

# ***Meridian Magnesium Products of America SF6 Conversion Path***

*EPA Round Table discussion May 31<sup>th</sup> San Francisco, CA  
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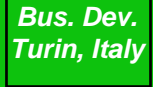
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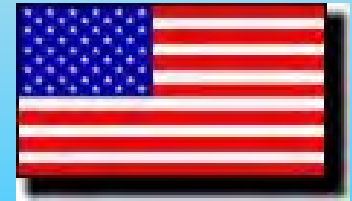
# Overview

## **Meridian is the Leading Full Service Supplier of Innovative Magnesium Diecasting Components and Assemblies in the Global Automotive Market**

- **Worlds Largest Producer of Magnesium Automotive Components**
- **Die Casting Company Evolving into a Provider of Engineered Solutions**
- **Die Casting Magnesium since 1981**
- **Flexible Skilled Workforce**
  
- **Facilities**
  - 3 North American Mfg. Facilities
  - 1 Mexico Facility
  - 2 European Mfg. Facilities
  - 2 Asian Mfg. Facilities
  - Global Technology Center
  
- Over 65 total DCM's from 280 to 3200 Tons
- Over 1200 dedicated employees
- Over 600,000 ft<sup>2</sup> of manufacturing space
- Over 40,000 Net Metric Tons of Product Shipped Annually
- Various secondary machining, coating, and assembly
  
- Meridian is committed to global growth as a leading automotive supplier



## Eaton Rapids, Michigan, USA



- ▶ Started production in 1994
- ▶ 360 employees
- ▶ 27,000 Net Metric Tons
- ▶ 208,000 ft<sup>2</sup> (13,800m<sup>2</sup>) Plant Size
- ▶ 15 Die cast cells
  - ▶ 2 - 800 ton
  - ▶ 4 - 1200 ton
  - ▶ 1 – 2500 ton
  - ▶ 8 - 3000 ton
  - ▶ 3 – Recycling cells Producing 19,000 metric tons annually
- ▶ Secondary Operations
  - ▶ 9 CNC machining centers
  - ▶ 2 Tri-Way machining centers
  - ▶ Special purpose drilling centers
  - ▶ Special purpose machining/assembly machines
  - ▶ Automated assembly equipment
  - ▶ Automated vision inspection stations for IP assembly and MRS programs
  - ▶ Leak Test equipment
  - ▶ Powder Coat line
  
- ▶ ISO/TS 16949:2002 Registered
- ▶ ISO14001 Registered
- ▶ Q1 Certified Supplier to Ford



## Strathroy, Ontario, Canada

- ▶ Started production in 1981
- ▶ 16,000 Net Metric Tons
- ▶ 408 employees
- ▶ 229,000 ft<sup>2</sup> (21274m<sup>2</sup>) Plant Size
- ▶ 21 Die cast cells
  - ▶ 4 - 800 ton
  - ▶ 8 - 1200 ton
  - ▶ 7- 1600 ton
  - ▶ 2 - 2500 ton
- ▶ Secondary Operations
  - ▶ 12 dedicated machining and assembly operations
  - ▶ Automated Vision Inspection Station for IP's
  - ▶ In-House Recycling operation
- ▶ ISO/TS 16949:2002 Registered
- ▶ ISO14001 Registered



## Strathroy, Ontario, Canada

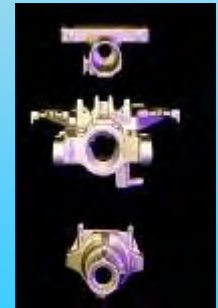
- ▶ Started production in 2001
- ▶ 2,666 Net Metric Tons
- ▶ 72 employees
- ▶ 71,000 sq. ft (6,595 sq.m) Plant Size
- ▶ 4 Die cast cells
  - ▶ 2 - 1600 ton
  - ▶ 2- 3200 ton
- ▶ Secondary Operations
  - ▶ 3 dedicated machining and assembly operations
- ▶
  
- ▶ ISO/TS 16949:2002 Registered
- ▶ ISO 14001 Registered



# Product Applications

## INTERIOR STRUCTURES

- *Instrument Panel*
- *Seat Frame*
- *Steering Column Components*



## BODY & CHASSIS STRUCTURES

- *Radiator Support*
- *Front of Dash*
- *Door Closures*
- *Cross members*
- *Engine Cradles*



## POWERTRAIN

- *Transfer Cases, Transmission Housings*
- *Intake Manifolds, Valve Covers, Oil Pans*
- *Engine Brackets, Engine Mounts*





# Cover Gas Decision Making Process

- Original testing by Meridian takes place in 2001 at our recycling facility in Strathroy, Canada.
- Several gases were tested during this time to determine the cover gas properties and feasibilities.
- Health and Safety concerns were also a major area of testing.

# Decision Making Process

- Further testing done by the EPA and IMA helped clarify the options.
- Testing revealed three gases that Meridian felt could perform well protecting magnesium.
- A decision matrix was used to determine which gas would be most suitable for our processes.

# Decision Making Process

Items considered in matrix

- Ability to protect
- Dross Production
- Health concerns normal and abnormal
- Operational costs
- Capitol required
- Global warming potential
- Affect on metal quality

# Decision Making Process

In 2002 we purchased a SO<sub>2</sub> mass flow controlled mixing station from Polycontrols in Brossard Quebec for our test site in Canada.

We wanted to collect further data on:

1. **Dross Production**
2. **Gas usage**
3. **Protection ability**
4. **Health & Safety measures taken were adequate**

We also continued to look at the other cover gases during this time.

# Decision Making Process

- Problem

- The capitol required to covert each site did not meet the return on investment required by our corporate standards.
- While committed to eliminating the use of SF 6 Meridian needed to be able to pay for the implementation costs.
- We were dedicated to meet the 2010 commitment we had made to the EPA.

**We needed a solution to help with the implementation! The project was on hold!!!**

## Finding A Solution

- A session at the EPA sponsored 4<sup>th</sup> International Conference on SF6 and the Environment in San Antonio, TX dealt with the carbon credit market and its ability to generate funds for environmental projects.
- We contacted several companies and discussed the Carbon Credit possibilities.

## Finding A Solution

- In January of 2007 Meridian signed a contract with Quality Tonnes (CCC) to develop a UN approved Methodology that would enable us and others to sell carbon credits. These credits could generate funds to help off set capitol and operating costs.
- The Project is back on track!!!!

# Implementation

- It was decided that we would run the Die Cast plants and all of recycling except the melt furnace on Novec™ 612 and the melt furnace in recycling would run on SO<sub>2</sub>.
- We obtained quotes from vendors for mixing stations and issued PO's to Polycontrols in late Sept of 2007. Lead time for the mixing stations was 90 days.



# Die Cast

- Die cast was determined to be the easiest to convert. It was decided to convert Die Cast first.
- Recycling would be done later

# Die Cast

- We installed 800' of type K copper tubing the entire length of the Die cast facility to run the Novec™ 612 gas through. All joints were silver soldered and done under an argon purge to prevent flaking inside the pipe.

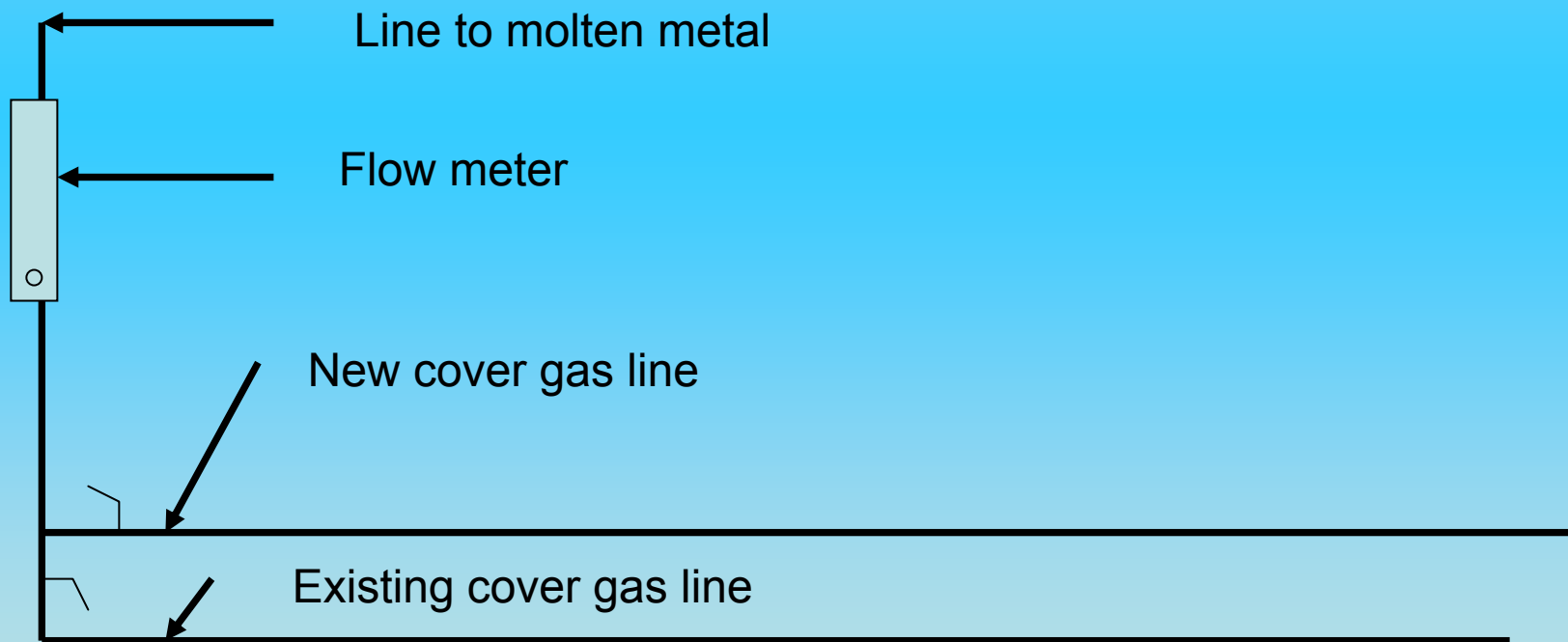
# Die Cast

This was done to enable us to do the conversion one cell at a time. By doing this it helped with operator buy in to the project

- We tied into our existing cover gas line during our Dec shut down and utilized the existing flow meters.

# Die Cast

- Typical installation



# Die Cast

- The existing SF6 cover gas is plumbed into the new cover gas panel to provide a back up system in case of Maintenance, electrical outage, or other panel malfunction.

# Die Cast

Change over Station



## Die cast

- The die cast plant panel arrived in late Jan and took 2 weeks to install.
- Once ready the conversion was done over a period of two days in the die cast plant.
- By the 14<sup>th</sup> of Feb the entire die cast facility was running the Novec gas.

## Die Cast

- Air monitoring for HF and other off gases was done to ensure employee health.
- The die cast conversion was extremely smooth. There was no impact to production during the conversion.
- Monitoring of dross production, air quality and gas consumption continues.



# Die Cast

- Original Concentrations were set at 250 PPM Novec with 18% air and balance CO<sub>2</sub>. Currently we are at 400 PPM Novec
- After running for several months we began to see an increase in dross generation.
- We also were seeing “Blue Flames” and the melt surface had begun to show signs of a Orange Red oatmeal type layer instead of the usual silvery color.

# Die Cast

- We formed a team to research what was happening
- The “Blue flames” would come and go with out explanation. We had, many years ago, experienced blue flames with  $Sf_6$  so it was not completely unusual. A check would reveal that there were not any flames present. Another check 5 minutes later would reveal blue flames????

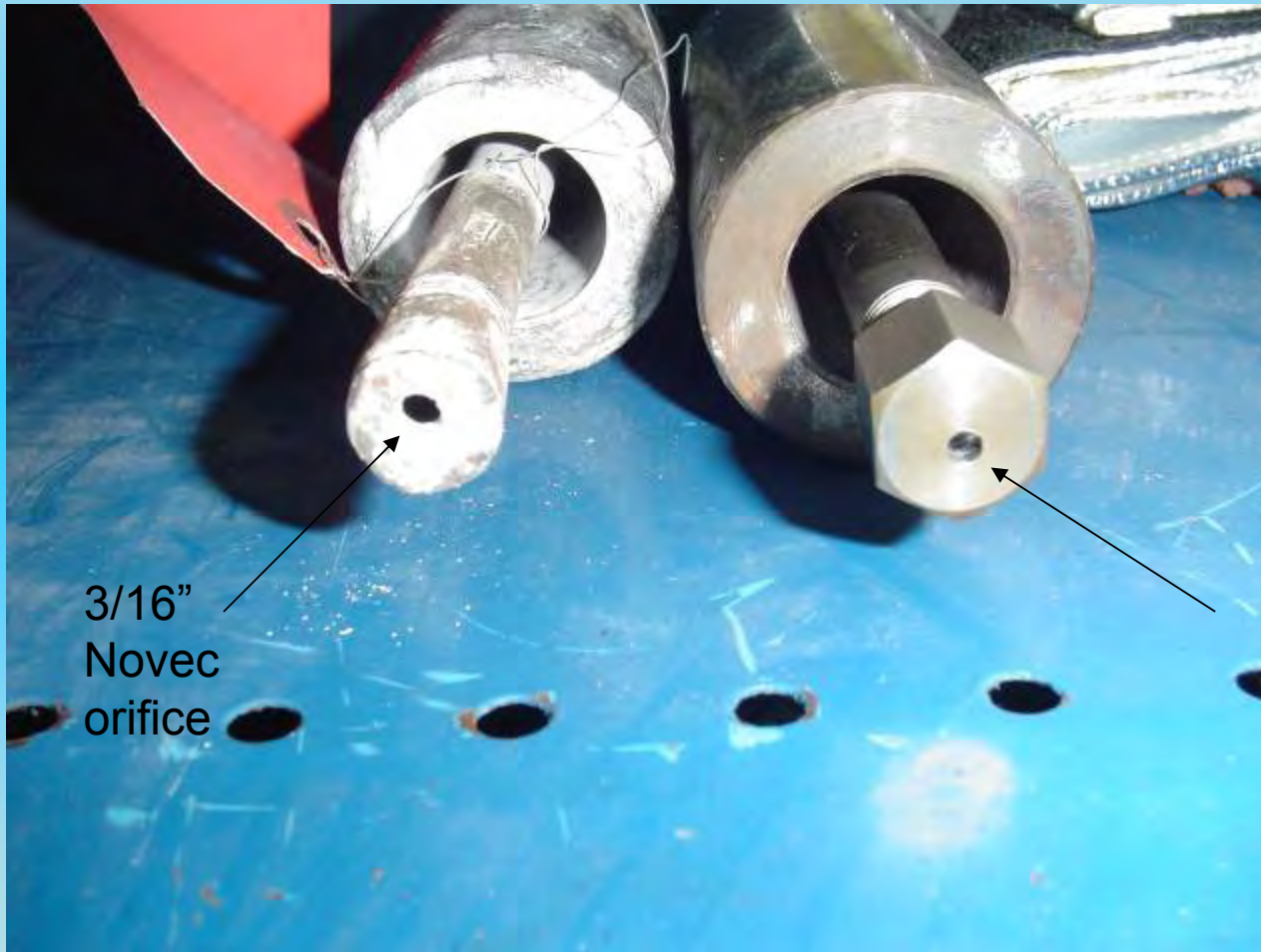
# Die Cast

- The blues flames were determined to be caused by generation of CO a byproduct of the break down of CO<sub>2</sub>. The reason why they were random was because if the pot was not burning there would not be an ignition source for the CO. Opening the lid to check on the condition of the pot would some times allow it to burn a little there by creating the ignition source for the CO.

## Die Cast

- Red Orange oatmeal. This was determined to be a result of a reaction of the Novec and the metal. The metal was actually burning which was causing the red orange color. Using SF6 we had installed orifices in our delivery system nozzles to increase velocity of the gas. This helped the gas delivery to the melt surface. We found the increased velocity with Novec actually disturbed the metal surface and created additional burning/dross. We opened up the orifice on the nozzles to solve this problem.

# Die Cast



3/16"  
Novec  
orifice

1/8" SF6  
orifice

# Die Cast

- On our larger pots (4 Ft round and larger) we had to add two additional delivery nozzles to provide additional coverage. We also increased the flow by 10%.
- Current dross levels are at or below levels with S<sub>f</sub>6
- Cost of the Novec gas is equal to or a little above that of SF<sub>6</sub>

# Die cast

Typical cover gas distribution



# Die Cast

- We found that a properly maintained delivery system and pot was essential.
- With SF 6 a marginally maintained delivery system and pot would still provide adequate protection.
- Novec is not as forgiving.
- To ensure pot conditions were maintained we created a check sheet and assigned an employee to daily monitor and report on pot conditions.



# Die Cast

## Furnace Evaluation Sheet

Date 5/21/2009

DCM	Lid Seal	Doors sealed	All Toe Clamps Secure on Lid	Gas Ports Clear	Gas Nozzle Correct Length	Gas Nozzles correct size	Gullotine Sealed	Gas Flow Rate	Hoses All Good	Furnace Platform Clean	Probes Free	Dross Measured	Dross Level	Bath Temp	Bath Level	Notes
Cell 1 Melt	0	0	0	0	0	0	0	0	0	0	0	51	5	1256	81	
Cell 1 Refine	0	0	0	0	0	0	0	0	0	0	0	52	4	1250	82	
Cell 2 Melt	0	0	0	0	0	0	1	0	0	0	0	53	3	1257	84	slide gate 2 has a large gap, probes need cleaned
Cell 2 Refine	0	0	0	0	0	0	0	0	1	0	0	51	5	1247	93	crimped hose needs replaced
Cell 3 Melt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a				
Cell 3 Refine	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a				
802	0	0	0	0	0	0	0	0	0	0	0	50	0	1200	82	
803	0	0	0	1	0	0	0	0	0	0	0	50	0	1248	83	unplugged one port
1205	0	0	0	0	0	0	0	0	0	0	0	49	1	1250	84	
1206	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a				
1207	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a				
3010	0	0	0	0	0	0	0	0	0	0	0	57	3	1278	81	Temp high shut down
3011	0	0	0	0	0	0	0	0	0	0	0	60	0	1234	85	
3012	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a				
3013	0	0	0	0	0	0	0	0	0	0	0	60	0	1249	86	hoses showing excessive wear but not leaking yet
3014	0	0	0	0	0	0	0	0	0	0	0	56	4	1250	86	hoses showing excessive wear and should be snooped, crimped hose, excessive flash on hoses, biscuit guillotine has a large gap
3015	0	0	0	0	0	0	1	0	0	0	0	43	3	1244	86	
3016	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a				
3017	0	1	0	0	0	0	1	0	0	0	0	46	0	1240	84	ingot guillotine tracks need cleaned, excessive flash on hoses, doors do not
2518	0	0	0	0	0	0	0	0	0	0	0	46	0	1250	84	

# Die cast



AM 60 @ 1250 F 40 LPM 30  
seconds



AM 60 @ 1250F 40 LPM 1 minute

# Die cast



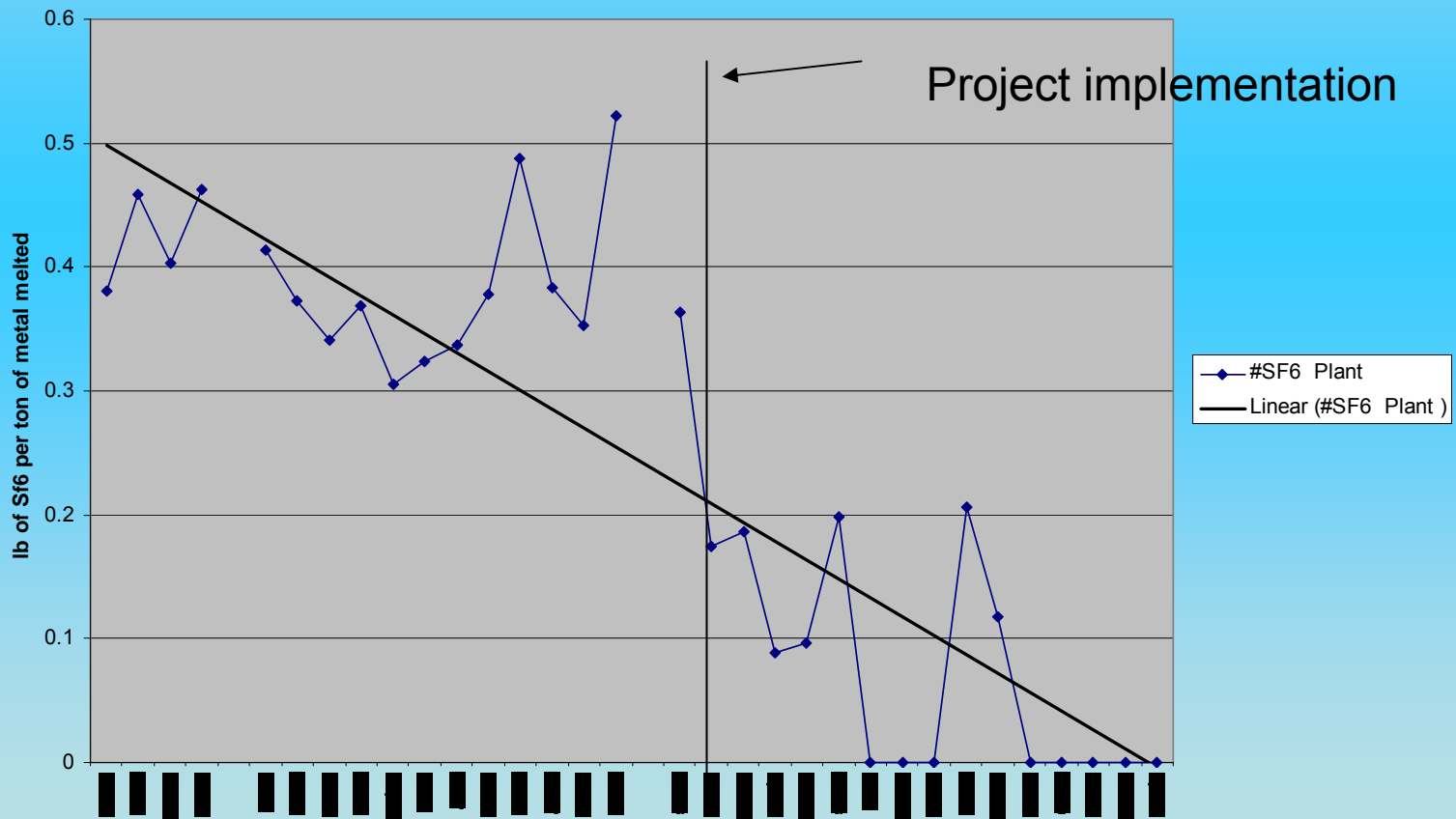
AM 60 @1250 F 40 LPM 2  
minutes



AM 60 @ 1250F 40 LPM 4 minutes

# Die Cast Sf6 usage

**SF6 Usage Per Ton  
of Metal Melted Die Cast**



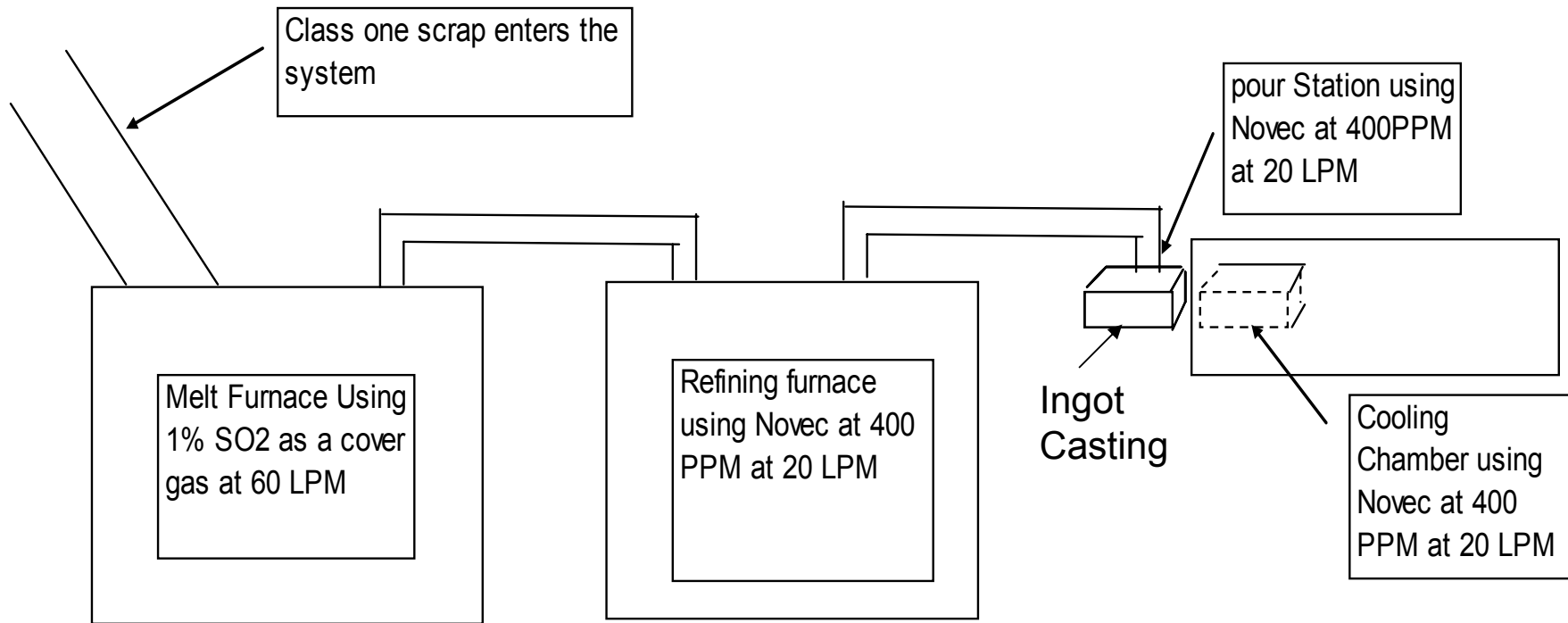
# Recycling

- Recycling uses cover gas in 4 areas.
- Melt furnace
- Refine furnace
- Ingot casting area
- Ingot cool down chamber

# Recycling



# Recycling Process



# Recycling

- In recycling we installed a SO<sub>2</sub>/ dry air cabinet combined with a Novec, CO<sub>2</sub> & dry air cabinet.
- SO<sub>2</sub> requires stainless steel pipe, Extra ventilation, and detector installation which adds to the capitol costs.



# Recycling

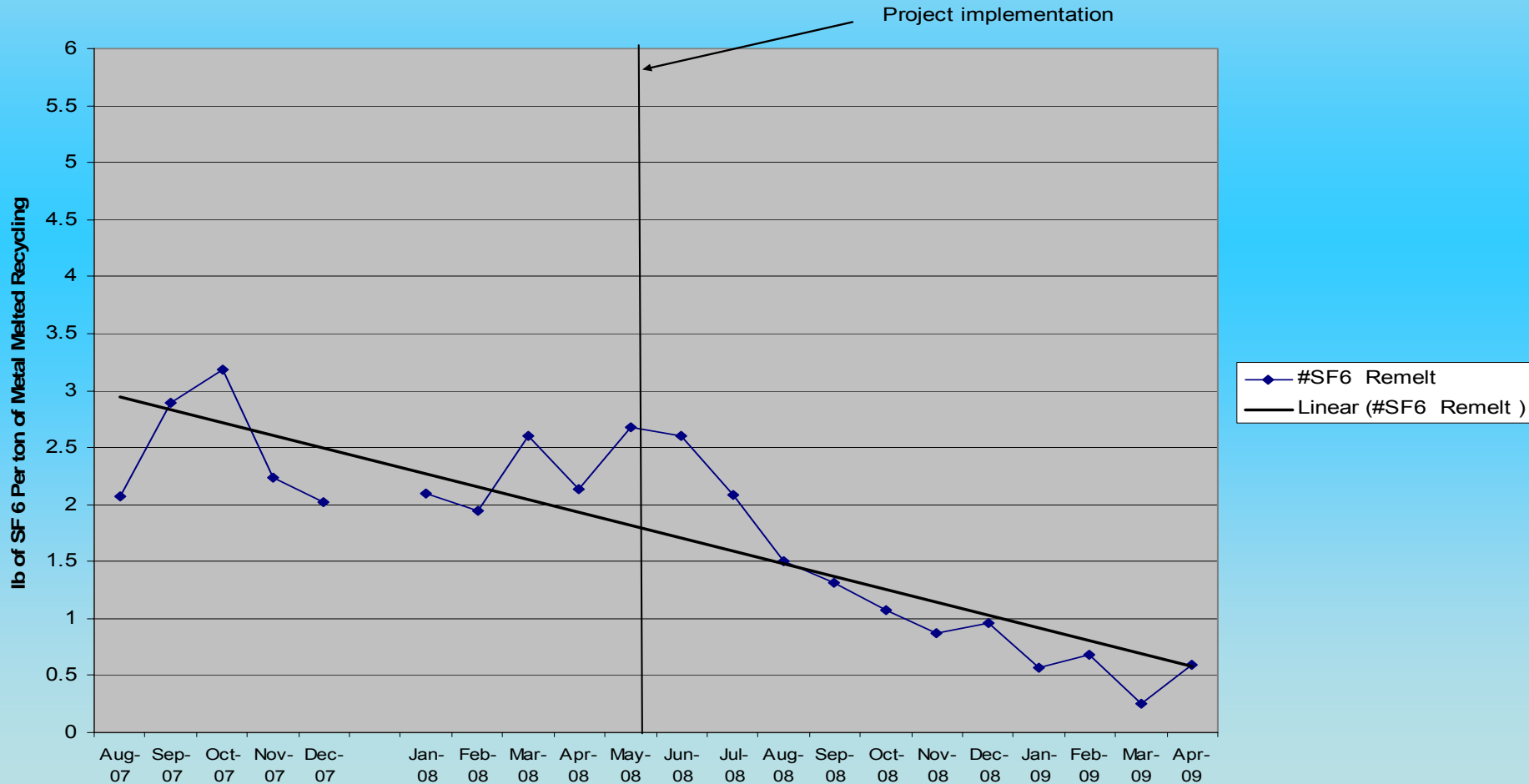
- The SO<sub>2</sub> installation in Recycling required additional monitoring to ensure employee health and safety. We installed 6 fixed detectors set to alarm at .5PPM. If this detection level is reached the SO<sub>2</sub> is shut down alarms are activated and SF<sub>6</sub> is energized.
- Employees in recycling are required to wear respirators in areas where SO<sub>2</sub> is in direct contact.
- Hand held detectors are required to check for leaks.

# Recycling

- SO<sub>2</sub> has a difficult time putting a pot that is burning out. Pots may begin to burn for a variety of reasons. Drossing too long. Scrap that has too much lube on it, Scrap that contains too many fines Ect.
- We installed a push button that activates a timer that will allow SF<sub>6</sub> to flow for 10 minutes to regain control if needed.

# Recycling

## LB of SF6 per ton of Metal Melted Recycling



# Recycling

- Recycling has seen a slight increase ( less than  $\frac{1}{2}$  %) in dross levels since implementing the alternate cover gases. This increase has come mainly from the Melt furnace that is utilizing SO<sub>2</sub>.

# Recycling



Personal detector worn by employees where SO<sub>2</sub> is used



Fixed detectors located in 7 locations in building to detect excess So<sub>2</sub> levels

# Recycling

- Leak detector



# Recycling Ingot Cast Using Novec

AM60



# Carbon Credits

- Carbon credits are a product of the Kyoto agreement that creates funding for pollution reduction projects.
- Carbon credits can be generated and sold to help finance a project.
- Some companies will consider providing capitol for conversion.
- A project must be registered before conversion is started.



# Carbon Credits

- If it is financially beneficial to convert then credits may not be sellable
- Good records of past SF6 use are helpful and will enhance value.

# Carbon Credits

- Credits may be purchased by a variety of sources. Electrical companies, Internet, others.
- Price received is variable depending upon the current market, quality of project, country they are generated in and company purchasing them.
- They serve as a mechanism to keep your conversion project on track.

## Conclusion

- Approximate capitol costs
- Mixing station range \$5,000 - \$15,000 Per Die cast machine depending upon what type of unit is used.
- Installation costs were approximately \$50,000 for each plant.
- Capitol costs can vary depending upon type of mixing station installed.

## Conclusion

- Additional injection ports may be needed depending on lid arrangement. Currently we are using about 1.5 LPM per sq ft ( $.09 \text{ m}^2$ ) of surface area that is protected.
- Dry air (Dew point -10 F) is needed for system to operate at optimum levels.

## Conclusion

- Involve employees in implementation.
- Dross levels are about the same
- If using SO<sub>2</sub> additional ventilation may be needed.
- Temperature can affect the quality of the gas protection. Temperature levels above 680 C show signs of deterioration.

## Conclusion

- Both Novec™ 612 and SO<sub>2</sub> work well for protection.
- If you have trouble with melt protection using SF<sub>6</sub> you will also have trouble with the alternate gases.
- Novec levels of 400 PPM and 20% air work the best in all conditions.

# Conclusion

- Control of gas levels must be maintained to prevent generation of HF (Novec) and high SO<sub>2</sub> levels that may impact employee health.
- If existing SF<sub>6</sub> station is kept as a back up. Establish a PM to ensure periodic use to ensure readiness when needed.

# Conclusion

- For additional information on cover gas review the EPA test results located at:

<http://epa.gov/magnesium-sf6/resources.html#paper>



# Conclusion

- Questions?