



**Verified Carbon
Standard**

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.

Project Title	Conversion of SF ₆ to an Alternative Cover Gas in Magnesium Production in Eaton Rapids, MI and Strathroy, ON
Version	Version 2.2
Report ID	Meridian_2021
Date of Issue	1-June-2022
Project ID	VCSPD618
Monitoring Period	01-January-2021 to 31-December-2021
Prepared By	Julie Kelleher Senior Manager, Carbon Projects 3Degrees
Contact	235 Montgomery St., Suite 320, San Francisco, CA (415) 692-6702 / jkelleher@3Degrees.com

CONTENTS

1	PROJECT DETAILS.....	3
1.1	Summary Description of the Implementation Status of the Project	3
1.2	Sectoral Scope and Project Type	4
1.3	Project Proponent	4
1.4	Other Entities Involved in the Project	4
1.5	Project Start Date	5
1.6	Project Crediting Period	5
1.7	Project Location	5
1.8	Title and Reference of Methodology	5
1.9	Participation under other GHG Programs.....	5
1.10	Other Forms of Credit.....	5
1.11	Sustainable Development Contributions	5
2	SAFEGUARDS	7
2.1	No Net Harm	7
2.2	Local Stakeholder Consultation	7
2.3	AFOLU-Specific Safeguards	7
3	IMPLEMENTATION STATUS	7
3.1	Implementation Status of the Project Activity	7
3.2	Deviations	8
3.3	Grouped Projects	9
4	DATA AND PARAMETERS.....	9
4.1	Data and Parameters Available at Validation	9
4.2	Data and Parameters Monitored.....	13
4.3	Monitoring Plan.....	17
5	QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS	19
5.1	Baseline Emissions	19
5.2	Project Emissions	19
5.3	Leakage.....	20
5.4	Net GHG Emission Reductions and Removals.....	20

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status 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 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, starting implementation 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 with the chemical formula C₂F₅COC₃F₇¹. 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

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-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-pentanone (<http://pubs.acs.org/doi/pdf/10.1021/es048088u>).

In the initial crediting period from 01/01/2007 through 12/31/2016, the project included credits generated from the location in Strathroy, Ontario. In the second crediting period the project has only included the Michigan location and is not registering credits for the activities in Ontario. The total GHG emission reductions generated in this monitoring period is **89,548 tCO₂e**.

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.” This is not a grouped project.

1.3 Project Proponent

Organization name	3Degrees Group, Inc.
Contact person	Nick Facciola
Title	Director, Carbon Projects
Address	235 Montgomery Street, Suite 320, San Francisco, CA 94104
Telephone	(415) 762-4727
Email	nick@3Degreesinc.com

1.4 Other Entities Involved in the Project

Organization name	Meridian Magnesium Products of America
Role in the Project	Magnesium Plant Owner
Contact person	Colin Chapman
Title	Continuous Improvement Manager
Address	2001 Industrial Drive, Eaton Rapids, MI 48827
Telephone	(517) 663-1158

Email

cchapman@meridian-mag.com

1.5 Project Start Date

The project start date is January 1, 2007.

1.6 Project Crediting Period

The project's initial crediting period ran from January 1, 2007 through December 31, 2016 for a total of ten years. The second crediting period started on January 1, 2017 and will end on December 31, 2026.

1.7 Project Location

Meridian Magnesium Products of America
2001 Industrial Drive
Eaton Rapids, Michigan, 48827

Longitude Latitude 42° 31' N 84° 38'W

1.8 Title and Reference of Methodology

The approved methodology for this project is the CDM Methodology AM0065 Version 2.1, "Replacement of SF6 with alternate cover gas in the magnesium industry."

1.9 Participation under other GHG Programs

This project is not participating in any other GHG programs.

1.10 Other Forms of Credit

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

No other form of Environmental Credit has been sought or received for this project.

1.11 Sustainable Development Contributions

The project contributes to SDG 13, through reduction of greenhouse gas emissions through the continued replacement of SF6 gas with Novec in industrial magnesium processing, as described in Section 1.1. There are currently no nationally stated sustainable development priorities associated with SDG 13.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase emissions avoided	Replaced use of SF6 with 7,143 kg of the alternative magnesium cover gas Novec, which has no GWP.	Prevented the release of over 2 million tonnes of carbon dioxide equivalent into the atmosphere, which improves air quality and reduces the impact of industrial manufacturing.

2 SAFEGUARDS

2.1 No Net Harm

We are not aware of any negative environmental or socio-economic impacts of this project implementation.

2.2 Local Stakeholder Consultation

Not applicable. The project is developed at a privately-held company site and was validated under the Verified Carbon Standard 2007.1, which was not subject to a 30-day public comment period.

2.3 AFOLU-Specific Safeguards

Not applicable. This is not an AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

During the monitoring period, Meridian continued to utilize the Novec and SO₂ cover gas alternatives to SF₆ in its magnesium recycling and die cast operations. The project continued to operate in accordance to AM0065 and to VCS requirements. Meridian produces magnesium ingots by recycling magnesium scrap in its recycling operations. The magnesium ingots are then melted in the die cast operations to make Meridian products, which are primarily for the automobile manufacturing industry.

SF₆ usage continued in recycling mainly due to the import of scrap from Meridian overseas operations. Because the scrap spends time on the ocean, sometimes it becomes coated with oxides and creates issues with the recycling operations when processed. This requires additional SF₆ to control the melt surface.

Periodic SF₆ usage spikes sometimes occur during a given month due to inferior metal quality, power outage, or some other operational problem with the alternative cover gas. Poor quality scrap metal creates a negative operating condition that makes it problematic to use the Novec and SO₂ alternatives thus requiring higher levels of SF₆ use than normal. In some cases SF₆ was used in conjunction with Novec to produce the optimal operating conditions. In these cases the metal is still listed as produced with Novec since it was the main gas used. 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. 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.

The VCS Project Description is up to date on the equipment used onsite relevant to project activity. Any changes to the cell counts over the course of the crediting period are due to changes in production demand and do not have any effect on the cover gas usage patterns unique to each facility. Note that the cover gas usage is a characteristic of the plant itself rather than the particular die cast cells in operation.

3.2 Deviations

2.1.1 Methodology Deviations

There are no methodology deviations.

2.1.2 Project Description Deviations

Global Warming Potential of SF₆

In accordance with the VCS Standard v4.1 released in April 2021, we are transitioning the source of global warming potential from IPCC's Fourth Assessment Report to the IPCC's Fifth Assessment Report (AR5). For SF₆ this results in a change from GWP of 22,800 to a GWP of 23,500. The use of the new GWP is more appropriate as it is a value approved in the VCS Standard for use for all emission reductions occurring on or before 31 December 2020, at project developer's discretion. Accordingly, the wide adoption of this value suggests overarching acknowledgement of its relevancy, accurateness, and appropriateness in the U.S.

The following project description deviations were applied in previous monitoring reports:

- 1) Due to a thermal event that occurred in May 2018, primary paper records of weight measurements as identified in the PDD for individual gases used on site were not available for part of the reporting period. Summary spreadsheets put together daily by shift managers on site were used for calculations and verified against secondary records, such as purchase orders for the gas supply. The accuracy of the summary records was verified and the project monitoring remains in compliance with the applied methodology. The deviation does not affect the applicability of the methodology, additionality of the project, the appropriateness of the baseline scenario, or the conservativeness and quality of the data.
- 2) Evidence was not available for the calibration performed in July 2018 for Cardinal Model 205 truck scale (s/n E22210-0122) that was used as a back-up scale for a portion of the reporting period. Per the validated project description, the scales' calibration records must support a six-month interval. The accuracy of the scale and

the calibration schedule was verified, and the subsequent calibration report from January 28, 2019 is provided. The deviation does not affect the applicability of the methodology, additionality of the project, the appropriateness of the baseline scenario, or the conservativeness and quality of the data.

3.3 Grouped Projects

This is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	GWP _{SF6}
Data unit	tCO ₂ e / tSF ₆
Description	Global Warming Potential of SF ₆
Source of data	International Panel on Climate Change (IPCC)
Value applied	23,500
Justification of choice of data or description of measurement methods and procedures applied	IPCC Fifth Assessment Report (AR5) as recognized by VCS Standard 4.1 (see Attachments).
Purpose of Data	Calculation of the baseline and project emissions
Comments	N/A

Data / Parameter	P _{Mg, BL, Total}
Data unit	tMg/year
Description	Amount of Magnesium (Mg) melted in the baseline scenario in the facility, by weight.
Source of data	Meridian Magnesium Products accounting
Value applied	28,348 for die casting 20,342 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.
Purpose of Data	Calculation of the baseline emissions

Comments	Values according to the last three years prior to project's implementation (2005, 2006, 2007) in the Michigan facility alone.
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	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 Data	Calculation of the baseline and project emissions
Comments	Values are validated in the initial crediting period according to the last three years prior to project's implementation (2005, 2006, 2007) in the Michigan facility alone.

Data / Parameter	DF _{SF6}
Data unit	Fraction
Description	Default percentage of SF ₆ assumed to be destroyed in the magnesium process and thus not emitted, thereby reducing the baseline emissions.
Source of data	AM0065 v2.1
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	Prescribed by the applied methodology.
Purpose of Data	Calculation of the baseline and project emissions
Comments	N/A

Data / Parameter	GWP _{Novec}
Data unit	tCO ₂ e/ t Novec
Description	Global Warming Potential of Novec
Source of data	AM0065 v2.1
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.
Purpose of Data	Calculation of project emissions
Comments	Novec-612 is the same as 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 byproducts emitted after the degradation of the alternate gas.
Source of data	AM0065 v2.1
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.
Purpose of Data	Calculation of the project emissions
Comments	Default value

Data / Parameter	Dl _{SF6, CON, BL}
Data unit	Fraction
Description	A conservative factor for portraying the Data Integrity of SF ₆ consumption in the baseline scenario (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 v2.1.
Purpose of Data	Calculation of the baseline and project emissions

Comments	N/A
----------	-----

Data / Parameter	Dl _{SF6, CON, PJ, k, j, y}
Data unit	Fraction
Description	A conservative factor for portraying the Data Integrity of SF ₆ consumption in the project scenario (C _{SF6, 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 v2.1.
Purpose of Data	Calculation of the project emissions
Comments	N/A

Data / Parameter	Lowest baseline emissions factor for Die Casting
Data unit	tSF ₆ / tMg
Description	Tonne of SF 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 v2.1
Purpose of Data	Calculation of the baseline 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	Lowest baseline emissions factor for Recycling
Data unit	tSF ₆ / tMg
Description	Tonne of SF 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	
Purpose of Data	Calculation of the baseline emissions
Comments	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	PMg, 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 monitored	16,730,664
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 1/26/2021 and 7/21/2021.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of the baseline emissions
Calculation method	Measured in lbs, and converted to kg in the calculations.
Comments	N/A

Data / Parameter	PMg, 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 automatically recorded into the Plex system.
Frequency of monitoring/recording	Daily
Value monitored	19,342,825
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 1/26/2021 and 7/21/2021.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of the baseline emissions
Calculation method	Measured in lbs, and converted to kg in the calculations.
Comments	N/A

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 monitored	7,143 in total (2,323 kg in Recycling and 4,820 kg in Die Cast)
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 1/26/2021 and 7/21/2021.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of the project emissions
Calculation method	Measured in lbs, and converted to kg in the calculations.
Comments	N/A

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 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 monitored	N/A
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B709773218), calibrated 1/26/2021, and 7/21/2021.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of the project emissions
Calculation method	Measured
Comments	SO ₂ consumption is tracked to remain in line with the requirements of the protocol, but values are not used within the calculations.

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 shutdown limit of 0.5 ppm (or 1.37 mg/m ³ of SO ₂).
Frequency of monitoring/recording	Leak detection occurs continuously at the facility .
Value monitored	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	N/A

Purpose of the data	Cap limit for SO ₂ concentration in the exhaust system.
Calculation method	Measured
Comments	N/A

Data / Parameter	PE _{SF6, 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 Weight 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 monitored	6,740 in total (6,740 kg in Recycling and 0 in Die Cast)
Monitoring equipment	Ohaus Defender 3000XtremeW (s/n B829135528 or B530462718, interchangeably), calibrated 1/26/2021 and 7/21/2021.
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of the project emissions
Calculation method	Measured in lbs, and converted to kg in the calculations.
Comments	N/A

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 monitored	12,657 tons shipped and 120 tons scrap sold to remelt
Monitoring equipment	Sales and scrap data logs
QA/QC procedures to be applied	Magnesium sales reports shall be verified by DOE as part of the verification process
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. Sales did not reach the 70% magnesium production threshold during this reporting period due to a decline in final product demand caused by first an economic slow-down due to the Covid-19 pandemic during early 2020, and the subsequent microchip shortage that has dramatically limited automobile production in Q3 and Q4 2020. As part of the verification process, the verifier has confirmed that there were no false claims of increased production on site.

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 determined during the first crediting period. In other words, the baseline emissions were determined by how much SF_6 would have been used with the metal production numbers based on data from the 3 years prior to the start of the initial crediting period in 2007. 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 GWP of 1 along with a default conservative factor of 2,830 to compensate for uncertainty in the GWP of the byproducts emitted upon contact with molten metal. 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 whether the use and handling of SO₂ is in compliance both with local regulations and with AM0065. Data sources other than those monitored are primarily the baseline, which includes the use of SF₆ and metal melted for each segment of the facility for up to three years.

Below is the organizational plan for the management of this project. Colin Chapman has overall responsibility for all aspects of monitoring this project, including:

- **Metal melted:** Compiling and confirming accuracy of the quantity of magnesium metal melted, the key factor for determining baseline emissions in each project year. This task includes routine calibration of the scales to ensure accuracy. In addition, Meridian has implemented an internal metal tracking system (Plex) to accurately track the metal melted.
- **Gas consumption:** For every cover gas consumed, Novec, SO₂, and when necessary, SF₆, all gas consumption numbers are compiled, 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 and weight scales are periodically checked and calibrated. Meridian also makes efforts to ensure that any situations that might require the resumption of SF₆ use are minimized. 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:** Meridian 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 DOE and the project proponent. 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 proponent.

Internal auditing of the data is performed first by Colin Chapman at Meridian and second by 3Degrees to assure all data is accurate. All project data is compiled by 3Degrees and

electronically archived on servers until at least two years after the end of the crediting period. Any non-conformities with data or data collection are addressed and noted in the deviations if they are not able to be corrected.

A Meridian Organizational Chart can be found in the Project Description document for the project, available on the Verra Public Registry.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

$$\begin{aligned}\text{Recycling Baseline} &= P_{\text{Mg, recycle, 2021}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (16,730,684 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0003850 \text{ tSF}_6/\text{tMg}) \times (23,500 \text{ tCO}_2\text{e/tSF}_6) \\ &= 151,371 \text{ tCO}_2\text{e}\end{aligned}$$

$$\begin{aligned}\text{Die Cast Baseline} &= P_{\text{Mg, die cast, 2021}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (19,342,849 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0000914 \text{ tSF}_6/\text{tMg}) \times (23,500 \text{ tCO}_2\text{e/tSF}_6) \\ &= 41,547 \text{ tCO}_2\text{e}\end{aligned}$$

$$\begin{aligned}\text{Total 2021 Baseline Emissions} &= \text{Recycling Baseline} + \text{Die Cast Baseline} \\ &= 151,371 \text{ tCO}_2\text{e} + 41,547 \text{ tCO}_2\text{e} \\ &= 192,916 \text{ tCO}_2\text{e}\end{aligned}$$

5.2 Project Emissions

$$\begin{aligned}\text{Recycling Project Emissions} &= \text{PE}_{\text{SF}_6, \text{ recycle, 2021}} \times \text{DF}_{\text{SF}_6} \times \text{GWP}_{\text{SF}_6} \times \text{DI}_{\text{SF}_6, \text{ CON, OJ, k, j, y}} \\ &+ \text{PE}_{\text{Novec, recycle, 2021}} \times \text{Conservative factor} \times \text{GWP}_{\text{Novec}} \\ &= (6,740 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,500 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) \\ &+ (2,323 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec}) \\ &= 89,729 \text{ tCO}_2\text{e}\end{aligned}$$

$$\begin{aligned}\text{Die Cast Project Emissions} &= \text{PE}_{\text{SF}_6, \text{ diecast, 2021}} \times \text{DF}_{\text{SF}_6} \times \text{GWP}_{\text{SF}_6} \times \text{DI}_{\text{SF}_6, \text{ CON, OJ, k, j, y}} \\ &+ \text{PE}_{\text{Novec, diecast, 2021}} \times \text{Conservative factor} \times \text{GWP}_{\text{Novec}}\end{aligned}$$

$$\begin{aligned}
 &= (0 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,500 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) \\
 &+ (4,820 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec}) \\
 &= 13,640 \text{ tCO}_2\text{e}
 \end{aligned}$$

Total 2021 Project Emissions = Recycling + Die Cast Project Emissions

$$= 89,728 \text{ tCO}_2\text{e} + 13,640 \text{ tCO}_2\text{e}$$

$$= 103,369 \text{ tCO}_2\text{e}$$

5.3 Leakage

There is no leakage of emissions associated with the project.

5.4 Net GHG Emission Reductions and Removals

Net GHG Emission Reductions are equal to Baseline Emissions minus Project Emissions.

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
Recycling Operations 2021	151,370	89,728	0	61,642
Die Cast Operations 2021	41,547	13,640	0	27,906
2021 Total	192,917	103,369	0	89,548

APPENDIX 1: SDG CONTRIBUTIONS

Carbon emission reductions from previous reporting periods are listed here. Documentation of these values can be found under the Issuance Records for the project on the VCS Registry [linked here](#).

Year	Total Emission Reductions (tonnes CO2-e)
2009	132,143
2010	199,913
2011	207,542
2012	244,098
2013	265,135
2014	303,506
2015	315,295
2016	328,436
2017	188,676
2018	88,505
2019	131,848
2020	114,492
Total	2,602,675