement this kind of project activity.

[9] NPV before and after tax will be same there is no tax applicable in host country.

Sub-step 2d: Sensitivity analysis

The sensitivity analysis considers as base case the one in which there are not CDM benefits. All the parameters are considered for sensitivity analysis with +/- 10%. The results are shown in the table below:

<u>Base Case</u>

Results	Alternative 1	Alternative 2	Alternative 5
Investment amount (US$)	59,895	59,895	0
NPV before tax (US$)	358,047	936,417	1,024,071

Increase in annual electricity Consumption by 10%				Decrease in annual electricity Consumption by 10%			
Results	Alternative 1	Alternative 2	Alternative 5	Results	Alternative 1	Alternative 2	Alternative 5
NPV before tax (US$)	402,626	936,417	1,024,071	NPV before tax (US$)	313,468	936,417	1,024,071

Increase in annual Aluminium production by 10%				Decrease in annual Aluminium production by 10%			
Results	Alternative 1	Alternative 2	Alternative 5	Results	Alternative 1	Alternative 2	Alternative 5
NPV before tax (US$)	358,047	936,417	1,024,071	NPV before tax (US$)	358,047	936,417	1,024,071

Increase in annual production cost (Non electricity) by 10%				Decrease in annual production cost (Non electricity) by 10%			
Results	Alternative 1	Alternative 2	Alternative 5	Results	Alternative 1	Alternative 2	Alternative 5
NPV before tax (US$)	358,047	822,161	909,815	NPV before tax (US$)	358,047	1,050,673	1,138,327

Increase in annual production cost (electricity) by 10%				Decrease in annual production cost (electricity) by 10%			
Results	**Alternative 1**	**Alternative 2**	**Alternative 5**	**Results**	**Alternative 1**	**Alternative 2**	**Alternative 5**
NPV before tax (US$)	358,047	901,621	989,266	NPV before tax (US$)	358,047	971,212	1,058,876

Increase in energy saving by 10%				Decrease in energy saving by 10%			
Results	**Alternative 1**	**Alternative 2**	**Alternative 5**	**Results**	**Alternative 1**	**Alternative 2**	**Alternative 5**
NPV before tax (US$)	402,626	936,426	1,024,071	NPV before tax (US$)	313,468	936,408	1,024,071

Increase in Project cost by 10%				Decrease in Project cost by 10%			
Results	**Alternative 1**	**Alternative 2**	**Alternative 5**	**Results**	**Alternative 1**	**Alternative 2**	**Alternative 5**
NPV before tax (US$)	352,057	930,427	1,024,071	NPV before tax (US$)	364,036	942,406	1,024,071

Increase in O & M cost by 10%				Decrease in O & M cost by 10%			
Results	**Alternative 1**	**Alternative 2**	**Alternative 5**	**Results**	**Alternative 1**	**Alternative 2**	**Alternative 5**
NPV before tax (US$)	355,262	933,632	1,024,071	NPV before tax (US$)	360,832	939,202	1,024,071

Increase in electricity escalation rate by 10%				Decrease in electricity escalation rate by 10%			
Results	**Alternative 1**	**Alternative 2**	**Alternative 5**	**Results**	**Alternative 1**	**Alternative 2**	**Alternative 5**
NPV before tax (US$)	372,577	925,076	1,012,727	NPV before tax (US$)	343,988	947,390	1,035,047

Increase in aluminium escalation rate by 10%				Decrease in aluminium escalation rate by 10%			
Results	**Alternative 1**	**Alternative 2**	**Alternative 5**	**Results**	**Alternative 1**	**Alternative 2**	**Alternative 5**

NPV before tax (US$)	358,047	976,825	1,064,480	NPV before tax (US$)	358,047	896,676	984,330

Increase in electricity rate by 10%				**Decrease in electricity rate by 10%**			
Results	**Alter 1**	**Alter 2**	**Alter 5**	**Results**	**Alter 1**	**Alter 2**	**Alter 5**
NPV before tax (US$)	402,626	936,417	1,024,071	NPV before tax (US$)	313,468	936,417	1,024,071

Increase in algorithm development cost by 10%				**Decrease in algorithm development cost by 10%**			
Results	**Alter 1**	**Alter 2**	**Alter 5**	**Results**	**Alter 1**	**Alter 2**	**Alter 5**
NPV before tax (US$)	352,057	930,427	1,024,071	NPV before tax (US$)	364,036	942,406	1,024,071

It is clear from the sensitivity analysis that the project activity is Additional as it is financially attractive, and therefore, feasible, only with CDM revenues.

Step 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity

In order to prove that the project activity is additional, the following barriers were identified:

1. Barriers due to business strategy: management business strategies are not focused on anode effect mitigation measures, so that the project activity is considered low priority by management;

2. Barriers due to prevailing practice: the project activity is the "first of its kind". No project activity of this type is currently operational in the host country.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

Barriers due to business strategy

Management business strategies of DUBAL are not focused on anode effect mitigation measures, so that the project activity is considered low priority by management. It may be worth noting that the Dubal is part of IAI voluntary initiative, according to which "Based on IAI annual survey results, by 2020 IAI member companies commit to operate with PFC emissions per tonne of production no higher than the 2006 global median level for their technology type."

In the year 2006 the global median was 0.24 tCO2eq/ton of aluminium. The PFC emissions from line 5&6 in the year 2007 was also 0.24 tCO2eq/ton, therefore for project proponent the project activity was not as per the voluntary initiative but over and above it.

Planned actions to reduce AE frequency are subject to large cost and risks. While the route to reduction in anode effects is timely alumina feed, it is often associated with ‘over feeding’ of cells; a situation deleterious to current efficiency and metal output.

Being the first of its kind in within Dubal, the management was hesitant in pursing such a project. The spectrum of risks across different technologies was of concern; it would be of concern if rare but high consequence events, such a sick cell were found to dominate the overall risk. The management wanted an assurance for the following:

1. What can go wrong with the proposed technological entity, or what are the initiators or initiating events (undesirable starting events) that lead to adverse consequence(s)?
2. What and how severe are the potential detriments, or the adverse consequences that the technological entity may be eventually subjected to as a result of the occurrence of the initiator?
3. What are their probabilities or frequencies of undesirable consequences?

Management’s concern was not unfounded – trial initiated in December 2007 caused higher cell instability and anode effects too jumped. Trial had to be reverted within six weeks, please refer Table below.

Cell Group/Trial	46 to 50/L6: Provide 8 Extra Alumina Dumps in SF Window			51 to 55/L6: Provide 12 Extra Alumina Dumps in SF Window		
	Before Trial	Trial Period	Change	Before Trial	Trial Period	Change
Duration	10 Nov to 27 Dec 07	31 Dec 07 to 14 Feb 08	Trial Period 6 Weeks	10 Nov to 27 Dec 07	31 Dec 07 to 14 Feb 08	Trial Period 6 Weeks
AE Frequency	0.52	0.68	**+ 0.16**	0.43	0.65	**+ 0.22**
Cell Volts	4.459	4.481	**+ 0.022**	4.448	4.463	**+ 0.015**
Instability Volts	0.010	0.014	**+ 0.004**	0.010	0.013	**+ 0.003**
Cell instability volts increased by 30% to 40%. Consequently, cell voltage increased too. Anode Effects also increased				**Result: Trial reverted after Six Weeks**		

Considering the CDM revenue inflow the management again considered to take the risk and started the pilot test. Therefore the project activity would not have happened in absence of the CDM revenues in the project and it is additional.

Barriers due to prevailing practice
DUBAL would be the first aluminium facility in applying this type of technology in Middle East. Thus, the project activity can be considered as the "first of its kind". The International Aluminium Institute (IAI) is the association of most of the aluminium producers in the world has given an approval letter mentioning the first of its kind of the project activity in the gulf region.

According to the explanation above, the implementation of the proposed project activity not undertaken as a CDM project activity (Alternative 1) faces prohibitive barriers that prevent its implementation.

Additionally, DUBAL would not implement any anode effect mitigation measure without the incentive of the CDM related revenues, since DUBAL could continue working with the anode effect conditions reached prior to project implementation. Thus, Alternative 3 (no implementation of any anode effect mitigation measure) is not prevented by these barriers and results to be the baseline scenario.

Impact of CDM: The project activity is first of its kind and it involves a lot of risk mentioned above. The CDM revenue will help project proponent to fine tune the implemented technology to reduce the GHG emissions over and above reported in the PDD. Moreover this revenue will give a boost to do more research and development work for reduction of anode effect in the DUBAL.

Step 4: Common practice analysis
Sub-step 4a: Analyze other activities similar to the proposed project activity
The proposed project involves a technological innovation, which would be implemented for the first time in UAE at the DUBAL.
For the common practice analysis all the plants in GCC (gulf cooperative council) has been considered. The following aluminium plants are available in the region[10]:

- Aluminium Bahrain (ALBA)
- Dubai Aluminium (DUBAL)
- Qatar aluminium
- Sohar aluminium (Oman)
- Emirates aluminium (EMAL)

[10] Aluminium international today; January/February 2009

Name of the plant	Technology	Source
Aluminium Bahrain (ALBA)	AP-30 PB cell technology	http://www.tms.org/pubs/journals/jom/0002/tabereaux-0002.html
Dubai Aluminium (DUBAL)	CD – 20	http://www.tms.org/pubs/journals/jom/0002/tabereaux-0002.html
Qatar aluminium	HAL - 275	http://www.improvingperformance.com/ papers/Primary%20Article%20AIT.pdf
Sohar aluminium (Oman)	AP- 35	http://www.improvingperformance.com/ papers/Primary%20Article%20AIT.pdf
Emirates aluminium (EMAL)	Dx-350 cell	http://www.improvingperformance.com/ papers/Primary%20Article%20AIT.pdf

According to additionality tool '... Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc...'.

The differentiation based on cell technology is shown in the table below:

Technology	Potline amperage (kAmp)	Anode effect rate (number/day/pot)
AP -30	380	0.2
CD – 20	230	0.32
HAL – 275	275	0.095
AP – 35	350	0.16
DX - 350	364.5	0.017

None of the projects above is relying on broadly similar technology.

Explanation on the technology: Aluminium companies are operating more than 50 different types of prebake (PB) cell technologies at smelters worldwide. Over the years, significant improvements and changes in the operation of PB cells have occurred. Potline amperages have increased 500% from the 1940 vintage 50 kA cells to the current 300 kA super pots. Correspondingly, the total carbon anode area in PB cells has increased with the use of larger anodes from 5 m2 to 38 m2. The operational performance of modern PB cells has dramatically improved to 95–96% current efficiency, 13.5 DC kWh/kg and 1.1 work hours per tonne aluminium. Other significant changes in the design and operation of PB cells include
Improved busbar designs (including magnetic compensation of older PB cells) to reduce magnetohydrodynamic effects

- Point break and feed of alumina
- **Computer process control systems and improved alumina and voltage control algorithms**
- Multipurpose cranes for tapping, changing anodes, etc.
- Low-ratio (high-excess AlF_3) bath chemistry

- Improved cell hooding and alumina dry-fume treatment systems
- Air slides and dense phase systems for the delivery of alumina to cells Improved anode quality
- Improved cathode designs with fully graphitized cathode blocks and SiC sidewall lining
- Automatic feeding of AlF3
- Mechanization of all aspects of smelter operations

As the project activity is related with **Computer process control systems and improved alumina and voltage control algorithms,** therefore similar type of technologies can only be compared. In the region there is no smelter which is using the similar type of technology (CD-20).

Sub-step 4b: Discuss any similar options that are occurring

ALBA is using different technology than Dubal[11]. According to the document (Prebake Cell Technology: A Global Review) ALBA is using 'Aluminium Pechiney' developed PB cell technology which is operating at 300 kA and technology is called AP-30 because of 30 Anodes. On the other hand Dubal is using CD-20[12] technology which has been developed by Comalco and Dubal and this is operating at 200 kA.

As the project activity is related with the Computer process control systems and improved alumina and voltage control algorithms, therefore it can be compared with the technologies which are having close range of operating current. In the case on Dubal and ALBA the operating current is more than 50% higher which changes the product quantity and quality drastically and therefore can't be compared. In the Aluminium process the current is the most important parameter on the technology and in ALBA and DUBAL this parameters are different. Moreover both the technologies have been developed by different companies and CD is the latest in Prebake technology and cannot be compared with AP 30. Therefore in the GCC region no plant is having the similar technology in the similar vintage as the project proponent and the project activity is implemented in the pot line 5 & 6 and it's first of its kind.There are no similar options currently occurring in the country.

The project becomes an attractive opportunity only after carbon credits are taken into account. Otherwise, the most likely scenario is the no implementation of any anode effect mitigation measure (Alternative 3). The proposed project activity also faces prohibitive barriers, which can be overcome thanks not only to CER revenues but also to public recognition.

Taking into account the previous step-driven analyses, it is concluded that the proposed CDM project activity is additional.

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[11] Status of pre bake technology

[12] CD-20 technology was called CD-200 because of 200 kA operating amperage. C stands for Comalco and D stands for Dubal.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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As mentioned above, the project activity uses an already existing baseline and monitoring methodology (AM0030) *"PFC emission reductions from anode effect mitigation at primary aluminium smelting facilities"*.
The project activity is intended primarily to reduce PFC emissions from anode effect in the aluminium smelter by improving the automatic control system, which leads to a reduction of the anode effect frequency. According to the methodology AM0030, only PFC emissions from anode effects are included in the project boundary, in the baseline and project scenarios.

Baseline emissions
According to the Revised 2006 IPCC Guidelines, the most precise method for determining PFC emissions is either to monitor smelter emissions continuously (Tier 3a) or to develop a smelter-specific long-term relationship between measured emissions and operating parameters, and to apply this relationship using activity data (Tier 3b).
The Tier 3b method requires comprehensive measurements to develop the smelter-specific relationship and on-going collection of operating parameter data (e.g., frequency and duration of anode effects and the anode effect over-voltage) and production data.
On the other hand the Tier 2 approach uses default values for the technology-specific slope and overvoltage coefficients, whereas the Tier 1 approach provides default emission factors by technology type.
According to the methodology, only Tier 3b and Tier 2 methods can be considered in the calculation of baseline emissions. Tier 2 is applicable if it can be proven and documented that 95% of the anode effects are manually terminated prior to the implementation of the project activity (cell hood must be opened during termination of the anode effect), while in all other cases, Tier 3b is applicable.

In the case of DUBAL Tier 3b method is used in order to determine baseline emissions.

In addition, according to the methodology, the following estimation relationships can be used:
_ Slope method: it should be used with aggressive fast kill anode effect practices.
_ Over-voltage method: it should be used with slow, repetitive anode effect kill practices.
In the case of DUBAL, the relationships established between the operating parameters and the PFC emissions are in accordance to the Slope method.

Baseline emissions *BE* (tCO2e/year) are determined as follow:

$$\overline{\overline{BE}}\ (tCO_2e/tAl) = \left(\frac{EF_{CF_4} \cdot GWP_{CF_4} + EF_{C_2F_6} \cdot GWP_{C_2F_6}}{1000} \right) \quad (1)$$

$$If\ : \overline{\overline{BE}} \leq BE_{IAI}, BE = \overline{\overline{BE}}.P_{Al}$$

$$If\ : \overline{\overline{BE}} \rangle BE_{IAI}, BE = BE_{IAI}.P_{Al}$$

Where:

$\overline{\overline{BE}}$ = Baseline emissions per tonne of Aluminium produced (t CO_2e/t Al)

BE_{IAI} = Average value of "PFC emission per tonne of Aluminium produced" according to the most recent published IAI Survey for the current technology (t CO_2e/tAl). Baseline should be updated every year with the most recent values published by IAI.

BE = Baseline Emissions (t CO_2e/year)

EF_{CF_4} = Emission factor of CF_4 (kg CF_4/t Al), discounted by the uncertainty range as specified by the IAI/USEPA Protocol

$EF_{C_2F_6}$ = Emission factor of C_2F_6 (kg C_2F_6/t Al), discounted by the uncertainty range as specified by the IAI/USEPA Protocol.

GWP_{CF_4} = Global Warming Potential of CF_4 = 6500

$GWP_{C_2F_6}$ = Global Warming Potential of C_2F_6 = 9200

P_{Al} = Total aluminium production of the company (t Al/year)

As mentioned above, the relationships established between the operating parameters and the PFC emissions are in accordance to the Slope method. Thus, the CF_4 and C_2F_6 emission factors are determined as follows:

Slope Method

$$EF_{CF4} = Slope \times AE \quad (2)$$

$$EF_{C2F6} = EF_{CF4} \times F_{C2F6/CF4}$$

Where:

EF_{CF4} = Emission factor of CF_4 (kg CF_4/t Al)

EF_{C2F6} = Emission factor of C_2F_6 (kg C_2F_6/t Al)

$Slope$ = Slope coefficient (kg PFC/t Al)/(AE-minute/cell.day)

AE = Anode Effect (min/cell.day) estimated as per equation 3

$F_{C2F6/CF4}$ = Weight fraction of C_2F_6/CF_4 (kg C_2F_6/kg CF_4)

To develop an accurate estimate of the slope, simultaneous measurements of CF_4 or C_2F_6 emissions and anode effect data over an appropriate period of time are collected.

$$AE = AEF \times AED \quad \textbf{(3)}$$

Where:

AE = Anode effect (min/cell.day)

AEF = Number of anode effects per cell.day, measured as per details provided in the monitoring section

AED = Anode effect duration in minutes (min), measured as per details provided in the monitoring section

In order to determine baseline emissions, the average Anode Effect Frequency and Duration are determined using historical data of the Dubal line 5 & 6.

Regarding the Slope Coefficients for CF_4 and C_2F_6, they are determined prior to project implementation, by developing simultaneous measurements of emissions, aluminium production, and anode effect data over an appropriate period of time. The measurement has followed the QA/QC procedure laid by IAI protocol page31 and 32.

Project emissions

$$PE \ \ (tCO_2e/year) = \left(\frac{EF_{CF_4} \cdot GWP_{CF_4} + EF_{C_2F_6} \cdot GWP_{C_2F_6}}{1000} \right) \cdot P_{Al} \quad \textbf{(4)}$$

Where:

PE = Project emissions (t CO_2e/year)

EF_{CF_4} = Emission factor of CF_4 (kg CF_4/t Al)

$EF_{C_2F_6}$ = Emission factor of C_2F_6 (kg C_2F_6/t Al)

GWP_{CF_4} = Global Warming Potential of CF_4 = 6,500

$GWP_{C_2F_6}$ = Global Warming Potential of C_2F_6 = 9,200

P_{Al} = Total aluminium production of the company (t Al/year)

<u>Slope Method</u>

$$EF_{CF4} = Slope \times AE \qquad (5)$$
$$EF_{C2F6} = EF_{CF4} \times F_{C2F6/CF4}$$

Where:

EF_{CF4} = Emission factor of CF_4 (kg CF_4/t Al

EF_{C2F6} = Emission factor of C_2F_6 (kg C_2F_6/t Al)

$Slope$ = Slope coefficient (kg PFC/t Al)/(AE-minute/cell.day)

AE = Anode Effect (min/cell.day) estimated

$F_{C2F6/CF4}$ = Weight fraction of C_2F_6/CF_4 (kg C_2F_6/kg CF_4)

To develop an accurate estimate of the slope, simultaneous measurements of CF_4 or C_2F_6 emissions and anode effect data over an appropriate period of time are collected.

AE = AEF× AED **(6)**

Where:

AE = Anode effect (min/cell.day)

AEF = Number of anode effects per cell.day, measured as per details provided in the monitoring section

AED = Anode effect duration in minutes (min), measured as per details provided in the monitoring section

Following project implementation, the Anode Effect Frequency and Duration, as well as the Slope coefficients, will be monitored, and the monitored values will be used in the *ex-post* determination of project emissions.

Regarding the Slope Coefficients for CF_4 and C_2F_6, they will be determined once after project implementation and every three years or less, according to the IAI/USEPA Protocol, by developing simultaneous measurements of emissions, aluminium production, and anode-effect data over an appropriate period of time.

Leakage emissions
No leakage is expected to occur in this type of project.

Emission reductions

According to the methodology, no leakage is expected to occur in this type of projects. Thus, the emission reductions, *ER* (tCO_{2e}/year), by the project activity are given by:

$$ER = BE - PE \qquad (7)$$

Where

ER = Emission Reductions (tCO_{2e}/year)

BE = Baseline Emission (tCO_{2e}/year)

PE = Project Emission (tCO_{2e}/year)

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**Average value of PFC emission per tonne of aluminium produced ($\overline{\overline{BE}}$)**
Data unit:	tCO_2e/tAl
Description:	Average value of PFC emission per tonne of aluminium produced according to the plant basic data
Source of data used:	Plant data
Value applied:	Line 5: 0.257 Line 6: 0.233 Combined: 0.245
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is in accordance to the methodology AM0030. The baseline emissions per tonne of aluminium produced is lower than the IAI average value (0.26) of "PFC emission per tonne of Aluminium Produced". The minimum value is used for baseline emissions.
Any comment:	It is used to determine baseline emissions. It is determined prior to project implementation and considered fixed along the crediting period.

Data / Parameter:	**Average Baseline Anode Effect Frequency**
Data unit:	AE/cell day
Description:	Number of anode effects per day in the cells in Pot line 5-6 (the cells included in the project boundary) in Dubal smelter corresponding to the baseline scenario.
Source of data used:	Historical data (measured)
Value applied:	Line 5: 0.32 Line 6: 0.32 Combined for line 5&6: 0.32

Justification of the choice of data or description of measurement methods and procedures actually applied :	In order to determine the average Anode Effect Frequency historical data from Dubal smelter is used.
Any comment:	The data is used for the period of January 2007 to May 2008. The data between the trail period is removed from the baseline estimation

Data / Parameter:	**Average Baseline Anode Effect Duration**
Data unit:	Minutes
Description:	Duration of the anode effect in the cells in Pot line 5-6 (the cells included in the project boundary) in Dubal smelter corresponding to the baseline scenario.
Source of data used:	Historical data (measured)
Value applied:	Line 5: 0.77 Line 6: 0.69 Combined for line 5 & 6: 0.73
Justification of the choice of data or description of measurement methods and procedures actually applied :	In order to determine the average Anode Effect Duration historical data from Dubal smelter is used.
Any comment:	The data is used for the period of January 2007 to May 2008. The data between the trail period is removed from the baseline estimation

Data / Parameter:	**Baseline slope coefficient**
Data unit:	(kgPCF/tAl)/(AE min/cell day)
Description:	Slope coefficient corresponding to the baseline scenario
Source of data used:	Measured
Value applied:	0.129 (kgCF_4 /tAl)/(AE min/cell day) 0.02232 (kgC_2F_6 /tAl)/(AE min/cell day)
Justification of the choice of data or description of measurement methods	According to the methodology, the slope coefficient should be determined by simultaneous measurements of emissions and collection of anode effect data over an appropriate time. This PFC emissions measurements performed by J Marks & Associates on D18 bar broken and D20 point fed Center Work

and procedures actually applied :	Prebake cells at the Dubal smelter. The testing took place from 16 January to 27 January, 2007. CF_4 and C_2F_6 were measured in a continuous and real-time manner on a gas sample stream continuously extracted from the stack exhausts downstream of the gas treatment facilities by a Fourier Transform Infrared (FTIR) spectroscopic system. The small amounts of fugitive PFC emissions escaping collection in the duct system through the roof top were calculated based on the estimated collection fraction for each of the lines. The measurements were carried out according to the *US EPA Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane Emissions from Primary Aluminum Production*, March 2003.
Any comment:	These values are calculated by third party aluminium expect before the implementation of project. The values are measured based on technology-wise. Line 5 & 6 are having same technology and this factor is same for line 5 and 6 both.

Data / Parameter:	**Weight fraction ($F_{C2F6/CF4}$)**
Data unit:	(kg C_2F_6/kg CF_4)
Description:	Weight fraction of C_2F_6/CF_4 (kg C_2F_6/kg CF_4)
Source of data used:	Measured
Value applied:	0.173
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the methodology, the slope coefficient should be determined by simultaneous measurements of emissions and collection of anode effect data over an appropriate time. This PFC emissions measurements performed by J Marks & Associates on D18 bar broken and D20 point fed Center Work Prebake cells at the Dubal smelter. The testing took place from 16 January to 27 January, 2007. CF_4 and C_2F_6 were measured in a continuous and real-time manner on a gas sample stream continuously extracted from the stack exhausts downstream of the gas treatment facilities by a Fourier Transform Infrared (FTIR) spectroscopic system. The small amounts of fugitive PFC emissions escaping collection in the duct system through the roof top were calculated based on the estimated collection fraction for each of the lines. The measurements were carried out according to the *US EPA Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane Emissions from Primary Aluminum Production*, March 2003.
Any comment:	These values are calculated by third party aluminium expect before the implementation of project. The values are measured based on technology-wise.

	Line 5 & 6 are having same technology and this factor is same for line 5 and 6 both.

B.6.3. Ex-ante calculation of emission reductions:

>>

Baseline emissions

Alternative 6 is the baseline for the project activity. Baseline emission as per the alternative 5 will be based on the (306,001+72) ton of Aluminium while alternative 6 will be based on 306,001 ton of aluminium. Therefore this has been used in the emission reduction calculation. Moreover during every verification period this same will be followed to be conservative.

	Item	Value	Units	Data sources
Slope (CF_4)	Slope Coefficient (CF_4)	0.129	(kg CF_4/tAl) / (AE min /cell day)	Dubal Measurement
Slope (C_2F_6)	Slope Coefficient (C_2F_6)	0.02232	(kg C_2F_6)/tAl) / (AE min /cell day)	Dubal Measurement
GWP (CF_4)	Global Warming Potential (CF_4)	6,500	$kgCO_2/kgCF_4$	Tetrafluoromethane this was 6,500 as per the IPCC 2006 report.
GWP (C_2F_6)	Global Warming Potential (C_2F_6)	9,200	$kgCO_2/kgC_2F_6$	Hexafluoroethane this was 9,200 as per the IPCC 2006 report.
IAI Protocol 2009 PFPB emission factor	**0.26**	**tCO2e/tAl**		

Baseline emissions

Year	Aluminium Production [tAl/year]	AE Frequency [AE/(cell day)]	AE Duration [min]	CF_4 emission factor [$kgCF_4$/tAl]	C_2F_6 emission factor [kgC_2F_6/tAl]	Baseline emissions [tCO_2e/tAl]	Baeline emissions (IAI) value [tCO2e/tAl]	Baseline emissions [tCO_2e/year]
2011	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74,991**
2012	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74991**
2013	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74,991**
2014	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74991**
2015	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74,991**

2016	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74,991**
2017	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74991**
2018	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74,991**
2019	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74991**
2020	306001	0.32	0.73	0.030	0.0052	0.245	0.260	**74,991**
Total								**749910**

Project Emissions

According to the methodology, in order to do the *ex-ante* calculation of project emissions, the plant should provide a justified estimation of the future values of the Anode Effect Frequency and Duration and the Slope coefficients.
According to the results obtained from the pilot test DUBAL expects to reach an Anode Effect Frequency of 0.1[13] anode effects per cell per day and an Anode Effect Duration of 49-50 seconds (same as in baseline) after the complete implementation of the project activity.
Regarding the Slope Coefficients for CF4 and C2F6, DUBAL carried out simultaneous measurements of emissions, aluminium production, and anode effect data over an appropriate period of time. Even these Slope Coefficients only correspond to the baseline period these values are the best approximations available in order to carry out the *ex-ante* estimation of project missions.

Ex ante project emission estimation:

	Item	Value	Units	Data sources
Slope (CF_4)	Slope Coefficient (CF_4)	0.129	(kg CF_4/tAl)/(AE min /cell day)	Dubal Measurement
Slope (C_2F_6)	Slope Coefficient (C_2F_6)	0.02232	(kg C_2F_6)/tAl)/(AE min /cell day)	Dubal Measurement
GWP (CF_4)	Global Warming Potential (CF_4)	6,500	$kgCO_2/kgCF_4$	Tetrafluoromethane this was 6,500
GWP (C_2F_6)	Global Warming Potential (C_2F_6)	9,200	$kgCO_2/kgC_2F_6$	Hexafluoroethane this was 9,200

Year	Aluminium Production [tAl/year]	AE Frequency [AE/(cell day)]	AE Duration [min]	CF_4 emission factor [$kgCF_4$/tAl]	C_2F_6 emission factor [kgC_2F_6/tAl]	Project emissions [tCO_2e/tAl]	Project emissions [tCO_2e/year]
2011	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2012	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2013	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2014	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2015	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2016	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**

[13] Internal communication ‘programme to kill an incipient AE_23072008’

2017	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2018	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2019	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
2020	306,073	0.10	0.83	0.011	0.0019	0.087	**26,624**
Total							**266,240**

Project emission from the actual data after the project implementation:

	Item	Value	Units	Data sources
Slope (CF_4)	Slope Coefficient (CF_4)	0.129	(kg CF_4/tAl) / (AE min /cell day)	Dubal Measurement
Slope (C_2F_6)	Slope Coefficient (C_2F_6)	0.02232	(kg C_2F_6)/tAl) / (AE min /cell day)	Dubal Measurement
GWP (CF_4)	Global Warming Potential (CF_4)	6,500	$kgCO_2/kgCF_4$	Tetrafluoromethane this was 6,500 as per the IPCC 2006 report.
GWP (C_2F_6)	Global Warming Potential (C_2F_6)	9,200	$kgCO_2/kgC_2F_6$	Hexafluoroethane this was 9,200 as per the IPCC 2006 report.

Year	Aluminium Production [tAl/year]	AE Frequency [AE/(cell day)]	AE Duration [min]	CF_4 emission factor [$kgCF_4$/tAl]	C_2F_6 emission factor [kgC_2F_6/t Al]	Project emissions [tCO_2e/t Al]	Project emissions [tCO_2e/year]
2011	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2012	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2013	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2014	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2015	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2016	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2017	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2018	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2019	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
2020	306,073	0.18	0.82	0.019	0.0033	0.156	**47812**
Total							**478120**

Emission reductions

From the above tables of project emissions it is clear that the actual value of project emissions is more than the ex ante estimations and therefore the actual value has been used in the emission reduction calculations. According to the methodology, no leakage is expected to occur in this type of projects. Thus, the emission reductions *ER* (tCO_2e/year) by the project activity is given by:

$ER = BE - PE$

ER = 74991 – 47812
= 27179 tCO_2/year

Year	Baseline emissions (tCO_2e/year)	Project emissions (tCO_2e/year)	Emission reductions (tCO_2e/year)
2011	74991	47,812	27,179
2012	74991	47,812	27,179
2013	74991	47,812	27,179
2014	74991	47,812	27,179
2015	74991	47,812	27,179
2016	74991	47,812	27,179
2017	74991	47,812	27,179
2018	74991	47,812	27,179
2019	74991	47,812	27,179
2020	74991	47,812	27,179
Total	**749,910**	**478,120**	**271,790**

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Year	**Estimation of project activity emissions (tonnes of CO_{2e})**	**Estimation of baseline emissions (tonnes of CO_{2e})**	**Estimation of leakage (tonnes of CO_{2e})**	**Estimation of overall emission reductions (tonnes of CO_{2e})**
June 2011 – May 2012	47,812	74991	0	27,179
June 2012 – May 2013	47,812	74991	0	27,179
June 2013 – May 2014	47,812	74991	0	27,179
June 2014 – May 2015	47,812	74991	0	27,179
June 2015 – May 2016	47,812	74991	0	27,179
June 2016 – May 2017	47,812	74991	0	27,179
June 2017 – May 2018	47,812	74991	0	27,179
June 2018 – May 2019	47,812	74991	0	27,179

June 2019 – May 2020	47,812	74991	0	27,179
June 2020 – May 2021	47,812	74991	0	27,179
Total (tonnes of CO_{2e})	**478,120**	**749,910**	0	**271,790**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**P_{Al}**
Data unit:	Tonne
Description:	Aluminium Production
Source of data to be used:	Aluminium Plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Ex-ante: Line 5: 157521 tons Line 6: 148480 tons Combine line 5&6: 306001 tons Ex post: Line 5: 157557 tons Line 6: 148516 tons Combine line 5&6: 306073 tons The combined line 5&6 data is used for ex ante estimation as it generates less emission reduction in the project.
Description of measurement methods and procedures to be applied:	The plant will monitor the production from Pot line 5 and 6 as per the accepted international procedure daily. These procedures will be taken from latest version of 'Protocol for Measurement of Tetrafluoromethane (CF4) and Hexafluoroethane (C2F6) Emissions from Primary Aluminum Production'.
QA/QC procedures to be applied:	Dubal is having a series of internal procedures that insures low uncertainty during monitoring process.
Any comment:	-----

Data / Parameter:	**AEF**
Data unit:	Number of anode effects per cell day
Description:	Anode effect frequency
Source of data to be used:	Aluminium Plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Line 5: 0.19 Line 6: 0.18 Combined line 5&6: 0.18 Ex ante estimation before the project implementation: 0.1 The combined line 5&6 data is used for ex ante estimation as it generates less emission reduction in the project.

Description of measurement methods and procedures to be applied:	The plant will monitor the anode effect frequency from potline 5 and 6 as per the accepted international procedure daily. These procedures will be taken from latest version of 'Protocol for Measurement of Tetrafluoromethane (CF4) and Hexafluoroethane (C2F6) Emissions from Primary Aluminum Production'.
QA/QC procedures to be applied:	Dubal is having a series of internal procedures that insures low uncertainty during monitoring process.
Any comment:	----

Data / Parameter:	**AED**
Data unit:	Minutes
Description:	Anode effect duration
Source of data to be used:	Aluminium Plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Line 5: 0.81 Line 6: 0.83 Combined line 5&6: 0.82 Ex ante estimation before the project implementation: 0.833The combined line 5&6 data is used for ex ante estimation as it generates less emission reduction in the project.
Description of measurement methods and procedures to be applied:	The plant will monitor the anode effect duration from Pot line 5 and 6 as per the accepted international procedure daily. These procedures will be taken from latest version of 'Protocol for Measurement of Tetrafluoromethane (CF4) and Hexafluoroethane (C2F6) Emissions from Primary Aluminum Production'.
QA/QC procedures to be applied:	Dubal is having a series of internal procedures that insures low uncertainty during monitoring process.
Any comment:	-----

Data / Parameter:	**Slope**
Data unit:	(kgPCF/tAl)/(AE min/cell day)
Description:	Slope coefficient in project scenario
Source of data to be used:	Aluminium Plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.129 (kgCF_4 /tAl)/(AE min/cell day) 0.02232 (kgC_2F_6 /tAl)/(AE min/cell day)
Description of measurement methods and procedures to be applied:	According to the methodology, the Slope coefficients should be determined by simultaneous measurements of emissions and collection of anode effect data over an appropriate period of time. This determination will be carried out once after project implementation and every three years or less according to the instructions shown in page 34 of the

	Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane from Primary Aluminium Production, USEPA and IAI.
QA/QC procedures to be applied:	DUBAL will follow the QA/QC procedures described in page 31-32 of the Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane from Primary Aluminium Production, USEPA and IAI.
Any comment:	These coefficients are used to determine the emission factors of CF_4 and C_2F_6 corresponding to the project scenario. The experiment will be done on any of line 5&6 and data will be used for both the lines.

Data / Parameter:	**Weight fraction ($F_{C2F6/CF4}$)**
Data unit:	(kg C_2F_6/kg CF_4)
Description:	Weight fraction of C_2F_6/CF_4 (kg C_2F_6/kg CF_4)
Source of data to be used:	Measured
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.173
Description of measurement methods and procedures to be applied:	According to the methodology, the Slope coefficients should be determined by simultaneous measurements of emissions and collection of anode effect data over an appropriate period of time. This determination will be carried out once after project implementation and every three years or lees according to the instructions shown in page 34 of the Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane from Primary Aluminium Production, USEPA and IAI.
QA/QC procedures to be applied:	DUBAL will follow the QA/QC procedures described in page 31-32 of the Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane from Primary Aluminium Production, USEPA and IAI.
Any comment:	According to the methodology, the slope coefficient should be determined by simultaneous measurements of emissions and collection of anode effect data over an appropriate time. This PFC emissions measurements performed by J Marks & Associates on D18 bar broken and D20 point fed Center Work Prebake cells at the Dubal smelter. The testing took place from 16 January to 27 January, 2007. CF_4 and C_2F_6 were measured in a continuous and real-time manner on a gas sample stream continuously extracted from the stack exhausts downstream of the gas treatment facilities by a Fourier Transform

	Infrared (FTIR) spectroscopic system. The small amounts of fugitive PFC emissions escaping collection in the duct system through the roof top were calculated based on the estimated collection fraction for each of the lines. The measurements were carried out according to the *US EPA Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane Emissions from Primary Aluminum Production*, March 2003. The experiment will be done on any of line 5&6 and data will be used for both the lines.

Data / Parameter:	**BE_{IAI}**
Data unit:	(tCO2e/t Al)
Description:	Average value of "PFC emission per tonne of Aluminium produced" according to the most recent published IAI Survey for the current technology (t CO_2e/t Al).
Source of data to be used:	The International aluminium Institutes' Report On The Aluminium Industry's Global Perflurocarbon Gas Emissions Reduction Programme, available at www.world-aluminium.org.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.26
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	Most recent IAI survey should be referred

Data / Parameter:	EF_{CF4}
Data unit:	Kg CF_4/t Al
Description:	Emission factor of CF_4
Source of data to be used:	Anode effect over voltage (AEO), Anode Effect Frequency (AEF) and Anode Effect Duration (AED) onsite measurements in order to introduce in the corresponding equations of IPCC Methods
Value of data applied	0.129

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	In accordance with Protocol for measurement of Tetrafluoromethane (CF4) Emissions from Primary Aluminium Production, USEPA and IAI, May 2003. Monitoring frequency: once in three years Measured and calculated.
QA/QC procedures to be applied:	Uncertainty level of data is Low. The aluminium smelting plant should of series of internal check procedures including scheduled calibration to ensure low uncertainties of the data produced during monitoring.
Any comment:	Will be done by the third party expert.

Data / Parameter:	EF_{C2F6}
Data unit:	Kg C_2F_6/t Al
Description:	Emission factor of C_2F_6
Source of data to be used:	AEO, AEF and AED on-site measurements in order to introduce in the corresponding equations of IPCC Methods
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.02232
Description of measurement methods and procedures to be applied:	In accordance with Protocol for measurement of Hexafluoroethane (C_2F_6) Emissions from Primary Aluminium Production, USEPA and IAI, May 2003 Monitoring frequency: once in three years Measured and calculated.
QA/QC procedures to be applied:	Uncertainty level of data is Low. The aluminium smelting plant should of series of internal check procedures including scheduled calibration to ensure low uncertainties of the data produced during monitoring.
Any comment:	Will be done by the third party expert.

B.7.2. Description of the monitoring plan:

>>

The structure that the company will implement for the monitoring process is showed through the following table.

Parameters monitored	Responsibility	Frequency	Documentation

Anode effect frequency	Process control Manager	Every Second	Automatic electronic report. The data is available in the monitoring board. The procedure is explained in annex 4 of the PDD.
Anode effect duration	Process control Manager	Every Second	Automatic electronic report, The data is available in the monitoring board. The procedure is explained in annex 4 of the PDD.
Aluminium production	Process control Manager	Daily	Automatic electronic report. The data is available in the monitoring board. The procedure is explained in annex 4 of the PDD.
Slope & Weight Fraction	Head Environment Department	Every three years or less according to the Protocol for Measurement of Tetrafluoromethane and Hexafluoroethane from Primary Aluminium Production, USEPA and IAI .	Report from the external consultant that will carry out the measurements
BE_{IAI}	Head Environment Department	As and when IAI published the data	IAI published report

The emission reductions will be calculated based on individual line 5&6 and combined. The lower emission reductions will be used during the verification.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

>>

Date of completion: 17th September 2010.

Name of the responsible person/entity:

1. Abu Dhabi Future Energy Company PJSC (MASDAR)

e-mail: cdm@masdar.ae

This entity is project participant and contact details are provided in annex 1.

2.

Organization:	Dubai Aluminium Company Limited
Street/P.O.Box:	Jebel Ali / 3627
Building:	Dubai Aluminium Company
City:	Dubai
State/Region:	Dubai
Postcode/ZIP:	3627
Country:	UAE
Telephone:	+971 4 8846666
FAX:	+971 4 8846871
E-Mail:	
URL:	www.dubal.ae
Represented by:	EHS & Technical Services
Title:	Manager
Salutation:	Dr.
Last name:	Otte
Middle name:	-
First name:	Ronald
Department:	EHS & Technical Services
Mobile:	+971 504562341
Direct FAX:	+971 4 8845596
Direct tel:	+971 4 8023814
Personal e-mail:	ronaldotte@dubal.ae

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:
>> 06/07/2008 (Starting date for Implementation)

C.1.2. Expected operational lifetime of the project activity:
>>

Life of the smelter pot line	30	Years	Based on the data available normal life time is 40 years (Press release by Qatar aluminium). Dubal is operating since last 30 years and conservatively same is considered the lifetime of smelter pot lines under the purview of project activity.
Remaining life of pot line 5 (Sept 1996)	16	Years	Dubal facts and figures publication
Remaining life of pot line 6 (May 1999)	19	Years	Dubal facts and figures publication
Operation life time of project activity	**16**	**Years**	Minimum of remaining life of both the pot lines

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:
>> Not applicable

C.2.1.2. Length of the first crediting period:
>> Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:
>> 1st June 2011 or date of registration of the project activity whichever is later.

C.2.2.2. Length:
>> 10 years 0 months

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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The objective of this project is to reduce the GHG emissions from anode effects through the improvement of the automatic control system and by slots along the width of the anode. The project does therefore not have any negative impact on the environment. The main environmental impact is that the project will reduce the impact on global warming.

Under the environmental regulations of UAE project does not fall under the Environmental Impact assessment.

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

>>

No negative environmental impacts are expected from the project activity and an environmental impact study is not required by UAE authorities.

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

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The project activity is implemented at DUBAL in the existing facility which is located in the industrial zone in Jebel Ali area in Dubal. The stakeholders identified for the project activity are:

a. Dubai Municipality
b. Employees working in the plant
c. Government/Environmental agency of UAE
d. International Aluminium Institute

The project proponent has send the stakeholder consultation letter to the all the stakeholders in the month of November 2009 and received response on the same. All the responses have been collected and compiled.

The project activity has been submitted with Designated National Authority (DNA), UAE for the approval.

After the validation site visit project proponent has requested comments from a non - governmental organisation (NGO) and received the response[14].

E.2. Summary of the comments received:

>>

The project activity is new state of the art technological innovation in Dubal. The project has received positive comments for the project like its good environmental initiative, first of its kind etc. The summary of comments from stakeholders is presented in the table below:

Name of the stake holder	Category	Comments
International Aluminium Institute	Institution	The proposed CDM Project **Line 5 & 6 - PFC emission reduction at DUBAL** would join only two others registered and one requesting registration from the primary aluminium industry worldwide (Ref 1610 - Aluar; 1860 - Albras; 1641 - Hindalco) and would be the first of its kind from the Gulf region – an important and expanding centre of aluminium production

[14] The letter from Emirates environmental group has been submitted.

Dubai Municipality	Institution	I would like to inform you that the Dubai Municipality as stakeholder strongly support the emission reduction of PFCs in the Potlines 5 & 6 and will certainly qualify as a CDM project. However, I would like to request you to submit to the Environment Department" Dubai Municipality the full documentation of this project in accordance with the CDM Project Design Document (PDD) format for our review and evaluation so that we can provide our adequate comment and validation as condition by the CDM Executive Board for registration and approval
Rania B. Tayeh	Employee	Well done. These are great news
Ahmed Hasan Ali Mohamed	Employee	While fully supporting the above project, we congratulate DUBAL on this achievement, and please let us know if we can be of further assistance.
Joseph D'Souza	Employee	Keep up the good work Doc. We need to get ideas (maybe specific towards similar projects) from the operational staff / operators and could make use of the DUBAL suggestion scheme specific towards GHG emission reduction in various areas.
Sara Khalfan Howaireb	Employee	Very impressive project I would like to know more details about it.
Emirates Environmental group	Non Governmental organisation	They appreciated the efforts of Dubal for the project.

The project proponent will submit the letters/emails to the validator.

E.3. Report on how due account was taken of any comments received:

>>

The project proponent has not received any negative comment on project activity. However some stakeholders have asked for additional information which has been provided in the form of project design document.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Abu Dhabi Future Energy Company PJSC
Street/P.O.Box:	Opposite presidential flights
Building:	Khalifa City A
City:	Abu Dhabi
State/Region:	Abu Dhabi
Postfix/ZIP:	54115
Country:	United Arab Emirates
Telephone:	+971 2 653 3333
FAX:	+971 2 653 5002
E-Mail:	CMU@masdar.ae
URL:	www.masdar.ae
Represented by:	Carbon Management Unit
Title:	Director
Salutation:	Mr.
Last Name:	Nader
Middle Name:	-
First Name:	Sam
Department:	Carbon Management Unit
Mobile:	+971 50 7842916
Direct FAX:	+971 2 653 5002
Direct tel:	+971 2 653 5003
Personal E-Mail:	snader@masdar.ae

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NO PUBLIC FUNDING RECEIVED FOR THE PROJECT ACTIVITY

Annex 3

BASELINE INFORMATION

Baseline data - DUBAL				
	AE frequency [AE/(cell day)]		AE duration (sec)	
1-Jan-07	0.26	0.43	42	42
2-Jan-07	0.25	0.54	37	45
3-Jan-07	0.26	0.43	44	46
4-Jan-07	0.31	0.41	45	43
5-Jan-07	0.35	0.46	40	35
6-Jan-07	0.28	0.37	44	42
7-Jan-07	0.27	0.40	34	36
8-Jan-07	0.23	0.54	47	40
9-Jan-07	0.34	0.63	41	44
10-Jan-07	0.34	0.46	47	49
11-Jan-07	0.35	0.34	38	48
12-Jan-07	0.31	0.49	38	44
13-Jan-07	0.34	0.34	37	37
14-Jan-07	0.28	0.27	44	37
15-Jan-07	0.28	0.33	36	43
16-Jan-07	0.40	0.55	40	56
17-Jan-07	0.47	0.35	39	48
18-Jan-07	0.35	0.30	53	49
19-Jan-07	0.26	0.34	40	44
20-Jan-07	0.24	0.25	38	43
21-Jan-07	0.26	0.32	53	44
22-Jan-07	0.27	0.30	41	41
23-Jan-07	0.29	0.29	41	39
24-Jan-07	0.37	0.36	53	34
25-Jan-07	0.29	0.43	42	43
26-Jan-07	0.33	0.39	41	39
27-Jan-07	0.35	0.45	40	35
28-Jan-07	0.38	0.49	51	44
29-Jan-07	0.35	0.57	40	51
30-Jan-07	0.35	0.31	44	37
31-Jan-07	0.38	0.35	49	41
1-Feb-07	0.35	0.38	35	39
2-Feb-07	0.34	0.47	42	40
3-Feb-07	0.26	0.43	42	48
4-Feb-07	0.25	0.48	50	39
5-Feb-07	0.31	0.49	43	42
6-Feb-07	0.27	0.53	50	37
7-Feb-07	0.28	0.62	43	40
8-Feb-07	0.31	0.55	37	36

9-Feb-07	0.36	0.50	38	39
10-Feb-07	0.32	0.44	51	36
11-Feb-07	0.26	0.49	39	36
12-Feb-07	0.26	0.56	47	39
13-Feb-07	0.29	0.42	41	44
14-Feb-07	0.33	0.46	57	45
15-Feb-07	0.23	0.36	67	47
16-Feb-07	0.22	0.53	44	41
17-Feb-07	0.25	0.53	58	40
18-Feb-07	0.18	0.42	39	34
19-Feb-07	0.16	0.43	40	44
20-Feb-07	0.10	0.51	61	49
21-Feb-07	0.16	0.55	43	49
22-Feb-07	0.22	0.51	46	54
23-Feb-07	0.18	0.60	38	45
24-Feb-07	0.26	0.34	40	38
25-Feb-07	0.21	0.38	37	43
26-Feb-07	0.29	0.48	45	53
27-Feb-07	0.29	0.33	45	48
28-Feb-07	0.40	0.32	49	42
1-Mar-07	0.39	0.38	48	37
2-Mar-07	0.53	0.37	38	46
3-Mar-07	0.34	0.38	42	42
4-Mar-07	0.38	0.32	43	47
5-Mar-07	0.37	0.33	44	41
6-Mar-07	0.28	0.33	42	41
7-Mar-07	0.34	0.37	37	33
8-Mar-07	0.37	0.31	40	37
9-Mar-07	0.45	0.42	42	34
10-Mar-07	0.25	0.38	29	39
11-Mar-07	0.27	0.36	31	46
12-Mar-07	0.38	0.53	36	48
13-Mar-07	0.20	0.38	39	37
14-Mar-07	0.20	0.37	43	39
15-Mar-07	0.16	0.29	45	44
16-Mar-07	0.15	0.23	34	40
17-Mar-07	0.21	0.31	39	44
18-Mar-07	0.23	0.43	40	45
19-Mar-07	0.30	0.36	50	41
20-Mar-07	0.34	0.28	61	33
21-Mar-07	0.28	0.33	43	44
22-Mar-07	0.26	0.31	35	32
23-Mar-07	0.23	0.25	44	42
24-Mar-07	0.24	0.31	37	36
25-Mar-07	0.36	0.24	47	38
26-Mar-07	0.30	0.27	48	39

27-Mar-07	0.30	0.28	41	35
28-Mar-07	0.31	0.20	54	38
29-Mar-07	0.34	0.19	42	42
30-Mar-07	0.31	0.28	52	34
31-Mar-07	0.27	0.26	49	38
1-Apr-07	0.29	0.26	40	34
2-Apr-07	0.18	0.23	45	40
3-Apr-07	0.21	0.24	59	62
4-Apr-07	0.12	0.26	46	43
5-Apr-07	0.16	0.18	32	37
6-Apr-07	0.15	0.24	52	44
7-Apr-07	0.24	0.26	49	40
8-Apr-07	0.16	0.30	44	37
9-Apr-07	0.29	0.42	38	45
10-Apr-07	0.23	0.53	45	37
11-Apr-07	0.20	0.43	42	41
12-Apr-07	0.28	0.30	35	41
13-Apr-07	0.27	0.39	54	34
14-Apr-07	0.29	0.51	46	41
15-Apr-07	0.26	0.37	50	47
16-Apr-07	0.34	0.41	44	40
17-Apr-07	0.35	0.38	48	41
18-Apr-07	0.30	0.44	36	39
19-Apr-07	0.39	0.41	46	36
20-Apr-07	0.40	0.38	47	37
21-Apr-07	0.39	0.43	51	35
22-Apr-07	0.46	0.38	59	34
23-Apr-07	0.54	0.49	47	48
24-Apr-07	0.44	0.45	53	38
25-Apr-07	0.39	0.32	42	43
26-Apr-07	0.49	0.30	47	58
27-Apr-07	0.66	0.28	51	44
28-Apr-07	0.40	0.25	41	42
29-Apr-07	0.31	0.27	43	40
30-Apr-07	0.34	0.26	45	43
1-May-07	0.34	0.26	35	41
2-May-07	0.34	0.24	42	38
3-May-07	0.36	0.31	42	42
4-May-07	0.39	0.38	35	40
5-May-07	0.26	0.28	39	58
6-May-07	0.26	0.29	41	38
7-May-07	0.29	0.33	38	46
8-May-07	0.30	0.49	43	44
9-May-07	0.39	0.39	46	43
10-May-07	0.42	0.38	47	59
11-May-07	0.34	0.29	43	48

12-May-07	0.41	0.30	48	50
13-May-07	0.45	0.31	51	72
14-May-07	0.43	0.35	42	56
15-May-07	0.44	0.31	48	48
16-May-07	0.45	0.38	43	41
17-May-07	0.48	0.37	40	49
18-May-07	0.50	0.43	54	48
19-May-07	0.44	0.33	43	41
20-May-07	0.40	0.32	44	50
21-May-07	0.33	0.38	44	55
22-May-07	0.34	0.34	44	55
23-May-07	0.36	0.35	33	45
24-May-07	0.32	0.49	49	40
25-May-07	0.35	0.32	39	46
26-May-07	0.30	0.32	40	45
27-May-07	0.36	0.40	40	41
28-May-07	0.37	0.55	43	59
29-May-07	0.40	0.32	42	45
30-May-07	0.50	0.37	55	46
31-May-07	0.29	0.34	37	48
1-Jun-07	0.28	0.44	42	40
2-Jun-07	0.24	0.37	34	44
3-Jun-07	0.27	0.54	58	50
4-Jun-07	0.30	0.46	46	49
5-Jun-07	0.36	0.51	61	54
6-Jun-07	0.38	0.43	51	60
7-Jun-07	0.30	0.35	47	53
8-Jun-07	0.36	0.35	43	51
9-Jun-07	0.35	0.30	46	51
10-Jun-07	0.38	0.30	47	45
11-Jun-07	0.47	0.40	46	46
12-Jun-07	0.41	0.30	46	49
13-Jun-07	0.38	0.43	49	54
14-Jun-07	0.39	0.30	46	36
15-Jun-07	0.42	0.46	49	47
16-Jun-07	0.36	0.45	34	45
17-Jun-07	0.37	0.47	51	65
18-Jun-07	0.26	0.52	40	53
19-Jun-07	0.33	0.46	62	53
20-Jun-07	0.30	0.44	42	50
21-Jun-07	0.35	0.36	40	32
22-Jun-07	0.31	0.43	37	49
23-Jun-07	0.31	0.42	36	65
24-Jun-07	0.37	0.38	47	68
25-Jun-07	0.38	0.35	41	54
26-Jun-07	0.41	0.38	45	41

27-Jun-07	0.27	0.35	51	49
28-Jun-07	0.19	0.36	68	51
29-Jun-07	0.28	0.35	51	40
30-Jun-07	0.27	0.38	48	45
1-Jul-07	0.24	0.32	46	51
2-Jul-07	0.27	0.23	37	59
3-Jul-07	0.35	0.21	52	40
4-Jul-07	0.32	0.35	45	40
5-Jul-07	0.39	0.54	44	54
6-Jul-07	0.46	0.26	46	38
7-Jul-07	0.34	0.20	45	36
8-Jul-07	0.40	0.23	47	43
9-Jul-07	0.35	0.25	46	47
10-Jul-07	0.30	0.16	52	47
11-Jul-07	0.20	0.23	58	33
12-Jul-07	0.26	0.24	45	48
13-Jul-07	0.25	0.17	44	37
14-Jul-07	0.28	0.28	50	40
15-Jul-07	0.32	0.35	44	40
16-Jul-07	0.31	0.40	37	49
17-Jul-07	0.26	0.38	98	48
18-Jul-07	0.21	0.32	37	45
19-Jul-07	0.20	0.30	58	46
20-Jul-07	0.24	0.28	48	42
21-Jul-07	0.35	0.27	58	44
22-Jul-07	0.12	0.39	40	52
23-Jul-07	0.18	0.35	52	50
24-Jul-07	0.23	0.32	71	39
25-Jul-07	0.20	0.31	65	35
26-Jul-07	0.19	0.25	114	62
27-Jul-07	0.23	0.24	69	47
28-Jul-07	0.30	0.23	71	37
29-Jul-07	0.24	0.19	71	46
30-Jul-07	0.23	0.18	70	35
31-Jul-07	0.36	0.21	67	48
1-Aug-07	0.39	0.25	76	37
2-Aug-07	0.45	0.30	66	43
3-Aug-07	0.39	0.23	61	55
4-Aug-07	0.34	0.28	50	36
5-Aug-07	0.32	0.23	44	71
6-Aug-07	0.26	0.42	47	53
7-Aug-07	0.27	0.40	57	51
8-Aug-07	0.26	0.28	42	47
9-Aug-07	0.23	0.38	39	63
10-Aug-07	0.22	0.27	52	46
11-Aug-07	0.19	0.34	42	49

12-Aug-07	0.16	0.34	44	62
13-Aug-07	0.26	0.28	37	46
14-Aug-07	0.21	0.26	42	51
15-Aug-07	0.22	0.28	55	34
16-Aug-07	0.25	0.25	55	42
17-Aug-07	0.19	0.25	50	33
18-Aug-07	0.21	0.21	48	42
19-Aug-07	0.18	0.21	43	43
20-Aug-07	0.21	0.26	50	49
21-Aug-07	0.29	0.15	55	68
22-Aug-07	0.33	0.21	49	31
23-Aug-07	0.28	0.19	50	39
24-Aug-07	0.42	0.18	62	37
25-Aug-07	0.38	0.16	55	40
26-Aug-07	0.32	0.15	52	50
27-Aug-07		0.33		69
28-Aug-07	0.17	0.17	52	57
29-Aug-07	0.20	0.18	63	42
30-Aug-07	0.17	0.20	62	33
31-Aug-07	0.17	0.21	56	54
1-Sep-07	0.20	0.20	40	31
2-Sep-07	0.24	0.23	49	36
3-Sep-07	0.30	0.23	41	33
4-Sep-07	0.32	0.23	35	34
5-Sep-07	0.26	0.24	35	45
6-Sep-07	0.28	0.32	42	36
7-Sep-07	0.25	0.27	49	36
8-Sep-07	0.29	0.25	44	35
9-Sep-07	0.28	0.34	35	34
10-Sep-07	0.23	0.29	48	36
11-Sep-07	0.25	0.26	47	32
12-Sep-07	0.18	0.30	43	40
13-Sep-07	0.13	0.32	33	34
14-Sep-07	0.22	0.33	49	35
15-Sep-07	0.18	0.30	53	35
16-Sep-07	0.19	0.30	40	31
17-Sep-07	0.26	0.22	50	43
18-Sep-07	0.15	0.23	57	44
19-Sep-07	0.32	0.25	40	29
20-Sep-07	0.34	0.23	46	34
21-Sep-07	0.31	0.20	50	32
22-Sep-07	0.26	0.20	42	35
23-Sep-07	0.29	0.20	50	28
24-Sep-07	0.26	0.24	41	27
25-Sep-07	0.20	0.29	43	35
26-Sep-07	0.25	0.23	42	30

27-Sep-07	0.22	0.16	45	38
28-Sep-07	0.25	0.16	44	31
29-Sep-07	0.31	0.20	38	26
30-Sep-07	0.29	0.20	46	24
1-Oct-07	0.29	0.17	39	29
2-Oct-07	0.23	0.16	53	50
3-Oct-07	0.20	0.20	51	43
4-Oct-07	0.25	0.16	39	37
5-Oct-07	0.29	0.23	42	38
6-Oct-07	0.21	0.25	45	31
7-Oct-07	0.19	0.23	56	30
8-Oct-07	0.24	0.24	48	30
9-Oct-07	0.26	0.23	56	29
10-Oct-07	0.30	0.25	55	36
11-Oct-07	0.36	0.25	45	29
12-Oct-07	0.28	0.28	45	34
13-Oct-07	0.26	0.25	53	37
14-Oct-07	0.30	0.19	45	35
15-Oct-07	0.35	0.26	47	34
16-Oct-07	0.40	0.23	51	37
17-Oct-07	0.33	0.23	44	35
18-Oct-07	0.32	0.18	49	31
19-Oct-07	0.30	0.26	46	31
20-Oct-07	0.32	0.23	55	38
21-Oct-07	0.24	0.18	39	42
22-Oct-07	0.36	0.20	50	32
23-Oct-07	0.39	0.24	42	25
24-Oct-07	0.25	0.23	47	28
25-Oct-07	0.27	0.23	45	32
26-Oct-07	0.29	0.20	40	26
27-Oct-07	0.29	0.19	64	37
28-Oct-07	0.29	0.24	46	28
29-Oct-07	0.22	0.18	50	49
30-Oct-07	0.26	0.16	37	30
31-Oct-07	0.28	0.22	50	39
1-Nov-07	0.24	0.33	68	35
2-Nov-07	0.21	0.24	70	30
3-Nov-07	0.23	0.20	51	52
4-Nov-07	0.29	0.29	40	38
5-Nov-07	0.32	0.57	47	41
6-Nov-07	0.30	0.38	40	37
7-Nov-07	0.32	0.33	45	39
8-Nov-07	0.43	0.27	62	31
9-Nov-07	0.43	0.30	53	32
10-Nov-07	0.40	0.28	45	36
11-Nov-07	0.37	0.35	38	60

12-Nov-07	0.30	0.35	44	41
13-Nov-07	0.37	0.38	49	36
14-Nov-07	0.38	0.40	65	42
15-Nov-07	0.39	0.40	45	31
16-Nov-07	0.40	0.42	45	38
17-Nov-07	0.36	0.25	37	34
18-Nov-07	0.38	0.33	40	35
19-Nov-07	0.44		48	
20-Nov-07	0.52	0.53	44	45
21-Nov-07	0.45	0.26	50	39
22-Nov-07	0.35	0.26	38	25
23-Nov-07	0.35	0.33	45	40
24-Nov-07	0.34	0.29	45	33
25-Nov-07	0.27	0.20	43	31
26-Nov-07	0.28	0.37	45	42
27-Nov-07	0.27	0.25	40	36
28-Nov-07	0.35	0.22	39	37
29-Nov-07	0.29	0.29	61	35
30-Nov-07	0.44	0.34	37	37
1-Dec-07	0.41	0.36	44	36
2-Dec-07	0.42	0.36	64	28
3-Dec-07	0.41	0.43	55	34
4-Dec-07	0.41	0.44	47	34
5-Dec-07	0.52	0.35	44	38
6-Dec-07	0.60	0.37	52	35
7-Dec-07	0.50	0.39	46	35
8-Dec-07	0.37	0.29	46	32
9-Dec-07	0.38	0.30	43	35
10-Dec-07	0.29	0.25	40	36
11-Dec-07	0.26	0.26	34	34
12-Dec-07	0.32	0.23	37	35
13-Dec-07	0.38	0.31	48	37
14-Dec-07	0.48	0.38	42	28
15-Dec-07	0.49	0.36	49	33
16-Dec-07	0.41	0.41	45	32
17-Dec-07	0.44	0.36	38	33
18-Dec-07	0.43	0.31	47	32
19-Dec-07	0.43	0.41	49	33
20-Dec-07	0.53	0.28	49	41
21-Dec-07	0.39	0.34	42	32
22-Dec-07	0.53	0.40	55	36
23-Dec-07	0.50	0.38	43	33
24-Dec-07	0.60	0.35	39	40
25-Dec-07	0.57	0.42	48	38
26-Dec-07	0.56	0.48	52	33
27-Dec-07	0.66	0.38	46	36

28-Dec-07	0.67	0.35	41	36
29-Dec-07	0.71	0.38	40	32
30-Dec-07	0.74	0.42	45	32
15-Feb-08	0.22	0.31	70	41
16-Feb-08	0.33	0.38	43	39
17-Feb-08	0.46	0.37	40	44
18-Feb-08	0.46	0.38	43	50
19-Feb-08	0.39	0.41	40	46
20-Feb-08	0.38	0.61	46	67
21-Feb-08	0.46	0.26	43	47
22-Feb-08	0.50	0.26	37	55
23-Feb-08	0.44	0.31	45	51
24-Feb-08	0.45	0.26	41	47
25-Feb-08	0.55	0.29	41	40
26-Feb-08	0.41	0.29	38	43
27-Feb-08	0.41	0.31	40	48
28-Feb-08	0.38	0.21	37	39
29-Feb-08	0.41	0.32	49	34
1-Mar-08	0.32	0.31	63	31
2-Mar-08	0.35	0.32	50	38
3-Mar-08	0.34	0.44	50	40
4-Mar-08	0.40	0.41	48	42
5-Mar-08	0.37	0.34	48	35
6-Mar-08	0.36	0.34	42	44
7-Mar-08	0.31	0.40	66	43
8-Mar-08	0.37	0.45	38	40
9-Mar-08	0.27	0.32	54	52
10-Mar-08	0.20	0.30	38	41
11-Mar-08	0.26	0.30	45	44
12-Mar-08	0.31	0.31	49	37
13-Mar-08	0.26	0.35	47	37
14-Mar-08	0.30	0.28	42	44
15-Mar-08	0.36	0.32	56	49
16-Mar-08	0.40	0.30	49	45
17-Mar-08	0.34	0.36	70	37
18-Mar-08	0.36	0.45	33	49
19-Mar-08	0.32	0.34	40	44
20-Mar-08	0.31	0.29	45	41
21-Mar-08	0.25	0.26	34	45
22-Mar-08	0.26	0.34	37	50
23-Mar-08	0.33	0.42	60	38
24-Mar-08	0.27	0.30	51	34
25-Mar-08	0.22	0.33	33	40
26-Mar-08	0.22	0.25	35	36
27-Mar-08	0.16	0.16	37	40
28-Mar-08	0.17	0.14	49	38

31dec 2007 to 14 feb 2008 trails

29-Mar-08	0.17	0.19	27	38
30-Mar-08	0.12	0.17	41	48
31-Mar-08	0.21	0.18	32	31
1-Apr-08	0.16	0.26	35	38
2-Apr-08	0.26	0.21	55	35
3-Apr-08	0.28	0.25	38	34
4-Apr-08	0.31	0.24	44	42
5-Apr-08	0.29	0.30	56	50
6-Apr-08	0.31	0.17	46	37
7-Apr-08	0.32	0.22	36	44
8-Apr-08	0.32	0.27	41	40
9-Apr-08	0.32	0.29	41	48
10-Apr-08	0.31	0.34	31	40
11-Apr-08	0.39	0.29	45	39
12-Apr-08	0.43	0.26	33	38
13-Apr-08	0.29	0.27	42	42
14-Apr-08	0.29	0.29	34	39
15-Apr-08	0.20	0.34	47	36
16-Apr-08	0.23	0.30	44	38
17-Apr-08	0.30	0.32	68	39
18-Apr-08	0.33	0.26	41	36
19-Apr-08	0.28	0.29	74	56
20-Apr-08	0.25	0.39	36	39
21-Apr-08	0.22	0.37	37	36
22-Apr-08	0.19	0.22	33	42
23-Apr-08	0.22	0.29	36	46
24-Apr-08	0.36	0.24	46	32
25-Apr-08	0.26	0.22	52	36
26-Apr-08	0.23	0.23	50	39
27-Apr-08	0.18	0.21	50	40
28-Apr-08	0.22	0.25	39	40
29-Apr-08	0.32	0.20	53	47
30-Apr-08	0.37	0.18	39	44
1-May-08	0.40	0.19	42	41
2-May-08	0.39	0.23	37	40
3-May-08	0.40	0.29	50	38
4-May-08	0.36	0.29	35	42
5-May-08	0.51	0.34	46	37
6-May-08	0.51	0.35	53	45
7-May-08	0.44	0.39	44	38
8-May-08	0.37	0.33	42	54
9-May-08	0.45	0.35	45	41
10-May-08	0.33	0.30	69	40
11-May-08	0.31	0.38	44	44
12-May-08	0.47	0.27	40	36
13-May-08	0.41	0.28	58	42

14-May-08	0.29	0.28	40	41	
15-May-08	0.40	0.33	42	42	
16-May-08	0.51	0.40	34	41	
17-May-08	0.43	0.42	35	38	Project activity trails started from 18/05/2008

Annex 4

MONITORING INFORMATION

MONITORING BOARD

ANALOGUE BOARD

The analogue board has four channels. Channels 1 to 3 accept voltage inputs. And the fourth channel accepts RS485 frequency input signal over twisted pair cables. All channels are optically isolated.

Voltage Scaling (Channel 1-3)

The input voltage for the first channel is scaled to 10:1 when its level reach up to more than 10volts. Note that high precision resistors are of 0.1% tolerance to minimize the temperature affect on the conversion. and the capacitors are silver mica or types of similar temperature and time stability.

Frequency Generation

The input signal is converted to a frequency proportional to the input voltage.
The high precision voltage to frequency converter (VFC320BP) integrated circuit is used to achieve the high accuracy of signal conversion. *This unit provides 0.04% conversion accuracy with minimal settling time.*

Optical Isolation and Indication

The signal generated by the voltage to frequency converter, drives the HCPL2611 optical isolator. The isolated output signal is then used to drive:

a. A 24-bit counter (3 x 8-bit) 74HC590N

b. A flashing LED gives immediate indication that the circuit is operational (although not necessarily calibrated correctly).

Data Transmission

The counter chip accumulates the input pulses coming from the opto-isolator and the CPU read the counter chips every 50ms.

RS485 Level Reception (Channel 4)

LTC485CN8 integrated circuit bus driver/receiver is provided to receive an input frequency signal over twisted pair cables.

The received frequency signal drives the HCPL2611 optical isolator and is processed the same way as channel 1-3. See section 1.3 and 1.4

CALIBRATION PROCEDURE

Dubal is having IT Procedures Volume 1 for the Calibration Procedures for this Board.

In calibrating the analogue boards an ISO standard instrument (FLUKE 5500A Calibrator) is used.

Analogue card calibration:

VFC-AI CALIBRATION PROCEDURE

Note: This calibration procedure refers to the calibration of circuit no. 1 on the printed circuit board. Component identities for circuit no. 2,3 are shown on parentheses, { }.

EQUIPMENT REQUIRED

ISO Approved Precision Frequency and Voltage Generator
ISO Approved Precision Multimeter
VFC-AI calibration sheet
110/220V AC Supply
Test jig

COMPONENT INSTALLATION AND INPUT POWER

Install components per required input/output range.
Check transformer installation whether 110 or 220VAC operation.
Position board in test jig.
Connect power/input cable adapter and supply with the appropriate input power voltage. Allow at least five minutes to stabilize.

ON-BOARD SUPPLY VOLTAGE CHECK

Set multimeter Hz range and connect the negative probe to TP1 (AG1/0V).
Connect the positive probe of multimeter pin 7 of (IC48, IC167, IC168) VFC320, reading must be +15.00V +- .25V.
Connect the positive probe of multimeter pin 12 of (IC49, IC168, IC216) INA118P, reading must be +15.00V +- .25V.

Connect the positive probe of multimeter pin 4 of (IC48, IC167, IC168) VFC320, reading must be -15.00V +- .25V.
Connect the positive probe of multimeter pin 4 of (IC49, IC168, IC216) INA118P, reading must be -15.00V +- .25V..

ADJUSTMENT OF THE 0 TO 10 INPUT VOLTAGE RANGE FOR CHANNELS (1, 2, & 3)

Power on the voltage source and plug the 2way connector into the channel to be calibrated **{Con2W1 for Channel 1, Con2W2 for channel 2, Con2W3 for channel 3}.**
Connect negative probe of the multimeter to TP13 (located under the 8-way switch), and the positive probe to the desired channel (**TP6 for Channel 1, TP8 for Channel 2, TP10 for Channel 3}.**
Inject +10 V from the voltage source and multimeter should read 100 KHz, if not, adjust the trim potentiometer for the selected channel **(trim 2 for Channel1, trim7 for Channel2, trim4 for channel 3}** until meter reading is 100 KHz.
Inject +1V from the voltage source, meter should read 10 KHz, if not, adjust (**trim3 for Channel1, trim9 for Channel 2, trim6 for Channel 3}** until meter reading is 10 KHz
Repeat steps 5.3 and 5.4 as until the desired results is achieved.
Record all the readings

CHECK FOR CHANNEL 4 OUTPUT
Power on the frequency generator, set the amplitude to 3.3V and input 10 KHz
Connect the positive probe of the multimeter to TP11
Connect the 2way plug of the frequency generator to Con2W4, multimeter should ready 10 KHz as well
Increase the frequency input by 10 KHz and check the output
Repeat step 6.3 until 100 KHz is reached.
Record all the readings and place the **calibrated sticker & card serial number** on the card

QA/QC Procedure: All CDM project related will be checked monthly by environmental department. For any data discrepancy, head environment will notify to process department and the corrective action will be taken.

Data recording and archiving procedure: All the data is available online and will be stored for one year. The data will be archived monthly and stored with the process and environmental department.

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