

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

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Project Title	Conversion of SF6 to an Alternative Cover Gas in Magnesium Production in Eaton Rapids, MI and Strathroy, ON
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Because molten magnesium burns in the presence of oxygen, 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 C₂F₅COC₃F₇. 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 total GHG emission reductions generated in this monitoring period is 353,344 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 1 – “Replacement of SF₆ with alternate cover gas in the magnesium industry.”

1.3 Project Proponent

Organization name	Origin Climate Inc.
Contact person	Nick Facciola
Title	Director, Carbon Projects
Address	4 Embarcadero Center, Suite 1400, San Francisco, CA 94111
Telephone	(415) 762-4727
Email	nick@OriginClimate.com

1.4 Other Entities Involved in the Project

Organization name	Meridian Magnesium Products of America
Role in the project	Project Host
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

1.5 Project Start Date

The project start date is January 1, 2007.

1.6 Project Crediting Period

The project crediting period is from January 1, 2007 through December 31, 2016 for a total of ten years.

1.7 Project Location

Site 1 – U.S.

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

Longitude Latitude 42° 31' N 84° 38'W

Site 2 - Canada

Meridian Lightweight Technologies Inc.
155 High St. East
Strathroy, Ontario N7G 1H4
Canada

Longitude Latitude 42° 59' N 81° 62'W

1.8 Title and Reference of Methodology

The approved methodology for this project is the CDM Methodology AM0065 Version 1, "Replacement of SF₆ with alternate cover gas in the magnesium industry."

1.9 Other Programs

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.

This project is not participating in any other GHG programs.

2 IMPLEMENTATION STATUS

2.1 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 in the U.S. and Canada. 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.

In the summer of 2015, Meridian showed an increased use of SF₆ which was actually due to a leak in the lines. The leak took time to recognize, isolate and repair but once it was fixed, the plant showed zero usage of SF₆ in November and December. This resulted in a couple thousand pounds of SF₆ use.

As previously indicated, GE Capital sold its controlling interest in December 2013 to Wanfeng Auto Holdings Group. While the ultimate owner of the company had changed there was no impact on the operation of the project or the management structure.

The VCS Project Description notes certain equipment used onsite relevant to project activity and we note a few changes that have occurred over the past few years. The Ontario plant was noted to have 21 die cast cells but now has 24:

- Two of the eight 1,200-ton cells have been decommissioned,
- One additional 1,600-ton cells for a new total of eight,
- Three additional 3,000-ton cells, and
- One new 4,000-ton cell.

The changes to the cell counts 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.

In October 2015, the project proponent was transferred from Climate Change Capital to Origin Climate Inc. The operation of the project remained unchanged by this.

2.2 Deviations

2.2.1 Methodology Deviations

There are no methodology deviations.

2.2.2 Project Description Deviations

Deviations applied during previous reporting periods:

1) Since the initial validation of this project we have changed the GWP of SF₆ to 23,900. This deviation from the Project Description is an acknowledgement that the CDM Executive Board has approved for use the values in the Second Assessment Report for initial crediting.

2) At validation, the mass flow controllers were identified as the primary monitoring devices for the quantity of cover gas used at the Meridian sites. However, Meridian relies on the mass balance weight method rather than the flow controllers to determine the quantity of cover gas used. The mass flow meters are utilized to control the amount (mixture or ratio) of all of the cover gas delivered to each cell. Meridian views the mass balance weight method as more accurate and aligned with their internal operations.

The key methods to determine how much SF₆ or SO₂ cover gas is actually consumed is based on (1) the accounting method (recording and putting into an inventory database the recorded amount of cover gas in the cylinder, as provided by the SO₂ and SF₆ manufacturer); and (2) the weight method. Using the weight method, the weight of the SO₂ and SF₆ cylinder is weighed when the bottle is full, at regular monthly intervals, and when the bottle is sent back to the manufacturer. The difference is the amount of SO₂ and SF₆ used.

The key method to determine how much Novec is actually consumed is based on recording the weight of the Novec tote as received by the manufacturer and weighing the tote each time it is used to fill the Novec delivery system. The difference is the quantity of Novec consumed. Using the mass balance weight method of tracking Novec, SO₂ and SF₆ usage is an accepted practice in the methodology that will not affect the accuracy of the results.

3) The validated project description incorrectly described this as a 'Grouped Project'. The project has been implemented as a 'non-Grouped Project' and the correct response has been made in section 2.3 of this document.

New Project Description Deviations

There are no additional deviations to report.

2.3 Grouped Project

This is not a grouped project.

3 DATA AND PARAMETERS

3.1 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	IPCC
Value applied:	23,900
Justification of choice of data or description of measurement methods and procedures applied	Second Assessment Report as recognized by CDM Executive Board for first crediting period.
Purpose of the data	Calculation of baseline and project emissions
Comments	

Data / Parameter	P _{Mg, BL, Total}
Data unit	tMg/year
Description	Amount of magnesium (Mg) melted in baseline scenario in the facility, by weight.
Source of data	Meridian Magnesium Products accounting
Value applied:	28,348 for die casting in U.S. 20,342 for recycling in U.S. 26,950 for die casting in Canada 6,262 for recycling in Canada
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 the data	Calculation of baseline emissions
Comments	

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 the data	Calculation of baseline and project emissions
Comments	

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
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.
Purpose of the data	Calculation of project emissions
Comments	Novec-612 is 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
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 the data	Calculation of project emissions
Comments	

Data / Parameter	DI _{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
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 SF_6 consumption in the project scenario ($C_{SF_6, CON, PJ, k, j, y}$).
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
Purpose of the data	Calculation of project emissions
Comments	

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	

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	

Data / Parameter	Lowest baseline emissions factor for Canada Die Casting
Data unit	tSF ₆ / tMg
Description	tSF ₆ per tonne of Mg metal melted
Source of data	Baseline assessment
Value applied:	0.0000549
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	

Data / Parameter	Lowest baseline emissions factor for Canada Recycling
Data unit	tSF ₆ / tMg
Description	tSF ₆ per tonne of Mg metal melted
Source of data	Baseline assessment
Value applied:	0.000684
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	

3.2 Data and Parameters Monitored

Site 1 – U.S.

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 monitored:	2014 (November 1 – December 31): 3,052,088 kg 2015: 20,524,075 kg
Monitoring equipment	Sterling Scale model 810 High Accuracy Weight Indicator (s/n 24098) Calibrated on 7/24/2014, 1/12/2015, and 7/23/2015
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of baseline emissions
Calculation method	Measured
Comments	The DW800 indicators are NTEP certified.

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 monitored:	2014 (November 1 – December 31): 3,707,893 kg 2015: 25,574,787 kg
Monitoring equipment	Sterling Scale model 810 High Accuracy Weight Indicator (s/n 24098) Calibrated on 7/24/2014, 1/12/2015, and 7/23/2015
QA/QC procedures to	Calibration twice per year

be applied	
Purpose of the data	Calculation of baseline emissions
Calculation method	Measured
Comments	

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:	2014 (November 1 – December 31): 757.0 kg (324.0 Recycling and 609.2 Die Cast) 2015: 5,404.6 kg (2,153.2 Recycling and 3,323.4 Die Cast)
Monitoring equipment	Sterling Scale model 810 High Accuracy Weight Indicator (s/n 24098) Calibrated on 7/24/2014, 1/12/2015, and 7/23/2015
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	

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 Sterling 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:	2014 (November 1 – December 31): 632 kg 2015: 4,218 kg
Monitoring equipment	Sterling Scale model 810 High Accuracy Weight Indicator (s/n 24098) Calibrated on 7/24/2014, 1/12/2015, and 7/23/2015
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of Project emissions
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 Sterling 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:	2014 (November 1 – December 31): 401.9 kg (400.1 Recycling and 1.8 Die Cast) 2015: 1,971.3 (1,971.3 Recycling and 0.0 Die Cast)
Monitoring equipment	Sterling Scale model 810 High Accuracy Weight Indicator (s/n 24098) Calibrated on 7/24/2014, 1/12/2015, and 7/23/2015
QA/QC procedures to be applied	Calibration twice per year
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	

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:	2014 (November 1 – December 31): 1,855 tons shipped and 3,232 tons scrap sold to remelt 2015: 12,786 tons shipped and 21,157 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.
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.

Site 2 - Canada

Data / Parameter	$P_{Mg, recycle, y}$
Data unit	kg Mg
Description	Metal melted in recycling in year y – Ontario 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 manually recorded into central Excel file.
Frequency of monitoring/recording	Daily
Value monitored:	2014 (November 1 – December 31): 863,419 kg 2015: 6,563,459 kg
Monitoring equipment	Pennsylvania 7600 – Wright Street (#00269455) Pennsylvania 7600 – High Street (#97242573) Calibration dates – May 15, 2014 and April 27, 2015
QA/QC procedures to	Annual calibration

be applied	
Purpose of the data	Calculation of baseline emissions
Calculation method	Measured
Comments	

Data / Parameter	$P_{Mg, diecast, y}$
Data unit	kg Mg
Description	Metal melted in die cast in year y – Ontario 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 manually recorded into central Excel file.
Frequency of monitoring/recording	Daily
Value monitored:	2014 (November 1 – December 31): 4,084,867 kg 2015: 29,698,110 kg
Monitoring equipment	Pennsylvania 7600 – Wright Street (#00269455) Pennsylvania 7600 – High Street (#97242573) Calibration dates – May 15, 2014 and April 27, 2015
QA/QC procedures to be applied	Annual calibration
Purpose of the data	Calculation of baseline emissions
Calculation method	Measured
Comments	

Data / Parameter	$PE_{Novec, y}$
Data unit	kg Novec
Description	Quantity of Novec cover gas used in year y – Ontario Plant
Source of data	Weight scales
Description of meas. Methods/ 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:	2014 (November 1 – December 31): 856.2 kg (Die Cast only) 2015: 5,460.8 kg (Die Cast only)

Monitoring equipment	Pennsylvania 7600 – Wright Street (#00269455) Pennsylvania 7600 – High Street (#97242573) Calibration dates – May 15, 2014 and April 27, 2015
QA/QC procedures to be applied	Annual calibration
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	No Novec is used in Recycling metal at the Ontario Plant.

Data / Parameter	SO ₂ consumption
Data unit	kg SO ₂
Description	SO ₂ consumed – Ontario Plant
Source of data	Weight scales
Description of meas. Methods/ procedures to be applied	Gas cylinders are weighed prior to installation and when replaced with a new cylinder using weight scales.
Frequency of monitoring/recording	Gas cylinders are weighed upon cylinder change-out using weight scales and the amount is manually entered into a central Excel file on a monthly basis.
Value monitored:	2014 (November 1 – December 31): 837 kg (Recycling only) 2015: 8,036 kg (Recycling only)
Monitoring equipment	Eagle (EI 2000) weight scales Calibration dates – May 15, 2014 and April 27, 2015
QA/QC procedures to be applied	Annual calibration
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	

Data / Parameter	PE _{SF6, y}
Data unit	kg SF ₆
Description	SF ₆ consumed in year y – Ontario Plant
Source of data	Weight scales
Description of meas. Methods/ procedures to be applied	Gas cylinders are weighed prior to installation and when replaced with a new cylinder using weight scales.
Frequency of	Gas cylinders are weighed upon cylinder change-out using weight

monitoring/recording	scales and the amount is manually entered into a central Excel file on a monthly basis.
Value monitored:	2014 (November 1 – December 31): 598.0 kg (441.5 Recycling and 156.5 Die Cast) 2015: 1,593.9 kg (602.8 Recycling and 991.1 Die Cast)
Monitoring equipment	Eagle (EI 2000) weight scales Calibration dates – May 15, 2014 and April 27, 2015
QA/QC procedures to be applied	Annual calibration
Purpose of the data	Calculation of Project emissions
Calculation method	Measured
Comments	

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	Ontario Plant records
Description of meas. Methods/ 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:	2014 (November 1 – December 31) = 3,569 2015: 27,749
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.
Purpose of the data	To prevent false claims of increased production.
Calculation method	Sales logged from MLTI Metal Report, as the sum of “Add: Lbs of Parts Shipped (net)” and “Add: Clean Remelt Sold”
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.

3.3 Monitoring Plan

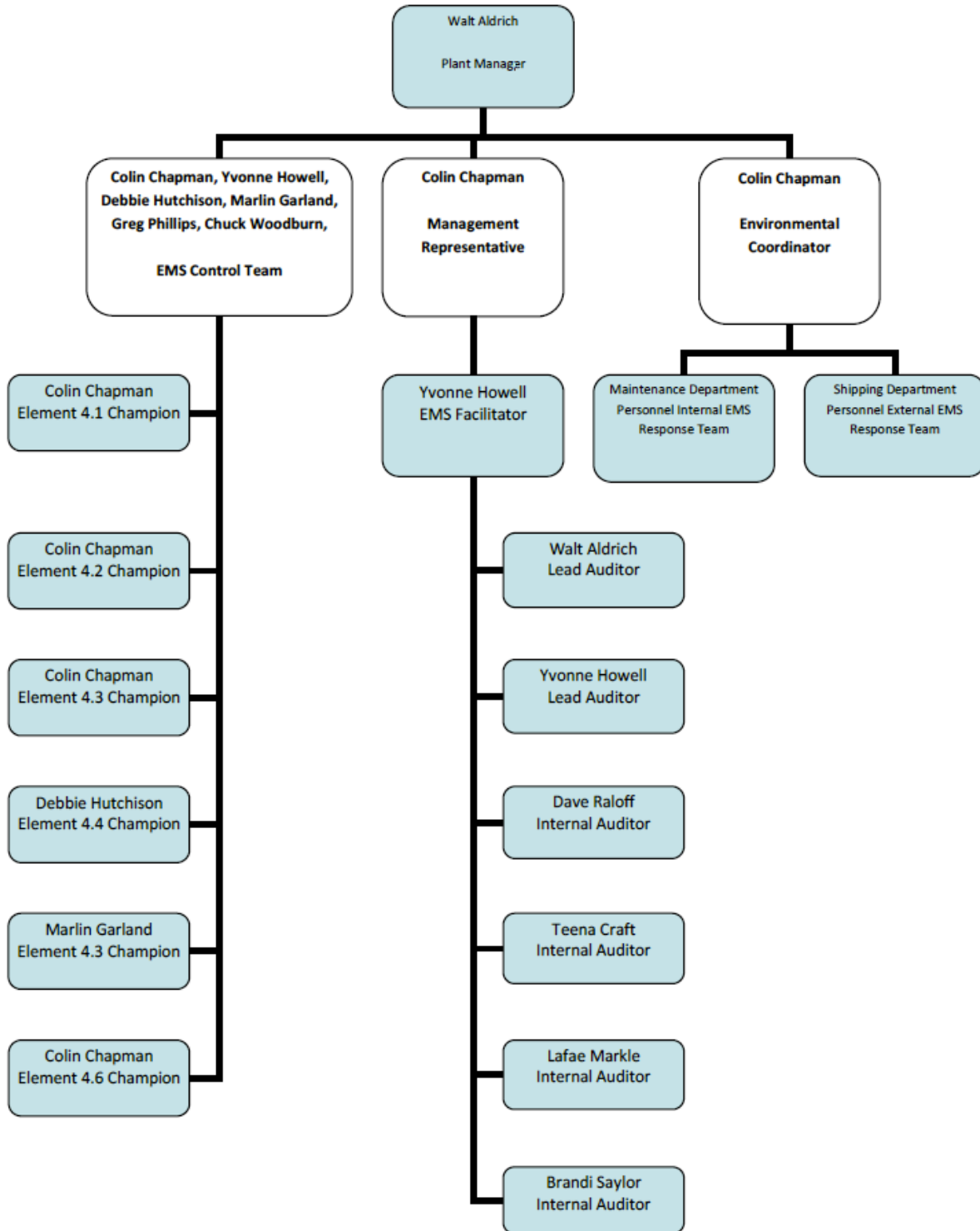
The monitoring plan requires the magnesium melted to be calculated using weighing methods and multiplying those numbers by the tSF_6/tMg ratio calculated in the baseline. In other words, the baseline emissions are determined by how much SF_6 would have been used with the metal production numbers in the 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. Charles Woodburn 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, Meridian 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 , Mr. Woodburn 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 flow controllers, 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. Meridian 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 has remained consistent throughout the crediting period of this project, and does not differ from previous monitoring reports. While the flow meters are used to regulate the gas flow, gas consumption is determined based on weighing the gas cylinders and Novec tote.
- SO_2 management: Meridian has an extensive training system so personnel who might be exposed to SO_2 fumes are properly prepared. This monitoring task includes the need to ensure that all SO_2 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 SO_2 use and management are fully in compliance with AM0065's specifications dealing with SO_2 .

See the Meridian Organizational Chart on the figure below.



4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

4.1.1 Site 1 – U.S.

2014 (November 1 through December 31)

$$\begin{aligned} \text{Recycling Baseline} &= P_{\text{Mg, recycle, 2014}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (3,052,088 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0003850 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 28,084 \text{ tCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{Die Cast Baseline} &= P_{\text{Mg, die cast, 2014}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (3,707,893 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0000914 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 8,100 \text{ tCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{Total 2014 U.S. Baseline Emissions} &= \text{Recycling Baseline} + \text{Die Cast Baseline} \\ &= 28,084 \text{ tCO}_2\text{e} + 8,100 \text{ tCO}_2\text{e} \\ &= 36,184 \text{ tCO}_2\text{e} \end{aligned}$$

2015 (January 1 through December 31)

$$\begin{aligned} \text{Recycling Baseline} &= P_{\text{Mg, recycle, 2015}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (20,524,075 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0003850 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 188,852 \text{ tCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{Die Cast Baseline} &= P_{\text{Mg, die cast, 2015}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (25,574,787 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0000914 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 55,867 \text{ tCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{Total 2015 U.S. Baseline Emissions} &= \text{Recycling Baseline} + \text{Die Cast Baseline} \\ &= 188,852 \text{ tCO}_2\text{e} + 55,867 \text{ tCO}_2\text{e} \\ &= 244,719 \text{ tCO}_2\text{e} \end{aligned}$$

4.1.2 Site 2 – Canada

2014 (November 1 through December 31)

$$\begin{aligned} \text{Recycling Baseline} &= P_{\text{Mg, recycle, 2014}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (863,419 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.000684 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 14,115 \text{ tCO}_2\text{e} \end{aligned}$$

$$\begin{aligned}\text{Die Cast Baseline} &= P_{\text{Mg, die cast, 2014}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (4,084,867 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0000549 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 5,360 \text{ tCO}_2\text{e}\end{aligned}$$

$$\begin{aligned}\text{Total 2014 Canada Baseline Emissions} &= \text{Recycling Baseline} + \text{Die Cast Baseline} \\ &= 14,115 \text{ tCO}_2\text{e} + 5,360 \text{ tCO}_2\text{e} \\ &= 19,475 \text{ tCO}_2\text{e}\end{aligned}$$

2015 (January 1 through December 31)

$$\begin{aligned}\text{Recycling Baseline} &= P_{\text{Mg, recycle, 2015}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (6,563,459 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.000684 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 107,297 \text{ tCO}_2\text{e}\end{aligned}$$

$$\begin{aligned}\text{Die Cast Baseline} &= P_{\text{Mg, die cast, 2015}} \times \text{Emission Factor for recycling} \times \text{GWP}_{\text{SF}_6} \\ &= (29,698,110 \text{ kg}) \times (0.001 \text{ tonne/kg}) \times (0.0000549 \text{ tSF}_6/\text{tMg}) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \\ &= 38,967 \text{ tCO}_2\text{e}\end{aligned}$$

$$\begin{aligned}\text{Total 2015 Canada Baseline Emissions} &= \text{Recycling Baseline} + \text{Die Cast Baseline} \\ &= 107,297 \text{ tCO}_2\text{e} + 38,967 \text{ tCO}_2\text{e} \\ &= 146,264 \text{ tCO}_2\text{e}\end{aligned}$$

4.2 Project Emissions

4.2.1 Site 1 – U.S.

2014 (November 1 through December 31)

$$\begin{aligned}\text{Recycling Project Emissions} &= \text{PE}_{\text{SF}_6, \text{recycle, 2014}} \times \text{DF}_{\text{SF}_6} \times \text{GWP}_{\text{SF}_6} \times \text{DI}_{\text{SF}_6, \text{CON, OJ, k, j, y}} \\ &+ \text{PE}_{\text{Novec, recycle, 2014}} \times \text{Conservative factor} \times \text{GWP}_{\text{Novec}} \\ &= (400.1 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) \\ &+ (324.0 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec}) \\ &= 5,937 \text{ tCO}_2\text{e}\end{aligned}$$

$$\begin{aligned}\text{Die Cast Project Emissions} &= \text{PE}_{\text{SF}_6, \text{diecast, 2014}} \times \text{DF}_{\text{SF}_6} \times \text{GWP}_{\text{SF}_6} \times \text{DI}_{\text{SF}_6, \text{CON, OJ, k, j, y}} \\ &+ \text{PE}_{\text{Novec, diecast, 2014}} \times \text{Conservative factor} \times \text{GWP}_{\text{Novec}} \\ &= (1.8 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) \\ &+ (609.2 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec}) \\ &= 1,747 \text{ tCO}_2\text{e}\end{aligned}$$

Total 2014 U.S. Project Emissions = Recycling + Die Cast Project Emissions

$$= 5,937 \text{ tCO}_2\text{e} + 1,747 \text{ tCO}_2\text{e}$$

$$= 7,684 \text{ tCO}_2\text{e}$$

2015 (January 1 through December 31)

Recycling Project Emissions = $PE_{SF_6, \text{recycle}, 2015} \times DF_{SF_6} \times GWP_{SF_6} \times DI_{SF_6, \text{CON, OJ, k, j, y}}$
+ $PE_{Novec, \text{recycle}, 2015} \times \text{Conservative factor} \times GWP_{Novec}$

$$= (1,971.3 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05)$$

$$+ (2,153.2 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec})$$

$$= 30,829 \text{ tCO}_2\text{e}$$

Die Cast Project Emissions = $PE_{SF_6, \text{diecast}, 2015} \times DF_{SF_6} \times GWP_{SF_6} \times DI_{SF_6, \text{CON, OJ, k, j, y}}$
+ $PE_{Novec, \text{diecast}, 2015} \times \text{Conservative factor} \times GWP_{Novec}$

$$= (0.0 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05)$$

$$+ (3,323.4 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec})$$

$$= 9,405 \text{ tCO}_2\text{e}$$

Total 2015 U.S. Project Emissions = Recycling + Die Cast Project Emissions

$$= 30,829 \text{ tCO}_2\text{e} + 9,405 \text{ tCO}_2\text{e}$$

$$= 40,234 \text{ tCO}_2\text{e}$$

4.2.2 Site 2 – Canada

2014 (November 1 through December 31)

Recycling Project Emissions = $PE_{SF_6, \text{recycle}, 2014} \times DF_{SF_6} \times GWP_{SF_6} \times DI_{SF_6, \text{CON, OJ, k, j, y}}$

$$= (441.5 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05)$$

$$= 5,539 \text{ tCO}_2\text{e}$$

Die Cast Project Emissions = $PE_{SF_6, \text{diecast}, 2014} \times DF_{SF_6} \times GWP_{SF_6} \times DI_{SF_6, \text{CON, OJ, k, j, y}}$
+ $PE_{Novec, \text{diecast}, 2014} \times \text{Conservative factor} \times GWP_{Novec}$

$$= (156.5 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05)$$

$$+ (856.2 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec})$$

$$= 4,387 \text{ tCO}_2\text{e}$$

Total 2014 Canada Project Emissions = Recycling + Die Cast Project Emissions

$$= 5,539 \text{ tCO}_2\text{e} + 4,387 \text{ tCO}_2\text{e}$$

$$= 9,926 \text{ tCO}_2\text{e}$$

2015 (January 1 through December 31)

$$\begin{aligned} \text{Recycling Project Emissions} &= PE_{\text{SF}_6, \text{ recycle}, 2015} \times DF_{\text{SF}_6} \times GWP_{\text{SF}_6} \times DI_{\text{SF}_6, \text{ CON, OJ, k, j, y}} \\ &= (602.8 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) \\ &= 7,563 \text{ tCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{Die Cast Project Emissions} &= PE_{\text{SF}_6, \text{ diecast}, 2015} \times DF_{\text{SF}_6} \times GWP_{\text{SF}_6} \times DI_{\text{SF}_6, \text{ CON, OJ, k, j, y}} \\ &+ PE_{\text{Novec}, \text{ diecast}, 2015} \times \text{Conservative factor} \times GWP_{\text{Novec}} \\ &= (991.1 \text{ kg SF}_6) \times (0.001 \text{ tonne/kg}) \times (0.5) \times (23,900 \text{ tCO}_2\text{e/tSF}_6) \times (1.05) \\ &+ (5,460.8 \text{ kg Novec}) \times (0.001 \text{ tonne/kg}) \times (2,830) \times (1 \text{ tCO}_2\text{e/t Novec}) \\ &= 27,890 \text{ tCO}_2\text{e} \end{aligned}$$

$$\begin{aligned} \text{Total 2015 Canada Project Emissions} &= \text{Recycling} + \text{Die Cast Project Emissions} \\ &= 7,563 \text{ tCO}_2\text{e} + 27,890 \text{ tCO}_2\text{e} \\ &= 35,453 \text{ tCO}_2\text{e} \end{aligned}$$

4.3 Leakage

There is no leakage of emissions associated with this project.

4.4 Net GHG Emission Reductions and Removals

Net GHG Emission Reductions are equal to Baseline Emissions minus Project Emissions. Note that totals shown in this chart may not add up due to rounding errors.

Site 1 – Eaton Rapids, U.S. (November 1, 2014 – December 31, 2014), in tCO₂e

	Recycling Operations	Die Cast Operations	Total
Baseline Emissions	28,084	8,100	36,184
Project Emissions	5,937	1,747	7,684
Emission Reductions	22,147	6,353	28,500

Site 2 – Strathroy, Canada (November 1, 2014 – December 31, 2014), in tCO₂e

	Recycling Operations	Die Cast Operations	Total
Baseline Emissions	14,115	5,360	19,475
Project Emissions	5,539	4,387	9,926
Emission Reductions	8,575	973	9,548

Site 1 – Eaton Rapids, U.S. (January 1, 2015 – December 31, 2015), in tCO₂e

	Recycling Operations	Die Cast Operations	Total
Baseline Emissions	188,852	55,867	244,719
Project Emissions	30,829	9,405	40,234
Emission Reductions	158,024	46,462	204,485

Site 2 – Strathroy, Canada (January 1, 2015 – December 31, 2015), in tCO₂e

	Recycling Operations	Die Cast Operations	Total
Baseline Emissions	107,297	38,967	146,264
Project Emissions	7,563	27,890	35,453
Emission Reductions	99,733	11,077	110,810*

*Rounded down for conservative measure.

Summary of Emission Reductions, in tCO₂e

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)
2014	55,658	17,610	--	38,048
2015	390,983	75,687	--	315,296
Total	446,642	93,297	--	353,344

*Numbers may not add due to conservative rounding down.