

CONVERSION OF SF₆ TO AN ALTERNATIVE COVER GAS IN MAGNESIUM PRODUCTION IN EATON RAPIDS, MI AND STRATHROY, ON



Document Prepared by Julie Kelleher, 3Degrees Group, Inc.

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Prepared By	Julie Kelleher, Project Manager, Carbon Projects, 3Degrees Group, Inc.
Contact	407 Sansome Street, Fourth Floor, San Francisco, CA (415) 692-3411 / carbonmarkets@3degreesinc.com

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PROJECT DETAILS

1.1 Summary Description of the Project

Molten magnesium burns in the presence of oxygen, and so production and casting of magnesium metal requires a protection system to prevent this oxidation. Among the various protection systems commonly used are those that use gaseous components with high global warming potential (GWP) values, such as SF₆, which typically escape into the atmosphere. SF₆, because it is such a non-reactive gas, is ideally suited for this kind of protection as a “covering” for molten magnesium (hence the term “cover gas”).

Meridian Magnesium Products – with locations in both Eaton Rapids, Michigan and Strathroy, Ontario – historically used SF₆ as a protective cover gas to prevent oxidation of its molten magnesium. The ongoing project switched over the cover gas from SF₆ to Novec-612, a gas patented by 3M, which has heretofore never been used commercially in the U.S., as well as SO₂. The Novec-612 and SO₂ perform the same functions as the SF₆ as cover gases to prevent the molten magnesium from reacting with the air. The Novec-612 and SO₂ gases are pumped from a gas mixer to the point-of-use and inserted over the melt surface. The purpose of the project activity is to stop using SF₆ and instead use cover gases that have smaller or no global warming potential, thus reducing GHG emissions to the atmosphere.

The baseline scenario is the continued use of SF₆ and the project scenario is the use of alternative cover gases. This project, implemented in January 2007, installed the necessary piping and other equipment required to switch from SF₆ to Novec-612 and SO₂. Novec-612 is a fluorinated ketone identified as dodecafluoro-2-methyl-3-pentanone or Perfluoro-2-methyl-3-pentanone with the chemical formula CF₃CF₂C(O)CF(CF₃)₂. While the GWP for SO₂ is zero, the GWP for Novec-612 is 2,830 (GWP of 1 with a conservative factor of 2,830).

The commissioning of the project has taken place in phases at different locations. After commissioning, the kit has continued to operate regularly. The project commissioning schedule is shown below:

US Die Casting	Feb. 1, 2008
US Recycling:	Apr. 1, 2008
Canada Die Casting:	May 1, 2008
Canada Recycling:	Jan. 1, 2007

The initial crediting period for this project ran for ten years, from 01/01/2007 through 12/31/2016. In the initial crediting period, the project included credits generated from the location in Strathroy, Ontario. In the second crediting period the project will only include the Michigan location and will not be seeking credits for the activities in Ontario. Averages of the initial crediting period result in an estimated GHG emissions reductions of 196,000 VCUs per year for the second crediting period.

1.2 Sectoral Scope and Project Type

The project activity falls into the following Sectoral Scopes: Scope 4 – Manufacturing Industries; Scope 9 – Metal Production; Scope 11 – Fugitive Emissions from Production and Consumption of

Halocarbons and Sulfur Hexafluoride. The project meets the criteria of the CDM Approved Baseline and Monitoring Methodology AM0065, version 2.1 – “Replacement of SF₆ with alternate cover gas in the magnesium industry.”

The project is implemented as a non-grouped project. The project will not be expanded subsequent to project validation.

1.3 Project Proponent

Organization name	Magnesium Products of America (also denoted as Meridian Magnesium Products of America or MPA)
Contact person	Charles Woodburn
Title	Project Manager
Address	2001 Industrial Drive, Eaton Rapids, MI 48827
Telephone	(517) 663-2700 ext. 124
Email	cwoodburn@meridian-mag.com

1.4 Other Entities Involved in the Project

Organization name	3Degrees Group, Inc.
Role in the project	Carbon Credit Developer
Contact person	Julie Kelleher
Title	Associate, Carbon Projects
Address	407 Sansome Street, Fourth Floor, San Francisco, CA 94111
Telephone	(415) 692-3411
Email	carbonmarkets@3degreesinc.com

1.5 Project Start Date

Project start date has been previously validated as January 2007, when Meridian Magnesium signed a contract with QualityTonnes, LLC (which later was acquired by Climate Change Capital) to provide all services related to monetizing the potential VERs from its US projects. This included the submission of a CDM methodology (later to become AM0065) to the CDM Executive Board.

The project start date, as previously validated, is January 1, 2007. This corresponds with the initial day of the trial period conducted at Strathroy Plant D – Recycling to determine which cover gas(es) would be the most effective as a replacement to SF₆.

1.6 Project Crediting Period

The initial project crediting period ran from January 1, 2007 through December 31, 2016 for a total of 10 years. This will be the first renewal of the project crediting period, allowed under VCS Standard v3.7.

The second crediting period sought will be another 10 years starting on January 1, 2017 and ending on December 31, 2026.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
2017	196,000
2018	196,000
2019	196,000
2020	196,000
2021	196,000
2022	196,000
2023	196,000
2024	196,000
2025	196,000
2026	196,000
Total estimated ERs	1,960,000
Total number of crediting years	10 years
Average annual ERs	196,000

1.8 Description of the Project Activity

The project operates in accordance with AM0065 and VCS requirements. MPA's operations include casting melted magnesium ingots in die cast and also melts magnesium scrap in its recycling operations. Both die cast and recycled ingots are used primarily for the automobile manufacturing industry.

The project activity is the utilization of Novec and SO₂ as cover gas alternatives to SF₆ in MPA's magnesium recycling and die cast operations in the U.S. This project included installation of the necessary piping and other equipment required to switch from SF₆ to Novec-612 and SO₂. Novec-612 is a patented gas by 3M. The gas is fluorinated ketone with the chemical formula CF₃CF₂C(O)CF(CF₃)₂. See the chart below for key characteristics of the possible cover gases.

		SF ₆	SO ₂	HFC-134a	Novec™ 612 Agent
Environmental Properties					
Ozone depletion potential (ODP)		-	-	-	-
Atmospheric Lifetime (years)		3,200		14	0.014
Global Warming Potential (GWP)		22,800	1	1,300	1

The baseline situation is the use of SF₆, the vast majority of which is simply emitted to the atmosphere. By using Novec and SO₂ as alternative cover gases, SF₆ use is severely reduced. The gases are pumped from a gas mixing station in the plant through a piping system to the points-of-use – the die cast furnaces and recycling operations – and inserted above the melt surface, so molten metal does not react with the air. The gases are stored in the gas mixing station in storage tanks (located in the cabinets) until the gas is required for use at the die cast cells or recycling furnaces. At the gas mixing stations, the Novec and SO₂ are mixed with a carrier gas – in this case CO₂ – for delivery to the points-of-use. In the case of Novec, the gas is first a liquid, which is stored in a large container next to the mixing stations. The liquid is pumped into the station where the pressure is reduced to the point it becomes a gas and mixed in with the carrier gas.

The Michigan plant has the following characteristics and equipment:

- 360 employees
- 13,140 Net Metric Tons Capacity
- Plant Size 208,000 ft² (13,800 m²)
- 15 die cast cells & 3 recycling cells
 - 4 - 1200 ton
 - 9 - 3000 ton
 - 1 – 4000 ton
 - 1 – 4500 ton
- Secondary Operations
 - 9 Computer Numerical Control (CNC) machining centers
 - Special purpose drill centers
 - Special purpose machines and assembly equipment
 - Automated assembly equipment

- Automated vision inspection stations for instrument panel assembly and Magnesium Radiator Support programs
- Leak test equipment
- Powder coat line for Magnesium Radiator Support program (not operated by MPA)

According to both manufacturer specifications and the experience of the project operators, die cast machines, if well maintained, can have a lifetime of 40 years. A CNC machine center has an average lifetime of 20 years. A specialized drill center will last 10 years, or the lifetime of the program it is needed for. The lifetimes have not changed since the implementation of the program and the alternative cover gases.

Load capacities and level of service of all die cast and recycling cells and plant capacity for the project remain the same as the baseline scenario as the alternative cover gas was chosen specifically for properties that would not have adverse effects on the metals or the equipment. The modifications for the project scenario included only installation of the necessary piping and other equipment required to switch from SF₆ to Novec-612 and SO₂.

To determine the level of service for the new alternative gases in comparison to the baseline scenario of SF₆, MPA conducted trials of SO₂ and Novec in its plants in the US and Canada. In the trials, it was concluded that for every unit of SF₆ used in the baseline, 33% as much SO₂ and 75% as much Novec would be required to provide the same melt protection. The baseline scenario established annual operation of the plant would need 5.5 tons of SF₆, meaning equivalent operation would require 1.815 tons of SO₂ and 4.125 tons of Novec. The relative usage of these alternative gases have stayed the same in the current conditions, as assured by the project operator. The quantity of metal melted at the facility is unchanged by the project activity and is instead driven by production volume.

SF₆ continues to be used in recycling at the facility, albeit a reduced amount to that used in the baseline, largely due to the import of scrap from MPA overseas operations. Because the scrap spends time on the ocean, it can become coated with oxides which creates issues with the recycling operations when processed. As a result, SF₆ tends to produce better results controlling the melt surface over the alternative gases. As a general rule, the project scenario sees Novec replacing SF₆ wherever practical.

A power outage results in the inability to use the Novec system, due to the fact that electricity is required to operate the air compressors and mixing cabinet. When there is a power outage, the backup SF₆ system kicks in to protect the molten metal on the die cast floor at the time of the power outage. SF₆ is also occasionally used in instances where they need to control any small fires that begin due to oxygen exposure to the metal. Similarly, if there is an operational issue with the Novec or SO₂ alternative cover gas system, the backup SF₆ system is used to keep the molten metal protected and to continue the manufacturing process.

1.9 Project Location

Meridian Magnesium Products of America (MPA)
2001 Industrial Drive
Eaton Rapids, Michigan, 48827
U.S.A.

Latitude Longitude 42° 31' N 84° 38'W



1.10 Conditions Prior to Project Initiation

Baseline scenario is the same as the conditions existing prior to project installation. See Section 2.4 (Baseline Scenario).

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

This project complies with all local laws and regulations. In Michigan, the Tailoring Rule (issued on May 13, 2010) sets thresholds for greenhouse gas emissions that define when a new, modified, or existing facility would be required to obtain a permit under the EPA's New Source Review (NSR) Prevention of Significant Deterioration (PSD) program. MPA does not trip the threshold of the Tailoring Rule for two reasons: first, MPA is not a new facility and the modified definition does not apply either, as the total surface area of the molten magnesium that is protected by the applicable GHGs has not changed since initial startup in 1999. Second, the emissions threshold for existing stationary sources is facilities that emit 100,000 tons per year (TPY) CO₂e and 100 TPY mass balance of six GHGs (CO₂, HFCs, CH₄, N₂O, PFCs, and SF₆). While MPA does emit more than 100 TPY of CO₂, the combined total emissions of CO₂ and SF₆ is below the 100,000 TPY CO₂e threshold. By not meeting the Tailoring Rule criteria, MPA is exempt from the NSR and PSD program, and Title V for GHG purposes.

There is currently no regulation dealing with the emissions of SO₂ in Michigan because the amounts are so small. The levels of SO₂ are also in compliance with the rules of AM0065, such as concentration levels being 1% or less, and emissions being less than 1,470 mg/m³.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

Per VCS Standard §3.11.1, project ownership arises “by virtue of statutory, property, or contractual right in the plant, equipment or process that generates GHG emission reductions”. Magnesium Products of America owns all property and process equipment in full that are used in the generation of GHG emission reductions.

1.12.2 Emissions Trading Programs and Other Binding Limits

This project does not fall under an Emission Trading Programs or Other Binding Limits.

This project is not participating in any other GHG programs.

1.12.3 Other Forms of Environmental Credit

No other form of environmental credit has been sought or received from this project.

1.12.4 Participation under Other GHG Programs

This project has not been registered and is not currently seeking registration under any other GHG programs.

1.12.5 Projects Rejected by Other GHG Programs

Not applicable.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

Not applicable.

Leakage Management

There is no leakage of emissions associated with this project.

Commercially Sensitive Information

Not applicable.

Sustainable Development

The project contributes to achieving nationally stated sustainable development priorities through the US EPA’s Fluorinated Gas Partnership Program (“F-Gas Partnership Program”). These programs were launched as a joint effort by EPA and industry groups to reduce the amount of fluorinated gases emitted by a variety of industry processes. The programs promote the development and adoption of cost-effective F-Gas emission reduction opportunities.

The EPA and the U.S. magnesium industry, with the support of the International Magnesium Association (IMA), worked together to better understand and reduce emissions of sulphur hexafluoride (SF₆) from magnesium production and casting processes, with the goal of eliminating SF₆ emissions by identifying, evaluating and implementing cost-effective climate protection strategies and technologies including alternative cover gases.

As noted on the EPA's F-Gas Partnership Program website (<https://www.epa.gov/f-gas-partnership-programs/magnesium-industry>), studies conducted by the magnesium industry identified technically proven alternative cover gas options for eliminating the use of SF₆. EPA's partners in the magnesium industry made significant progress in improving their operational efficiencies and environmental performance by deploying alternative cover gas technologies and optimizing SF₆ cover gas concentrations, flow rates and delivery mechanisms, as well as identifying and repairing leaks in SF₆ gas distribution systems. These activities and technological innovations provided both economic and environmental benefits.

Note that this program does not regulate in any way the replacement of SF₆ with alternative gases.

Under subpart T of EPA's Greenhouse Gas Reporting Program (40 CFR Part 98), owners or operators of facilities that contain magnesium production processes are required to annually report emissions from use of cover or carrier gases as well as for all other source categories located at the facility for which methods are defined in the rule. Facilities covered by subpart T are those that have emissions equal to or greater than 25,000 MTCO₂e per year in combined emissions from stationary fuel combustion and all other source categories identified by the rule.

MPA has reported GHG emissions to the EPA for several years but after 3 consecutive years below 25,000 MTCO₂e was not required to report its 2016 emissions.

Further Information

Not applicable.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

This project is using an approved CDM Methodology, AM0065 – “Replacement of SF₆ with alternate cover gas in the magnesium industry”, Version 2.1 (EB44).

The following tool is referenced in the methodology, and was applied by the project upon registration and validation of the initial crediting period. It was not necessary to revisit or demonstrate additionality again for the renewed crediting period, per VCS Standard v3.7, Section 3.8.5.2.

- “Combined tool to identify the baseline scenario and demonstrate additionality” (EB28, annex 14)”, as used at the time of the original crediting period validation but not redone for this crediting period, per VCS Standard v3.7, Section 3.8.5.2.

The following tool was applied by the project to reassess the originally identified baseline and additionality, per VCS Standard v3.7, Section 3.8.5.1-2:

- “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (EB66, annex 47).

2.2 Applicability of Methodology

This project is applicable to this methodology because the following applicability criteria – listed in AM0065 – apply to this project:

1. 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 alloy 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.

This project covers both die-casting and recycling and are thus eligible under AM0065.

2. Advanced “dilute SO₂” melt protection technology is technology that meets the following specifications:
 - . Well controlled SO₂ concentration and flow rates with concentration typically 1 percent or less. The concentration is approximately 1%.
 - . An associated SO₂ exhausting and abatement system to ensure SO₂ 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 SO₂ concentration in the exhausting system – 1470 mg/m³ (dry basis, 273 K, 101,325 kPa at an oxygen concentration of 6% (v/v)); There is no local law dealing with SO₂ emissions in Michigan because the amounts are so small
 - . Precise gas mixing and delivery system using mass balance weight method or similarly accurate device and heated gas lines to SO₂;
 - . Gas cabinet with leak monitors and emergency ventilation system;
 - . Redundant / backup melt protection technology in case SO₂ leak requires system shut down and repair;
 - . Emergency back-up 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.

The portions of the MPA project that include SO₂ use meet all of the above criteria.

3. This methodology applies to project activities that replace the use of cover gas SF₆ in full or in part by another cover gas. HFC14a, Perfluoro-2-methyl-3-pentanone (CF₃CF₂C(O)CF(CF₃)₂) or SO₂ using lean SO₂ technology in existing facilities:

This project replaced SF₆ with SO₂ and Novec and was implemented in 2007 – 2008.

4. The methodology is only applicable if the baseline scenario is the continuation of current practice of using SF₆ as a cover gas.

The baseline for MPA would have been the continued use of SF₆ had a project not been implemented on site.

2.3 Project Boundary

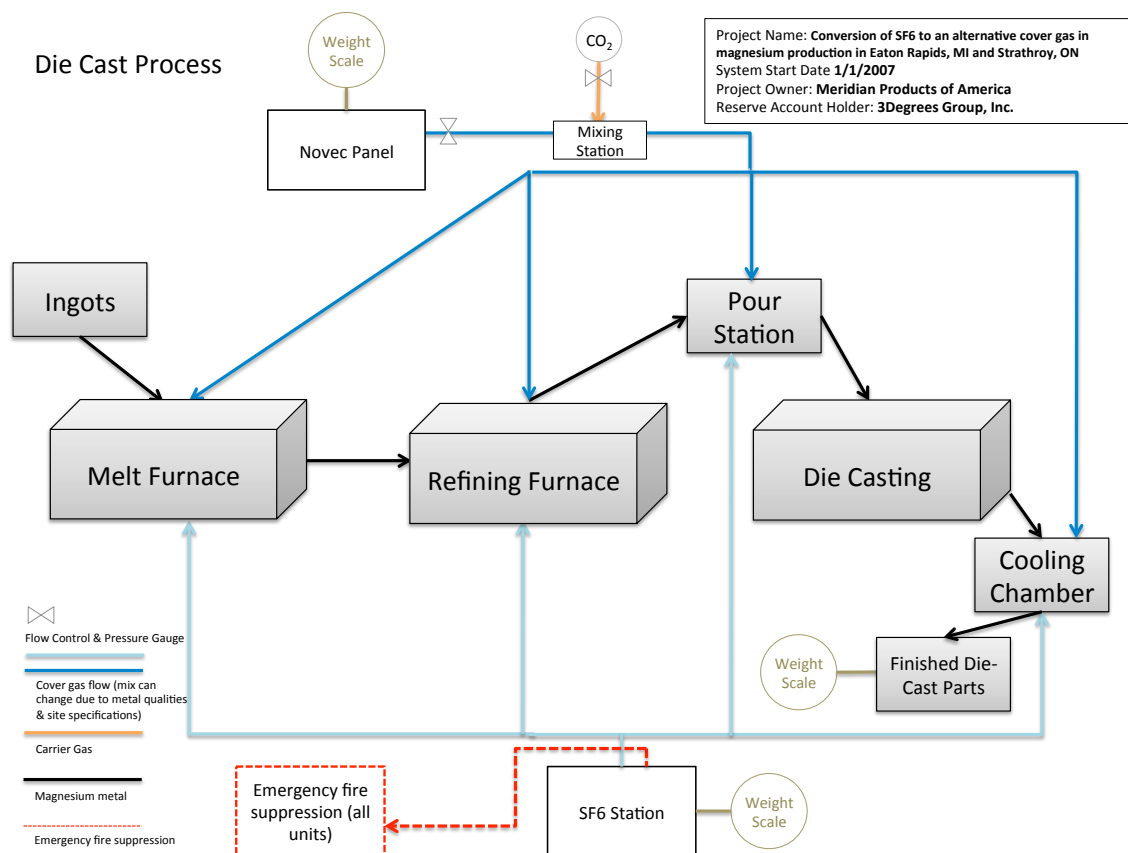
Source		Gas	Included?	Justification/Explanation
Baseline	Cover gas mix to protect molten magnesium	CO ₂	No	CO ₂ was used as a carrier gas for SF ₆ in the baseline. As specified in the methodology, since CO ₂ is used both in baseline and project scenarios, it is excluded from both calculations for the sake of simplicity.
		SF ₆	Yes	This is the primary gas, which will be substituted in the project scenario.
		CH ₄	No	CH ₄ is excluded from the baseline calculations. Exclusion of this gas is conservative.
		N ₂ O	No	N ₂ O is excluded from the baseline calculations. Exclusion of this gas is conservative.
Project	Inserted as cover gas mix to protect molten magnesium	CO ₂	No	CO ₂ is used as a carrier gas for the Novec. Since it is used as a carrier gas in both the baseline and project scenarios, it is excluded from the project emissions calculations as well as the baseline calculations.
		Perfluoro-2-methyl-3-pentanone ¹	Yes	Replacement gas to SF ₆ . Must be considered in project emissions calculations.
		SF ₆	Yes	In cases where SF ₆ is used in the project scenario, it is included in project emission calculations and monitored data.

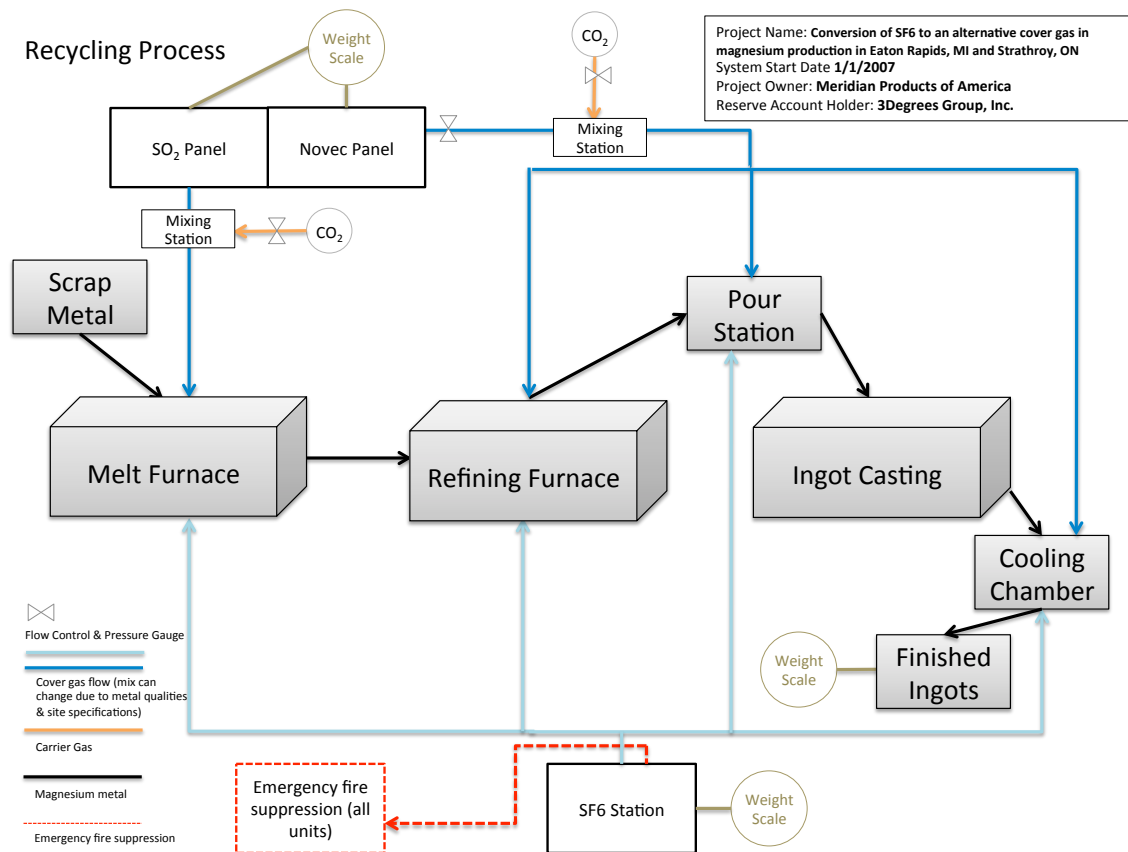
¹ Perfluoro-2-methyl-3-pentanone, as referred to in AM0065 is chemically identical to Novec 612 fluid, or dodecafluoro-2-methyl-3-pentanone, as referred to in 3M's Product Information sheet. 3M references the condensed structural formula for dodecafluoro-2-methyl-3-pentanone as CF₃CF₂C(O)CF(CF₃)₂, which can also be written as the molecular formula of C₆F₁₂O. The National Institutes of Health's Open Chemistry Database sites perfluoro-2-methyl-3-pentanone as the chemical name of C₆F₁₂O (https://pubchem.ncbi.nlm.nih.gov/compound/Perfluoro_2-methyl-3-pentanone#section=Top). The chemical structure shown on this page is the same as the condensed structural formula for dodecafluoro-2-methyl-3-pentanone. Additionally, a reference cited 3M white paper titled "3M Novec 612 as a Substitute for SF₆ in Magnesium Processing" refers to a study to determine the global warming potential of Novec, whereby perfluoro-2-methyl-3-pentanone is described with the condensed structural formula of CF₃CF₂C(O)CF(CF₃)₂, the same dodecafluoro-2-methyl-3-pentanone (<http://pubs.acs.org/doi/pdf/10.1021/es048088u>).

Source	Gas	Included?	Justification/Explanation
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 since this project is using Novec or Perfluoro-2-methyl-2-pentanone.
	C ₂ F ₆		
	C ₃ F ₈		
	N ₂ O	No	Cover gas HFC-134a is not used; N ₂ O does not need to be included.

For this project, the project boundary includes the Eaton Rapids facility from which SF₆ was used in the baseline and from which the by-products of Novec are emitted in the project scenario.

A diagram of the project boundary for the die cast and recycling processes, including equipment, systems and flows of mass and energy, are shown below.





2.4 Baseline Scenario

Per the VCS Standard v3.7, Section 3.8.5, for the “Renewal of Project Crediting period”, the validity of the original baseline scenario must be assessed according to the *CDM Tool to assess the validity of the original/ current baseline and to update the baseline at the renewal of a crediting period (EB 66, v03.0.1)*. The original baseline was determined according to version EB28 of the “Combined tool to identify the baseline scenario and demonstrate additionality”.

The steps for the reassessment are as follows:

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

The original baseline scenario is the continued use of SF₆ as a cover gas. Of the alternative scenarios proposed in the original validation, the continued use of SF₆ remains the most likely scenario. Indeed, without the revenue from the sale of carbon offsets the project would very likely revert to heavier usage of the more affordable SF₆ gas.

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

There have been no new laws, federal or local to Michigan, regulating the use of SF₆ in magnesium production, nor requiring the use of alternative cover gases such as Novec or SO₂. The project complies with all mandatory requirements for SF₆ usage and magnesium production.

Step 1.2: Assess the impact of circumstances

As the baseline scenario identified was the continued use of SF₆ without any additional investment, an assessment of the changes in market characteristics was conducted to assess relevant changes in the second crediting period.

While operating under the baseline scenario in 2006, Meridian Magnesium paid about US\$8.11 per pound of SF₆. As far as usage of the alternative cover gases, MPA conducted trials of SO₂ and Novec in its plant in the US and Canada. In the trials, it was concluded that for every unit of SF₆ used in the baseline, 33% as much SO₂ and 75% as much Novec would be required to provide the same melt protection. The baseline scenario established annual operation of the plant would need 5.5 tons of SF₆, meaning equivalent operation would require 1.815 tons of SO₂ and 4.125 tons of Novec. The relative usage of these alternative gases have stayed the same in the current conditions, as assured by the project operator.

At the time of the original validation, the cost of SO₂ (\$3.25/lb) was about 40% cost of SF₆ (\$8.11/lb). As for Novec, the price of \$15/pound was about twice the cost of SF₆. The current market values for these cover gases are: SF₆ (\$8.75), SO₂ (\$1.89), and Novec (\$18.00). Novec remains twice as expensive as SF₆, while SO₂ prices have dropped to 15% the cost of SF₆.

Capital costs, ongoing maintenance, and annual operating costs from the initial crediting period validation remain unchanged and have only been adjusted for inflation or price changes. For VER production, the project presently looks to produce an average of 196,000 VERs per year. The average VCS carbon price of \$2.3/tCO₂e transacted in 2016² would result in \$450k per year in income. Including all costs of operating the project scenario, MPA stands to gain about \$3.9 Million through a second crediting period versus losing almost \$3 Million without carbon revenue.

In current market conditions, the investment analysis still holds true that MPA would have no incentive to continue the project scenario for another crediting period without the potential of generating verified emission reduction credit revenue.

² <https://www.cbd.int/financial/2017docs/carbonmarket2017.pdf>

2017 Market Characteristics

Cover Gas	Cost per pound	On-going maintenance costs per year*	Tons of Cover Gas Needed per year	Total Annual operating costs**	Capital costs to switch	Total Cost***
SF6	\$ 8.75	\$ -	5.50	\$ 96,250	\$ -	\$ 962,500
Novec	\$ 18.00	\$ -	4.125	\$ 148,500	\$ 261,955	\$ 1,746,955
SO2	\$ 1.89	\$ 166,670	1.815	\$ 173,531	\$ 427,189	\$ 2,162,496

Total Net Costs through 2016 of switching	\$ 3,909,451
Carbon Revenue Assuming total of 196,000 VERs/year total	\$ 4,508,000
Net loss without carbon revenue (total costs - costs of using SF6)	\$ (2,946,951)
Net gain with Carbon revenue	\$ 598,549

*19.05% - inflation rate for labor between 2006 and 2016

**Assuming 5.5 tons of SF6 per year's worth of MG and equivalent amount of alternative is required

Based on Novec : SF6 usage ratios of 0.75:1 ton per kg MG

Based on SO2 : SF6 usage ratios of 0.33:1 ton per kg MG

***Assuming a 10 year crediting period and assuming MG production & prices of gas do not change

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

The baseline scenario identified at validation is the continuation of the use of current equipment without any investment. The lifetime of the equipment used on site is significantly longer than the 10-year crediting periods, other than routine maintenance performed due to wear and tear regardless of project activities. The continuation of use of the current baseline equipment is therefore the most likely scenario for the second crediting period.

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

The IPCC value for the GWP of SF₆ has been updated since the initial crediting period validation, which at the time used the IPCC Third Assessment Report value of 22,200 tCO₂eq/tSF₆. This parameter was updated in the 2009 verification through an approved project description deviation to the Second Assessment Report value of 23,900 tCO₂eq/tSF₆. For the second crediting period, we refer to the GWP of 22,800 from the Fourth Assessment Report as recognized by CDM Executive board and stipulated by the VCS Standard version 3.7. The emissions factors for Novec and SO₂ have remained the same since the initial crediting period validation. No other baseline parameters require adjustment.

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

After evaluation of the original baseline, it was determined that the existing baseline should be updated to reflect current IPCC values for the GWP of SF₆ of 22,800.

Because the original/current baseline scenario can be used as previously validated we need not reapply the combined tool to identify the baseline scenario. The previously established baseline emission factors shall be used, as described below in Section 3.1.

2.5 Additionality

Per the VCS Standard v3.7, Section 3.8.5 – “Renewal of Project Crediting Period”, a full reassessment of additionality is not required when renewing the project crediting period.

See the initial project description for a discussion on additionality of the project.

There is no requirement, either local or federal, that requires the limitation or elimination of SF₆. MPA's choice to utilize a replacement gas for SF₆ is not the result of any legal or regulatory mandate, nor are the Meridian Magnesium facilities regulated entities under any emissions trading schemes in Michigan.

2.6 Methodology Deviations

There are no methodology deviations.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

The baseline emissions are based on the Project's ratio of SF₆ consumed to magnesium melted, by weight, over three baseline years prior to the project start date (and adjusted with a degradation factor) as prescribed by AM0065. That emissions factor ratio is multiplied by the amount of magnesium produced in each segment (die casting or recycling) per year to determine how much SF₆ would have been used and emitted had the project continued use to SF₆.

As prescribed in AM0065, the original baseline was calculated according to Case 2: "In [the] case only the historical consumption for SF₆ for the total facility is available". In the 3 years prior to the installation of the project, SF₆ was the only cover gas used on site; total SF₆ emitted in the baseline per year was therefore only tracked by total facility usage. There was no tracking of the amount used separately per piece of equipment. Magnesium products manufactured corresponding to the total SF₆ usage is aggregated into total facility usage in the baseline calculations as well.

The formula can be expressed as follows:

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

Where:

BE _y	= Baseline emissions in year y (tCO ₂ e/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 ₂ e/ tSF ₆)

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

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 (t SF_6 / yr)

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

$C_{SF6,CON,BL}$ = Total annual consumption of SF_6 in the industrial facility, in the baseline (t SF_6 / yr)

DF_{SF6} = Degradation Factor of SF_6 that reacts with the magnesium in the production process assumed as 0.5⁴

Baseline calculations, based on the original baseline data from 2005-2007 and reassessed according to the *CDM Tool to assess the validity of the original/ current baseline and to update the baseline at the renewal of a crediting period (EB 66, v03.0.1)* are shown below:

Michigan		Original Baseline			Assessment for renewal of crediting period
Die Casting		2005	2006	2007	
	US Die casting SF_6 (lbs)	14,740	10,788	10,981	Unable to update; reflective of historical situation that no longer exists on site.
	US Die casting Metal (lbs)	62,672,227	56,085,588	56,696,032	Unable to update; tied to historical SF_6 usage.
$P_{Mg,BL}$	Total Mg Production (short tons)	31,336	28,043	28,348	
SF_6con	Total SF_6 Use (short tons)	7.37	5.39	5.49	
DF_{SF6}	50% discount	3.69	2.70	2.75	Degradation Factor in AM0065_ver02.1 remains 0.5.
$DISF_6,CON$	5% discount	3.50	2.56	2.61	Conservative Factor in AM0065_ver02.1 remains the default value of 0.95.
EF_{SF6}	EF	0.000112	0.0000914	0.0000920	Minimum emission factor for 3 years data (t SF_6 / tMg)
GWP of SF_6		22,800	22,800	22,800	Updated IPCC default values (AR4, adopted 2007)
Recycling		2005	2006	2007	
	US Die casting SF_6 (lbs)	34,234	34,923	44,222	Unable to update; reflective of historical situation that no longer exists on site.
	US Die casting Metal (lbs)	42,236,980	40,996,103	40,683,251	Unable to update; tied to historical SF_6 usage.
$P_{Mg,BL}$	Total Mg Production (tons)	21,118	20,498	20,342	
SF_6con	Total SF_6 Use (tons)	17.12	17.46	22.11	
DF_{SF6}	50% discount	8.56	8.73	11.06	Degradation Factor in AM0065_ver02.1 remains 0.5.
$DISF_6,CON$	5% discount	8.13	8.29	10.50	Conservative Factor in AM0065_ver02.1 remains the default value of 0.95.
EF_{SF6}	EF	0.000385	0.000405	0.000516	Minimum emission factor for 3 years data (t SF_6 / tMg)
GWP of SF_6		22,800	22,800	22,800	Updated IPCC default values (AR4, adopted 2007)

Anticipated ex-ante baseline emissions for this crediting period have been calculated based on a forecast of extrapolated annualized metal melted from the first 10 months of 2017, which have been processed as of the time of this project description. Calculations are provided below:

$$\text{Recycling baseline} = P_{Mg, \text{recycle}} \times \text{Emission Factor for recycling} \times GWP_{SF6}$$

$$= (20,185,267.77 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0003850 \text{ t}SF_6/\text{tMg}) \times (22,800 \text{ tCO}_2\text{e}/\text{t}SF_6)$$

$$= 177,186 \text{ tCO}_2\text{e}$$

$$\text{Die Cast Baseline} = P_{Mg, \text{die cast}} \times \text{Emission Factor for recycling} \times GWP_{SF6}$$

$$= (27,388,135.64 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0000914 \text{ t}SF_6/\text{tMg}) \times (22,800 \text{ tCO}_2\text{e}/\text{t}SF_6)$$

$$= 57,074.68$$

Total Baseline Emissions = Recycling Baseline + Die Cast Baseline

2017 Ex-Ante Estimate = 234,260 tCO₂e

3.2 Project Emissions

GHG emissions from the project itself includes both emissions of SF₆ which occur during the project period and the use of Novec. According to AM0065, Novec has a GWP of 1 but has the potential to emit by-products after degradation. Thus, the methodology applies a default Conservative Factor 2,830 to the GWP of Novec. For every ton of Novec used, 2,830 tons of CO₂eq must be considered as project emissions. In the case of MPA, averages show that its die casting facility in Michigan uses about 4 tons per year, or about 11,320 tCO₂eq.

Thus, the following formulae will be used:

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

Where:

- PE_y = Project emissions in year *y* (tCO₂e/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* (tCO₂e/yr)
- PE_{SF6,y} = Project emissions from the use of SF₆ - summing of all segments *j* - in year *y* (tCO₂e/yr)
- C_{CO2,PJ,j,y} = Consumption of CO₂ gas in project scenario for each segment per year. Shall be used when CO₂ 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

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

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)

Project emissions from the use of SF₆

$$PE_{SF_6,y} = \sum_j \sum_k C_{SF_6,EM,PJ,k,j,y} * GWP_{SF_6} \quad (11)$$

Where:

- $C_{SF_6,EM,PJ,k,j,y}$ = SF₆ actually emitted in the project scenario in each equipment k of each segment j , per year y (tSF₆/yr)
 GWP_{SF_6} = Global Warming Potential of SF₆ (tCO₂e/tSF₆)

$$C_{SF_6,EM,PJ,k,j,y} = C_{SF_6,CON,PJ,k,j,y} * DF_{SF_6,k,j} * DI_{SF_6,CON,PJ,k,j,y} \quad (12)$$

Where:

- $C_{SF_6,CON,PJ,k,j,y}$ = Total consumption of SF₆ in the project scenario in each equipment k for each segment j , per year y (tSF₆/yr)
 $DF_{SF_6,k,j}$ = Degradation Factor of SF₆ that reacts with the magnesium in the production process assumed as 0.5
 $DI_{SF_6,CON,PJ,k,j,y}$ = A conservative factor portraying the Data Integrity of $C_{SF_6,CON,PJ,k,j,y}$ in each segment, per year. (Fraction), estimated as per information in Data and Parameters not monitored section

Anticipated ex-ante project emissions for this crediting period have been calculated based on a forecast of extrapolated annualized SF₆ and Novec used from the first 10 months of 2017, which have been processed as of the time of this project description. Calculations are provided below:

$$\begin{aligned} \text{Recycling Project Emissions} &= PE_{SF_6, \text{recycle}} \times DF_{SF_6} \times GWP_{SF_6} \times DI_{SF_6, CON, OJ, k, j, y} \\ &+ PE_{Novec, \text{recycle}} \times \text{Conservative factor} \times GWP_{Novec} \end{aligned}$$

$$= (1,615.52 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (22,800 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) + (2,369.93 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec})$$

$$= 26,044.67$$

$$\begin{aligned} \text{Die Cast Project Emissions} &= PE_{SF_6, \text{diecast}} \times DF_{SF_6} \times GWP_{SF_6} \times DI_{SF_6, CON, OJ, k, j, y} \\ &+ PE_{Novec, \text{diecast}} \times \text{Conservative factor} \times GWP_{Novec} \end{aligned}$$

$$= (3.81 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (22,800 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) + (4,300 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec})$$

$$= 12,214.61$$

$$\text{Total Project Emissions} = \text{Recycling} + \text{Die Cast Project Emissions}$$

$$2017 \text{ Ex-Ante Estimate} = 38,260 \text{ tCO}_2\text{e}$$

3.3 Leakage

There is no leakage of emissions associated with this project.

3.4 Net GHG Emission Reductions and Removals

Emissions reductions are calculated as baseline emissions minus project emissions, for the recycling and die cast operations at the facility separately, and summed for the total GHG emissions reductions. There are no sources of leakage from this project.

Emissions Reductions:

$$\text{Total Baseline Emissions} - \text{Total Project Emissions} = \text{Total Emission Reductions}$$

Uncertainties associated with the calculation of emissions volumes would result from normal fluctuations in total metal melted for the year or cover gases used based on situations such as metal quality. As these factors are tracked for our emissions reductions calculations, the uncertainty is low.

Anticipated total emissions reductions for this crediting period have been calculated based on a forecast of extrapolated annualized data from the first 10 months of 2017, which have been processed as of the time of this project description. Calculations are provided below:

$$\text{Total Baseline Emissions} - \text{Total Project Emissions} = \text{Total Emission Reductions}$$

$$2017 \text{ Ex-Ante Estimate} = 234,260 - 38,260 = 196,000 \text{ tCO}_2\text{e}$$

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
2017	234,260	38,260	---	196,000
2018	234,260	38,260	---	196,000
2019	234,260	38,260	---	196,000
2020	234,260	38,260	---	196,000
2021	234,260	38,260	---	196,000
2022	234,260	38,260	---	196,000
2023	234,260	38,260	---	196,000
2024	234,260	38,260	---	196,000
2025	234,260	38,260	---	196,000
2026	234,260	38,260	---	196,000
Total	2,342,600	382,600	---	1,960,000

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	GWP of SF ₆
Data unit	tCO ₂ e / tSF ₆
Description	Global warming potential of SF ₆
Source of data	IPCC AR4
Value applied	22,800
Justification of choice of data or description of measurement methods and procedures applied	IPCC Fourth Assessment Report as recognized by CDM Executive board for second crediting period.
Purpose of Data	Calculation of baseline and project emissions.
Comments	

Data / Parameter	P _{Mg, BL, Total}
Data unit	tMG per year
Description	Amount of Mg products manufactured in baseline scenario in the facility, by weight
Source of data	Meridian Magnesium Products accounting
Value applied	28,348 total for die casting 20,342 total for recycling
Justification of choice of data or description of measurement methods and procedures applied	Measured by calibrated scales according to on-site working procedures. Scales are calibrated frequently since this parameter is essential to the core business of the plant. Calibration frequency shall follow on-site calibration procedures. Calibration data can be provided.
Purpose of Data	Calculation of baseline emissions
Comments	Values according to the last three years prior to project's implementation (2005, 2006, 2007)

Data / Parameter	$C_{SF_6, TOT, BL}$
Data unit	tSF_6
Description	Minimum of annual total consumption of SF_6 in the facility for the last three years prior to initial validation.
Source of data	Meridian Magnesium Products accounting
Value applied:	5.7057 for die casting 12.4625 for recycling
Justification of choice of data or description of measurement methods and procedures applied	As per the approved methodology, the key method to determine how much SF_6 is actually consumed is based on (1) the accounting method (recording and compiling into an inventory database the amount of SF_6 in the cylinder, as provided by the SF_6 manufacturer); and (2) the weight method. Under (2), the weight of the SF_6 cylinder should be weighed when the bottle is full and when the bottle is sent back to the manufacturer. The difference would be the amount of SF_6 used.
Purpose of the data	Calculation of baseline and project emissions
Comments	Values as validated in the initial crediting period according to the last three years prior to project's implementation (2005, 2006, 2007)

Data / Parameter	DF_{SF_6}
Data unit	Fraction
Description	Degradation Factor of SF_6 assumed to react with the magnesium process and thus not emitted, thereby reducing the baseline emissions.
Source of data	AM0065
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied	Prescribed by the applied methodology.
Purpose of the data	Calculation of baseline and project emissions
Comments	

Data / Parameter	GWP _{Novec}
Data unit	tCO ₂ e/ t Novec
Description	Global Warming Potential of Novec
Source of data	AM0065
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	AM0065 specifies the GWP of alternate gas in the case of using Perfluoro-2-methyl-3-pentanone. GWP reassessed at the renewal of this crediting period, and it remains the same.
Purpose of the data	Calculation of project emissions
Comments	Novec-612 is perfluoro-2-methyl-3-pentanone

Data / Parameter	CF
Data unit	Fraction
Description	Conservative Factor to compensate for uncertainty in the global warming potential of the by-products emitted after the degradation of the alternate gas.
Source of data	AM0065
Value applied:	2,830
Justification of choice of data or description of measurement methods and procedures applied	Because Novec-612 is the same as perfluoro-2-methyl-3-pentanone we use the value prescribed in AM0065. Conservative Factor reassessed at the renewal of this crediting period, and it remains the same.
Purpose of the data	Calculation of project emissions
Comments	Default value

Data / Parameter	DI _{SF₆, CON, BL}
Data unit	Fraction
Description	A conservative factor for portraying the Data Integrity of measured total consumption of SF ₆ in the facility (C _{SF₆, CON, BL}).
Source of data	AM0065, which uses IPCC guidelines
Value applied:	0.95
Justification of choice of data or description of measurement methods and procedures applied	As per AM0065. Conservative factor reassessed at the renewal of this crediting period, and it remains the same.
Purpose of the data	Calculation of baseline and project emissions
Comments	

Data / Parameter	$DI_{SF_6, CON, PJ, k, j, y}$
Data unit	Fraction
Description	A conservative factor for portraying the Data Integrity of measured consumption of SF_6 in each equipment k in each segment j ($C_{SF_6, CON, PJ, k, j, y}$).
Source of data	AM0065, which uses IPCC guidelines
Value applied:	1.05
Justification of choice of data or description of measurement methods and procedures applied	As per AM0065. Conservative factor reassessed at the renewal of this crediting period, and it remains the same.
Purpose of the data	Calculation of project emissions
Comments	Default value

Data / Parameter	Lowest baseline emissions factor for US Die Casting
Data unit	tSF_6 / tMg
Description	tSF_6 per tonne of Mg metal melted
Source of data	Baseline assessment
Value applied:	0.0000914
Justification of choice of data or description of measurement methods and procedures applied	Measured by calibrated scales according to on-site working procedures as per AM0065.
Purpose of the data	Calculation of baseline emissions
Comments	Minimum of the values as validated in the initial crediting period according to the last three years prior to project's implementation (2005, 2006, 2007)

Data / Parameter	Lowest baseline emissions factor for US Recycling
Data unit	tSF ₆ / tMg
Description	tSF ₆ per tonne of Mg metal melted
Source of data	Baseline assessment
Value applied:	0.000385
Justification of choice of data or description of measurement methods and procedures applied	Measured by calibrated scales according to on-site working procedures as per AM0065.
Purpose of the data	Calculation of baseline emissions
Comments	Minimum of the values as validated in the initial crediting period according to the last three years prior to project's implementation (2005, 2006, 2007)

4.2 Data and Parameters Monitored

Data / Parameter	P _{Mg, recycle, y}
Data unit	kg Mg
Description	Metal melted in recycling in year y – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	Once the Mg ingots are placed on a pallet, the pallet is weighed on a batch basis and the amount is electronically recorded into the Plex system and a bar code is adhered to the stack.
Frequency of monitoring/recording	Daily
Value applied:	~20,000,000
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n NA)
QA/QC procedures to be applied	Calibration twice per year. Information reviewed for accuracy by MPA & 3Degrees Group, Inc.
Purpose of the data	Calculation of baseline emissions
Calculation method	Measured
Comments	Ohaus Defender scales do not have serial numbers.

Data / Parameter	P _{Mg, diecast, y}
Data unit	kg Mg
Description	Metal melted in die cast in year y – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	Every time a pallet of Mg ingots is delivered to a die cast cell, the bar code on the stack is scanned, and the weight is electronically recorded into the Plex system.
Frequency of monitoring/recording	Daily
Value applied:	~27,000,000
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n NA)
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of baseline emissions. Information reviewed for accuracy by MPA & 3Degrees Group, Inc.
Calculation method	Measured
Comments	Ohaus Defender scales do not have serial numbers.

Data / Parameter	PE _{Novec, y}
Data unit	kg Novec
Description	Quantity of Novec cover gas used in year y – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	The weight of the Novec tote is tracked using the same weight scales as the metal at the facility.
Frequency of monitoring/recording	The Novec tote is weighed every time the Novec panel is filled and the amount is manually entered into a central Excel file at that time.
Value applied:	~6,000
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n NA)
QA/QC procedures to be applied	Calibration twice per year. Information reviewed for accuracy by MPA & 3Degrees Group, Inc.
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	Ohaus Defender scales do not have serial numbers.

Data / Parameter	SO ₂ consumption
Data unit	kg SO ₂
Description	SO ₂ consumed – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	At the Eaton Rapids plant, the Ohaus Scale is used to track the SO ₂ gas usage from cylinder weights.
Frequency of monitoring/recording	Gas cylinders are weighed prior to installation and when replaced with a new cylinder and the amount is manually entered into a central Excel file on a monthly basis.
Value applied:	~3,000
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n NA)
QA/QC procedures to be applied	Calibration twice per year. Information reviewed for accuracy by MPA & 3Degrees Group, Inc.
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	Ohaus Defender scales do not have serial numbers.

Data / Parameter	SO ₂ Emissions
Data unit	mg/m ³
Description	Ambient Air SO ₂ Emissions – Michigan Plant
Source of data	SO ₂ Ambient Air Leak Monitors
Description of measurement methods and procedures to be applied	SO ₂ emissions to the facility ambient air are tracked & measured to comply with the cap limit for SO ₂ concentration in the exhausting system. Five plant monitors track leaks and are set at a shut down limit of 0.5 ppm (or 1.37 mg/m ³ of SO ₂).
Frequency of monitoring/recording	Leak detection is constant at the facility.
Value applied:	Maximum of 1,470 mg/m ³ (dry basis, 273 K, 101.325 kPa at an oxygen concentration of 6% (v/v)).
Monitoring equipment	Plant-wide ambient air leak detection system
QA/QC procedures to be applied	
Purpose of the data	Cap limit for SO ₂ concentration in the exhausting system
Calculation method	Measured
Comments	

Data / Parameter	$PE_{SF_6, y}$
Data unit	kg SF_6
Description	SF_6 consumed in year y – Michigan Plant
Source of data	Weight scales
Description of measurement methods and procedures to be applied	At the Eaton Rapids plant, the Ohaus Scale is used to track the SF_6 gas usage from cylinder weights.
Frequency of monitoring/recording	Gas cylinders are weighed prior to installation and when replaced with a new cylinder and the amount is manually entered into a central Excel file on a monthly basis.
Value applied:	~1,600
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n NA)
QA/QC procedures to be applied	Calibration twice per year. Information reviewed for accuracy by MPA & 3Degrees Group, Inc.
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	Ohaus Defender scales do not have serial numbers.

Data / Parameter	Magnesium Sales Reports
Data unit	tMg/year
Description	In order to dispel concerns that a company increases production levels just to gain verified emission reductions, project developers must show proof of sales of magnesium.
Source of data	Michigan Plant records
Description of measurement methods and procedures to be applied	Annual Magnesium sales shall be compared to the term $P_{Mg, PJ, J, y}$ (annual magnesium produced).
Frequency of monitoring/recording	Annually
Value applied:	~13,000 tons shipped and ~15,000 tons scrap sold to remelt.
Monitoring equipment	Sales data logs
QA/QC procedures to be applied	Magnesium sales reports shall be verified by DOE as part of the verification process. Information reviewed for accuracy by MPA & 3Degrees Group, Inc.
Purpose of the data	To prevent false claims of increased production.

Calculation method	Sales logged
Comments	Kilograms of sales from the recycling plant include ingots cast, which is about 98% of total sales and dross (waste) which is about 2% of total sales. Kilograms of sales from the die cast facility include both sales of finished parts which account for approximately half of the total and the sale of scrap sent to the recycling plant which also accounts for about half of the total.

4.3 Monitoring Plan

The monitoring plan requires the magnesium melted to be calculated using weighing methods and multiplying those numbers by the tSF_6/tMg ratio calculated in the baseline. In other words, the baseline emissions are determined by how much SF_6 would have been used with the metal production numbers in the crediting year. Project emissions are calculated by determining the amount of SF_6 that was used in the project year and the amount of alternative gas used. Using the weighing of bottles (SF_6 and SO_2), and the weighing of the Novec tote, we can determine the amounts of SF_6 and alternative cover gases used. In the case of Novec, we multiply the amount of Novec used by a default conservative factor of 2,830 and a GWP of 1. Project emissions are deducted from the baseline emissions to obtain annual emission reductions for the crediting year.

Data sources that are therefore monitored are: magnesium metal melted, SF_6 used, and Novec used. In addition, we monitor the amount of SO_2 because while SO_2 is not a GHG, we need to determine that the use and handling of SO_2 is in compliance both with local regulations and with AM0065. Data sources other than those monitored are primarily the baseline, which primarily includes the use of SF_6 and metal melted for each segment of the facility for up to three years.

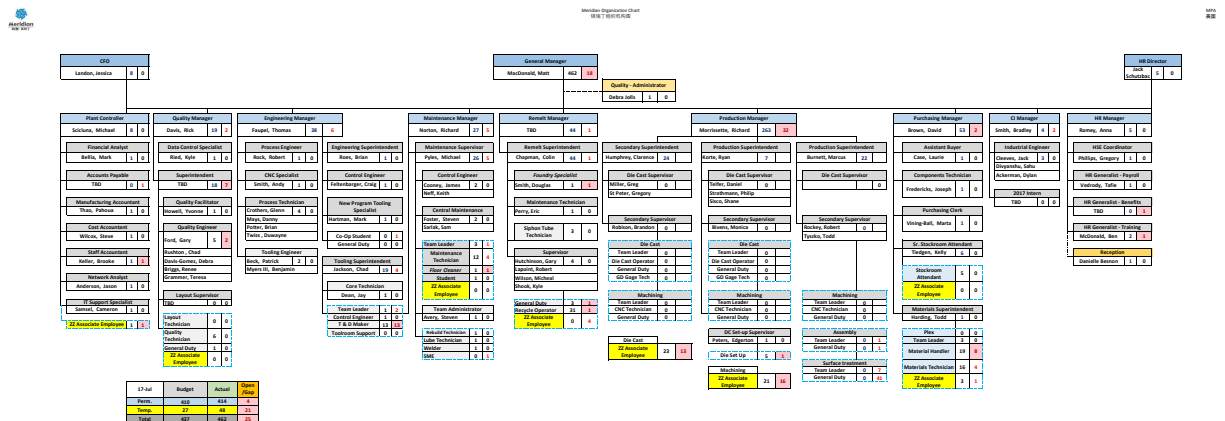
Below is the organizational chart for the management of this project. The project manager at MPA has overall responsibility for all aspects of monitoring this project, including:

- Metal melted. Compiling all magnesium metal melt numbers, so we can accurately know the quantity of metal melted, the key factor for determining baseline emissions in each project year. This task includes calibrating the scales to ensure they are accurate. In addition, MPA has implemented an internal metal tracking system (Plex) to accurately track the metal melted.
- Gas consumption: For every cover gas consumed, Novec, SO_2 , and when necessary, SF_6 , the project manager compiles all gas consumption numbers, including gas invoices, floor tracking sheets with gas consumption values based on scale weights, and compilation of readings off the mass balance weight meters, so the data can be archived. This task also involves ensuring all flow meters are periodically checked and calibrated to ensure smooth operation. This task also includes calibrating the weigh scales to ensure they are accurate. MPA will also work to ensure that any situations that might require the resumption of SF_6 use are minimized as much as possible. The gas consumption data gathering methodology remained consistent throughout the first crediting period of this project, and will continue to be monitored and calibrated according to the plan laid out in

the second crediting period PD. While the flow meters are used to regulate the gas flow, gas consumption is determined based on weighing the gas cylinders and Novec tote.

- SO₂ management: MPA has an extensive training system so personnel who might be exposed to SO₂ fumes are properly prepared. This monitoring task includes the need to ensure that all SO₂ sensors are operating effectively, so if emissions do exceed certain limits, an alarm will sound and that section of the plant can be evacuated. Finally, this monitoring task involves ensuring SO₂ use and management are fully in compliance with AM0065's specifications dealing with SO₂.
- Magnesium Sales: Sales are monitored by accounting, and final data is overseen by both the project manager. Kilograms of sales from the recycling plant include ingots cast, which is about 98% of total sales and dross (waste) which is about 2% of total sales. Kilograms of sales from the die cast facility include both sales of finished parts which account for approximately half of the total and the sale of scrap sent to the recycling plant which also accounts for about half of the total. These numbers are compiled into total parts shipped and ingots moved worksheets, which are monitored and quality controlled by the project manager.

See the Meridian Magnesium Products of America Organizational Chart below for further detail.



5 SAFEGUARDS

5.1 No Net Harm

Environmental and socio-economic impacts of this project are expected to be small. Novec has no known environmental impacts and has been determined to have very low toxicity³. The use of SO₂ is too small to require any kind of permitting or licence. We are not aware of any other negative environmental or socio-economic impacts associated with this project implementation.

5.2 Environmental Impact

No environmental impact assessments were carried out with respect to the project, and we are not aware of any negative environmental impacts of this project implementation.

5.3 Local Stakeholder Consultation

Not applicable.

5.4 Public Comments

This project was initially validated under the Voluntary Carbon Standard 2007.1 which were not subject to a 30-day public comment period.

³ <https://multimedia.3m.com/mws/media/713947O/3mtm-novectm-612-magnesium-protection-fluid.pdf>