Project design document form
(Version 10.1)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Conversion of SF_6 to the alternative cover gas SO_2 at RIMA magnesium production.
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	Version 04
Completion date of the PDD	15/06/2018
Project participants	RIMA Industrial S/A; Nordic Environment Finance Corporation (NEFCO); and Electrabel NV/SA.
Host Party	Brazil (host).
Applied methodologies and standardized baselines	AM0065 - Replacement of SF_6 with alternate cover gas in the magnesium industry version 02.1.
Sectoral scopes linked to the applied methodologies	9: Metal production;
Estimated amount of annual average GHG emission reductions	301,196 tCO_2e.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The purpose of the project activity was substituting sulphur hexafluoride (SF_6), a high global warming potential (GWP) gas, with a non-global warming sulphur dioxide (SO_2) gas at RIMA magnesium factory.

SF_6 was used as a cover gas to prevent oxidation of the liquid metal during production and casting of magnesium metal products, and typically escape to the atmosphere. SF_6 was considered a non-reactive gas, and is ideally suited for this kind of protection as a “covering” for liquid magnesium (hence the term “cover gas”). Although SO_2 is not a greenhouse gas, this gas has health impacts, therefore new latest environmental/safety high control technology was transferred to RIMA, to ensure safe handling of SO_2.

The primary objective of RIMA Project is to help Brazil meet the eight Millennium Goals (United Nations, 2008) as established by United Nations – eradicate extreme poverty and hunger, achieve universal primary education, promote gender equality and empower women, reduce child mortality, improve maternal health, combat HIV/AIDS, malaria and other diseases, ensure environmental sustainability and develop a goal partnership for development, contributing to the environmental, social and economic sustainability by reducing greenhouse gas (GHG) emissions.

The estimated annual GHG emission reductions are 301,196 tCO_2 equivalents and the total estimated reductions are 2,108,374 tCO_2 equivalents by the project in the second 7-year crediting period.

Relevant dates for the project activity

- On 10 March 2007, after the registration of the first CDM project developed by RIMA, the company Board started to think and discuss about a second CDM project. During the month of March/07, the possibility to switch the cover gas SF_6 to a non-green house gas started to be discussed inside RIMA;
- In January 2008, RIMA closed the ERPA (Emission Reduction Purchase Agreement) with 33 Asset Management;
- In February 2008, an applicable CDM methodology AM0065 was approved and publicized by EB, consultants to develop CDM process were contacted and RIMA started construction of the room to install the SO_2 gas supplier,
- Between June-July 2008, after a long period testing with SO_2 gas, the first results were not good. The testing and adjustment continued through all validation period as well, and little by little good results started to appear. During all testing period, withdrawing the project activity was always a possibility as there was no income generation and huge adaptation efforts as the SO_2 is a toxic and dangerous gas;
- On 31 October 2008, the full change of the gas supplying system was done;
- Between April-June 2009, the completely decommissioning and disposal of all piping and pumping equipment used for previous cover gas SF_6 was done;
- On 02 July 2009, this project was approved;
- In 06 January 2011, was approved by the CDM Executive Board the monitoring plan revised and issued on 20 December 2010 by Rima. The changes occurred on monitoring plan was revised during the second verification for the period from 01/01/2010 to 30/06/2010;
- In November 2012, after understandings between RIMA and 33 Asset Management signed the term to terminate the ERPA (Emission Reduction Purchase Agreement);
- In February 2014, RIMA announced to UNFCCC the withdrawal of 33 Asset Management as project participant;
- In February 2014, RIMA announced to UNFCCC the addition of Electrabel NV/SA as project participant. RIMA does not have ERPA (Emission Reduction Purchase Agreement) with Electrabel NV S/A;

- In October 2014, RIMA closed the ERPA (Emission Reduction Purchase Agreement) with Nordic Environment Finance Corporation (NEFCO) valid until December 2017. This ERPA involves CER of this project; and

- In June 2015, RIMA closed a second ERPA (Emission Reduction Purchase Agreement) with Nordic Environment Finance Corporation (NEFCO) valid until June 2021. This ERPA involves CER of this project.

Company Profile

RIMA Industrial S/A, the project owner, was founded in 1987 operating in several areas as mining, engineering, agriculture-livestock and tourism and has a diverse line of products such as silicon metal, pure magnesium, magnesium alloys, calcium silicon alloys, magnesium-iron-silicon, iron-silicon 75%, inoculants, specialty cored wires and magnesium die cast pieces.

RIMA is a member of International Magnesium Association (IMA). IMA and United States Environmental Protection Agency (EPA)'s Partners created the "SF_6 Emission Reduction Partnership for the Magnesium Industry"[1]. They join companies committed to eliminate SF_6 emissions from magnesium production and casting processes by year-end 2010.

In conference of International Magnesium Association (IMA) in june of 2014, the Environmental Responsibility Award[2] was presented to RIMA, regarding your Primary Magnesium Production Process (where CDM project RIMA is installed). After presenting the paper "RIMA's Process: Green Magnesium From a Fully Integrated Plant" during 2011 IMA Annual Conference in Prague, German carmaker AUDI AG and RIMA Industrial decided to make a complete Life Cycle Assessment (LCA) of RIMA's primary magnesium process. PE International, a German consultancy for sustainability, conducted a comprehensive LCA that evaluated the environmental impact of the RIMA magnesium process. The RIMA Process Study showed that RIMA's plant greenhouse gas emissions are only 10.1 Kg CO_2eq/Kg Mg when the average of other companies that use the same technology is 25.8 Kg CO_2eq /Kg Mg.

RIMA is the world's 4th largest producer of Silicon Metal, the 2nd largest Magnesium Die Caster, as well as the only magnesium producer on south hemisphere. RIMA is also the only one integrated magnesium plant in the world. Manufacturing magnesium from the raw material (dolomite), induction/casting, and die casting.

RIMA has environmental and social responsibility evidenced by its initiatives through Vicintin Foundation[3]. Vicintin Foundation objective is social acting through the articulation of three sectors: government, private companies and communities. The foundation implements several activities in health, education and environment areas in Belo Horizonte and Minas Gerais state.

[1] For more information see: http://www3.epa.gov/highgwp/magnesium-sf6/.
[2] For more information see: http://www.intlmag.org/newsroom/news_070114.cfm.
[3] For more information see: http://www.vicintinfoundation.org/.

A.2. Location of project activity

The project activity is located in Bocaiuva city, Northern region of Minas Gerais state, Midwest region of Brazil. Bocaiuva city is 369 km from Belo Horizonte, the capital of the state[4], latitude 17° 36' 07" South and longitude 43º 48' 28" West.

Map 1 – Political division of Brazil showing the state of Minas Gerais, where is located the city of Bocaiuva.(Source: Political map of Brazil[5], 2015)

Map 2 – Record showing the satellite town of Bocaiuva, located in Minas Gerais. (Source: Google Earth[6], 2015)

[4] Available at : http://bocaiuva.mg.gov.br/index.php?option=com_content&view=article&id=67&Itemid=78.
[5] Available at: http://portaldemapas.ibge.gov.br/portal.php#mapa97. Retrieved on 28 September 2015.
[6] Available at: http://www.google.com/earth/. Retrieved on 01 October 2015.

A.3. Technologies/measures

Cover gas substitution project description

RIMA produces magnesium crystals from dolomite, by silico-thermic process under vacuum. Magnesium crystals are then further processed in Fusion Area into ingots or transferred in liquid form to Die Casting Area.

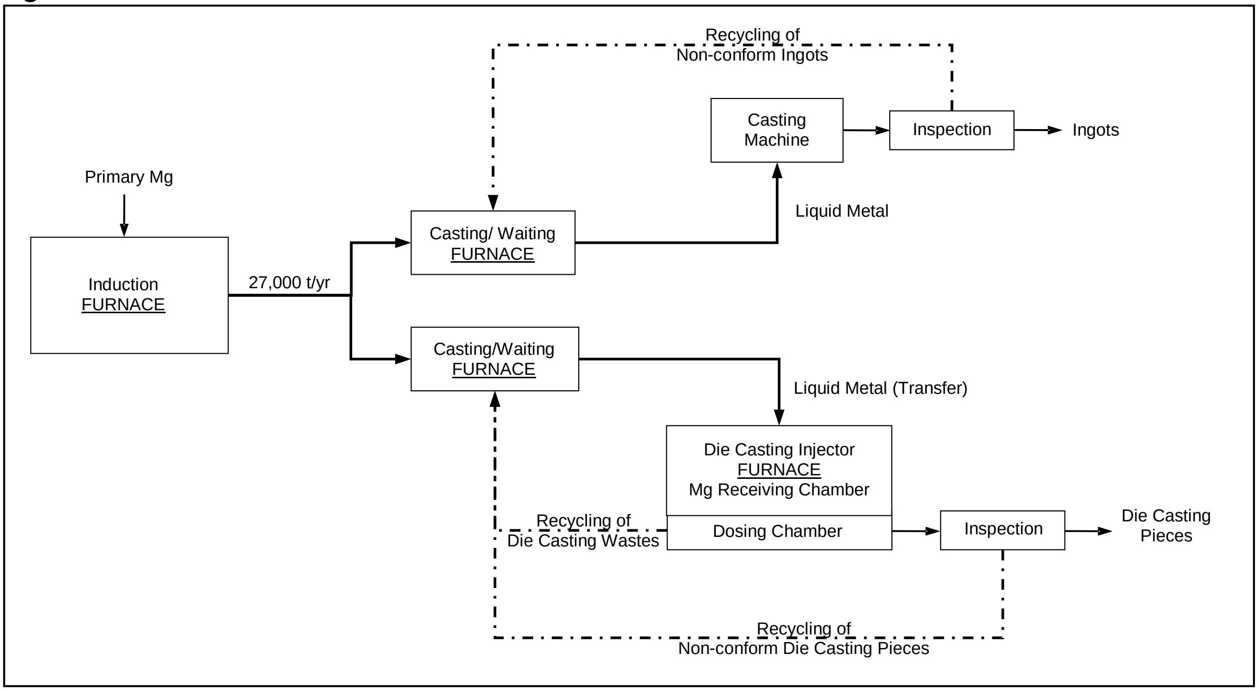
During the molten of magnesium to manufacture ingots or die casting pieces, was used a cover gas to protect the metal against oxidation. RIMA was utilized sulfur hexafluoride (SF_6) as cover gas which has high global warming potential and was substituted by sulfur dioxide (SO_2). The technology was transferred from Austria.

RIMA project was installed the necessary piping, equipments and procedures (including staff safety equipments and training) required to switch from SF_6 to SO_2.

The project itself consisted of the following elements:

- Installation of new piping, pumping, metering and other equipment needed to pump SO_2 over the molten magnesium in order to protect the metal. The project removed piping and pumping equipments used to protective cover gas SF_6. Removed equipments was sent to final disposal or scrap;
- Installation of gas cabinet or cylinder storage area with leak monitors and emergency ventilation system;
- Installation of redundant/back-up melt protection technology in case accidental SO_2 leakage requires system shut-down and/or repair;
- Control and monitoring of SO_2 emissions are in compliance with the local environmental regulations;
- Held staff technical training for proper handling procedures, to reduce dangerous accidental exposure to SO_2;
- Developed and trained staff for emergency response plan;
- Back-up power/generator for gas mixing system and necessary controls, compressors, etc. Capable of running independently for 12 hours;
- Provided personal safety equipment: protective wear and gears, respirator, dosimeter and monitors when operating in an environment under SO_2; and
- Developed and executed Maintenance Plan for equipment and gas distribution system to assure safe and consistent operation.

Magnesium Products Production



Flowchart 1 – Simplified RIMA Magnesium Production Process (Installed Capacity)

The induction furnace is where the magnesium crystals (primary magnesium) are melted with a salt protection, no SF_6 is used to protect the surface. The liquid magnesium is transferred to the next furnaces.

The casting furnaces, waiting furnaces, production of ingots and production of liquid metal are located in the Fusion Area of the RIMA plant. Liquid metal is then transported in containers by folk-lifts to the Die Casting Area, called as FSP (Casting Under Pressure) in RIMA.

In the Fusion Area:

- There are 3 casting machines, where is necessary the use of cover gas.

  When this project activity was approved in 2009 year, there were 2 casting machines installed, where is necessary the use of cover gas.

  Since 2011 Rima has experienced an increase in the production of the magnesium in fusion area (liquid metal and ingot) due to the growth in demand in several industrial consumer segments such as aluminium, aerospace, electronic (smartphone, computer chips,etc).

  This growth contributed positively to Rima's increase in the production of magnesium (especially ingots) from Rima which, between 2011 and 2014, registered an average annual growth of 5.70%.

  As a consequence of this scenario, the frequency of use of the two casting machines has become continuous and uninterrupted.

  As shown on this version of PDD of the second crediting period (approved in 20/01/2017), Rima projects that demand for magnesium ingots will continue growing in the next years.

  It happens that, in the event of any or both of the two existing casting machines, whether due to preventive or corrective maintenance, the ingot production is reduced and compromised until the maintenance procedures are finalized.

  Therefore, in order not to compromise Rima's magnesium casting operations, it was decided to install a third casting machine in 2017 year. Since August/2017 there are 3 casting machines in operation in Fusion Area.

It is important to emphasize that the installation of this third casting machine has the sole purpose of serving the operation and maintenance plan of the magnesium ingot stage. That is, there is no increase in the production capacity of magnesium.

The capacity of production did not changed after of installation of third casting machine because this equipment is used exclusively to give a format of ingots at liquid magnesium received from the furnaces. The liquid magnesium it is produced in the furnaces and Rima did not install new furnaces or expanded the capacity of production of actual furnaces.

Thus, considering that the capacity of production of magnesium did not changed/expanded, there is no change on generation of emission reductions estimated in the project.

- There are 11 furnaces, as follows:
  - Induction: are 03 induction furnaces used to melt the primary magnesium, with capacity to produced 27,000 t/yr of liquid magnesium;
  - Casting/Waiting: are 08 casting/waiting furnaces, commonly 6 furnaces operate as casting furnace and 2 as waiting furnace, where is necessary the use of cover gas. They receive the liquid magnesium (from induction furnaces), the alloying elements and production recycling (non-conform ingots, non-conform die casting pieces and die casting waste);

In the Die Casting Area:

- There are 12 units of die casting, where is necessary the use of cover gas. Die casting unit receives the liquid metal by container that is coupled at the unit. The liquid metal in injected into the first chamber, and then injected to the piece model.

In the Fusion Area, there was only one point of cover gas supply, while in the Die Casting Area, each unit injector has its own system of coverage of gas supply and some of them are supplied by the same supply point of Fusion Area.

Actually there is a central gas which provides the cover gas of dilute SO_2, Thus, there is a supply line for the Fusion Area and another line to the Die Casting Area.

Each equipment in both areas has its own system of coverage gas supply.

Liquid Magnesium transport

In its start, RIMA was only a ingot manufacture. Later, the Die Casting Area was constructed. The Die Casting Area was supplied/fed by the solid ingot produced in the Fusion Area of RIMA, which was re-melted to feed die caster, as is the common practice in the world.

Aluminium industry initiated to transport the metal in liquid form, and RIMA took this idea to make similar process for magnesium. But there is an extra difficult in doing similar process with Mg, as it could not have contact with air. Large effort of Research & Development was made.

As it is not possible to transport Mg for long distances in liquid state without cover gas, increasing the metal cost, RIMA decided to start transporting the Mg in liquid state directly from the Fusion Area to the Die Casting Area, inside the same plant, decreasing transport distance, and decreasing energy consumption to re-melt the ingots.

This is the reason RIMA is the only one integrated plant in the world, manufacturing magnesium from the raw material (dolomite), induction/casting, and die casting.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)

Brazil (host)	RIMA Industrial S/A	No
Norway	Nordic Environment Finance Corporation (NEFCO)	No
Netherlands	Electrabel NV/SA	No

A.5. Public funding of project activity

There is no public funding from Annex I countries is provided for this Project.

A.6. History of project activity

We confirm that:

(a) The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA), and;

(b) The proposed CDM project activity is not a project activity that has been deregistered.

We declare that:

(c) The proposed CDM project activity was not a CPA that has been excluded from a registered CDM PoA, and;

(d) It is not a registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity.

A.7. Debundling

Not applicable because this project activity it is a project of large-scale.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

- AM0065 - Replacement of SF_6 with alternate cover gas in the magnesium industry (version 02.1);
- Combined tool to identify the baseline scenario and demonstrate additionality (version 06.0);[7]

B.2. Applicability of methodologies and standardized baselines

Applicability Clause	Applicabitlity of the clause to the project activity
<u>Activity:</u> This methodology applies to project activities that replace the use of cover gas SF_6 in full or in part by another cover gas, HFC-134a, Perfluoro-2-methyl-3-pentanone ($CF_3CF_2C(O)CF(CF_3)_2$) or SO_2 using lean SO_2 technology.	RIMA project was replaced full SF_6 by SO_2. Since then there has been no more consumption SF_6 on RIMA magnesium plant.
<u>Facility:</u> The facility has an operating history of at least three years prior to validation.	RIMA Industrial S/A has been operational since 1987 and has more than 3 years operation history and all data is archived and available.
<u>Sector:</u> All segments of the magnesium industry where SF_6 is replaced. The magnesium metal casting industry, for the purposes of this methodology, is defined as being included in one or more of the following industry segments:	RIMA has both Primary ingot casting and Die casting processes, as well as recycle the waste from the die casting into the process again.

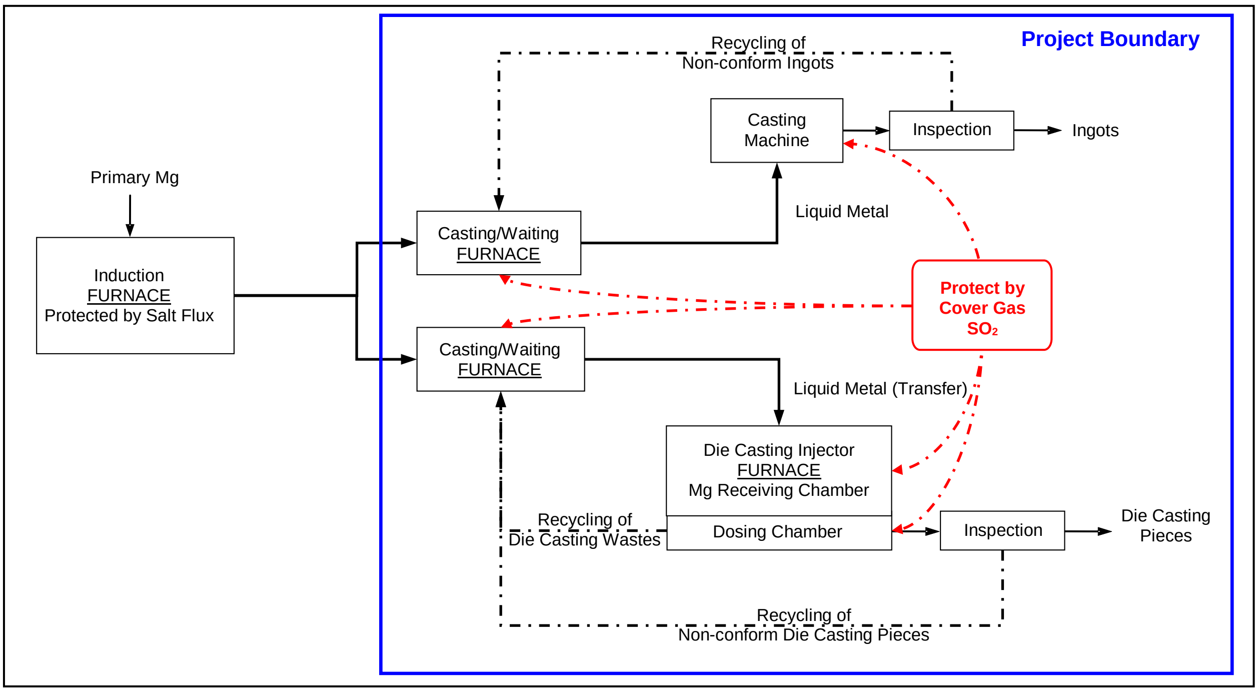
[7] The methodology and combined tool can be found at the following link: https://cdm.unfccc.int/methodologies/DB/GNX2U6RAUIP1UD1IP3CRDPVPPIGSS0

• Primary ingot casting (includes alloying furnaces, does not refer to primary magnesium production from metallic magnesium such as electrolysis or thermal reduction processes); • Die casting; • Gravity casting; • Production of secondary magnesium through recycling of magnesium or its alloys;	
Technology: If SO_2 is used as cover gas in the project activity, only "dilute SO_2" technology is used which meets the definition provided in the Definitions as per the methodology. Advanced "dilute SO_2" melt protection technology is technology that meets the following specifications: • Well controlled SO_2 concentration and flow rates with concentration typically 1 percent or less. An associated SO_2 exhausting and abatement system to ensure SO_2 emissions are in compliance with the local environmental regulations. Emissions from the facility to the ambient air should comply with the local standards of the country. If no local standards exist, the following value should be taken into account as a cap limit for SO_2 concentration in the exhausting system – 1,470 mg/m^3 (dry basis, 273 K, 101,325 kPa at an oxygen concentration of 6 %(v/v); • Precise gas mixing and delivery system using mass flow controllers (MFC) or similarly accurate device and heated gas lines to SO_2; • Gas cabinet or cylinder storage area with leak monitors and emergency ventilation system; • Redundant/back-up melt protection technology in case SO_2 leak requires system shut-down and repair; • Emergency response plan, training, and personal safety equipment; • Back-up power/generator for gas mixing system and necessary controls, compressors, etc. Capable of running independently for 12 hours; and • Maintenance plan for equipment and gas distribution system to assure safe and consistent operation.	All requirements have been met by RIMA project that is in full operation.
Regulations: Local regulations in the host country regarding SO_2 emissions in the exhausting system should be complied with. If such regulations are not in place, the following value should be taken into account as a cap limit of SO_2 concentration in the exhausting system – 1,470 mg/m^3 (dry basis, 273 K, 101,325 kPa at an oxygen concentration of 6% (v/v).	The Minas Gerais States Environmental Policies Council (COPAM - Conselho Estadual de Política Ambiental), establishes through the Deliberation number 11 of 16 December 1986, and revised by Deliberation number 01 of 24 February 1992, the SO_2 emission limit for a fixed of non-listed source is 2,500 mg/Nm^3 (ref:[8]). Since year 2013 there is a new normative deliberation COPAM number 187 of 19.09.2013

[8] SEMAD - Secretaria de Estado de Meio Ambiente e Desenvolvimento Sustentável (Environment and Sustainable Development State Secretariat):
Deliberation nº 11/1986: Available on http://www.siam.mg.gov.br/sla/download.pdf?idNorma=92;
Deliberation nº 1/1992: Available on http://www.siam.mg.gov.br/sla/download.pdf?idNorma=396;
Deliberation nº 187/2013: Available on http://www.siam.mg.gov.br/sla/download.pdf?idNorma=29875;

	that established the limit on 1,800 mg/Nm³. According to CONAMA - National Environmental Policies Council, which establishes overall frame from environmental policies, the limit concentration is dry basis; 273 K, 101,325 kPa.
Baseline: The methodology is only applicable if the baseline scenario is the continuation of current practice of using SF_6 as a cover gas.	As will be proven below in the section B.4 - Establishment and description of baseline scenario, the baseline is the continuation of current practice of using SF_6 as cover gas.
The methodology is not applicable to the following: • Sectors other than magnesium that use SF_6; • Project activities that replace the use of SF_6 with salt fluxes, or sulfur powder and; • New facilities.	• Only magnesium sector consumes SF_6 in RIMA; • SF_6 will be replaced by dilute SO_2; and • Since its start RIMA produces primary magnesium ingots, and since May 2001, has 12 injectors in die casting segment.

B.3. Project boundary, sources and greenhouse gases (GHGs)



Flowchart 2 – Simplified RIMA Magnesium Production Process (Project Boundary)

Source		GHG	Included?	Justification/Explanation
Baseline	Cover gas mix to protect molten magnesium	CO_2	No	Used in some cases as diluent to SF_6 in the cover gas mix. Since it is used both in baseline and project scenarios, for the sake of simplicity it is excluded from both calculations. When CO_2 is used only in the baseline activity, it will not be included as a conservative assumption.
		CH_4	No	CH_4 is excluded from the baseline calculations. Exclusion of this gas is conservative.
		N_2O	No	N_2O is excluded from the baseline calculations. Exclusion of this gas is conservative.
		SF_6	Yes	Major source of emissions in the baseline.
Project activity	Inserted as cover gas mix to protect molten magnesium	CO_2	No	Used as diluent in the cover gas mix. If it is used both in baseline and project scenarios, it is excluded from both calculations. If used only in project scenario, it is included in project emissions calculations.
		HFC-134a, Perfluoro-2-methyl-3-pentanone	No	Replacement gas to SF_6. Must be considered in project emission calculations. This source will be taken into account if the cover gas used is HFC-134a or Perfluoro-2-methyl-3-pentanone.
		SF_6	No	Replaced full by SO_2 (not GHGs).
	By-product of reaction between cover gas mix and molten magnesium	CH_4	No	Accounted for through the calculation of project emissions. This source will be taken into account if the cover gas used is HFC-134a or Perfluoro-2-methyl_3-pentanone.
		N_2O	No	Accounted for through the calculation of project emissions. This source will be taken into account if the cover gas used is HFC-134a.
		C_2F_6	No	Accounted for through the calculation of project emissions. This source will be taken into account if the cover gas used is HFC-134a or Perfluoro-2-methyl_3-pentanone.
		C_3F_8	No	Accounted for through the calculation of project emissions. This source will be taken into account if the cover gas used is Perfluoro-2-methyl_3-pentanone.

B.4. Establishment and description of baseline scenario

In accordance to the latest version of the "*Combined tool to identify the baseline scenario and demonstrate additionality*", the baseline definition for the project is: the continuation of the current practice, i.e., the continued SF_6 consumption.

For the second crediting period, the continued validity of the original baseline should be assessed, in accordance to the latest version of the Methodological Tool "Assessment of the validity of the original/current baseline and update the baseline at the renewal of the crediting period" (version 03.0.1), the stepwise procedure as follows should be adopted to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period:

Step 1: Assess the validity of the current baseline for the next crediting period

The Procedures for the renewal of the crediting period of a registered CDM project activity approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline. The validity of the current baseline is assessed using the following Sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

The current baseline is the continuation of SF_6 consumption, complies with all relevant mandatory national and/or sectoral policies which have come into effect after the submission of the request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period, so go to Step 1.2.

Step 1.2: Assess the impact of circumstances

When the project activity was approved in 2009, the local regulation was the deliberation normative number 01 of 1992 established the SO_2 emission limit in 2,500 mg/Nm^3

In 2013 it was published the new local regulation that is the deliberation normative number 187 of 19/09/2013 which established the new limit in 1,800 mg/Nm^3.

Therefore, the SO_2 limit emissions for internal ambient concentration purposes in the project activity has reduced from 2,500 mg/Nm^3 to 1,800 mg/Nm^3.

This change has no impact on project activity and/or in the baseline, since the results obtained in the measurements are far below this limit (1,800 mg/Nm^3). We presented in the table below the results of measurements of the last certificated monitoring period:

Table 1: Exhaust Gas Emission (mg/Nm^3) Internal:

	2012	2013	2013	2013	2013	2014	2014	2014	2014
Chimney	Dec	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec
1	16.72	17.27	17.33	17.37	17.43	17.37	18.08	15.70	16.96
2	17.38	16.90	17.13	17.20	17.00	17.33	17.34	18.02	17.33
3	17.02	17.23	17.23	17.10	16.83	16.70	18.31	16.73	16.94
4	16.34	17.27	16.83	17.10	17.43	16.73	17.83	18.25	16.72
5	17.41	16.90	17.13	17.17	16.70	17.13	15.95	17.41	17.64
6	16.59	17.23	17.10	17.33	17.13	17.07	16.92	16.56	16.43

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

This sub-step is not applicable since the identified baseline scenario at the validation of the project activity did not correspond to the continuation of use of the current equipments without any investment and, the projects proponents or third party (or parties) would undertake an investment later.

The necessary investments were made prior to submission of project activity for validation, and are not expected future investments related to equipment involved in the continuation of the project for the new period of crediting.

Step 1.4: Assessment of the validity of the data and parameters

According to the methodological tool "*Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period*", updates should be undertaken in the following cases:

• *Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC, for example, in guidelines for national GHG inventories, IPCC assessment report or special reports by the IPCC;*

• *Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the project and can not be updated because the historical situation does not exist anymore as a result of the CDM project activity.*

In the case of this renewal, should be considered the second option, that is the emission factors are based on the historical situation at the site of the project activity and can not be updated because the historical situation does not exist anymore as a result of the CDM project activity.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline for the second crediting period has been updated considering the changes in the value of GWP (SF_6). The GWP changed from 23,900 to 22,800 accordingly with 69th meeting EB. From January 2013 to calculate the ER will be used the value of GWP 22,800.

Step 2.2: Update the data and parameters

Considering the changes in GWP (SF_6) the calculation of baseline emissions BE_y has been revised for the second crediting period. Details see section B.6.1, B.6.2 (GWP of SF_6) and B.6.3.

B.5. Demonstration of additionality

Not applicable for the second crediting period.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

There are two ways to calculate Baseline emissions:

- **Case 1**: In case historical annual consumption for SF_6 and magnesium production **per equipment *k* in each segment *j*** is available, baseline emissions shall be calculated using the following equations; or
- **Case 2**: In case **only** the historical annual consumption for SF_6 for the **total** facility is available, emissions shall be calculated using the following equations;

For RIMA project, there is no historical annual consumption of SF_6 per equipment, **only** historical annual consumption of SF_6 for the total facility is available, therefore is used the Case 2.

Baseline Emissions shall be calculated using the following equations:

$$BE_y = P_{Mg,PJ,y} \times GWP_{SF_6} \times EF_{SF_6,Mg} \quad \textbf{(Equation 1)}$$

Where:
BE_y = Baseline emissions in year "*y*" (tCO_2e/yr)
$EF_{SF6,Mg}$ = Baseline emission factor for the facility calculated as the minimum emission factor for 3 years of data (tSF_6/tMg)
$P_{Mg,PJ,y}$ = Annual amount of Mg products manufactured in project scenario in the facility per year "*y*"
GWP_{SF6} = Global Warming Potential of SF_6 (tCO_2e/tSF_6)

$$EF_{SF_6,Mg} = Min\left\{\frac{C_{SF6,EM,BL,y}}{P_{Mg,BL,Total,y}}\right\} \quad \textbf{(Equation 2)}$$

y = 1,2,3 (corresponding to the last three years before the implementation of the project activity)

Where:
$P_{Mg,BL,Total,y}$ = Total Amount of Mg products manufactured in baseline scenario in the facility in year "*y*" for each year of the 3 years prior to the project. One year may be used if 3 years of data are not available (tMg/yr)
$C_{SF6,EM,BL,y}$ = Total SF_6 actually emitted in the baseline in the facility in year "*y*" (tSF_6/yr)

$$C_{SF_6,EM,BL} = C_{SF_6,CON,BL} \times DF_{SF_6}$$ **(Equation 3)**

Where:
$C_{SF6,CON,BL}$ = Total annual consumption of SF_6 in the industrial facility, in the baseline (tSF_6/yr)
DF_{SF6} = Degradation Factor of SF_6 that reacts with the magnesium in the production process assumed as 0.5[9]

For the purpose of ex ante baseline calculations for reporting in the CDM-PDD, future production levels shall be assumed as the past 3-year minimum production levels i.e. $P_{Mg,PJ,y} = P_{Mg,Bl,Total}$.

The Annual Consumption of SF_6 ($C_{SF6,CON,BL}$) shall be estimated as the minimum of the following values:

- Minimum of Annual TOTAL consumption of SF_6 in the facility for the last three years prior to validation (1 year data can be used in case 3 years data are not available) ($C_{SF6,Total,BL}$), multiplied by data integrity factor $DI_{SF6,CON,BL}$, which is a conservative factor portraying the Data Integrity of measured total SF_6 consumption, estimated as per information in Data and Parameters not monitored section; and

- Total consumption of SF_6 in the facility, per year as per the 2006 IPCC Guidelines ($C_{SF6,IPCC,BL}$) as per following equation;

$$C_{SF_6,IPCC,BL} = C_{SF_6,SPIPCC} \times P_{Mg,BL,Total}$$ **(Equation 4)**

Project emissions

Project emissions include:

- Emissions from the cover gas used: HFC-134a or Perfluoro-2-methyl-3-pentanone;

- Emissions from the use of SF_6, if any; and

- Emissions from the consumption of CO_2, in case it is only used in the project scenario and not in the baseline.

In the RIMA project activity, none of the gases above will be used during crediting period.

Leakage
No leakage is expected from the project activity.

Emission reductions
Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ **(Equation 5)**

Where:
ER_y = Emission reductions in year "*y*" (tCO_2e/yr)
BE_y = Baseline emissions in year "*y*" (tCO_2e/yr)
PE_y = Project emissions in year "*y*" (tCO_2/yr)

[9] The Board after due consideration of available literature and structural design of the magnesium production facilities arrived at the conclusion that in absence of a proper system to collect the covers gases and exhaust, the uncertainties in current procedures to estimate the SF6 destruction are very high. Therefore, a conservative default has been provided to ensure that emission reductions credited are real. Project Proponents are encouraged to submit to the Board request for revision of the methodology describing new procedures for undertaking measurement on project site to estimate the destruction efficiency. Procedures should be sufficiently robust, based as much as possible in International Standards and properly documented to ensure reliable estimates. The procedures should be based on experimentation of sufficient duration taking into account the variability in equipment used in different segments, variations in operating conditions/practices, different type of alloys manufactured and similar other real-time production issues.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	GWP_{SF6}
Data unit	tCO_2e/tSF_6
Description	Global Warming Potential of SF_6
Source of data	CDM EB69
Value(s) applied	22,800
Choice of data or Measurement methods and procedures	Provided by the IPCC and EB69, Annex 3 to calculate the global warming potential of SF_6. Prior to the renewal of a crediting period it should be assessed if GWP values have changed.
Purpose of data	Baseline emission
Additional comment	The GWP changed from 23,900 to 22,800 accordingly with 69th meeting EB. From January 2013 to calculate the ER it will be used the value of GWP 22,800.

Data / Parameter	$P_{Mg,BL,TOTAL,y}$
Data unit	tMg/yr
Description	Amount of Mg products manufactured in baseline scenario in the facility in year y for each year y of the 3 years prior to the project. One year may be used if 3 years of data are not available (tMg/yr)
Source of data	Industrial facility
Value(s) applied	Year / tMg 2005 / 19,744 2006 / 21,964 2007 / 24,334
Choice of data or Measurement methods and procedures	Production data is based on sale amount, and not gross production. All non-conformance products are excluded.
Purpose of data	Baseline emission
Additional comment	-

Data / Parameter	$C_{SF6,TOT,BL}$
Data unit	tSF_6
Description	Minimun of annual TOTAL consumption of SF_6 in the facility for the last three years prior to validation
Source of data	Industrial facility
Value(s) applied	Year / tSF_6 2005 / 19.050 2006 / 21.550 2007 / 25.950
Choice of data or Measurement methods and procedures	RIMA measurement method is a combined from 2 methods recommended by IPCC: • *Recording delivered purchases and inventory changes (accounting method); and* • *Measuring the difference in cylinder weight for gas used/returned (weight difference method).* The used cylinders are weighted to ensure that they are empty, if not, the cylinder is returned to the process to use its full content.
Purpose of data	Baseline emission
Additional comment	-

Data / Parameter	**GWP_{ALTGAS}**
Data unit	tCO_2e/t alternative gas
Description	Global Warming Potential of alternate gas.
Source of data	CDM EB
Value(s) applied	0
Choice of data or Measurement methods and procedures	Prior to the renewal of a crediting period it should be assessed if GWP values have changed
Purpose of data	Baseline emission
Additional comment	SO_2 will be used as an alternative cover gas, thus generating no by-products which are greenhouse gases.

Data / Parameter	**$DI_{SF6,CON,BL,k,j}$/$DI_{SF6,CON,BL}$**
Data unit	Fraction
Description	A conservative factor portraying the Data Integrity of measured consumption of SF_6 in each equipment "*k*" in each segment "*j*" ($C_{SF6,CON,BL,k,j,}$) and measured total consumption of SF_6 in the facility ($C_{SF6,Total,BL}$). Default = 0.95.
Source of data	*IPCC Guidelines 2006*
Value(s) applied	*Default = 0.95*
Choice of data or Measurement methods and procedures	Following the IPCC recommendation, is used conservatively the lowest 0.95 uncertainty level. Prior to the renewal of a crediting period it should be assessed if the Conservative Factor default should be changed.
Purpose of data	Baseline emission
Additional comment	This value shall account for the uncertainty in SF_6 consumption. IPCC guidelines state that direct reporting has a 5% uncertainty level[10]. 0.95 shall be used as the default factor unless the project proponent can demonstrate to the DOE that their estimates of measured consumption of SF_6 in each equipment "*k*" in each segment "*j*" ($C_{SF6,CON,BL,k,j}$) or measured total consumption of SF_6 in the facility ($C_{SF6,CON,BL,k,j}$) are more than 95% accurate. Project proponents that submit monitoring data for measured consumption of SF_6 in each equipment "*k*" in each segment "*j*" ($C_{SF6,CON,BL,k,j}$) or measured total consumption of SF_6 ($C_{SF6,Total,BL}$) using two or more of measurement procedures listed in the monitoring section (e.g., both the weight difference and accounting method), and can consistently demonstrate a difference of less than 5% between these two estimates over the time series are allowed to multiply their SF_6 consumptions by a factor greater than 0.95. In no case should a factor of 100% be used.

Data / Parameter	**$DI_{SF6,CON,PJ,k,j,y}$**
Data unit	%
Description	A conservative factor portraying the Data Integrity of $C_{SF6,CON,PJ,k,j,y}$ in each segment, per year. Default = 1.05.
Source of data	IPCC Guidelines 2006
Value(s) applied	Default = 1.05
Choice of data or Measurement methods and procedures	Following the IPCC recommendation, is used conservatively the highest: 1.05 uncertainty level. Prior to the renewal of a crediting period it should be assessed if the Conservative Factor default should be changed.

[10] 2006 IPCC Guidelines for NGGI PA. 4.68.

Purpose of data	Baseline emission
Additional comment	This value shall account for the uncertainty in SF_6 consumption. IPCC guidelines state that direct reporting has a 5% uncertainty level[11]. 1.05 shall be used as the default factor unless the project proponent can demonstrate to the DOE that their estimates of $C_{SF6,CON,BL,k,j,y}$ are more than 95% accurate. Project proponents that submit monitoring data for $C_{SF6,CON,BL,k,j,y}$ using two or more of measurement procedures listed in the monitoring section (e.g., both the weight difference and accounting method), and can consistently demonstrate a difference of less than 5% between these two estimates over the time series should then be allowed to multiply their SF_6 consumptions by a factor smaller than 1.05. In no case should a factor of 100% be used.

Data / Parameter	**DF_{SF6}**
Data unit	Fraction
Description	Degradation Factor of SF_6 that reacts with the magnesium in the production process assumed as 0.5.
Source of data	According to AM0065, version 02.1.
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	The Board after due consideration of available literature and structural design of the magnesium production facilities arrived at the conclusion that in absence of a proper system to collect the covers gases and exhaust, the uncertainties in current procedures to estimate the SF_6 destruction are very high. Therefore, a conservative default has been provided to ensure that emission reductions credited are real. Project proponents are encouraged to submit new procedures for undertaking measurement on project site to estimate the destruction efficiency. Procedures should be sufficiently robust, based as much as possible in International Standards and properly documented to ensure reliable estimates. The procedures should be based on experimentation of sufficient duration taking into account the variability in equipment used in different segments, variations in operating conditions/practices, different type of alloys manufactured and similar other real-time production issues.
Purpose of data	Baseline emission
Additional comment	Prior to the renewal of a crediting period it should be assessed if the Degradation Factor default should be changed.

B.6.3. Ex ante calculation of emission reductions

Baseline Emission Factor for the facility ($EF_{SF6,Mg}$)

The Annual Consumption of SF_6 ($C_{SF6,CON,BL}$) shall be estimated as the minimum of the following values:

- Minimum of Annual TOTAL consumption of SF_6 in the facility for the last three years prior to validation (1 year data can be used in case 3 years data are not available) ($C_{SF6,TOTAL,BL}$), multiplied by data integrity factor $DI_{SF6,CON,BL}$, which is a conservative factor portraying the Data Integrity of measured total SF_6 consumption, estimated as per information in Data and Parameters not monitored section; and

- Total consumption of SF_6 in the facility, per year as per the 2006 IPCC Guidelines ($C_{SF6,IPCC,BL}$) as per following equation:

$$C_{SF_6,IPCC,BL} = C_{SF_6,SPIPCC} \times P_{Mg,BL,TOTAL} \quad \textbf{(Equation 4)}$$

Where:
$C_{SF6,SPIPCC}$ = Specific consumption of SF_6 in each equipment "*k*" of each segment "*j*" as per 2006 IPCC Guidelines (0.001tSF_6/tMg casting).

[11] 2006 IPCC Guidelines for NGGI pa. 4.68.

Annual Consumption of SF_6:

Historical consumption

Year	$C_{SF6,TOTAL,BL}$ (tSF_6/yr)
2005	19.050
2006	21.550
2007	25.950
Minimum	**19.050**

IPCC Guidelines Equation

$C_{SF6,IPCC}$ (0.001 tSF_6/ tMg casting)	$P_{Mg,Bl,TOTAL}$ (tMg/yr)	$C_{SF6,IPCC,BL}$ (tSF_6/yr)
0.001	19,744	19.744
0.001	21,964	21.964
0.001	24,334	24.334
Minimum	19,744	19.744

Minimal amount of SF_6 consumption is delivered from the historical consumption, thus:

$C_{SF6,CON,BL}$ = 19.050 x $DI_{SF6,CON,BL}$

$C_{SF6,CON,BL}$ = 19.050 x 0.95

$C_{SF6,CON,BL}$ = 18.098 tSF_6/yr

Applying this value in:

$$C_{SF_6,EM,BL} = C_{SF_6,CON,BL} \times DF_{SF_6}$$ **(Equation 3)**

$C_{SF6,EM,BL}$ = 18.098 x 0.5 = 9.049 tSF_6/yr

Applying this value in:

$$EF_{SF_6,Mg} = Min\left\{\frac{C_{SF6,EM,BL,y}}{P_{Mg,BL,Total,y}}\right\}$$ **(Equation 2)**

$EF_{SF6,Mg} = \frac{9.049}{19,744} = 0.000458$ tSF_6/tMg

For the calculation of estimates of baseline emissions for the second crediting period for this project, the estimated production of magnesium ($P_{Mg,Bl,TOTAL,y}$) for this crediting period is required. Thus:

Table 2: Estimated Project Annual Mg Production

Period	**Project Annual Mg production (t)**		
	Ingot + Liquid Metal	**Die Casting Pieces**	**Total**
02/07/2016 to 31/12/2016	11,566	836	12,402
2017	24,451	1,672	26,123
2018	25,845	1,672	27,517
2019	27,318	1,672	28,990
2020	28,875	1,672	30,547
2021	28,875	1,672	30,547
2022	28,875	1,672	30,547
01/01/2023 to 01/07/2023	14,398	834	15,232
TOTAL	190,203	11,702	201,905

Applying the values related to the: total estimated production for first period (02/07/2016 to 31/12/2016), GWP and EF, we have:

$$BE_y = P_{Mg,PJ,y} \times GWP_{SF_6} \times EF_{SF_6,Mg}$$ (**Equation 1)**

BEy = 12,402 x 22,800 x 0.000458

BEy = 129,507

Applying the "Equation 1" for all production estimates to calculated the baseline emissions, as shown below:

Table 3: Estimated Project Annual Baseline Emissions

Project Annual Baseline Emissions (t/yr)							
No	**Year**	**Fusion + Primary Ingot + Liquid Mg**	**Die Casting**	**Total**	**GWP SF_6**	**EF SF_6,Mg (tSF_6/tMg)**	**BE tCO_2/year**
1	02/07/2016 to 31/12/2016	11,566	836	12,402	22,800	0.000458	129,507
2	2017	24,451	1,672	26,123	22,800	0.000458	272,787
3	2018	25,845	1,672	27,517	22,800	0.000458	287,344
4	2019	27,318	1,672	28,990	22,800	0.000458	302,725
5	2020	28,875	1,672	30,547	22,800	0.000458	318,984
6	2021	28,875	1,672	30,547	22,800	0.000458	318,984
7	2022	28,875	1,672	30,547	22,800	0.000458	318,984
8	01/01/2023 to 01/07/2023	14,398	834	15,232	22,800	0.000458	159,059

Detailed calculation is available in the spreadsheet “RIMA_SF6_CER.xls”.

Regarding leaks according section B.6.1 no leakage is expected from the project activity.

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ **(Equation 5)**

However, according to section B.6.1 should not consider project emissions (PE_y). Thus, emission reductions (ER_y) will equal the baseline emissions (BE_y).

B.6.4. Summary of ex ante estimates of emission reductions

To carry out the projection the estimation of Emission to the second period of this project (Years: 2016-2023), was considered the following assumptions:

- The 1st emission reduction period is valid until 01/07/2016;
- The 2nd emission reduction period begins on 02/072016;
- To project magnesium production for the 2nd emission reduction period was considered effective production of magnesium (Fusion Area + Die Casting Area) certified in the years 2012-2014 as the baseline;
- In the year 2015 there is an increase of 9.20% in magnesium production of Fusion Area (ingots + liquid metal) in the period from January-September of the year 2015 compared to the same period in 2014. This increase in the production of Fusion Area is due to increased magnesium demand in foreign markets mainly and in several segments of industries (aluminium, automotive, aerospace, and others) where is applied; and

- For the period 2016-2020 it is expected an increase in the production of Fusion Area of 5.70%, in average. This percentage corresponds to the average annual increase in production of Fusion Area between 2011 and 2014.

Table 4: Estimative of Baseline Emissions for the 2nd Period

Year	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage (tCO_2e)	Emission reductions (tCO_2e)
02/07/2016 to 31/12/2016	129,507	0	0	129,507
2017	272,787	0	0	272,787
2018	287,344	0	0	287,344
2019	302,725	0	0	302,725
2020	318,984	0	0	318,984
2021	318,984	0	0	318,984
2022	318,984	0	0	318,984
01/01/2023 to 01/07/2023	159,059	0	0	159,059
Total	2,108.374	0	0	2,108.374
Total number of crediting years	7 years			
Annual average over the crediting period	301,196	0	0	301,196

About the emissions of reduction for the second period of this project (2016-2023), RIMA has an ERPA (Emission Reduction Purchase Agreement) to sell the volumes that will be generated until year 2020.

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$P_{Mg,PJ,k,j,y}$
Data unit	tMg/yr
Description	Production output: annual amount of Mg or Mg products manufactured in project scenario in each equipment "*k*" in each segment "*j*", per year.
Source of data	Industrial Facility
Value(s) applied	See table below. Estimated for total plant, not by equipment.

Period	Total Net Production (t)		
	Primary Ingot + Liquid Metal	Die Casting Pieces	Total
02/07/2016 to 31/12/2016	11,566	836	12,402
2017	24,451	1,672	26,123
2018	25,845	1,672	27,517
2019	27,318	1,672	28,990
2020	28,875	1,672	30,547
2021	28,875	1,672	30,547
2022	28,875	1,672	30,547
01/01/2023 to 01/07/2023	14,398	834	15,232
TOTAL	190,203	11,702	201,905

Estimated for total plant, not by equipment.

Measurement methods and procedures	**<u>Produced amount</u>** of ingots, liquid metal and die casting pieces are measured by calibrated scales in various points of the plant. These values are used to calculate emission reductions. **<u>Sold amount</u>** of ingots and die casting pieces are measured by calibrated scale (01 BAL 0005) at the Gatehouse. All weighting procedures are in accordance to on-site working procedures. These values are used to cross-check purpose.
Monitoring frequency	Continuously
QA/QC procedures	Measurement data to be cross-checked with internal sales and stock reports. QA/QC procedures are explained in Appendix 5. The scales are calibrated with an annual frequency.
Purpose of data	Baseline emission
Additional comment	-

Data / Parameter	$C_{SF6,CON,PJ,k,j,y}$
Data unit	tSF_6/yr
Description	The total consumption of SF_6 in the industrial facility in the project scenario in each equipment “k” in each segment “j”, per year.
Source of data	Industrial Facility
Value(s) applied	0 There was no SF_6 consumption in the project activity. All SF_6 system was substituted to the SO_2 system.
Measurement methods and procedures	*As recommended by IPCC direct reporting of SF_6 consumption can be measured in the following ways:* • *Recording delivered purchases and inventory changes (accounting method);* • *Measuring the difference in cylinder weight for gas used/returned (weight difference method); and* • *Measuring flow rates and integrating over time (flow measurement method).* *If more than one method is used for measurement, use the highest value for calculation of project emission.*
Monitoring frequency	Once at first verification
QA/QC procedures	Not Applicable, as there is no SF_6 usage.
Purpose of data	Project emission
Additional comment	-

Data / Parameter	$C_{ALTGAS,PJ,k,j,y}$
Data unit	t/yr
Description	Consumption of alternate gas SO_2, in project scenario for each equipment *“k”* in each segment *“j”* per year.
Source of data	Industrial Facility

<table>
<tr><td>Value(s) applied</td><td>
<table>
<tr><td>Period</td><td>Total Production Mg (t)</td><td>Total SO_2 Consumption (t)</td></tr>
<tr><td>02.07.2016 to 12.31.2016</td><td>12,402</td><td>5.590</td></tr>
<tr><td>2017</td><td>26,123</td><td>11.776</td></tr>
<tr><td>2018</td><td>27,517</td><td>12.404</td></tr>
<tr><td>2019</td><td>28,990</td><td>13.068</td></tr>
<tr><td>2020</td><td>30,547</td><td>13.770</td></tr>
<tr><td>2021</td><td>30,547</td><td>13.770</td></tr>
<tr><td>2022</td><td>30,547</td><td>13.770</td></tr>
<tr><td>01.01.2023 to 01.07.2023</td><td>15,232</td><td>6.866</td></tr>
<tr><td>TOTAL</td><td>201,905</td><td>91.014</td></tr>
</table>
Estimated for total plant, not by equipment.</td></tr>
<tr><td>Measurement methods and procedures</td><td>The same procedures recommended by IPCC for direct reporting of SF_6 consumption, used in the baseline scenario will be used for SO_2:

RIMA measurement and calculate method is a combined from 2 methods recommended by IPCC:

• Recording delivered purchases and inventory changes (accounting method); and
• Measuring the difference in cylinder weight for gas used/returned (weight difference method).

The used cylinders are weighted to ensure that they are empty, if not, the cylinder is returned to the process to use its full content.</td></tr>
<tr><td>Monitoring frequency</td><td>Accounting Method - once purchase is made
Weight difference method – once cylinder is replaced</td></tr>
<tr><td>QA/QC procedures</td><td>See Appendix 5, for details of QA/QC procedures.</td></tr>
<tr><td>Purpose of data</td><td>Other (parameter not used for emissions calculation, but for reference)</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

Data / Parameter	**SO_2** emissions
Data unit	mg/m³
Description	SO_2 emissions
Source of data	External Laboratory Analysis
Value(s) applied	1,800 mg/Nm³ for internal atmosphere[12]; and 365 µg/m³ to external atmosphere[13].
Measurement methods and procedures	See Appendix 5, for details of measurement methods and procedures.
Monitoring frequency	On-site periodically measurement (4 four times a year), outsourced by an external laboratory specialized.

[12] Deliberation nº 187/2013: Available on http://www.siam.mg.gov.br/sla/download.pdf?idNorma=29875;
[13] MMA – Ministério do Meio Ambiente (Ministry of the Environment):
Resolution 003/1990: Available on: http://www.mma.gov.br/port/conama/res/res90/res0390.html;

QA/QC procedures	The analysis equipment are calibrated by the manufacture. Local Regulation: • CONAMA – National Environmental Policies Council (Air Quality Standard: 365 µg/m³); and • COPAM – Minas Gerais States Environmental Policies Council (Exhaust Gas Emission Limit: 1,800 mg/Nm³). Reference methods: • Reference methods in the methodology for measuring ambient air quality: ABNT NBR 9,546, ABNT NBR 10,562; and • Reference methods in the methodology for measuring on the exhaust gas emission: ABNT NBR 10,700, ABNT NBR 10,701, ABNT NBR 10,702, ABNT NBR 11,966/MB 3080, ABNT NBR 12,020, ABNT NBR 12,022/MB 3358 e CETESB L9,240.
Purpose of data	Other. Emissions from the facility to the ambient air should comply with the local standards of the country. If SO_2 emissions do not comply with the above, the CERs cannot be claimed for the period between the last issuance of CERs (or registration for the first verification period) and the date where non-compliance was detected.
Additional comment	-

Data / Parameter	**Magnesium sales reports**
Data unit	tMg/yr
Description	In order to dispel concerns that a company increases production levels just to gain more CERs, the project developers must show proof of sales of magnesium.
Source of data	Industrial Facility
Value(s) applied	Not applicable
Measurement methods and procedures	Sold amount of ingots and die casting pieces are measured from scale (01 BAL 0005) at the Gatehouse. The liquid metal is an internal sale, therefore with no sale invoice, but only internal reports. Sold amount of liquid metal are measured from scale (03 BAL 0001) at the Buffer Area. Annual Magnesium sales shall be compared to $P_{Mg,PJ,k,j,y}$.
Monitoring frequency	Annually
QA/QC procedures	The magnesium sales reports shall be verified by DOE as part of the verification process. QA/QC procedures are explained in Appendix 5. The scales are calibrated with an annual frequency.
Purpose of data	Cross-check for Baseline emission. If less than 70% of total magnesium produced was sold then the value of annual magnesium sales shall be used as the value for $P_{Mg,PJ,k,j,y}$. Unless a project developer can prove to DOE that a decline in demand had occurred (due to sector price changes or other reasons) or that producing 30% more than sales is the common practice in the plant and was common practice prior to the implementation of CDM project activity.
Additional comment	-

B.7.2. Sampling plan

The sampling plan should contain information relating to: (A) sampling design; (B) data to be collected; and (C) implementation plan.

a. Sampling design

a.1 Objectives and reliability requirements

In accordance to the latest version of the “Standard - Sampling and surveys for CDM project activities and programmes of activities" (version 05) and the latest version of the “Guideline - Sampling and surveys for CDM project activities and programmes of activities" (version 04.0), the objective of Sampling Plan is determining the mean monthly value of parameter of interest $P_{(Mg,PJ,k,j,y)}$ for the baseline and second crediting period.

The parameter $P_{(Mg,PJ,k,j,y)}$ is defined by summing the weights of net ingots, total liquid metal and net die casting pieces.

In the production of Rima process, the production of ingots and liquid metal is measured and registered by weight, therefore, the production data are in the same unit/criteria that the parameter $P_{(Mg,PJ,k,j,y)}$.

In the case of die casting pieces the registry of production is given by the quantity produced and not by its weight. Thus, it is necessary to adjust this unit/criteria to the same used by parameter $P_{(Mg,PJ,k,j,y)}$.

The first option would weigh all the die casting pieces produced, but this option is not viable due to the large number of pieces produced. Thus, in the case of die casting pieces for to obtain weight produced a random sampling is carried out, the weight of the sample is used to determine the monthly average weight of the die casting pieces, finally this monthly average weight is multiplied by the quantity of produced die casting pieces.

In relation to the reliability requirements according to the definition in section 4 of “Appendix 4: Best-practice examples for reliability calculations” of the “Guideline - Sampling and surveys for CDM project activities and programmes of activities”. The reliability in the case of large-scale projects shall be verified considering 95/10 confidence/precision.

a.2 Target population

The target population is defined by all types of the die casting pieces of magnesium. The produced amount of die casting pieces represents one of values to used for calculation the total produced amount of magnesium.

a.3 Sampling method

The sampling method chosen is stratified random sampling, the choice this method is justified, especially:

- the target population is not homogeneous but instead consists of several sub-populations or strata are homogeneous;
- is most applicable to situations where there are obvious groupings of population elements whose characteristics are more similar within groups than across groups;
- improves the precision of the estimate (compared to simple random sampling) if there are differences between the strata; and
- ensures that the estimates of a population characteristic are accurate, especially if there are differences amongst the strata.

Therefore, is verified that between each type of die casting piece the characteristics are heterogeneous but the same types of pieces have homogeneous characteristics.

a.4 Sample size

The calculations for sample size were based on definition in section 3.2 and 3.2.1 of “Appendix 1: Best-practice examples for sample size calculations” of the “Guideline - Sampling and surveys for CDM project activities and programmes of activities”.

The sample size must be estimated considering the total number of die casting pieces produced, the average weight of each type of die casting pieces, standard deviation and the level of reliability/precision.

The total number of die casting pieces produced used for sample size calculation refers to the period corresponding to the Monitoring Period # 7 (01/10/2012 to 31/12/2014), thus, the data has already been validated during monitoring.

A summary of each stratification group is given below:

Table 5: Summary of Stratification Group

Number	Stratification group Mg die casting pieces	Number of pieces produced per month	Mean (Kg)	Standard Deviation (Kg)
1	Bicycle Fork	1,871	0.592500	0.007542
2	Engine Block (R)	789	5.356188	0.143314
3	Engine Block (L)	855	5.740056	0.131568
4	Clutch Housing (107-JN)	19,530	4.523445	0.025415
5	Transmission Housing (103 L)	3,286	3.812929	0.026780
6	Transmission Housing (103 AA)	17,815	3.727528	0.025349
7	Steering Wheel (GM)	3,005	0.488500	0.002121
8	Steering Wheel (Ford)	3,052	0.621500	0.000707
-	Total - Number of pieces produced	50,203	-	-

a. Using the data in the table above, one can estimate the overall mean and standard deviation:

Overall mean:

$$mean = \frac{(g_a \times m_a) + (g_b \times m_b) + (g_c \times m_c) + \cdots + (g_k \times m_k)}{N}$$

(Equation 6)

Where:
mean = Weighted overall mean
g_i = Size of the i[th] group where i=1,…,k
m_i = Mean of the i[th] group where i=1,…,k
N = Population total

b. Substituting the values from our example into the above expression gives:

$$mean = \frac{(1{,}871 \times 0.592500) + (789 \times 5.356188) + \cdots + (3{,}052 \times 0.621500)}{50{,}203}$$

(Equation 6)

$$mean = 3.603075$$

c. Overall Standard Deviation:

$$SD = \sqrt{\frac{(g_a \times SD_a^2) + (g_b \times SD_b^2) + (g_c \times SD_c^2) + \cdots + (g_k \times SD_k^2)}{N}}$$

(Equation 7)

Where:
SD = Weighted overall standard deviation

SDi = Standard deviation of the i^{th} group where i=1,…,k, (note that these are all squared – so the group size is actually being multiplied by the group variance)

d. Using the values from our example gives:

$$SD = \sqrt{\frac{(1{,}871 \times 0.007542^2) + (789 \times 0.143314^2) + \cdots + (3{,}052 \times 0.000707^2)}{50{,}203}} \quad \textbf{(Equation 7)}$$

$$SD = 0.033856$$

e. The sample size equation uses the overall mean and standard deviation calculated above:

$$n \geq \frac{1.96^2 \times NV}{(N-1) \times 0.1^2 + 1.96^2 V} \quad \textbf{(Equation 8)}$$

Where:

V = $\left(\frac{SD}{mean}\right)^2$

n = Sample size
N = Population total
mean = Weighted overall mean
SD = Weighted overall standard deviation
1.96 = Represents the 95% confidence required
0.1 = Represents the 10% precision

f. Substituting in the values from our examples gives:

$$V = \left(\frac{SD}{mean}\right)^2 = \left(\frac{0.033856}{3.603075}\right)^2 = 0.000088 \quad \textbf{(Equation 9)}$$

$$n = \frac{1.96^2 \times N \times V}{(N-1) \times 0.1^2 + 1.96^2 \times V} = 0.033920 \quad \textbf{(Equation 8)}$$

g. This gives us the total number of pieces that should be sampled across the eight pieces types. The section below assumes proportional allocation – which means that the number of pieces we want to sample from each piece type is proportional to the number of total produced by each piece type within the population.

General equation: $n_1 = \frac{g_1}{N} \times n$ **(Equation 10)**

h. According to the formula presented above follows detailed table to the calculations of sample size for each type of Mg die casting pieces:

Table 6: Detailed Calculations of Sample Size

Pieces/ Parameter	1 Bicycle Fork	2 Engine Block (R)	3 Engine Block (L)	4 (107-JN)	5 (103 L)	6 (103 AA)	7 Steering Wheel (GM)	8 Steering Wheel (Ford)
g	1,871	789	855	19,530	3,286	17,815	3,005	3,052
N	50,203	50,203	50,203	50,203	50,203	50,203	50,203	50,203
g/N	0.037269	0.015716	0.017031	0.389021	0.065454	0.354859	0.059857	0.060793
n	0.033920	0.033920	0.033920	0.033920	0.033920	0.033920	0.033920	0.033920
n_1	0.001264	0.000533	0.000578	0.013196	0.002220	0.012037	0.002030	0.002062
n_2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

i. Completing these table results in a sample consisting of a sample (rounding to an integer) for each type of die casting pieces. However, after checking the reliability came to the ideal number of 3 samples per month for each type of piece. Adding these sample sizes (group 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 = 24). For more details see section "Reliability calculations" below.

j. The sample size calculated above assumes 100% response, as in the case of this project the data are obtained directly from the project site.

Reliability calculations

The calculations for reliability were based on definition in section 4 of “Appendix 4: Best-practice examples for reliability calculations” of the “Guideline - Sampling and surveys for CDM project activities and programmes of activities”. The reliability in the case of large-scale projects shall be verified considering 95/10 confidence/precision.

Standard error of the mean

The equation for the standard error of the mean when data have been collected using simple random sampling is:

$$SE_1 = \sqrt{(1 - f_1)\frac{s_1^2}{n_1}} \qquad \text{(Equation 11)}$$

Where:

SE = Standard error

f = Sampling fraction $f_1 = \frac{n_1}{g_1}$ (**Equation 12)**

n = Sample size
s^2 = Sample variance
g = Size of the group

t-value

This value depends on (i) the level of confidence and (ii) the size of the sample. The exact figure can be acquired from statistical tables for the t-distribution, or using standard statistical software. The value can also be derived in Microsoft Excel using the TINV function.

Precision

The precision associated with an estimate is:

$$precision_1 = t-value_1 \times SE_1$$ (**Equation 13)**

The ratio of this precision is:

$$ratio_1 = \frac{precision_1}{mean_1}$$ (**Equation 14)**

And so the relative precision is:

$$precision_{relative} = ratio_1 \times 100$$ (**Equation 15)**

According to the formulas presented above follows detailed table to the calculations of reliability for each type of die casting piece of magnesium considering n=1:

Table 7: Detailed Calculations of Reliability (n=1)

Pieces/ Parameter	1 Bicycle Fork	2 Engine Block (R)	3 Engine Block (L)	4 (107-JN)	5 (103 L)	6 (103 AA)	7 Steering Wheel (GM)	8 Steering Wheel (Ford)
n	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
g	1,871	789	855	19,530	3,286	17,815	3,005	3,052
f	0.00053447	0.00126743	0.00116959	0.00005120	0.00030432	0.00005613	0.00033278	0.00032765
(1-f)	0.99946553	0.99873257	0.99883041	0.99994880	0.99969568	0.99994387	0.99966722	0.99967235
s	0.00754219	0.14331421	0.13156813	0.02541486	0.02677963	0.02534875	0.00212132	0.00070711
s^2	0.00005688	0.02053896	0.01731017	0.00064592	0.00071715	0.00064256	0.00000450	0.00000050
s^2/n	0.00005688	0.02053896	0.01731017	0.00064592	0.00071715	0.00064256	0.00000450	0.00000050
SE	0.00754017	0.14322336	0.13149117	0.02541421	0.02677555	0.02534804	0.00212097	0.00070699
t-value	12.70620473	12.70620473	12.70620473	12.70620473	12.70620473	12.70620473	12.70620473	12.70620473
precision	0.09580698	1.81982534	1.67075371	0.32291820	0.34021563	0.32207741	0.02694945	0.00898317
mean	0.59250000	5.35618750	5.74005556	4.52344481	3.81292857	3.72752778	0.48850000	0.62150000
ratio	0.16169955	0.33976132	0.29106926	0.07138767	0.08922686	0.08640510	0.05516775	0.01445402
relative precision	16.17%	33.98%	29.11%	7.14%	8.92%	8.64%	5.52%	1.45%

As it can be seen in the above table the result of the accuracy of samples of the pieces Bicycle Fork, Engine Block (R) and Engine Block (L) was 16.17%, 33.98% and 29.11%, respectively. However, these results do not meet the required specifications for reliability/precision accordingly the sample size should be corrected.

For a sample size that does not meets the criteria of reliability/precision it is necessary to make some corrections. According to section 6 "How to deal with failure to Achieve reliability" of appendix 4 and sub-section 6.7 "Analysis approach 3: Take an additional sample", another option to improve the precision of the data is to take an additional sample. It is also advisable to try different combinations of the values in order to identify a total sample size which will be large enough to address the reliability concern.

Thus, the tests began to taking an additional sample for all types of pieces, but the result was not satisfactory. Continuing the tests it took up two additional samples and after the completion of reliability calculations the results obtained met the criteria of reliability/precision of 95/10, because, in any of the types of die casting pieces the relative precision did not exceeded the limit 10%.

Following detailed table with reliability calculations for each type of die casting pieces of magnesium, considering one original sample and two additional samples, n = 3:

Table 8: Detailed Calculations of Reliability (n=3)

Pieces/ Parameter	1 Bicycle Fork	2 Engine Block (R)	3 Engine Block (L)	4 (107-JN)	5 (103 L)	6 (103 AA)	7 Steering Wheel (GM)	8 Steering Wheel (Ford)
n	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
g	1,871	789	855	19,530	3,286	17,815	3,005	3,052
f	0.00160342	0.00380228	0.00350877	0.00015361	0.00091296	0.00016840	0.00099834	0.00098296
(1-f)	0.99839658	0.99619772	0.99649123	0.99984639	0.99908704	0.99983160	0.99900166	0.99901704
s	0.00754219	0.14331421	0.13156813	0.02541486	0.02677963	0.02534875	0.00212132	0.00070711
s^2	0.00005688	0.02053896	0.01731017	0.00064592	0.00071715	0.00064256	0.00000450	0.00000050
s^2/n	0.00001896	0.00684632	0.00577006	0.00021531	0.00023905	0.00021419	0.00000150	0.00000017
SE	0.00435099	0.08258504	0.07582751	0.01467215	0.01545416	0.01463388	0.00122413	0.00040805
t-value	4.30265273	4.30265273	4.30265273	4.30265273	4.30265273	4.30265273	4.30265273	4.30265273
precision	0.01872081	0.35533476	0.32625946	0.06312917	0.06649390	0.06296449	0.00526702	0.00175569
mean	0.59250000	5.35618750	5.74005556	4.52344481	3.81292857	3.72752778	0.48850000	0.62150000
ratio	0.03159630	0.06634099	0.05683908	0.01395599	0.01743906	0.01689176	0.01078203	0.00282492
relative precision	3.16%	6.63%	5.68%	1.40%	1.74%	1.69%	1.08%	0.28%

It is concluded that three samples per month for each type of die casting pieces meets the required specifications for reliability/precision.

Detailed calculation is available in the spreadsheet “RIMA_SAMPLING_PLAN.xls”.

a.5 Sampling Frame

Below is a sampling frame referring to eight types of die casting pieces currently in production at the project site. It is noteworthy that the total number of types of pieces production can be changed according to demand.

Table 9: Sampling Frame

Number	Stratification group	Simple Size per Month
1	Bicycle Fork	3
2	Engine Block (R)	3
3	Engine Block (L)	3
4	Clutch Housing (107-JN)	3
5	Transmission Housing (103 L)	3
6	Transmission Housing (103 AA)	3

7	Steering Wheel (GM)	3
8	Steering Wheel (Ford)	3

Although the size of the sample established to be 3 pieces per month, in order to adapt the sampling process to the production process of the die casting pieces of magnesium and simultaneously obtaining a higher reliability/precision, will be taken a sample for each shift worked.

b. Data to be collected

b.1 Field measurements

In the case of field measurements was identified only one variable to be measured, the weight of die casting pieces of magnesium and measurements occur at random every production shift. Thus, the measurements are not performed in limited periods of time and are not subject to seasonal fluctuations.

b.2 Quality assurance/Quality control

The samples will be performed at random 1 once every work shift, the sampled pieces are treated in the same way as other pieces. If some kind of piece of production monthly schedule is less than three turns in this case will be guaranteed the calculated sample size of 3 samples per month.

The weighing of the sample is held in the laboratory of the Die Casting Area. The scale (03 BAL 0002) used for the weighing of samples is calibrated with an annual frequency and is part of project monitoring plan.

For the sampling design of the project is not considered the possibility of refusal or other non-response supplies, since the data are obtained at the project site, without the interference of third parties.

b.3 Analysis

The monthly average weight of each type of die casting piece obtained by sampling is multiplied by the output quantity of each type of die casting piece being the result of multiplying the total die casting pieces by weight produced in the month.

Thus, the total die casting pieces produced is added to the total production of ingots and liquid metal to obtain the total of parameter $P_{(Mg,PJ,k,j,y)}$.

c. Implementation

c.1 Implementation plan

Because it is the second crediting period, the implementation of this sampling effort will be necessary the change only one parameter from the previous sampling effort. Thus the sample size will decrease from the current 2 samples per work shift, for 1 sample per work shift.

Therefore, the factors necessary for the implementation of this sampling effort as the skills, resources and procedures for data collection and analysis remain the same.

Thus, this sampling effort will be implemented on the same start date of the second credit period, scheduled for 02/07/2016.

B.7.3. Other elements of monitoring plan

Other elements of monitoring plan are described on appendix 5.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

01/05/2009. Tests with SO_2 cover gas were started and completed by RIMA in 2008. In view of the feasibility of using the same as alternate cover gas in magnesium production, RIMA decided to operate only with the SO_2 from May 2009.

Also in May 2009, RIMA sold the entire stock of existing SF_6 in the company. Since then and until today, no consumption of SF_6 by RIMA in the project activity.

All documentation evidencing this change will be available for verification by the DOE.

C.2. Expected operational lifetime of project activity

21 years 0 months.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period (second crediting period)

C.3.2. Start date of crediting period

02/07/2016

C.3.3. Duration of crediting period

7 years 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

During the first testing with “dilute SO_2” in June 2008, contracted third-party environment consultant was hired to analyze the potential impacts of its use.

For the environment view, there are emissions concentration limit and air quality standards (external).

In the country level, National Environmental Policies Council - CONAMA, establishes the emission limits and air quality.

CONAMA Resolution number 003, of 28/06/1990, establish 2 standards (primary and secondary) according to the classification of the location of the activity. When there is no defined classification, as is the case of RIMA, article 7 of the resolution requires using the more restringing standard, in this case the primary standard. The values below are for the Primary standard:

- annual arithmetic average concentration of 80 (eighty) micrograms per cubic meter of air; and
- average concentration of 24 (twenty four) hours of 365 (three hundred sixty-five) micrograms per cubic meter of air, which should not be exceeded but once a year.

Additionally, the state level agency has autonomy to require more stringent limits. In Minas Gerais state, where RIMA project is located, The Minas Gerais States Environmental Policies Council - COPAM is the legal environmental entity establishes the air quality standard that for emission limits (internal), there is no

requirement in the country level, however the state entity COPAM, in its Deliberation Normative number 01, of 24/02/1992, establishes for all other non-listed emission sources, a limit of 2,500 mg/Nm^3.

In 2013 it was published the new deliberation normative number 187 of 19/09/2013 which established the new limit in 1,800 mg/Nm^3.

Therefore, the SO_2 limit emissions for internal ambient concentration purposes in the project activity has reduced from 2,500 mg/Nm^3 to 1,800 mg/Nm^3.

Additionally, procedures should attend the Brazilian Technical Standard ABNT-NR15 for insalubrious activities and operations. The standard requires ambient air (inhalation) limits for worker exposure. This is controlled by the Labor Ministry and not by Environment competence.

Annex 11 of the Standard states the "chemical agents that insalubrities is characterized by tolerance limit and inspections at work place":

Limit concentration at work place: 4ppm or 10 mg/m^3 for 48 hours work/exposure per week.

The insalubrity characteristic is eliminated or neutralized with:

a) adoption of general measures to control the concentration under the tolerance limit;

b) utilization of individual protection devices.

Regulation related to Environmental Impact Assessment/Environmental Report – EIA/RIMA is under Minas Gerais State Law: Nr. 7,772 of 08 September 1980, and does not require new EIA/RIMA for process changing, but only for new constructions. However, for the Operation License renewal, it is required that all regulated emissions concentrations are under the standards.

D.2. Environmental impact assessment

As explained above, no additional environmental impact assessment was required for the substitution of cover gas to SO_2. However, during the project activity lifetime will be required to monitor the SO_2 concentrations for:

- Occupational Monitoring (Worker Safety);
- Neighborhood Air Quality Monitoring (External Monitoring); and
- Waste gas Emission Limit (Internal Monitoring).

Insalubrity will be handled internally using protective gear and special training procedures for the staff.

Also emergencial procedures were developed and operators are been trained.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

Brazilian Designated National Authority - DNA, "Interministerial Commission on Global Climate Change[14]", requests several documents and the fulfillment of some requisites in order to provide the Letter of Approval for a CDM project.

One of these requisites, is to invite comments from local stakeholders as described in its Resolution Nr 7 of the DNA.

The Resolution determines that copies of the invitations for comments sent by the project proponents at least to the following agents involved in and affected by project activities:

- Municipal governments and City Councils;
- State and Municipal Environmental Agencies;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;
- Community associations;
- State Attorney for the Public Interest; and
- Federal Attorney for the Public Interest;

At that time, before the approval of the first crediting period by CDM, RIMA sent invitation letters to the following agents:

- Bocaiuva City Hall;
- Municipal Assembly of Bocaiuva;
- Environmental and Urban Services Agency of Bocaiuva;
- Artisan Association of Bocaiuva;
- Minas Gerais Environmental Agency - FEAM;
- State Attorney for the Public Interest of Minas Gerais State;
- Federal Attorney for the Public Interest; and
- Forum of NGOs and Social Movements for the Development and Environment.

Copies of the letters and post office confirmation of receipt communication are still available upon request. However, for this second crediting period, this requisite is no necessary.

For this second crediting period, RIMA came into contact with the DNA requesting clarifications on the renewal of the letter of approval. The DNA after clarifications sent the new letter of approval in 26/10/2015. Copy of this letter is available upon request.

E.2. Summary of comments received

RIMA has received 4 positive comments and 1 no comment about this project, from the following stakeholders:

- Municipal Assembly of Bocaiuva;
- Bocaiuva City Hall;
- State Attorney for the Public Interest of Minas Gerais State;
- Environmental and Urban Services Agency of Bocaiuva;
- Artisan Association of Bocaiuva.

[14] Brazilian Designated National Authority - DNA web-page: http://www.mct.gov.br/index.php/content/view/4016.html.

See summary report of the comments received from local stakeholder in Appendix 6 of this PDD.

E.3. Consideration of comments received

Four comments have been received and they were very positive for project implementation.

RIMA sent a letter to the Artisan Association of Bocaiuva. The summary of the letter is the following:

The safety procedures were audited during the validation of the CDM project by TUV-SUD. During the annual CDM verification process these procedures will be audited by an DOE authorized by EB who will check the implementation and operation of the safety plan.

SECTION F. Approval and authorization

The project participant has received the letters of approval from Brazil, Norway and Netherlands as can be checked in https://cdm.unfccc.int/Projects/DB/TUEV-SUED1239262577.48/view

Appendix 1. Contact information of project participants

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Rima Industrial S/A
Street/P.O. Box	District Industrial of Bocaiuva
Building	
City	Bocaiuva
State/Region	Minas Gerais
Postcode	38.390-000
Country	Brazil
Telephone	+55 31 3329 4192
Fax	
E-mail	acr@rima.com.br
Website	www.rima.com.br
Contact person	Anderson Clayton dos Reis
Title	Administrative and Finance Director
Salutation	Mr.
Last name	Reis
Middle name	Clayton
First name	Anderson
Department	Finance
Mobile	
Direct fax	+55 31 3329 4226
Direct tel.	+55 31 3329 4192
Personal e-mail	acr@rima.com.br

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Nordic Environment Finance Corporation
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State/Region	
Postcode	
Country	Finland
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Fax	
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Website	
Contact person	Helle Lindegaard
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Salutation	Ms.
Last name	Lindergaard

Middle name	
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Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Electrabel NV/SA
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Country	Belgium
Telephone	+32 2 510 7687
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Contact person	Nore, Nicolas
Title	
Salutation	Mr.
Last name	Nore
Middle name	
First name	Nicolas
Department	
Mobile	
Direct fax	
Direct tel.	+32 2 510 7687
Personal e-mail	co2@gdfsuez.com

Appendix 2. Affirmation regarding public funding

There is no public funding from Annex I countries is provided for this Project.

Appendix 3. Applicability of methodologies and standardized baselines

The methodology and standardized baseline selected is AM0065 - Replacement of SF_6 with alternate cover gas in the magnesium industry (version 02.1) and Combined tool to identify the baseline scenario and demonstrate additionality (version 06.0).

This methodology is applicable to the proposed CDM project activity because satisfy the following conditions:

- Replaces the use of cover gas SF_6 in (full or in part) by SO_2 technology, in existing facilities.

RIMA project was replaced full SF_6 by SO_2. Since then there has been no more consumption SF_6 on RIMA magnesium plant.

Historical SF_6 consumption monitoring

RIMA plant is divided in 2 sectors:

- Fusion Area, where is included the production of ingot and the liquid metal. There is only one supply point of SF_6 for all Fusion Area; and
- Die Casting Area, receives the liquid metal from the Fusion Area. There is one supply point in each die casting equipment.

The consumption amount for each area is monitored by inventory control of the cylinders. In RIMA plant was used 50kg cylinders, weighting 50kg empty and comporting 50kg of SF_6 gas.

Every time the operator needed new cylinders, the empty cylinder is returned, and input in the company management system. A take-order is filled by the operator and delivered to the inventory department, describing for which area/equipment is the cylinder.

The empty cylinder is weighted to ensure all gas was used. If is note completely empty, the cylinder is returned to the process to be used to the end.

In the Fusion Area the SF_6 concentration is controlled in 15 normal litters per hour of SF_6 diluted with 7,500 normal litters per hour of nitrogen.

In the Die Casting Area, cover gas is used in 2 different point:

- Injecting inside the liquid metal container. The SF_6 concentration is 0.20% or 0.22%; and
- During injection of the liquid metal into the die casting mold. The SF_6 concentration is 0.18% or 0.20%.

The control of the flow rate and SF_6 and nitrogen mixture rate was made by micro-valves using 0 to 10V signals. The flow rate is separated is 3 ways:

- 250 l/h when the die casting unit is not operating;
- 350 l/h during operation; and
- 650 l/h each 85 seconds during the injection pulse to the mold.

Maximum concentration limit of SF_6 is 0.30%. Higher concentration causes the release of hydrofluoric acid (HF).

Appendix 4. Further background information on ex ante calculation of emission reductions

Information detailed about ex ante calculation of emission reductions is described in section B.6.3.

Appendix 5. Further background information on monitoring plan

MONITORING PLAN INFORMATION

1. Magnesium Production Monitoring Procedure

Monitoring of magnesium production could be divided in 3 sectors:

1.1 Ingot Production

Cover gas is used during all casting process until the ingot has reached its solid form. The production will be monitored and registered separately per type of ingot.

The weight the produced ingots are performed in the Dispatch Area, and after quality inspection the non-conform ingots are returned to the casting furnace.

The produced ingots amount will be delivered from the scale (01 BAL 0004) of Dispatch Area. Monthly ingots gross production is aggregated summing all ingots type production in that month. Monthly gross production subtracting the non-conform ingots results in the monthly net production of ingots. This amount is the one used to calculated emissions reductions.

The amount sold is determined by the Sale Invoice and this amount is delivered from scale (01 BAL 0005) in the Gatehouse.

Sale invoice will be used to cross-check the produced amount as well as to verify if more than 70% of the produced amount is sold to the market. If this is verified, then the produced amount is used to calculate the emissions reductions. If not, the amount used for the calculation is the quantity sold.

1.2 Liquid Metal Production

This is a plant internal supply, from the Fusion Area to the Die Casting Area.

The liquid metal produced in the Fusion Area is injected in a container of 500 kg capacity. This container is transported by a fork-lift, and weighted all together before transporting the liquid metal to the Die Casting Area. The weight difference from [fork-lift + empty container] and [fork-lift + container with liquid metal] is used as the liquid metal production amount. The weights are registered in a form by the operator of fork-lift.

The produced liquid metal amount will be delivered from the scale (03 BAL 0001) in the Buffer Area in the Fusion Area. Monthly liquid metal production is aggregated summing all liquid metal type production in that month. Monthly liquid metal production is added to net production of ingots to obtain the net production of Fusion Area.

Cover gas is used during the transfer of liquid metal from the casting furnace to the container. During the container transport, cover gas is not consumed, but, the cover gas continues to protect the liquid metal.

In the case of liquid metal, the “sale” is an internal sale with no Sale Invoice issuance. Therefore, the “production amount” is the same of “sale amount”, thus, the production amount is used to calculate emissions reductions.

1.3 Die Casting Pieces Production

During the production of die casting pieces the cover gas is used for the protection of the liquid metal inside containers coupled the injectors, as well as, in the chambers of the dosing furnaces of injectors.

The production will be monitored and registered separately per type of die casting piece and per injector. During the production of pieces, rough edges and channels (wastes) are inevitable. These wastes are returned to the casting furnace. After quality inspection the non-conform die casting pieces are returned to the casting furnace.

For the calculation of total amount production of die casting pieces, is used the monthly average weight (per each type of pieces and per each injector) multiplied by the monthly amount of produced pieces (per each type of pieces and per each injector). The non-conform pieces quantity is also registered, making possible the calculation of net production, this amount is the one used to calculate emissions reductions.

The average weight is obtained through the random selection of a sample per work-shift, per each type of pieces and per each injector. The sample weight will be delivered from the scale (03 BAL 0002) in the Laboratory in the Die Casting Area and registered in spreadsheet.

The amount sold is determined by the Sale Invoice and this amount is delivered from scale (01 BAL 0005) in the Gatehouse.

There are 12 injectors installed and included in the emissions reductions:

Table 10: Identification of Injectors

Injector Number TAG[15]	
01	TV006
02	TV005
03	TV009
04	TV010
05	TV001
06	TV007
07	TV002
08	TV014
09	TV003
10	TV013
11	TV008
12	TV004

1.4 Total Amount of Magnesium Production

All production data, of ingots, liquid metal and die casting pieces production are monthly compiled and registered by the control department in RIMA plant.

The sum of the Net Production of Ingots, the Total Liquid Metal Production and the Net Production of Die Casting Pieces is the Total Amount of Magnesium Production ($P_{Mg,PJ,k,j,y}$) used to calculate the emissions reductions, unless the value of the sale is less than 70% of the total amount of magnesium production. In this case it will use the total amount of sales.

2. SO_2 Consumption Monitoring

In accordance to the latest version of the methodology AM0065, to ensure consistency between baseline and project calculations, the measurement method of alternate gas shall follow the same method conducted for SF_6.

For SF_6 was used the accounting method (Recording delivered purchases and inventory changes), and also was used the weight difference method (Measuring the difference in cylinder weight for gas used/returned) as auxiliary to ensure that all gas was consumed.

Therefore, the same methods will be used for SO_2, recording the cylinders inventory and weight. However the monitoring methodology requires that the project monitoring should be done per equipment.

Differing from the SF_6 small cylinders (50kg), that was installed one for each injector, due to the harmful characteristics of the new alternative cover gas, SO_2, there will have only one supply point, with one large gas cylinder.

[15] It refers to the internal control for the identification of injectors.

Having more than one Gas Room or more than one cylinder to make possible the individual monitoring per equipment, would increase too much the investments costs and mainly the operation and maintenance procedures overloading the operators with safety procedures.

The procedures that will be performed to have consumption of SO_2 “per equipment” will be as follows:

At each SO_2 consumption point, was installed flow meters of the gas mix SO_2 and nitrogen to control the flow rate of SO_2 to each equipment.

From the flow rate at each consumption point and SO_2 total consumption measure at the Gas Room, the SO_2 consumption per equipment will be estimated per proportional calculation.

Flow rate of the gases exiting the Gas Room are measured separately for the gases going to Fusion Area and Die Casting Area. There are 4 modules containing 2 flow meters each. One flow meter measures the SO_2 and the other measures the N_2.

3. SO_2 Environment Monitoring

All air samples collected are analyzed and certified through the analyses from the chemical laboratory.

The specialized laboratories has approval from the Metrological Network of Minas Gerais state – RMMG for measurement of SO_2 and other procedures.

The RMMG is the organ in the Minas Gerais state responsible for the accreditation, certification and inspection of laboratories in accordance with the standard ABNT NBR ISO/IEC 17025:2005, possessing the formal recognition by the state government through the normative deliberation nº 89 of 15/09/2005 of Minas Gerais state environmental policy council – COPAM.

3.1 Occupational Monitoring (Worker Safety)

In according to NIOSH 6004 the monitoring method and chemical analysis of SO_2 for purposes of occupational requires that the sample size must be between 40 and 200 liter, for a flow rate between 0.5 to 1.5 liters per minute.

The CDM project RIMA carried out the collection of samples for 60 minutes for a flow rate of 1 liters per minute, resulting in a sample size of 60 liters.

Measurement is performed by simple device attached in operator work cloth. The SO_2 is monitored by collecting air through a low flow sampler of a gravimetric Gillian Type Pump. The periodicity of monitoring is monthly.

Regarding SO_2 tolerance limits, the Brazilian Regulatory Standard - NR 15 (approved by the Ministry of Labor and Employment through Ordinance No. 3214 of 8/06/1978) sets in Table 1 of Annex 11, the SO_2 concentration limit of 10 mg/m^3.

The item 9.3.6.2 of Brazilian Regulatory Standard - NR 9 (approved by the Ministry of Labor and Employment through Ordinance No. 3214 of 8/06/1978) sets the action limit as the SO_2 concentration of 5 mg/m^3.

3.2 Neighborhood Air Quality Monitoring (External Monitoring)

In accordance with technical standards ABNT NBR 9,546 and 10,562 published by the Brazilian Association of Technical Standards - ABNT, the monitoring method and chemical analysis of SO_2 for purposes of neighborhood air quality monitoring requires that the sample size must be between:

- 30 minutes, for a flow rate of 1 liter per minute;
- 1 hour, for a flow rate of 0.5 liter per minute; and
- 24 hours, for a flow rate of 0.2 liter per minute;

The CDM project RIMA carried out the collection of samples for 24 hours for a flow rate of 0.2 liter per minute, resulting in a sample size of 288 liters by measuring point.

Measurement is performed by pararosaniline method for determining the concentration of SO_2 in ambient air. The reference conditions are: 25° C/101.3 kPa, with a measuring range of 25 - 1050 µg/m³ and the frequency of monitoring is four times a year.

Regarding SO_2 tolerance limits, the Resolution number 003, of 28/06/1990 by the National Environmental Policies Council - CONAMA, established the SO_2 average concentration limit of 24 hours of 365 µg/m³.

Measurements of SO_2 and environmental analyzes are carried out by specialized external laboratory with accreditation to the scope of analyzes.

3.3 Waste gas Emission Limit (Internal Monitoring)

In accordance with technical standards ABNT NBR 10,700, 10,701, 10,702, 11,966, 11,967, 12,020 and 12,022 published by the Brazilian Association of Technical Standards - ABNT and CETESB L9,240 published by the Environmental Company in the State of Sao Paulo - CETESB, the monitoring method and chemical analysis of SO_2 for purposes of Waste gas Emission monitoring requires that the sample size must be: air sampling of 720 liters in flow of 2,0 liter/min.

The CDM project RIMA carried out the collection of 3 samples for 20 minutes for a flow rate of 2.0 liters per minute, resulting in a sample size of 120 liters by measuring point. The air samples are collected at six fixed points, thus the total sample size is 720 liters.

Measurement is performed by air collection by an isokinetic flow sampler for determining the concentration of SO_2 in ambient air, SO_2 with a lower limit of detection is 3.4 mg/m³ and the frequency of monitoring is four times a year.

Regarding SO_2 tolerance limits, the Normative Deliberation number 187, of 19/09/2013 by the Minas Gerais States Environmental Policies Council - COPAM, established the SO_2 average concentration limit of 1,800 mg/Nm³.

Measurements of SO_2 and environmental analyzes are carried out by specialized external laboratory with accreditation to the scope of analyzes.

4. Others Parameters to be Monitored:

4.1 Magnesium Sales Reports

According to the latest version of the methodology AM0065, which states, "*in order to dispel concerns that a company increases production levels just to gain CERs, project developers must show proof of sales of magnesium*", the total Amount of Magnesium Sales must be compared with the total Amount Magnesium Produced, so the emission reduction calculations can be based on the plant's production data.

Sale and production amount should not have more than 30% difference. It is important to notice that to make this comparison, the liquid metal production is an internal sale, from the Fusion Area to the Die Casting Area with no sale receipt and the amount sold is determined by the Sale Invoice and this amount is delivered from scale (01 BAL 0005) in the Gatehouse.

4.2 Calibration & Maintenance Procedures

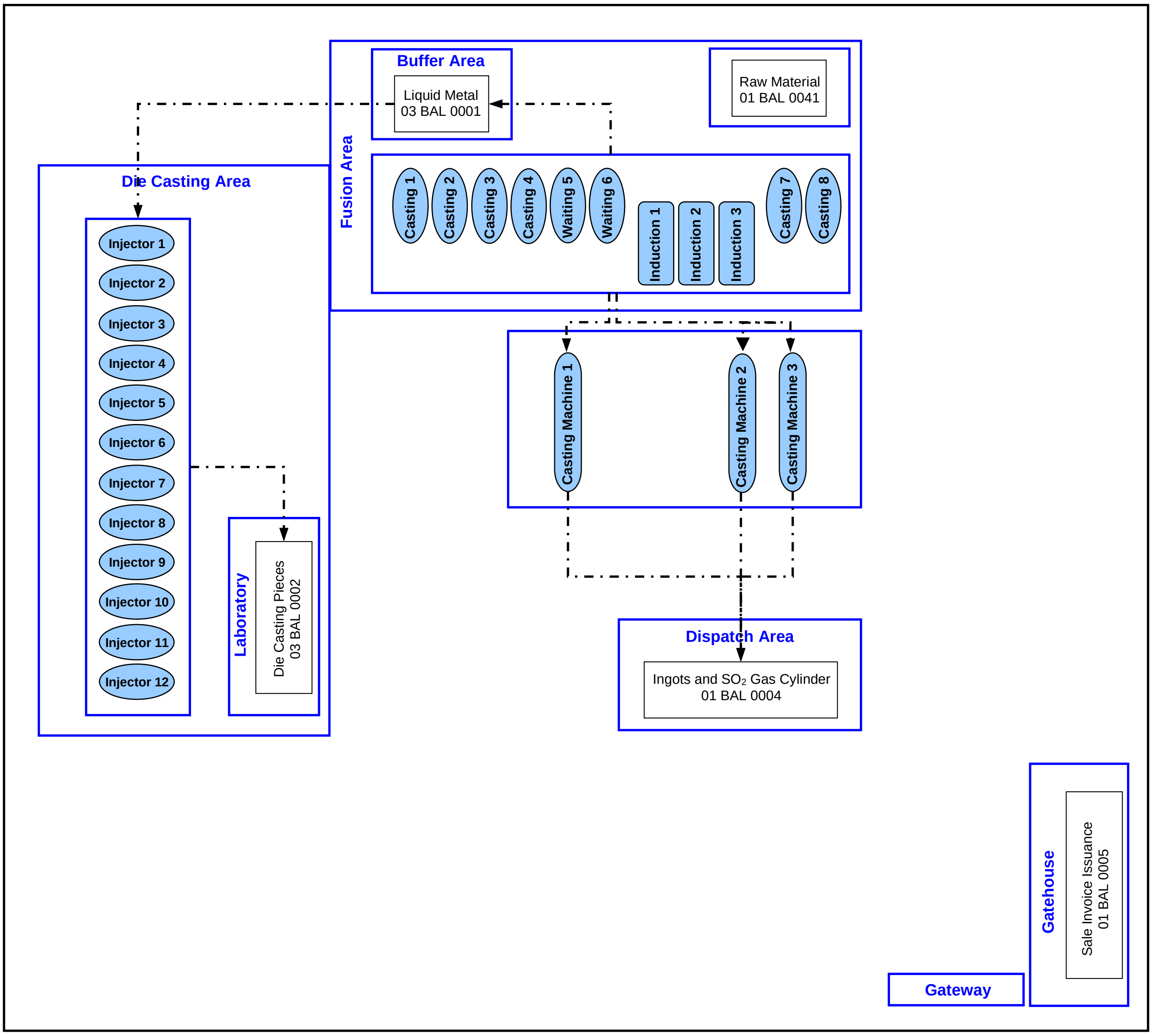
Weight scales and cover gas flow rate meter's calibration and maintenance are made by an external certified company, according to the service order of RIMA. The service order is programmed by an on-line management system, and near the next calibration/maintenance day, the responsible is notified automatically by the system. The scales and flow rates have a one year calibration frequency.

4.2.1 Identification and Calibration Information of Scales

Table 11: Identification and Calibration Information of Scales

Location	TAG[16]	Equipment Type	Accuracy Level	Weighted Product	Calibration Frequency
Fusion Area	01 BAL 0041	Platform Scale	±0.03%	Raw Material	Annual
Fusion Área (Buffer Area)	03 BAL 0001	Platform Scale	±0.05%	Liquid Metal	Annual
Die Casting Area (Laboratory)	03 BAL 0002	Bench Scale	±0.01%	Die Casting Pieces	Annual
Dispatch Area	01 BAL 0004	Platform Scale	±0.03%	Ingots and SO_2 Gas Cylinder	Annual
Gatehouse	01 BAL 0005	Road Scale	±0.01%	Sale Invoice Issuance	Annual

4.2.2 Location of Scales



Flowchart 3 – Location of Scales

4.3 Data

[16] It refers to the internal control for the identification of scales.

The data monitored and required for verification and issuance will be kept and archived for two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

4.4 Emergency Procedures

All consolidated data are backed-up done electronically by the central office. Also monthly consolidated data will be printed on paper and are filed.

Appendix 6. Summary report of comments received from local stakeholders

See below the comments received from local stakeholders from the CDM project activity:

Table 12: Comments Received About Project

Stakeholder	Position	Summary of comments
Municipal Assembly of Bocaiuva	Favorable to the project	The implementation of the project will bring environmental benefits to the region. The project contributes to sustainable development, once it will reduce the emission of a greenhouse gas.
Bocaiuva City Hall	Favorable to the project	The implementation of the project will bring social and environmental benefits to the region. The project contributes to sustainable development of the municipality.
State Attorney for the Public Interest of Minas Gerais State	No comments	According to the law 34/94 the State Attorney can not provide comments about projects.
Environmental and Urban Services Agency of Bocaiuva	Favorable to the project	This project shows the RIMA commitment with the environment and community.
Artisan Association of Bocaiuva	Favorable to the project	The Association approved the project but additional information about SO_2 safety procedures was required by them. They requested a technical visit to the plant.

Appendix 7. Summary of post-registration changes

This project was approved on 02 July 2009 and after this date occurred changes about technical conditions and/or operational on project, as following:

- In 06 January 2011, was approved by the CDM Executive Board the monitoring plan revised and issued on 20 December 2010 by Rima. The changes occurred on monitoring plan was revised during the second verification for the period from 01 January 2010 to 30 June 2010;
- In November 2012, after understandings between RIMA and 33 Asset Management signed the term to terminate the ERPA (Emission Reduction Purchase Agreement);
- In February 2014, RIMA announced to UNFCCC the withdrawal of 33 Asset Management as project participant;

- In February 2014, RIMA announced to UNFCCC the addition of Electrabel NV/SA as project participant. RIMA does not have ERPA (Emission Reduction Purchase Agreement) with Electrabel NV S/A;
- In October 2014, RIMA closed the ERPA (Emission Reduction Purchase Agreement) with Nordic Environment Finance Corporation (NEFCO) valid until December 2017. This ERPA involves CER of this project; and
- In June 2015, RIMA closed a second ERPA (Emission Reduction Purchase Agreement) with Nordic Environment Finance Corporation (NEFCO) valid until June 2021. This ERPA involves CER of this project.
- In August 2017, RIMA installed a third casting machine in Fusion Area, where is necessary the use of cover gas. There is no increase in the production capacity of magnesium.

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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