Approved baseline and monitoring methodology AM0065

"Replacement of SF_6 with alternate cover gas in the magnesium industry"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

This baseline and monitoring methodology is based on the following proposed new methodologies:

- NM0212 "SF_6 Switch at Dead Sea Magnesium" prepared by EcoTraders;
- NM0222 "Conversion of SF_6 to the Alternative Cover Gas SO_2 in Magnesium Production in China" prepared by QualityTonnes.

This methodology also refers to the latest approved version of the following tool:

- Combined tool to identify the baseline scenario and demonstrate additionality.

For more information regarding the proposed new methodology and the tool as well as its consideration by the Executive Board please refer to <http://cdm.unfccc.int/goto/MPappmeth>.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Definitions

For the purpose of this methodology, the following definitions apply:

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:

- 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;
- A cover gas is an inert gas used to avoid oxidation of molten magnesium in casting and alloying processes.

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 one 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 – 1470 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;
- Maintenance plan for equipment and gas distribution system to assure safe and consistent operation.

Applicability

This methodology applies to project activities that replace the use of cover gas SF_6 in full or in part by another cover gas, HFC134a, Perfluoro-2-methyl-3-pentanone ($CF_3CF_2C(O)CF(CF_3)_2$) or SO_2 using lean SO_2 technology, **in existing facilities**[1].

The methodology is applicable under the following conditions:

- All segments of the magnesium industry (as defined in Definitions section above) where SF_6 is replaced;
- 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 section above;
- 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 – 1470 mg/m^3 (dry basis, 273 K, 101,325 kPa at an oxygen concentration of 6 %(v/v).

The methodology is only applicable if the baseline scenario is the continuation of current practice of using SF_6 as a cover gas.

[1] The facility has an operating history of at least three years prior to validation.

The methodology is not applicable to the following:

- Sectors other than magnesium that use SF_6; or
- Project activities that replace the use of SF_6 with salt fluxes, or sulfur powder;
- New facilities.

In addition, the applicability conditions included in the tool referred to above apply.

II. BASELINE METHODOLOGY PROCEDURE

Identification of the baseline scenario

Project participants shall apply the procedures detailed in the latest version of the "Combined tool to identify the baseline scenario and demonstrate additionality" to identify the baseline scenario.

When applying the "Combined tool to identify the baseline scenario and demonstrate additionality", the following guidance should be taken into account:

Step 1: Define alternative scenarios to the proposed CDM project activity

In the magnesium sector these alternatives may include the use of:[2]

(a) Advanced "dilute SO_2" melt protection technology;
(b) SF_6- continuation of current practice;
(c) HFC134a;
(d) Perfluoro-2-methyl-3-pentanone;
(e) SF_6 capture and reuse;
(f) Process modifications / optimizations to minimize SF_6 consumption.

Step 2: Barrier analysis

The main barriers relevant to this sector are technological barriers and barriers due to prevailing practice.
Technological Barriers

The use of advanced "dilute SO_2" melt protection technology (scenario 1), HFC 134a (scenario 3), Perfluoro-2-methyl-3-pentanone (scenario 4) for melt protection is an entirely new technique that is being introduced to the magnesium sector due to the sectors growing awareness concerning climate change.

[2] As realistic and credible scenarios should be identified in cases where SF_6 is currently being used, it would be unrealistic and not credible to assume that projects that have advanced to the superior cover gas technology of using SF_6 shall regress technologically to using salt fluxes, sulfur powder, or SO_2 (old technology). Despite the facts that these technologies have been implemented previously, these technologies are still considered a technological regression in the case SF_6 is being currently used.

Step 3: Investment Analysis

If investment analysis is undertaken, then each scenario should include in the financial indicator a calculation of all relevant costs. These should include, if relevant (but are not limited to):

- Cost of retrofitting equipment to work on alternate cover gas;
- Cost of installing new equipment to work on alternate cover gas;
- Additional maintenance and training costs due to the SF_6 switch;
- Cost of raw material;
- Cost of new safety measures (in the case of advanced “dilute SO_2” melt protection technology), including the abatement system;
- Payment of royalty fees.

The financial analysis should also consider the actual quantity of cover gas used. For example the quantity of HFC134a needed is 50% in comparison to SF_6.

It should be noted that an ex-ante estimation of project emissions and the quantity of cover gas used in the project scenario may be required to conduct a financial analysis for the additionality assessment. In this case project emissions can be calculated by estimating the amount of alternative cover gas used and multiplying it by the calculated GWP weighting of the estimated by-products. The GWP weightings are based on defaults and do not change during the crediting period. To calculate ex-ante project emissions, one only needs to know how much cover gas is likely to be used. The ratio of cover gas to SF_6 may not be 1:1. In other words, it is possible that less or more cover gas may be required to provide the same level of protection as SF_6. In these cases, it is assumed that tests would be carried out on the alternative gas before the project is implemented. These tests would provide the plant managers with the amount of gas that would be needed to provide the desired level of protection. This number, along with the GWP weightings and the estimated magnesium production over the crediting period, should provide a reasonable estimate of project emissions. The sensitivity analysis should include financial calculations based on variations on this assumption.

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the “Combined tool to identify the baseline scenario and demonstrate additionality”.

Project boundary

The **spatial extent** of the project boundary encompasses the specific industrial process in the magnesium plant where SF_6 was used as a cover gas and is being replaced with the alternate cover gas.
The greenhouse gases included in or excluded from the project boundary are shown in Table 1.

Table 1: Emissions sources included in or excluded from the project boundary

	Source	Gas	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.
		SF_6	Yes	Major source of emissions in the baseline.
		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.
Project activity	Inserted as cover gas mix to protect molten magnesium	CO_2	Yes/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	Yes	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	Yes	In cases where SF_6 is used in the project scenario, it is included in project emission calculations and monitored data.
	By-product of reaction between cover gas mix and molten magnesium	CH_4	Yes	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	Yes	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	Yes	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	Yes	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.

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:

$$BE_y = \sum_j \sum_k (EF_{SF6,Mg,k,j} * P_{Mg,PJ,k,j,y}) * GWP_{SF6} \qquad \textbf{(1)}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e/yr)
$EF_{SF6,Mg,k,j}$	=	Baseline emission factor for each equipment *k* in each segment *j* .(tSF_6/ tMg)
$P_{Mg,PJ,k,j,y}$	=	Annual amount of Mg products manufactured in project scenario in each equipment *k* in each segment *j* per year *y*.
GWP_{SF6}	=	Global Warming Potential of SF_6 (tCO_2e/ tSF_6)

For each equipment *k* in each segment *j* and year *y*:

$$\cancel{EF_{SF6,Mg,k,j} = \frac{C_{SF6,EM,BL,k,j}}{P_{Mg,BL,k,j}}}$$

$$EF_{SF6,Mg,k,j} = Min\{\frac{C_{SF6,EM,BL,k,j,y}}{P_{MG,BL,k,j,y}}\} \qquad \textbf{(2)}$$

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

Where:

$P_{Mg,BL,k,,j,y}$	=	Annual Amount of Mg products manufactured in baseline scenario in each equipment k of each segment j (tMg/yr) for each year *y* of the three years prior to the project. One year data may be used in case 3 years data are not available (tMg/ yr). ~~Amount of Mg products manufactured in baseline scenario in each equipment *k* of each segment *j* (tMg/ yr). Minimum of the last three years prior to validation (1 year data can be used in case 3 years data are not available) should be used.~~
$C_{SF6,EM,BL,k,j,y}$	=	SF_6 actually emitted in the baseline in each equipment *k* of each segment *j* in year *y*. (tSF_6/ yr)

$$C_{SF6,EM,BL,k,j,y} = C_{SF6,CON,BL,k,j,y} * DF_{SF6} * DI_{SF6,CON,BL,k,j} \qquad \textbf{(3)}$$

Where:

$C_{SF6,CON,BL,k,j,y}$	=	Annual consumption of SF_6 in the industrial facility in each equipment *k* of each segment *j*, in the baseline in year *y* calculated for each year *y* of the year/s prior to the project for the last three years (or one year if three-year data is not available) before the project's implementation. (tSF6/ yr). ~~Total annual consumption of SF_6 in the industrial facility in each equipment *k* of each segment *j*, 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.[3]
$DI_{SF6,CON,BL,k,j}$	=	A conservative factor portraying the Data Integrity of $C_{SF6,CON,BL,j}$ in each equipment *k* of each segment *j* (Fraction), estimated as per information in Data and Parameters not monitored section.

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. $P_{Mg,PJ,k,j,y} = P_{Mg,BL,k,j}$.
The Annual Consumption of SF_6 ($C_{SF6,CON,BL,k,j}$) shall be estimated as the minimum of the following values:

- Minimum of Annual consumption of SF_6 in each equipment *k* of each segment *j* for the last three years prior to validation (1 year data can be used in case 3 years data are not available) ($C_{SF6,EST,BL,k,j}$);
- Total consumption of SF_6 in each equipment *k* of each segment *j*, per year as per the 2006 IPCC Guidelines ($C_{SF6,IPCC,BL,k,j,}$):

$$C_{SF6,IPCC,BL,k,j} = C_{SF6,SPIPCC} * P_{Mg,BL,k,j} \qquad \textbf{(4)}$$

Where:

$C_{SF6,SPIPCC}$	=	Specific consumption of SF_6 in each equipment *k* of each segment *j* as per 2006 IPCC Guidelines (0.001t SF_6/t Mg casting)

<u>Case-2:</u> In case **<u>only</u>** the historical annual consumption for SF_6 for the **<u>total</u>** facility is available, baseline emissions shall be calculated using the following equations:

$$BE_y = P_{Mg,PJ,y} * GWP_{SF6} * EF_{SF6,Mg} \qquad \textbf{(5)}$$

[3] 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 ~~to the DOE~~ 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.

Where:

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

$$\cancel{EF_{SF6,Mg} = \frac{C_{SF6,EM,BL}}{P_{Mg,BL,TOTAL}}}$$

$$EF_{SF6,Mg} = Min\{\frac{C_{SF6,EM,BL,y}}{P_{Mg,BL,Total,y}}\} \quad (6)$$

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

Where:

$P_{Mg,BL,TOTAL,\cancel{j},y}$	=	Total 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).
$C_{SF6,EM,BL,\cancel{j},y}$	=	Total SF_6 actually emitted in the baseline in the facility in year y. (tSF_6/ yr)

$$C_{SF6,EM,BL} = C_{SF6,CON,BL} * DF_{SF6} * DI_{SF6,CON,BL} \quad (7)$$

$C_{SF6,CON,BL}$	=	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.[4]
$DI_{SF6,CON,BL}$	=	A conservative factor portraying the Data Integrity of $C_{SF6,CON,BL}$ (Fraction), estimated as per information in Data and Parameters not monitored section.

[4] 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 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.

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. $P_{Mg,PJ,\cancel{j,k},y} = P_{Mg,Bl,,TOTAL}$.
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 SF6 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) (CSF6,TOT,BL);
- Total consumption of SF6 in the facility, per year as per the 2006 IPCC Guidelines (CSF6,IPCC,BL) as per following equation:

$$C_{SF6,IPCC,BL} = C_{SF6,SPIPCC} * P_{Mg,BL,TOTAL} \tag{8}$$

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

Project emissions are calculated as follows:

$$PE_y = PE_{ALTGAS,y} + PE_{SF6,y} + \sum_{j,y} C_{CO2,PJ,j,y} \tag{9}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e/yr)
$PE_{ALTGAS,y}$	=	Project emissions from the use of HFC134a or Perfluoro-2-methyl-3-pentanone, if it is used as cover gas in project scenario - summing of all segments *j* - in year *y* (tCO_2e/yr)
$PE_{SF6,y}$	=	Project emissions from the use of SF_6 - summing of all segments *j* - in year *y* (tCO2e/yr)
$C_{CO2,PJ,j,y}$	=	Consumption of CO_2 gas in project scenario for each segment per year. Shall be used when CO_2 is used as diluent in cover gas mix in the project scenario alone (i.e. not in the baseline scenario) (tCO2/yr)

Project emissions from the use of alternate gas

$$PE_{ALTGAS,y} = \sum_j \sum_k C_{ALTGAS,PJ,k,j,y} * GWP_{ALTGAS} * CF \tag{10}$$

Where:

$C_{ALTGAS,PJ,k,j,y}$	=	Consumption of alternate gas in project scenario for each equipment *k* in each segment *j* per year (t / yr)
GWP_{ALTGAS}	=	Global Warming Potential of alternate gas. In case of using Perfluoro-2-methyl-3-pentanone the value used is 1
CF	=	Conservative Factor. To compensate for the uncertainty in the global warming potential of the by products emitted after the degradation of the alternate gas (default value of 1.26 for HFC134a and 2,830 for Perfluoro-2-methyl-3-pentanone[5])

Project emissions from the use of SF_6

$$PE_{SF6,y} = \sum_j \sum_k C_{SF6,EM,PJ,k,j,y} * GWP_{SF6} \qquad \textbf{(11)}$$

Where:

$C_{SF6,EM,PJ,k,,j,}$	=	SF_6 actually emitted in the project scenario in each equipment k of each segment j, per year *y* (tSF_6/ yr)
GWP_{SF6}	=	Global Warming Potential of SF_6 (tCO_2e/ tSF_6)

$$C_{SF6,EM,PJ,k,j,y} = C_{SF6,CON,PJ,k,j,y} * DF_{SF6,k,j} * DI_{SF6,CON,PJ,k,j,y} \qquad \textbf{(12)}$$

Where:

$C_{SF6,CON,PJ,k,j,y}$	=	Total consumption of SF_6 in the project scenario in each equipment *k* for each segment *j*, per year *y* (tSF_6/ yr)
$DF_{SF6,k,j}$	=	Degradation Factor of SF_6 that reacts with the magnesium in the production process assumed as 0.5.
$DI_{SF6,CON,PJ,k,j,y}$	=	A conservative factor portraying the Data Integrity of $C_{SF6,CON,PJ,k,j,y}$ in each segment, per year. (Fraction), estimated as per information in Data and Parameters not monitored section.

Ex-Ante estimation of the consumption of HFC134a in the project scenario

$C_{ALTGAS,PJ,j,y}$ shall be calculated ex-ante for the purpose of estimating emission reductions in the CDM-PDD with the following equation:

$$C_{ALTGAS,PJ,k,j,y} = C_{SF6,CON,BL,k,j} * 0.5 \qquad \textbf{(13)}$$

For the purpose of ex ante project emission calculations for reporting in the CDM-PDD, future production levels shall be assumed as the past 3 year maximum production level i.e. $P_{Mg,PJ,k,j,y} = P_{Mg,BL,k,j}$.

[5] Based on the combination of the maximum values as per test results provided in EPA, "Characterization of Cover Gas Emissions from U.S. Magnesium Die Casting", Office of Air and Radiation, May 2004.

When **only** the historical annual consumption for SF_6 for the **total** facility is available:

$$\sum_{j}\sum_{k} C_{ALTGAS,PJ,k,j,y} = C_{SF6,CON,BL} * 0.5 \tag{14}$$

Ex-Ante estimation of the consumption of Perfluoro-2-methyl-3-pentanone in the project scenario

$C_{ALTGAS,PJ,k,j,y}$ shall be calculated ex-ante for the purpose of estimating emission reductions in the CDM-PDD. If the cover gas used by the project activity is Perfluoro-2-methyl-3-pentanone, then $C_{ALTGAS,PJ,j,y}$ will be estimated as the theoretical amount of Perfluoro-2-methyl-3-pentanone necessary for the future production , which can be estimated as the past 3 year maximum production levels i.e. $P_{Mg,PJ,j,k,y} = P_{Mg,BL,k,j}$.

Leakage

No leakage is expected from the project activity.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \tag{15}$$

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)

Data and parameters not monitored

ID Number:	1
Data/Parameter:	GWP_{SF6}
Data unit:	tCO2e/ tSF6
Description:	Global Warming Potential of SF_6
Source of data:	CDM EB
Measurement procedures (if any):	Prior to the renewal of a crediting period it should be assessed if GWP values have changed.
Any comment:	

ID Number:	2
Data/Parameter:	$P_{Mg,BL,k,,j,y}$
Data unit:	tMg /yr
Description:	Amount of Mg products manufactured in baseline scenario in each equipment *k* of each segment *j* per year *y* of the last three years before the project's implementation (tMg/ yr).
Source of data:	Industrial Facility
Measurement procedures (if any):	Measured by calibrated scales according to on-site working procedures
Any comment:	Scales are usually calibrated frequently since this parameter is essential to the core business of the plant. Calibration frequency shall follow on-site calibration procedures. Minimum of the last three years prior to validation (1 year data can be used in case 3 years data are not available) should be used.

ID Number:	3
Data/Parameter:	$C_{SF6,EST,BL,k,j}$
Data unit:	tSF_6
Description:	Mimimum of Annual consumption of SF_6 in each equipment *k* of each segment *j* for the last three years prior to validation (1 year data can be used in case 3 years data are not available)
Source of data:	Industrial Facility
Measurement procedures (if any):	Measuring flow rates and integrating over time (flow measurement method)
Any comment:	In case historical annual consumption for SF_6 per equipment *k* in each segment *j* is available

ID Number:	4
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:	
Measurement procedures (if any):	
Any comment:	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 ~~to the DOE~~ 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.

ID Number:	5
Data/Parameter:	GWP_{ALTGAS}
Data unit:	tCO2e/ t alternative gas
Description:	Global Warming Potential of alternate gas. In case of using Perfluoro-2-methyl-3-pentanone the value used is 1.
Source of data:	CDM EB
Measurement procedures (if any):	Prior to the renewal of a crediting period it should be assessed if GWP values have changed.
Any comment:	

ID Number:	6
Data/Parameter:	$DI_{SF6,CON,BL,k,j}$ / $DI_{SF6,CON,BL}$
Data unit:	Fraction
Description:	A conservative factor portraying the Data Integrity of $C_{SF6,CON,BL,k,j,y}$/$C_{SF6,CON,BL}$ in each equipment k in each segment. Default= 0.95.
Source of data:	IPCC guidelines
Measurement procedures (if any):	Prior to the renewal of a crediting period it should be assessed if the Conservative Factor default should be changed.
Any comment:	This value shall account for the uncertainty in SF_6 consumption. IPCC guidelines state that direct reporting has a 5% uncertainty level[6]. 0.95 shall be used as the default factor unless the project proponent can demonstrate to the DOE that their estimates of $C_{SF6,CON,BL,k,j}$/$C_{SF6,CON,BL}$ are more than 95% accurate. Project proponents that submit monitoring data for $C_{SF6,CON,BLk,j}$/$C_{SF6,CON,BL}$ 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.

ID Number:	7
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
Measurement procedures (if any):	Prior to the renewal of a crediting period it should be assessed if the Conservative Factor default should be changed.
Any comment:	This value shall account for the uncertainty in SF_6 consumption. IPCC guidelines state that direct reporting has a 5% uncertainty level[7]. 1.05 shall be used as the default factor unless the project proponent can demonstrate to the DOE that their estimates of $C_{SF6,CON,PJ,k,j,y}$ are more than 95% accurate. Project proponents that submit monitoring data for $C_{SF6,CON,PJ,k,j,y}$ 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.

[6] 2006 IPCC Guidelines for NGGI pa. 4.68.
[7] 2006 IPCC Guidelines for NGGI pa. 4.68.

ID Number:	8
Data/Parameter:	CF
Data unit:	--
Description:	Conservative Factor. To compensate for the uncertainty in the global warming potential of the by products emitted after the degradation of the alternate gas (default value of 1.26 for HFC134a and 2,830 for Perfluoro-2-methyl-3-pentanone)
Source of data:	Based on the test results provided in EPA, "Characterization of Cover Gas Emissions from U.S. Magnesium Die Casting", Office of Air and Radiation, May 2004.
Measurement procedures (if any):	Prior to the renewal of a crediting period it should be assessed if the Conservative Factor should be changed, due to the publication of new experiment results or GWP values.
Any comment:	

ID Number:	9
Data/Parameter:	$C_{SF6,TOT,BL}$
Data unit:	tSF_6
Description:	Minimum of annual TOTAL consumption of SF_6 in the facility for the last three years prior to validation.
Source of data:	Industrial Facility
Measurement procedures (if any):	As recommended by IPCC[8], "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) Measuring flow rates and integrating over time (flow measurement method)
Any comment:	As stated by the IPCC the first two methods are more accurate because they are both based on total weight used. Vintage of data should be from the last three years.

[8] IPCC industrial processes 220.

ID Number:	10
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
Measurement procedures (if any):	Measured by calibrated scales according to on-site working procedures
Any comment:	Scales are usually calibrated frequently since this parameter is essential to the core business of the plant. Calibration frequency shall follow on-site calibration procedures. ~~Minimum of the last three years prior to validation should be used.~~

III. MONITORING METHODOLOGY

All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

The monitoring methodology is based on two main parameters to be monitored:

- Amount of Mg manufactured in project scenario;
- Consumption of alternate cover gas in project scenario.

In cases where SF_6 is used in project scenario another parameter is monitored:

- Consumption of SF_6 in project scenario.

In cases where CO_2 is used in project scenario another parameter is monitored:

- Consumption of CO_2 in project scenario.

Monitoring of all parameters shall be conducted separately for each segment. These parameters shall be used to calculate project emissions and dynamic ex post calculation of baseline emissions.

The industrial facility shall be in charge of supplying the data.

The parameters monitored are basic parameters that are often rigorously recorded by the industrial facility for internal purposes. The measuring instruments shall be operated and maintained by the industrial facility. Executive responsibility of carrying out periodic calibration is on the industrial facility that may conduct the calibration themselves or by an external certified company.

Data and parameters monitored

Data / Parameter:	$P_{Mg,PJ,k,j,y}$ / $P_{MG,PJ,,y}$
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./ Annual amount of Mg products manufactured in project scenario in the facility per year *y*.
Source of data:	Industrial Facility
Measurement procedures (if any):	Measured by calibrated scales according to on-site working procedures
Monitoring frequency:	Continuous or per batch
QA/QC procedures:	Scale should be calibrated annually with standard weight. Figures to be cross-checked with internal sales and stock reports.
Any comment:	Scales are usually calibrated more than once a year since this parameter is essential to the core business of the plant. Calibration frequency shall follow on-site calibration procedures, but shall be conducted at least annually.

Data / Parameter:	$C_{ALTGAS,PJ,k,j,y}$
Data unit:	t / yr
Description:	Consumption of alternate gas in project scenario for each equipment *k* in each segment *j* per year.
Source of data:	Industrial facility
Measurement procedures (if any):	The same procedures recommended by IPCC for direct reporting of SF_6 consumption shall be practiced for the measurement of alternate gas which 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) 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:	Accounting Method- once purchase is made Weight difference method – once cylinder is replaced Flow measurement method - continuously
QA/QC procedures:	To ensure consistency between baseline and project calculations, the measurement method of alternate gas shall follow the same method conducted for SF_6. When relying on measurements of cylinder weight or flow rates, measurements shall be cross-checked with purchase receipts. In case of uncertainty, the highest value of alternate gas shall be used resulting in the highest value for $C_{ALTGAS,PJ,k,j,y}$ and therefore the highest value of project emissions (conservative assumption). When using the weight difference method, scales should be calibrated annually using a standard weight. When using the flow measurement method, flow meters should be calibrated annually using an on-site standard gas sample of alternate gas or by an external certified company. The measurement of flow rate should be measured in normal cubic meter and converted to weight units. Normalization should be based on temperature and pressure readings and on the density of alternate gas.
Any comment:	As stated by the IPCC the first two methods are more accurate because they are both based on total weight used. When the accounting or weight difference method is used in casting facilities that include production of several magnesium segments (e.g. die cast & secondary magnesium) it is essential to make sure that data is recorded separately for each industry segment. If data is not recorded separately then the flow measurement method must be used.

Data / Parameter:	$C_{SF6,CON,PJ,k,j,y}$
Data unit:	tSF6 /yr
Description:	The total consumption of SF_6 in the industrial facility in the project scenario in each equipment in each segment, per year.
Source of data:	Industrial facility
Measurement procedures (if any):	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) 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:	Accounting Method- once purchase is made Weight difference method – once cylinder is replaced Flow measurement method - continuously
QA/QC procedures:	To ensure consistency between baseline and project calculations, the measurement method of SF_6 in the project scenario shall follow the same method conducted for SF_6 in the baseline scenario. When relying on measurements of cylinder weight or flow rates, measurements shall be crosschecked with purchase receipts. In case of uncertainty, the highest value of SF_6 shall be used resulting in the highest value of project emissions (conservative assumption). When using the weight difference method, scales should be calibrated annually using a standard weight. When using the flow measurement method, flow meters should be calibrated annually using an on-site standard gas sample of SF_6 or by an external certified company. The measurement of flow rate should be measured in normal cubic meters and converted to weight units. Normalization should be based on temperature and pressure readings and on the density of SF_6.
Any comment:	As stated by the IPCC the first two methods are more accurate because they are both based on total weight used. When the accounting or weight difference method is used in casting facilities that include production of several magnesium segments (e.g. die cast & secondary magnesium) it is essential to make sure that data is recorded separately for each industry segment. If data is not recorded separately then the flow measurement method must be used.

Data / Parameter:	$C_{CO2,PJ,j,y}$
Data unit:	tCO_2/yr
Description:	Consumption of CO_2 gas in project scenario for each segment *j* per year.
Source of data:	Industrial facility
Measurement procedures (if any):	The same procedures recommended by IPCC for direct reporting of SF_6 consumption shall be practiced for the measurement of CO_2. CO_2 can be measured in the following ways: Recording delivered purchases and inventory changes (accounting method) Measuring the difference in cylinder/ containers weight for gas used/ returned (weight difference method) 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:	Accounting Method- once purchase is made Weight difference method – once cylinder is replaced Flow measurement method - continuously
QA/QC procedures:	To ensure consistency between baseline and project calculations, the measurement method of CO_2 shall follow the same method conducted for SF_6. When relying on measurements of cylinder weight or flow rates, measurements shall be crosschecked with purchase receipts. In case of uncertainty, the highest value of CO_2 shall be used resulting in the highest value of project emissions (conservative assumption). When using the weight difference method, scales should be calibrated annually using a standard weight. When using the flow measurement method, flow meters should be calibrated annually using an on-site standard gas sample of CO_2 or by an external certified company. The measurement of flow rate should be measured in normal cubic meter and converted to weight units. Normalization should be based on temperature and pressure readings and on the density of CO_2.
Any comment:	As stated by the IPCC the first two methods are more accurate because they are both based on total weight used. $\mathbf{C_{CO2,PJ,y}}$ is only measured when CO_2 is used as diluent in cover gas mix in the project activity alone (i.e. not in the baseline activity). When the accounting or weight difference method is used in casting facilities that include production of several magnesium segments (e.g. die cast & secondary magnesium) it is essential to make sure that data is recorded separately for each industry segment. If data is not recorded separately then the flow measurement method must be used.

Data / Parameter:	SO_2 emissions
Data unit:	mg/m^3
Description:	SO_2 emissions
Source of data:	
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures:	
Any comment:	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 of SO_2 concentration in the exhausting system – 1470 mg/m^3 (273 K, 101,325 kPa at an oxygen concentration of 6 %(v/v). When "dilute" SO_2 is the alternative gas replacing SF_6 and "dilute" SO_2 emissions do not comply with the above, 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.

Data / Parameter:	Magnesium sales reports
Data unit:	tMg/ yr
Description:	In order to dispel concerns that a company increases production levels just to gain CERs, project developers must show proof of sales of magnesium.
Source of data:	Industrial facility
Measurement procedures (if any):	Annual Magnesium sales shall be compared to $P_{Mg,PJ,j,y}$, annual magnesium produced.
Monitoring frequency:	Annually
QA/QC procedures:	Magnesium sales reports shall be verified by DOE as part of the verification process.
Any comment:	If less than 70% of total magnesium produced is sold then the value of annual magnesium sales shall be used as the value for $P_{Mg,PJ,j,y}$. Unless a project developer can prove to DOE that a decline in demand has 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.

IV. REFERENCES AND ANY OTHER INFORMATION

Not applicable.

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History of the document

Version	Date	Nature of revision(s)
02	EB 41, Annex 2 02 August 2008	To include a changed procedure to estimate the baseline emission factor of SF_6 based on the minimum value of emission factor for the three years prior to the start of implementation of the project activity.
01	EB 37, Annex 2 01 February 2008	Initial adoption.