Ontario

AMENDMENTS TO THE FOUNDRIES – INDUSTRY STANDARD

UNDER THE

LOCAL AIR QUALITY REGULATION (O.REG. 419/05)

Ontario Ministry of the Environment and Climate Change
Environmental Sciences and Standards Division
Standards Development Branch
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Table of Contents

EXECUTIVE SUMMARY

In 2009, the Ontario Ministry of the Environment and Climate Change (ministry) amended Ontario Regulation 419/05: Air Pollution - Local Air Quality (O. Reg. 419/05) to include a technical standard compliance approach.

The “Technical Standard Publication” has now been updated to include version 2.0 of the Foundries – Industry Standard (FIS). The amendments were in response to requests made by the Canadian Foundry Association (CFA) and an FIS implementation pilot project contracted by the ministry. The proposed amendments were posted for a 60 day public comment period from May 19, 2015 to July 18, 2015 (see EBR # 012-3538). The rationale for the amendments to the original version of the FIS (originally published December 2009) are included in this document.

In 2010, the CFA expressed interest in updating the FIS in order to expand the list of contaminants and sources. In 2011, the ministry conducted a pilot study to evaluate implementation of the requirements of the FIS at three foundries in Ontario. The objective of the pilot project was to work with the sector to determine the effectiveness of the FIS including an evaluation of the level of effort required, the costs, and to assess the administrative regulatory requirements. The findings of this study gave rise to many of the amendments that will be discussed throughout this rationale document.

<u>Summary of Key Amendments:</u>

1. Include 195 Additional Contaminants Available for Registration
   The list of contaminants available for registration includes all potential contaminants that may be emitted from foundry operations. The newly compiled list of contaminants includes the 111 contaminants found in the 2009 FIS plus 195 newly added contaminants, totaling 306 contaminants.

2. New Air Pollution Control Requirements for Three Foundry Sources
   Three new sources have been included in the FIS each with associated air pollution control requirements: (1) liquid spray coating operations, (2) electric arc furnaces and argon oxygen decarburizers, and (3) thermal sand reclaiming equipment.

3. Changes to Specified Parameters & Typical Ranges for Equipment
   In order to avoid recommending operating ranges which differ from the manufacturer’s specifications for air pollution control devices like baghouses, the range of values for operating parameters (formerly listed in Table 2-1) can be replaced by a professional’s recommendation.

4. Changes to Specified Parameters & Frequency of Typical Inspections/ Preventative Maintenance for Capture and Collection Equipment
   This amendment allows changes to the frequency of inspection and maintenance activities for air pollution control equipment (formerly listed in Table 2-2) with a professional’s recommendation.

5. Ventilation Program & Assessment Applicable to All Ventilation Systems
   The ventilation program (see section 5 of FIS) and ventilation assessment (see section 6 of FIS) are applicable to all ventilation systems. The objective of this amendment is to develop a more comprehensive evaluation of performance as it pertains to the entire ventilation systems as opposed to select processes within a foundry.

6. Foundries located in Multi-Tenant Buildings
   Foundries with shared occupancy in buildings with non-foundry related tenants are required to replace the air make up unit filters on a semi-annual basis, and clean these ducts annually. Activities are limited to air supply equipment associated with non-foundry related tenants and may be restricted if permission for access to non-foundry units is not granted.

7. Change Management - Threshold for Combustion Sources
   An amendment is included to address what was formerly contained in section 17 of the 2009 FIS. This requirement ensures that, prior to implementing any change to a ventilation system an assessment must be carried out to determine how the planned changes will affect the ventilation system. The goal is to ensure that the same level of performance will be maintained. A threshold value has also been included which scopes this evaluation to combustion processes which may affect the ventilation systems.

8. Air Pollution Control - Requirement to Continue
   This new section requires that air pollution control devices or other requirements that are currently in place will continue to be in service.

9. Summary Reports
   This section has been amended to require new public reporting requirements. It now requires two annual summaries, namely the *Implementation Summary Table* and the *Performance Summary Table* be available to the public.

10. Minimization of SPM from Outdoor Foundry Processes
    A new requirement has been added that requires the preparation of a written log and the development of written procedures to mitigate SPM emissions for certain foundry processes when conducted outdoors. Written procedures are not required if a partial enclosure is employed by the foundry during such occurrences.

11. Notice Authority for Director to Require Ventilation Assessment
    This amendment allows for a Director to require the preparation of a ventilation assessment with respect to a ventilation system that may not be operating effectively in a particular area of the foundry.

12. Electronic Building Pressure Monitoring Provision
    This amendment is a provision that affords registrants the choice to use electronic building pressure monitoring devices as part of the ventilation program instead of preparing a volumetric flow table.

13. Aluminum Reverberatory Furnaces – Scrap Metal Requirements
    An amendment has been included for reverberatory furnaces that are charged with scrap aluminum which ensures that the fumes are captured and conveyed to a baghouse.

14. Torch Cutting Metal for Charging Furnace Requirements
    This amendment requires that the use of a torch cutter for the preparation of metal for charging a furnace ensures that the fumes are captured and conveyed to a baghouse.

1.0 INTRODUCTION TO TECHNICAL STANDARDS UNDER ONTARIO'S REGULATION 419/05

Ontario's local air quality regulation (O. Reg. 419/05: Air Pollution – Local Air Quality) made under the Environmental Protection Act (EPA) works within the province's air management framework by regulating air contaminants released into communities by various sources including local industrial and commercial facilities. The regulation aims to limit exposure to substances released into air that can affect human health and the environment while allowing industry to operate responsibly under a set of rules that are publicly transparent.

The regulation includes three compliance approaches for industry to demonstrate environmental performance and make improvements when required. Industry can meet the air standard, request and meet a site-specific standard, or register and meet the requirements of a sector-based technical standard (if available). All three approaches are allowable under the regulation.

Provincial air standards are set based solely on science and therefore, may not be achievable by a facility or a sector due to unique technical or economic limitations. Instead of making the air standard less stringent, the regulation allows facilities or sectors to exceed the air standard as long as they are working to reduce their air emissions as much as possible with technology-based solutions and best practices. The ministry closely oversees their progress using a framework to manage risk that was developed in cooperation with Public Health Units in Ontario and other stakeholders. Some facilities may never meet the air standard and instead will be regulated under one of the other compliance approaches. There are two types of technical standards:

- Industry Standards regulate all sources of a specified contaminant(s) within an industry sector.
- Equipment Standards address a source of contaminant, but may apply to one or multiple industry sectors.

Facilities in a sector that are operating under a technical standard may not meet one or more air standards; however, the focus is on best practices and lower emissions that reduce risks to local communities. In developing the amendments to the Foundries – Industry Standard (FIS), key sources of contaminants were identified and prescribed steps and timelines were considered to address them. Some facilities may also choose to register under the technical standard for contaminants where they meet the air standards. This allows them to be excluded from the modelling requirements of the regulation and reduce regulatory burden.

A technical standard is a technology-based solution designed for two or more facilities in a sector that may not be able to meet an air standard due to technical or economic limitations. This approach can include technology, operation, monitoring and reporting requirements. Once the technical standard is published, any facility in the sector (that may or may not meet the air standard) may apply to be registered under this compliance approach. Such registration would involve a posting on the Environmental Registry and may involve other forms of public outreach. The goal is to have a more efficient tool to better manage air emissions in the sector and manage overall exposure from various industrial and commercial facilities.

The Technical Standards are published under the authority of section 38 of the regulation. The Technical Standards publication specifies the classes of facilities and the contaminants the technical standard applies to and the steps and time periods for compliance. A facility may be registered for an industry standard, an equipment standard or a combination of industry standards and equipment standards.

If a published technical standard addresses all sources of a contaminant from a facility, then the registered facility is exempt from the relevant air standard(s) – and instead must abide by the requirements of the technical standard. If the published technical standards do not address all sources of a contaminant from a facility, then only certain sources of the contaminant may be excluded from the Emission Summary and Dispersion Modelling (ESDM) report. A facility can also choose which contaminants it registers for. In the development of a technical standard, the ministry assesses all sources of a contaminant related to a North American Industry Classification System (NAICS) code, and makes a decision as to whether or not that source needs to be better controlled, monitored or managed. Development of a technical standard includes a better understanding of sources of the contaminant for that sector, benchmarking technology to address the sources of a contaminant, and consideration of economic issues. Specific requirements are included in the technical standard for those major sources that are determined to need better management or control. Timeframes are specified for implementation of the requirements. Since this is an amendment to the FIS, timelines have also been included to assist those facilities already registered to transition to the new requirements.

In general, the FIS applies to Ferrous Metal Foundries, Iron Foundries, Steel Foundries, Non-ferrous Metal Foundries, Non-ferrous Die-casting Foundries and Non-ferrous Foundries (except Die-casting). In 2010, the Canadian Foundry Association (CFA) expressed interest in updating the FIS by expanding the list of contaminants and sources. The former version of the FIS allows for registration of up to 111 contaminants, whereas this update allows for an additional 195 contaminants, totaling 306 contaminants available for registration. The list of additional contaminants adopted into the FIS is available in the appendices of the amended FIS and includes the contaminants emitted from the newly addressed sources discussed in this rationale document, as well as additional contaminants identified by the sector.

The purpose, scope and background is outlined in Chapter 1.0 of this document. An overview of the sector is also provided (Chapter 2.0) followed by a general operational summary (Chapter 3.0) and a process flow chart (Figure 3). Chapter 4.0 is a jurisdictional review which summarizes how other governing bodies worldwide regulate air emissions from foundries.

Chapter 5.0 provides an overview of the air pollution control methods that are applicable to the newly addressed sources of emissions. Chapter 6.0 discusses the types of pollution control methods available to address emissions from these sources and any new additions to the FIS.

Chapter 7.0 summarizes the public consultation responses to comments from stakeholders. Finally, Chapter 8.0 provides conclusions and recommendations.

1.1 Purpose and Scope of Updating the Foundries-Industry Standard

In 2010, the CFA expressed interest in updating the sector's technical standard by expanding the list of contaminants to include substances that were omitted in the first schedule of contaminants, and including the additional contaminants from other significant sources. The sources being considered for addition to this technical standard are for liquid spray coating operations, thermal sand reclamation equipment, and electric arc furnaces / argon oxygen decarburizers.

In the fall of 2011, the ministry contracted a third party team with foundry expertise to conduct a pilot project. The purpose of the pilot project was to work with three volunteer foundries to evaluate the implementation of the FIS including the level of effort required. As part of the pilot project, the third party experts were also required to provide a "Recommendations Report', including recommended changes to the FIS, based on their experience with the three foundries.

The ministry pilot project also highlighted several other areas where changes may be warranted, such as revising the "typical operating range" for pressure drop across a baghouse in Table 2-1 of the FIS as it may not necessarily coincide with the manufacturer's specification. During the pilot it was also brought to the ministry's attention that the schedule for maintenance in Table 2-2 needed to be reviewed.

1.2 Background

In December 2009, the ministry published the "Technical Standard Publication" which contained version 1.0 of the Foundries – Industry Standard (FIS).

This publication allowed any facility that is part of a class identified by NAICS code 3315 (Foundries) to register for the technical standard compliance approach. Facilities in this class include 33151 (Ferrous Metal Foundries), 331511 (Iron Foundries), 331514 (Steel Foundries), 33152 (Non-ferrous Metal Foundries), 331523 (Non-ferrous Die-casting Foundries) and 331529 (Non-ferrous Foundries (except Die-casting)). The FIS does not include secondary lead smelters. FIS addressed suspended particulate matter (SPM) including metals such as lead, cadmium as well as volatile organic compounds and sulphur dioxide.

The technical standard requirements are designed to promote pollution reduction through the use of technology at the facility, the operation of the facility, the monitoring and reporting of information, and any other related matter.

2.0 SECTOR OVERVIEW

This chapter provides a general overview of the key foundry activities that impact air emissions and the sector as a whole in Ontario. Generally speaking, foundries produce metallic parts called castings by pouring molten metal into molds.

Foundries play an integral role in Ontario's economy by contributing to the communities in which they reside, while supporting the greater manufacturing supply chain with high quality metal parts. Their participation in Ontario's supply chain is prominent in the automotive and construction sectors, and noteworthy in other sectors such as mining and petroleum.

Ontario foundries are particularly important when the need arises for large castings such as industrial sized heat exchangers, pumps, motor housings, or ship engine propellers which would otherwise incur a high transportation cost had they been manufactured overseas. According to data obtained by Statistics Canada and Industry Canada, Ontario hosts the highest percentage of foundries in Canada.

Industry Canada organized data compiled by Statistics Canada's in their Canadian Business Patterns Database which helps convey the importance of Ontario's foundries in Canada. In December 2011, Industry Canada reported that, there were 265 foundries with the NAICS Code 3315 in Canada; of those almost 50% were located in Ontario. The breakdown of Canadian foundries is as follows: Ontario (127), Quebec (83), British Columbia (32), and Alberta (11). All other provinces represent less than 5% of all the foundries in Canada.

The majority of foundries are small to medium enterprises, each drawing on its own technical expertise to service a portion of the cast metal market. Only a small fraction of Ontario's foundries are very large operations with an international footprint. Industry Canada reported that as of December 2011 approximately 60% of the Ontario foundries were small with 5-99 employees and 13% were designated as medium-sized with 100-499 employees. Only one facility in Ontario had greater than 500 employees and is thus designated as large. Approximately 16% of the foundries have less than 1-4 employees. There are presently approximately 77 foundries operating in Ontario and CFA represents 31 regular members and 26 associate members in Ontario.

Foundries are generally categorized as ferrous or non-ferrous. Ferrous foundries cast various types of iron and steel, whereas non-ferrous foundries typically cast various types of aluminum, brass, bronze, copper and zinc. Recognizing this categorization of foundries is useful in the development of the update to the FIS. It enables better management of air emissions since certain contaminants of interest are used in higher amounts according to particular subsectors and the products they manufacture. For example, brass and bronze foundries will likely have higher emissions of lead and lead compounds since lead is a raw material used in brass. Similarly, stainless steel foundries will have higher emissions of nickel and chromium.

All foundries emit suspended particulate matter (SPM) and metallic fumes; the amount varies depending on the activity that is being carried out. Sand related activities emit SPM and activities that involve metal will emit metallic particulate or fumes. Depending on the type of foundry, metallic fumes may include iron, aluminum, zinc, copper, nickel, magnesium, mercury, manganese, chromium, cadmium, lead, cobalt, titanium, beryllium, tin and many others in varying amounts. In addition, foundries may also emit volatile organic compounds (VOCs). VOCs can be emitted from the organic binders used for the sand mold (i.e. sea coal) which emit VOCs when curing or when heated by the molten metal. Other sources of VOCs include emissions from coating applications.

It should be noted that prior to this technical standard, many Ontario foundries installed air pollution control equipment for many foundry related sources such as local ventilation ducting to capture fumes from melting, and ventilated shakeout enclosures connected to a baghouse to capture SPM.

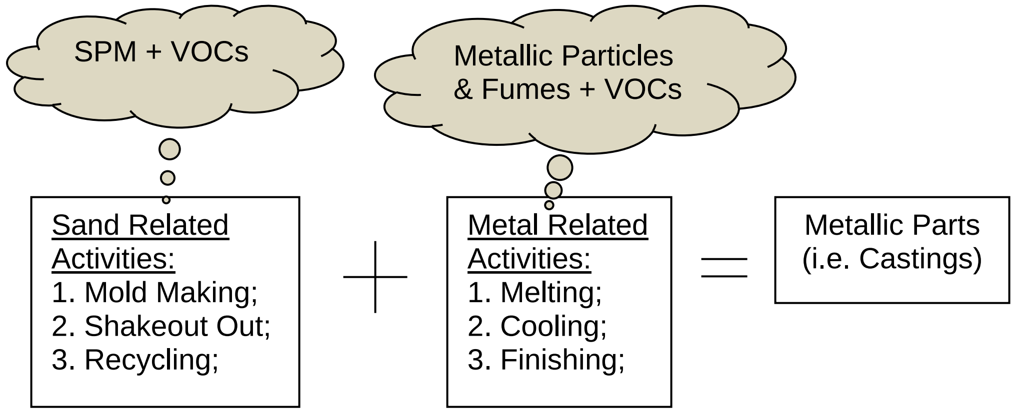

Figure 1 Categorical Representation of Foundry Activities and Emissions

A typical foundry uses various metallurgical and physical processes to cast molten metal into a variety of products ranging from decorative plaques to specialty components used in the aerospace industry. Depending on the ultimate function of these items, foundry metallurgists will determine the most appropriate bulk metal mixtures to create high quality, cost effective products. This also involves the addition of metal salts into the molten metal which give rise to special characteristics in the final casting. For example, relatively small quantities of manganese salts are used in iron castings prepared for the construction industry in order for the part to acquire impact hardening properties.

Foundries may also be categorized into smaller classes called subsectors which are often designated according to the alloys they manufacture. Alloy is the term used to describe a blend of metals. For example, brass and bronze foundries make alloys containing mostly copper with some zinc and tin, respectively. However, depending on the application, it is not uncommon for brass and bronze alloys to also contain lead. As such, the original version of the FIS has additional requirements and controls for non-ferrous foundries that emit lead and lead compounds, such as brass and bronze foundries. These requirements include assessing the ventilation system's performance, and incorporating air pollution control and alarms to ensure proper operation of equipment. This includes pressure drop alarms on a baghouse. The requirements help in minimizing air emissions of lead and lead compounds to the natural environment.

Apart from the metals being used, the amount and melting temperatures must also be considered. Every metal has a melting point - which is the temperature at which a metal changes from a solid to molten metal. As the temperature rises, the molten metal approaches another important temperature called the vapourization temperature. This is the temperature where a metal changes from the liquid phase to the gas phase. As each metal approaches its vapourization temperature, the rate of fume generation increases exponentially.

Figure 2 below depicts melting and vapourization temperatures of various metals and provides an indication of the potential for fume generation. Foundries will vary the composition of molten metal alloys by adding salts. These salts will dissolve in the metal and become captured in the metal alloy crystal matrix or in the slag, or even release in air borne fumes.

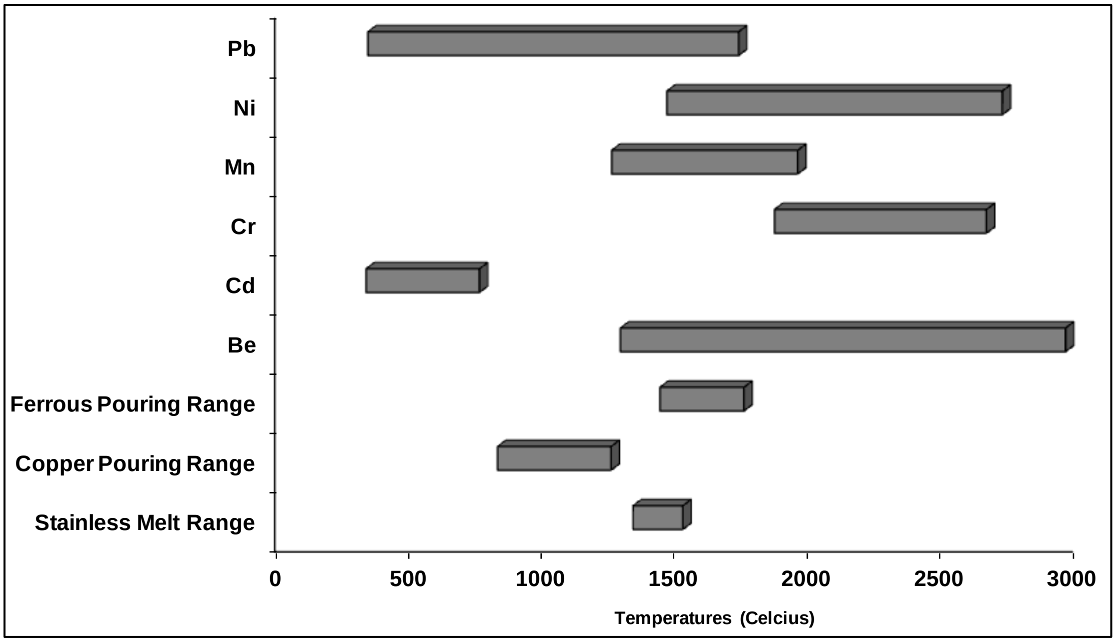

Figure 2 Range of Vapourization and Melting Temperatures of Some Metals

The above graph illustrates the melting and vapourization temperature of some of the metals found in the alloys being manufactured. The pouring temperature of the alloys being cast is therefore important in comparison to a metal's liquid temperature range. Higher emissions of metal fumes will be generated as the molten metal pouring temperature approaches the metal's liquid vapourization temperature.

It is very difficult to know the fate and fraction of metal salts upon addition to a molten metal bath. Hence, emission rates are difficult to estimate because the retention and distribution of the metals is highly dependent on many competing factors.

3.0 GENERAL SUMMARY OF INDUSTRIAL OPERATIONS AND ASSOCIATED AIR EMISSIONS

This chapter is intended to help provide some general background on foundry processes and related air emissions. Although the processes are typical for all foundries, some foundries may be operated in a different manner. Nevertheless, all foundries typically melt various metals in a furnace, pour the molten metal in sand molds or inject into die-casts, allow the metal to cool and then remove the solid metallic part sometimes referred to as a cast. Apart from this fundamental process, other auxiliary steps are required such as metal finishing and managing the spent sand from molds by recycling or disposal.

Figure 3 illustrates a generic foundry process flow diagram with typical air emissions and possible pollution control equipment. Each of the processes has a potential to discharge contaminants into the air. A typical foundry uses the following processes to make metal castings:

- Material handling;
- Metal melting and metal treatment;
- Mold and core making;
- Molten metal injection or pouring;

- Breakout or Shakeout (physical separation of the casting from the mold);
- Sand reclamation; and,
- Metal Finishing.

Painting and welding are carried out for the purpose of manufacturing an item. They are added here for completeness but are not unique to a foundry process. They are better understood to be activities that may be carried out in the manufacturing of any products.

- Painting (Possibly); and,
- Production Welding (Possibly).

3.1 Foundry Processes and Emissions

Material handling can include the unloading, storage and movement of materials used by a foundry. Typical on-site materials include sand and resins (chemical binders) for the molds and mold cores, metals and alloys, fluxes, and slag. Material handling may generate SPM emissions depending on the method of conveyance used, its moisture content, and its propensity to break down due to its abrasiveness. Moving or handling material makes the smaller particles airborne, which are subsequently picked up by forced or natural convection currents in the building.

Metal melting is usually done in an induction furnace and sometimes in a coke-fired cupola. There are different types of furnaces used in the foundry sector depending on the melted alloy, production volume, costs, etc. Most furnaces typically have an open top to add raw materials (metals, fluxes, etc.). Some furnaces can be tilted to pour out the molten metal, while non-tilting furnaces require operators to ladle the metal out. Die casters move the molten metal into molds using pressure. Often during the metal melting process, fluxing agents (such as limestone, fluoride or calcium carbide) are added to improve the properties of the metal or remove non-metallic impurities. These fluxing agents may generate SPM upon addition to the melt in addition to the actual evaporation of metal commonly referred to as metal fumes.

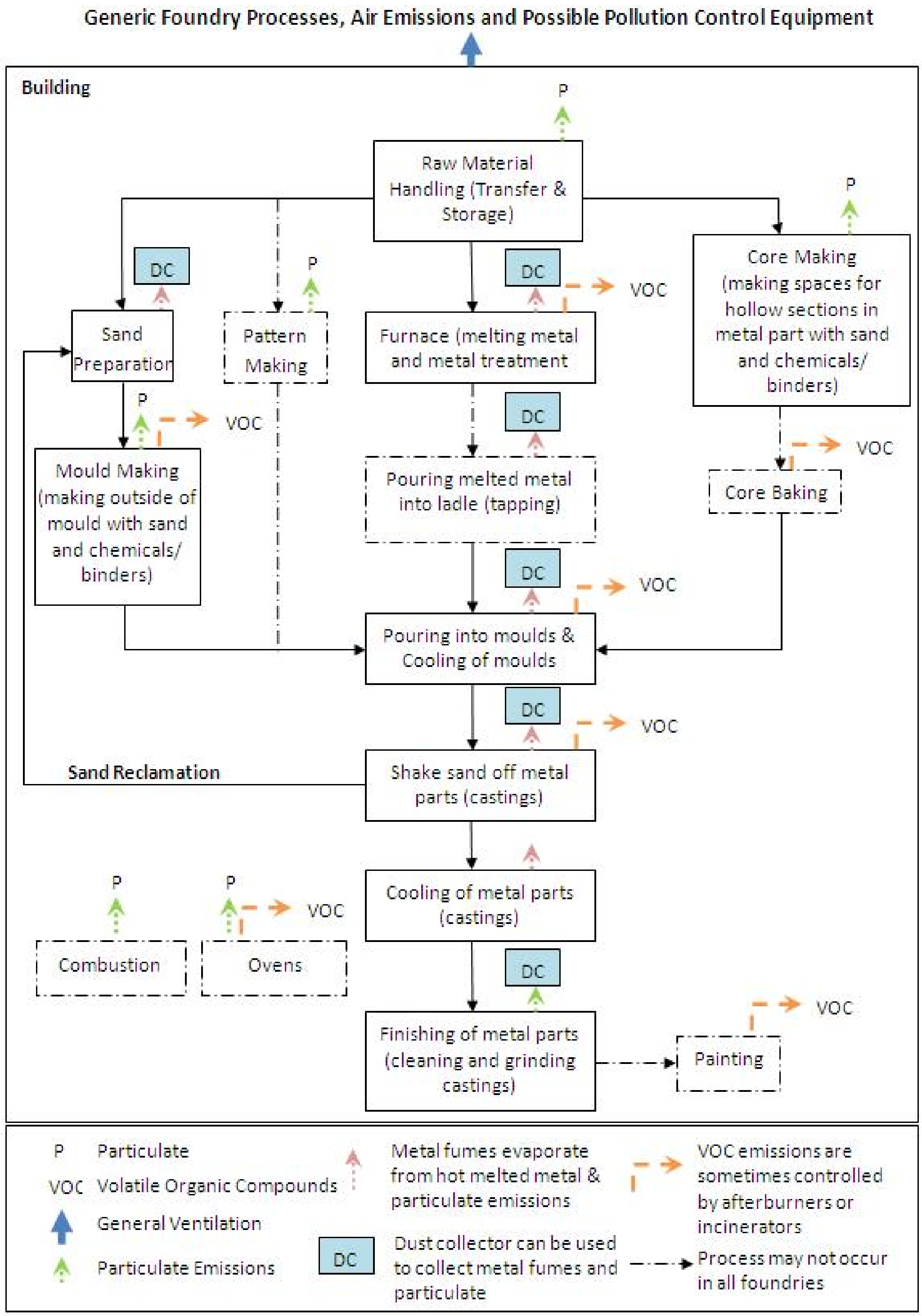

Figure 3 Foundry Processes and Associated Emissions

Mold and core making can be performed manually, or with automated machines. In both cases, the molds and mold cores used in metal castings are formed using sand. There are different types of molds and cores, and a variety of techniques and sands available for making each component. Molten metal is poured into these molds and held in place by the sand until it cools to form the casting. The casting is then removed and the sand is now ‘spent’ (i.e. cannot be re-used as a mold or core unless recycled and re-formed). Molds are made from sand mixed with a ‘binder’ and additives. Binders allow the sand to hold its shape, and there are many different types, including: chemical binders (typical chemical binders include resins but can include cereal binders such as starch and dextrin), clay, wax covered by ceramic and sand, or foam covered by a refractory coating and sand. To make a mold, sand is mixed with a binder and additives, and compacted around a “pattern”. Once the mold is compacted, the pattern is removed and if required, a core is inserted. The most common mold is a green sand mold, which uses “green” sand and a clay/water mixture as a binder. Cores are also made with sand, but typically require chemical binders in order to retain their shape once the hot molten metal is poured. As a result, the cores must be cured after the sand is compacted. Common curing methods include oven baking for hot setting resins. For cold setting resins, curing takes place in ambient temperatures. Binders used to hold the shape of the molds are often organic resins and need to be heated or activated with a catalyst to fasten the mold permanently. Prior to heating, resins naturally off-gas VOCs at room temperature. During the curing process, any resin that is not captured in the mold is released through the applied heat into the surrounding areas.

Molten metal pouring into sand molds can be done manually using a ladle, by a portable ‘tipping’ furnace, or in the case of die casting, the melted metal is forced under high pressure into metal molds or dies. A convention current of air is circulated above the pouring stream of metal which introduces cool air at the bottom of the pouring vessel which is heated along the molten metal stream. This drastic temperature change generates metal fumes which rise due to the air’s buoyancy caused by the elevated temperature.

Castings recovery is commonly termed *shakeout* and is achieved either by manually breaking the mold to recover the casting, or by placing the mold-encased casting on vibrating conveyors or grids to breakdown and shake off loose sand. Casting recovery cannot be done until the castings have cooled to a point where the metal structure and quality will not be affected by the physical nature of the shakeout process.

Sand reclamation is the process where the spent sand from molds is recovered and re-used. This generally requires cleaning the sand of remaining metal fragments or binders, and removing any ‘fines’ (sand particles too small to be used). The metal fragments can be removed using magnetic separators or a heated fluidized bed, and fines are removed using sieves. This emission is similar in origin to the description provided above regarding material handling. Thermal sand reclamation uses heat as opposed to mechanical energy to recover spent sand and will be discussed later in chapter five.

Finishing of castings can involve several different processes, each of which condition the surface of the metal for aesthetic appeal, functional capacity (such as adding fitting or threading piping connections), and/or improving structural integrity (by releasing stress via thermal treatment).

Finishing includes but is not limited to:

- removal of the runners, gates, and risers using hammers, saws or torches;
- grinding to remove burrs with grinding wheels or stones;
- sand blasting or shot blasting to smooth over the metal surface;
- punching or milling of castings to further shape castings; and

- thermal treatment of castings to change their metallic properties, such as strength or hardness, which is typically done by heating and quickly cooling by quenching in a bath or by forced air cooling.

All of the finishing techniques will generate metallic particulate matter because the objective is often to reduce the surface roughness of a finished part for aesthetic reasons and to remove the burrs for easy handling. The reduction of surface roughness to a smooth finish generates SPM by the momentum of the finish tool which drives particles into the air and results in the small ones remaining suspended.

Finally, it should be understood that there are other common building processes (heating and maintenance related activities) carried out in foundries, in addition to value-added production processes such as machining or painting.

3.2 Dominant Source Analysis

Since new air standards for some metals were introduced in 2011 (and take effect in 2016), the ministry conducted a literature review and dominant source analysis of emissions of these new or updated air standards to determine if additional requirements should be considered. New and/or updated air standards that will come into effect on July 1st, 2016 include benzene, benzo-a-pyrene (as a surrogate for total PAHs), chromium compounds (hexavalent), chromium compounds (metallic, divalent and trivalent forms), dioxins, furans and dioxin-like PCBs, manganese and manganese compounds and nickel and nickel compounds.

As part of the updates to the FIS, the ministry undertook a closer review of air emissions for these contaminants to determine if additional controls and management of the key sources of the contaminants are needed. The review focused on the iron and steel foundry subsector since manganese and manganese compounds are used in high percentages for ductile iron, and nickel and nickel compounds, and chromium compounds (metallic, divalent and trivalent forms) are used in higher quantities for stainless steel. It was determined that there was not enough information regarding sources of benzene, benzo-a-pyrene, chromium compounds (hexavalent) and dioxin, furans and dioxin-like PCBs to conduct a thorough analysis. For example, there may have been no emission factors or source testing information or poor data quality of emission factors. Limited information about foundry emission sources of chromium compounds (metallic, divalent and trivalent forms), manganese and manganese compounds and nickel and nickel compounds was found.

With respect to nickel, manganese, and chromium, an analysis of the dominant sources from ferrous foundries (both steel and iron foundries, large and small) that contribute to the maximum point of impingement (POI) concentration was conducted under various operating scenarios. A range of results were found and the dominant sources differed based on the emission factors used. However, the lack of data quality associated with the available emission factors and scarce source testing information make it difficult to determine if exceedences of these metals would be generally expected, and which are the dominant sources. Based on the available information, the three most common dominant sources were pouring, cooling and melting typically from general ventilation exhausts. However, depending on which emission factors of similar data quality were used, other dominant sources were observed, such as finishing and sand systems. Without confidence in the dominant sources, it is not possible to identify appropriate technologies for reducing emissions and impacts.

Since emission information on metals such as manganese and manganese compounds, nickel and nickel compounds, and chromium and chromium compounds (metallic, divalent and trivalent) and chromium compounds (hexavalent) was not readily available for assessment, the ministry is conducting a source testing study to derive higher quality emission information on these compounds emitted by this sector.

4.0 JURISDICTIONAL REVIEW

In 2006, the ministry contracted a study for a sector based profile of Ontario Foundries that included a jurisdictional review. This jurisdictional review was revisited by ministry staff as part of this amendment to ensure that the third party review was still relevant and reflects the most up to date information.

A review was conducted of regulatory requirements and codes of practice for emissions of metals, particulates, volatile organic compounds (VOCs), polychlorinated dibenzo-*p*-dioxins / polychlorinated dibenzofurans (PCDD/Fs), nitrogen oxides (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO), chlorides and fluorides from foundries. Metals found in the jurisdictional review included aluminum (Al), antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), vanadium (V) and zinc (Zn). The regulatory review covers requirements and codes of practice from Canadian jurisdictions (federal, provincial/territorial and CCME), the United States (U.S.) (federal, California, Great Lakes States) and Europe (European Union, United Kingdom). Various instruments from these jurisdictions were identified and described where available.

The description includes emission limits and, where available, control technologies and strategies needed to meet the requirements. Where available, additional information is provided on:

- emission reduction due to implementation;
- overall effectiveness and cost; and,
- evaluation of other benefits/disadvantages.

4.1 Review of Canadian Requirements

4.1.1 Federal

No Federal regulations or guidelines specifically pertaining to air emissions from foundries have been identified.

4.1.2 Provincial

Although occupational hygiene regulations that apply to foundries exist for each province, specific regulations controlling releases of pollutants to ambient air were not identified, except in Ontario, Alberta and Quebec. In Alberta, the Substance Release Regulation incorporates a Code of Practice for Foundries. In Ontario, Regulation 419/05, Air Pollution – Local Air Quality applies to all facilities emitting air contaminants. Ontario also published the Foundries – Industry Standard in December 2009. Section 148 to 152 of Quebec's Clean Air Regulation is devoted to regulation which pertains to Steel Mills. These sections make specific references to activities that are carried out in a foundry.

Ontario Local Air Quality Regulation

Ontario protects air quality through a comprehensive air management framework that includes regulations, targeted programs, and partnerships with other jurisdictions to address sources of air pollution. This framework addresses emissions from the electricity sector (including coal-fired generation stations), vehicles, cross-border sources, as well as commercial and industrial facilities.

Ontario has several tools for managing air quality in Ontario. Below are some regulatory requirements that likely pertain to this sector:

- Environmental Compliance Approval;
- Environmental Activity and Sector Registry; and,
- O.Reg. 419/05: Air Pollution - Local Air Quality.

Environmental Compliance Approval

Under the Environmental Protection Act, any facility that releases emissions to the atmosphere, and manages or disposes of waste must obtain an Environmental Compliance Approval (ECA). Facilities that alter any equipment that may discharge a contaminant into the air also require an ECA.

Approvals generally do not contain stack limits for air emissions. Air Dispersion Models are used to assess point of impingement (POI) concentrations for various contaminants. Modelling or monitoring values are assessed against legal standards established in applicable regulations, or guidelines and policies including:

- Guideline A-5 Atmospheric Emissions from Stationary Combustion Turbines: This policy controls emissions of NOx from new and modified stationary combustion turbines by specifying atmospheric emission limits for NOx, SO2, and CO. This policy applies to all new and modified stationary combustion turbines using gaseous, liquid or solid-derived fuels.

- Guideline A-9: NOx Emissions from Boilers and Heaters: This guideline specifies limits for emissions of NOx for new or modified fossil fuel boilers and heaters that have a fuel energy input greater than 10 million Btu/h (10.5 GJ/h). The guideline specifies various NOx emission limits, based on the type of fuel and the size of boiler or heater, with specified credits for high efficiency boilers. These emission limits do not apply to coal-fired or wood-fired boilers and heaters.

- Other guidance documents relevant to O. Reg. 419/05 below.

Environmental Activity and Sector Registry

In addition, the Environmental Activity and Sector Registry (EASR) allows businesses to register certain activities with the ministry, rather than apply for an approval. The registry is available for common systems and processes, to which pre-set rules of operation can be applied.

O.Reg. 419/05: Air Pollution - Local Air Quality

Ontario's local air quality regulation (O. Reg. 419/05: Air Pollution – Local Air Quality) works within the province's air management framework by regulating air contaminants released into communities by various sources, including local industrial and commercial facilities. The regulation aims to limit exposure to substances released into air that can affect human health and the environment, while allowing industry to operate responsibly under a set of rules that are publicly transparent.

The regulation includes three compliance approaches for industry to demonstrate environmental performance, and make improvements when required. Industry can meet an air standard, request and meet a site-specific standard or register and meet the requirements under a technical standard (if available). All three approaches are allowable under the regulation.

The regulation sets out air standards as POI limits for contaminants. Standards for 139 contaminants in Schedule 2 of the regulation are set for half-hour averaging periods. Standards for126 substances in Schedule 3 of the regulation are set for variable times, including 1-hour, 24-hour, annual, 30-day, 10-minute and half-hour averaging periods.

The facility identifies all sources of all contaminants and, using air dispersion modelling, determines the POI concentrations surrounding the facility. Foundries were required to meet air standards in Schedule 3, using the more advanced air dispersion models, by February 1, 2013. The regulation specifies that facilities must complete and update their Emission Summary and Dispersion Modelling (ESDM) reports annually. These requirements would not apply to the contaminants a foundry would have registered for under the FIS.

Significant progress has been made in recent years to update or set new air standards. Since 2005, 68 new and/or updated air standards have been introduced into the regulation.

The site-specific standard and technical standards compliance approaches allow facilities the time needed to develop and implement an action plan and to work towards improving their environmental performance when necessary.

<u>Site-Specific Standard</u>

When a facility cannot meet an air standard, it may be eligible to request a site-specific standard. Facilities eligible to request a site-specific standard are those facing technical or economic challenges in meeting a provincial air standard.

A site-specific standard is an approved air concentration based on technology considerations. It is approved by an appointed director of the ministry for an individual facility.

This approach focuses on actions to reduce emissions to air as much as possible considering the technology that is available and best operational practices. Economic factors may also be considered.

A facility that meets its site-specific standard is in compliance with the regulation.
Site-specific standards can be approved for a period of five years to 10 years, upon which a facility may make a subsequent request.

<u>Technical Standards</u>

If two or more facilities in a sector cannot meet an air standard due to technical or economic issues, the regulation allows for sector-based technical standards to be developed.

Sector-based technical standards set out technical and operational requirements for major sources of air emissions identified in a sector.

A technical standard can be an industry standard applied to multiple facilities within one sector, or an equipment standard that addresses a source of contaminant in one or more industry sectors.

A facility that meets its obligations under a technical standard is in compliance with the regulation.

Technical standards do not expire, but can be updated based on the availability of newer technologies, updated science on a contaminant that suggests more controls are needed, or at the request of the industry sector.

Relevant guidelines and guidance

The following guidelines and guidance are relevant to the local air quality regulation:

- SUMMARY of STANDARDS and GUIDELINES to support Ontario Regulation 419/05 - Air Pollution – Local Air Quality;
- Guideline A-10: Procedure for Preparing an Emission Summary and Dispersion Modelling (ESDM) Report: This document provides guidance regarding the preparation of an ESDM report as per required by O. Reg. 419/05;
- Guideline A11: Air Dispersion Modelling Guideline for Ontario: This guideline provides an overview of the approved dispersion models; and,
- Guideline for the Implementation of Air Standards in Ontario: This document provides guidance on the information needed to support a request for a site-specific air standard.

Alberta's Code of Practice for Foundries (1996)

Persons responsible for foundries in Alberta are regulated by the Alberta Code of Practice for Foundries (the "Code") and must meet all of its requirements, including registering with Alberta Environmental Protection prior to commencing operation of a foundry, and obtaining approval for larger foundries. The Code came into effect on September 30, 1996, and was scheduled for a 10-year review in 2006. The Code defines the minimum operating requirements for foundries. Foundries must use pollution control technology and operating practices that meet the following requirements:

- opacity from all air emission sources at the foundry shall not exceed 20%, averages over 6 minutes (except for one 6-minute period per hour of not more than 40% opacity);
- concentration of particulates in the effluent stream from all air emission sources at the foundry must not exceed 0.20 g/kg of effluent;
- fugitive dust emissions from the foundry must not cause an adverse effect; and,
- run-off from the foundry and related operations must be controlled in a manner to prevent adverse effects.

In addition, the person responsible must:

- conduct a full inspection of all baghouses and associated equipment each year, and keep records of such inspections;
- operate all wet scrubber type dust collectors as follows:
    - ensure sufficient retention time in the system to settle out collected dirt and sediment, and,
    - ensure that the scrubber water supply pump is of sufficient size to provide the circulation flow rate required for proper scrubber operation.
- keep a copy of the registration at the foundry at all times;
- keep records (for a minimum of 5 years) in an environmental log of all inspections, problems and corrective actions at the foundry; and
- immediately notify the Director of the Pollution Control Division of any contraventions of the Code of Practice.

Quebec's Clean Air Act (ss.148-152)
Section 148 to 152 of Quebec's Clean Air Regulation is devoted to regulation which pertains to Steel Mills. These sections make specific references to activities that are carried out in foundry. There are four subsections: (1) Particle emission standards applicable to cast iron or steel production; (2) Emission standards applicable to certain activities; (3) Monitoring equipment; and (4) Emission monitoring measures.

This regulation enacted under the Environment Quality Act focuses on particulate emissions from cast iron and steel production processes with a production rate of 5 tonnes per hour or less and has more stringent requirements for new facilities. For example, new foundries which operate at 5 tonnes per hour of feed must meet a particulate of 4.6 kilograms particulate per hour whereas existing foundries which operate at this production rate would be required to maintain their particulate emissions below 5.9 kilograms per hour.

Local ventilation systems in iron and steel foundries must be installed where all of the following activities take place: metal casting, cutting, shake-out, grit blasting, grinding or sanding, mold and core making. Additionally, an emission limit of 30 milligrams per cubic meter of dry gas must be maintained for these exhaust systems. Finally, as of June 2013 scrubbers on iron and steel furnaces at existing steel mills must be equipped with continuous leak and malfunction detection devices.

Any cast iron of steel production foundry that operates at a feed production rate greater than five tonnes per hour is also required to carry out air sampling every five years from the furnace's scrubber exhaust and also in the general building that houses the furnaces.

4.2 Review of United States Requirements

4.2.1 NESHAP for Iron and Steel Foundries (MACT)

In 2004, the US EPA promulgated National Emission Standards for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries, came into effect April 22, 2004. Two more amendments were promulgated in 2005 and 2007, however, the values listed in Table 4-1 remained unchanged. Finally, affected facilities are new or existing iron and steel foundries that are major sources of HAP emissions.

Major sources are those that emit or have the potential to emit 10 tons/year or more of any single HAP, or 25 tons/year or more of any combination of HAP.Hazardous air pollutants (HAPs) include many, but not all, VOCs, as well as other substances such as certain heavy metals. Important metal HAPs at iron and steel foundries are lead and manganese (from low alloy metal castings), chromium and nickel (from high alloy metal or stainless steel castings) and cadmium. Organic HAP emissions from foundries include acetophenone, benzene, cumene, dibenzofurans, dioxins, formaldehyde, methanol, naphthalene, phenol, pyrene, toluene, triethylamine and xylene.

The purpose is stated in the background section of this national emission standard as follows, “The NESHAP for iron and steel foundries (40 CFR part 63, subpart EEEEE) establishes emissions limitations and work practice requirements for the control of hazardous air pollutants (HAP) from foundry operations. The NESHAP implements section 112(d) of the CAA by requiring all iron and steel foundries that are major sources of HAP to meet standards reflecting application of the maximum achievable control technology (MACT).”

The NESHAP covers fugitive emissions, as well as emissions from metal melting furnaces, scrap preheaters, pouring areas, pouring stations, automated conveyor and pallet cooling lines that use a sand mold system, and mold and core making lines. This rule includes:

- emission limits for particulate matter (PM) and opacity, which serve as surrogates for metal HAP emissions;
- alternate emission limits for total metal HAP;
- emission limits for volatile organic HAP (VOHAP) and triethylamine (TEA); and,
- work practice requirements.

Emission limits and work practice standards are summarized in Table 4-1. Additional requirements include:

- a written operation and maintenance plan for capture systems and control devices;
- a start-up, shutdown and malfunction plan;
- notifications of applicability, performance evaluations and compliance status; and,
- record keeping and reporting.

Table 4-1 Iron and Steel Foundry NESHAP Emission Limits

Process	**Pollutant**	**Emission Limit[a] or Work Practice Standard**
Electric arc metal melting furnace, electric induction metal melting furnace, or scrap preheater at an existing foundry	PM, or Total metal HAP	0.005 gr/dscf[b] 0.0004 gr/dscf
Cupola metal melting furnace at an	PM, or	0.006 gr/dscf

Process	Pollutant	Emission Limit[a] or Work Practice Standard
existing foundry	Total metal HAP	0.0005 gr/dscf
Cupola metal melting furnace or electric arc metal melting furnace at a new foundry	PM, or Total metal HAP	0.002 gr/dscf 0.0002 gr/dscf
Electric induction metal melting furnace or scrap preheater at a new foundry	PM, or Total metal HAP	0.001 gr/dscf 0.00008 gr/dscf
All metal melting furnaces	HAPs	Scrap certification, or scrap selection and inspection program
Pouring station at an existing foundry	PM, or Total metal HAP	0.010 gr/dscf 0.0008 gr/dscf
Pouring area or pouring station at a new foundry	PM, or Total metal HAP	0.002 gr/dscf 0.0002 gr/dscf
Cupola metal melting furnace at a new or existing foundry	VOHAP	20 ppmv[c]
Scrap preheater at an existing foundry	VOHAP	Direct contact gas-fired preheater, or scrap certification, or 20 ppmv
Scrap preheater at a new foundry	VOHAP	20 ppmv, or scrap certification
Automated conveyor and pallet cooling lines and automated shakeout lines that use a sand mold system at a new foundry	VOHAP	20 ppmv[d]
TEA cold box mold and core making line at a new or existing foundry	TEA	1 ppmv, or 99% emissions reduction[e]
Furan warm box mold and core making line at a new or existing foundry	Methanol	No methanol in the catalyst
Fugitive emissions from a building or structure at a new or existing foundry	Opacity	20%[f]

[a] Except for the fugitive emissions opacity limit, the emissions limit apply to emissions discharged to the atmosphere through a conveyance.
[b] Grains per dry standard cubic foot (gr/dscf)
[c] Parts per million by volume (ppmv), corrected to 10% oxygen.
[d] Flow-weighted average.
[e] Emissions reduction as determined when scrubbing with fresh acid solution.
[f] Except for one 6-minute average per hour that does not exceed 27% opacity.

Many iron and steel foundries in the United States have emission controls similar to those required by the NESHAP already in place. However, when fully implemented the NESHAP is still expected to reduce total HAP emissions from iron and steel foundries by >820 tonne/year. Expected emission reductions for PM and VOCs combined are approximately 2,550 tonne/year. Scrap selection and inspection procedures are expected to reduce mercury emissions by 1.4 tonne/year (*i.e.,* by 80% of current levels).

4.2.2 NESHAP for Aluminum, Copper, and Other Nonferrous Foundries. (GACT)

On June 25, 2009, the US EPA's final rule was promulgated and established Generally Available Control Technologies, GACT to address hazardous air emissions from aluminum, copper, and other nonferrous foundries. This rule does not apply to the iron and steel foundries since these foundries are governed by the aforementioned national emission standards.

Foundries that melt more than 600 US tons of more per year of aluminum, copper, or any other nonferrous metal are subject to this rule. Additionally, the requirements cited in this rule are particularly focused on area sources from melting operations at these foundries. Any metal melting activity that emits less than 10 tons of a single toxic air pollutant or less than 25 tons of any combination of toxic air pollutants is subject to control.

When the two conditions cited above are triggered, aluminum, copper and other nonferrous foundries must have controls on their melt furnaces. For example, furnaces that are equipped with covers or enclosures must employ these covers or enclosures during melting activities. A concerted effort must also be taken by foundry operators to purchase scrap metal that has been separated from hazardous metals (lead, nickel, chromium, cadmium, beryllium, and manganese) to the extent possible. Furthermore, different foundries must meet certain threshold limits of hazardous metals in the scrap they melt. Finally, a management plan must be developed by the foundry to determine and implement measures to reduce their air toxics emissions as much as feasibly possible.

Large copper foundries and other nonferrous foundries that exceed a melt rate of 6000 tons per year are subject to further control. Existing foundries of this type must limit their particulate emissions to 0.015 grains per dry standard cubic foot from melting operations or use an air pollution control device to reduce the amount of particulate emitted from the melting activities by at least 95%. New copper and other nonferrous foundries of this size are required to limit their particulate emissions to 0.010 grains per dry standard cubic foot from melting operations or use an air pollution control device to reduce the amount of particulate emitted from melting activities by at least 99%.

As of June 2011, large copper and nonferrous foundries must have conducted a performance test of the air pollution control devices that control melt emissions to ensure that the particulate emission limits are being met. New facilities are subject to performance testing upon start up. If a foundry chooses to employ fabric filters to control particulate from melting operations, visual checks of the exhaust emissions from these devices must be carried out regularly in addition to being equipped with a bag leak detection system.

Additionally, requirements for the purpose of record keeping are also expressed in this GACT and must be carried out in such a way that facilitates prompt review. For example, copies of any notifications that are sent to the US EPA, the air toxics reduction management plan, performance tests, inspections, maintenance and visual monitoring and bag leak detection data must be recorded. The facility must also have production records that identify what magnitude of production they are operating at which ensures that they have not triggered the requirements reserved for large copper and nonferrous foundries.

The GACT uses a bulk melt rate to regulate air toxic emissions from aluminum, copper, and other non-ferrous foundries. The final rule requires greater control on sources in foundries which melt any material that contains beryllium, cadmium, chromium and lead in amounts greater than or equal to 0.1%, or manganese greater than or equal to 1.0%) with a total annual melt rate (regardless of the metal content) of at least 600 tons. The US EPA published a Fact Sheet on the "PROPOSED RULE TO REDUCE AIR TOXICS EMISSIONS FROM AREA SOURCE" which stated, "[m]ost facilities in these source categories are small businesses. EPA estimates that the proposed rule would apply to approximately 318 out of an estimated total of 962 area source aluminum, copper, and other nonferrous foundries. The proposed rule would have a total annualized cost of $645,000/year, with no significant adverse economic impacts on any foundry". Hence, the application of this rule to 318 out of an estimated 962 foundries gives rise to an additional average annualized cost of ~$2,000 USD per year per facility.

4.2.3 NESHAP for EAF Steelmaking Facilities

The National Emission Standard for EAF Steelmaking Facilities was promulgated by the US EPA on December 28, 2007 and is intended to address area source emissions (ie. source that has the potential to exceed 10 tons per year of an individual HAPs or 25 tons per year of any combination of HAPs if left unabated) generated by the use of Electric Arc Furnaces (EAFs) used in steelmaking facilities.

The compliance phase in dates for this rule have passed and are currently in force for all EAFs in steelmaking facilities. Since argon oxygen decarburizers (AODs) are typically operated in series following EAFs this rule also applies to these devices as well. All of these facilities are regulated by way of a Title V permit.

There are specific requirements in this rule to address mercury, other contaminants, and particulte. Monitoring of the capture and control systems and record keeping is also stipulated in this rule.

To mitigate mercury emissions, operators of EAFs in steelmaking must either submit for approval a site-specific plan for the removal of mercury switches from vehicle scrap, or purchase from a US EPA approved vehicle supplier that removes mercury switches from vehicle scrap, or purchased from vehicle scrap that has been parcelled out in such a manner that specialty alloys have been specifically removed and it is reasonably expected that no mercury switches are present.

Requirements are also stipulated to minimize emissions of other contaminants such as chlorinated plastic, free organic liquids, lead, and polychlorinated biphenyls. A plan must submitted to the US EPA by the facility for approval which ensures that selection and inspection efforts are taken to minimize the amount of chlorinated plastics, free organic liquids, and lead (with the exception of leaded steel) are removed from scrap prior to being melted. Additionally, charging material to the EAF that may contain the above cited contaminants is entirely not permitted, this includes, transformers and capacitors that contain polychlorinated biphenyls, oil filters, engine blocks, machine shop borings, oily turnings.

To control particulate emissions in general, the EAF and AOD at a steelmaking facility must be equipped with a capture system that collects emissions from these devices. Small steel producers which operate at less than 150,000 tons per year must meet a particulate emission intensity of 0.8 pounds per ton of steel produced whereas larger foundries must meet a particualte emission rate of 0.0052 grains per dry standard cubic foot for each EAF and AOD. Finally, their opacity from the melting operations must be maintained below 6 percent.

Reporting and record keeping requirements are also discussed in this rule. Most notably, a notification of compliance status is required for mercury and the other contaminants which must also include performance test to determine compliance with PM and Opacity limits. These records are either sent to the State permitting authority or the US EPA depending on whether the State permitting authority has accepted delegation of this rule.

4.2.4 RACT/BACT/LAER Clearinghouse

Under the US EPA's New Source Review (NSR) program, companies whose emissions exceed a threshold must obtain permits prior to building new plants or modifying an existing plant. The NSR operating permit requires the company to minimize air pollution emissions through process changes and/or pollution control. Permitted emissions vary between facilities depending on factors such as existing emissions and production rate.

- Reasonably Available Control Technology (RACT) is required on existing sources in non-attainment areas (*i.e.,* areas that are not meeting national ambient air quality standards).

- Best Available Control Technology (BACT) is required on major new or modified sources in attainment areas, and represents the maximum emission reduction achievable, taking into account both environmental and economic impacts.

- Lowest Achievable Emission Rate (LAER) is required on major new or modified sources in non-attainment areas, and is the most stringent emission limitation achieved in practice by a source or required in any State Implementation Plan.

BACT and LAER (and sometimes RACT) are determined on a case-by-case basis, usually by State or local permitting agencies. The RACT/BACT/LAER Clearinghouse, RBLC, was established to provide a central database of air pollution technology information (including past RACT, BACT, and LAER decisions[1] contained in NSR permits) to promote the sharing of information among permitting agencies and to aid in future case-by-case determinations. Reporting to the RBLC by state agencies is not mandatory and the geographical distribution of foundries for which reports are available is not even, nor does it match the distribution of foundries reported by US EPA (1998)[2].

[1] That is, determinations made in the context of an NSR permit, for a particular facility, that a control technology represents RACT, BACT or LAER.

[2] The highest geographic concentration of foundry (metal casting) facilities is in the Great Lakes, mid-west, southeast regions and California. The top states by number of facilities are: (1) California, (2) Ohio, (3) Pennsylvania, (4) Michigan, (5) Illinois, (6) Wisconsin, and (7) Indiana.

While the database is not truly representative of the US industry, (*i.e.* a number of important States, California, New York, *etc*., are not represented in the database) there is a wealth of data that could be useful for regulators. The RBLC Database information that can be found for the Iron, Steel and Aluminum Foundries by searching foundry processes listed in categories *81.0 Ferrous Metal Processes* and *82.0 Non-Ferrous Metal Processes* using the RBLC Database Search Engine. It contains useful information on pollutants that are controlled, type of processes that are controlled, types of controls that have been installed, and restrictions applied.

4.2.5 California

In California, industrial emissions are controlled by several air quality management districts, the most important and influential of which are the South Coast Air Quality Management District (SCAQMD) and the Bay Area Air Quality Management District (BAAQMD).

SCAQMD Rule 1407

The SCAQMD has adopted the federal NESHAPs by reference. In 1994, the SCAQMD adopted Rule 1407 Control of Emissions of Arsenic, Cadmium, and Nickel from Non-Ferrous Metal Melting Operations. The Rule applies to all persons who own or operate non-ferrous metal melting operations, including foundries and die-casters. The following are exempt from the Rule:

- facilities that melt only small quantities of metal (<1 tonne/year);
- facilities that do not melt scrap (except clean aluminum scrap or rerun scrap) and melt only pure metal or metal alloy (containing less than 0.004% cadmium and less than 0.002% arsenic);
- furnaces used exclusively to melt clean aluminum scrap or a combination of clean aluminum scrap and ingot to produce extrusion billet;
- the combustion chamber in a reverberatory furnace, if
  - the furnace is used solely to melt aluminum and aluminum based alloys,
  - the furnace is constructed with a charging well or similar device in which feed is added to molten metal in a separate chamber
- ladles, launders or other equipment used to convey aluminum from a melting or holding furnace to casting equipment;
- facilities that emit lead and who have demonstrated 99% or greater control efficiency for particulate matter or 98% or greater for lead pursuant to the requirement of Rule 1420 paragraph (e)(2). and,
- devices used solely to control fugitive emissions.

Under SCAQMD Rule 1407, owners and operators of facilities must meet the following requirements:

- all emission points must be vented to an emission collection system, and ducted to a control device with 99% efficiency in removing particulates;
- the temperature of the gas stream must be ≤360F as it enters the control device (unless 99% efficiency in removal of arsenic and cadmium at higher temperatures can be demonstrated);

- demonstrate good operating practices through a maintenance program and use of measuring devices (or other approved procedures) to maintain air movement and emission collection efficiency;
- fugitive emissions must be controlled to a point where discharges from any activity do not exceed either one half as dark as Shade 1 on the Ringlemann Chart, or 10% opacity for a period aggregating more than 3 minutes/hour;
- dust forming material must be stored in an enclosed area or in a manner that meets the opacity limits;
- particulate matter collected by the control system must be discharged into closed containers or kept in an enclosed system; and,
- surfaces subject to vehicular or foot traffic must be maintained (*e.g.,* by wet mopping or vacuuming) according to an approved housekeeping plan.

The Authority may approve alternate control measures if the owner/operator can demonstrate that the alternate measures are enforceable, achieve equivalent or greater reductions in emissions and risk, and achieve the reduction within the same time period as required by SCAQMD Rule 1407. Owner/operators must also maintain records and keep them on site for at least two years.

BAAQMD Regulation 11, Rule 15
The BAAQMD also adopted a Rule in 1994 to control metal emissions from foundries, the Airborne Toxic Control Measure for Emissions of Toxic Metals from Non-Ferrous Metal Melting (Rule1115). The Rule applies to non-ferrous metal melting furnaces, with exemptions similar to those from SCAQMD. Under BAAQMD Rule 1115, no person shall operate a non-ferrous metal melting furnace unless requirements essentially the same as those from SCAQMD are met.

4.2.6 Wisconsin, Michigan, Pennsylvania, New York

Wisconsin
Two instruments that are applicable to the control of air emissions from foundries from the Wisconsin Department of Natural Resources were identified:

- NR419 Control of Organic Compounds Emissions; and,
- NR448 Control of Beryllium Emissions.

NR419 applies to all sources that emit organic compounds. In general, these emissions must not substantially contribute to the exceeding of an air standard, or cause air pollution. Organic compounds must be handled according to good operating practices and with reasonable care. Additional general requirements relate to the transfer, storage and disposal of organic compounds and to the remediation of soil contaminated with organic compounds. Requirements for facilities manufacturing cores or molds for use at iron or steel foundries that: 1) are located in the counties of Kenosha, Kewaunee, Manitowoc, Milwaukee, Ozaukee, Racine, Sheboygan, Washington or Waukesha; and 2) have maximum theoretical emissions of VOC from core and mold manufacturing of either ≥25 or ≥100 tons/year (depending on the county) are specified. These are:

- the VOC content of any core or mold coating must not exceed 30%, including water, for coatings which have an as purchased density of ≥15.0

lb/gal, or 70%, including water, for coatings which have an as purchased density of <15.0 lb/gal;

- core and mold coating storage vessels must be kept covered; and,
- emissions of organic gases used in the catalysis step in the formation of urethane cold box binders must be controlled with an overall efficiency of ≥90%.

NR448 applies to all sources that emit beryllium. Emissions to the atmosphere of beryllium from foundries may not exceed 10 g over a 24-hour period, and the burning of beryllium or beryllium-containing waste is prohibited.

Michigan

In Michigan, emission limitations and prohibitions are set by the Department of Environmental Quality. The applicable limits are found in Part 3 of the Air Pollution Control Rules titled *Emission Limitations and Prohibitions – Particulate Matter*.

Table 4-2a Michigan Emission Limitations and Prohibitions

Process	**Size**	**Pollutant**	**Emission Limit or Prohibition**
Any process or process equipment		Opacity	20%,6-min. average[a]
Existing ferrous foundry production cupolas	Total plant melt rate 0-10 tonne/hr	PM	0.40 lb/1,000 lb of gas
Existing ferrous foundry jobbing cupolas		PM	0.40 lb/1,000 lb of gas
Electric arc melting at ferrous foundries		PM	0.10 lb/1,000 lb of gas
Sand handling		PM	0.10 lb/1,000 lb of gas
All new ferrous foundry cupolas	Total plant melt rate 0-15 tonne/hr	PM	1.8-0.7[b] lb/tonne of charged material
	Total plant melt rate > 15 tonne/hr	PM	0.7 lb/tonne of charged material
Ferrous cupola located in specified areas	Melting capacity ≥20 tonne/hr	CO	Must be equipped with an afterburner control system (or equivalent) with 90% efficiency in removing CO

[a] Except for a maximum of 27% opacity for one-6 minute period per hour.
[b] Emission limitations for specific size ratings are determined by linear interpolation between the ranges shown.

Pennsylvania

Title 25, Chapter 123, Standards for Contaminants of the Pennsylvania Code sets industrial emission limits for various pollutants. Fugitive emissions of air contaminants are generally prohibited, and all reasonable actions must be taken to prevent particulate matter from becoming airborne. Additional limits are summarized below in Table 4-2b.

Table 4-2b Pennsylvania Emission Limits

Process	Pollutant	Emission Limit
Melting in an iron foundry ($\leq$5 tons/hr)	PM	150 lb/tonne iron [a]
Melting in an iron foundry (>5 tons/hr)	PM	50 lb/tonne iron [a]
Sand handling in an iron foundry	PM	20 lb/tonne sand [a]
Shake-out in an iron foundry	PM	20 lb/tonne sand [a]
Any source	SO_x	500 ppmv, as SO_2
Any source	Opacity	20%, except for periods aggregating <3 min in any hour, up to 60% opacity

[a]Value is a process factor. The emission limit is the greater of 0.02 grains/dscf of effluent gas, or the result of the calculation $0.76(F \times W)^{0.42}$ where F is the process factor and W is the production or charging rate in units/hour.

New York

In New York State, air emissions from foundries are controlled by Part 213, Contaminant Emissions from Ferrous Jobbing Foundries. Particulate emissions are limited according to process weight, ranging from 3.05 lb PM/hr for a process weight of 1,000 lb/hr, to 42.40 lb PM/hr for a process weight of 50,000 lb/hr (unless a collecting efficiency of 80% can be demonstrated).

4.3 Review of European Requirements

4.3.1 European Union

The latest European Commission's Best Available Techniques (BAT) Reference Document (BREF) for Smitheries and Foundries is the result of an exchange of information between European Union (EU) Member States and the FIS on best available techniques (BAT) to reduce air emissions by using associated monitoring techniques in conjunction with other developments. Published in 2004, the BREF discusses foundry processes, identifies BAT for each process step, and suggests emission levels that are associated with the use of BAT. According to the Council Directive on Integrated Pollution Prevention and Control (96/61/EC), competent authorities within the EU may grant or amend a permit only where integrated environmental protection measures for air, water and land have been used. Such permits should contain emission limit values, parameters or equivalent technical measures based on BAT. The BREF must be taken into account when determining BAT. However, the BREF does not set or propose emission limit values.

The BREF states that it includes limited detail on non-ferrous foundries as only limited information on these operations was received. It also lists the following areas for future work: techniques for VOC abatement, waste water treatment, melting of non-ferrous metals, and economic data for BAT techniques.

The generic BAT elements that apply for all foundries, regardless of the processes used and products produced are:

- optimize the management and control of internal flows, in order to prevent pollution, prevent deterioration, provide adequate input quality, allow recycling and reuse, and to improve the process efficiency;
- for dust-generating finishing techniques, collect and treat the finishing off-gas using a wet or dry system;
- for heat-treatment techniques, use clean fuels, automated furnace operation and burner/heater control, and also to capture and evacuate exhaust gas;
- develop and implement a noise reduction strategy;
- implement waste water management, including prevention, separation, maximizing internal recycling, and treatment;
- use material handling and transport measures to minimize fugitive emissions, and optimize exhaust gas capture and cleaning;
- implement and adhere to an Environmental Management System; and,
- apply all necessary measures to prevent pollution upon decommissioning.

The following BAT elements apply to ferrous metal melting:

- for the operation of cupola furnaces, collect, cool and dedust the off-gas, and apply post combustion and heat recovery under specific conditions;
- for cupola furnaces, implement residue management, including minimizing slag formation, pretreating slags to allow external re-use, and collecting and recycling coke breeze;
- for the operation of electric arc furnaces, apply reliable and efficient process controls to shorten melting and treatment time, use the foamy slag process, efficiently capture furnace off-gas, cool furnace off-gas, dedust using a bag filter, and recycle filter dust into the furnace;
- for the operation of induction furnaces, melt clean scrap, use good practice measures for the charging and operation of the furnace, use medium frequency power, evaluate the possibility of waste heat recuperation and implement if appropriate;
- for exhaust gas capture and treatment from induction furnaces, use a hood, lip extraction or cover extraction on each furnace to capture the furnace off-gas and maximize the off-gas collection during the full working cycle, use dry flue-gas cleaning, and keep dust emissions below 0.2 kg/tonne molten iron;
- for the operation of rotary furnaces, implement a combination of measures to optimize furnace yield, use an oxyburner, collect the off-gas close to the furnace exit, apply post combustion, cool it using a heat-exchanger and apply dry dedusting;

- for the prevention and minimization of PCDD/F emissions from the operation of rotary furnaces, use a combination of specified measures;
- collect the exhaust gas from argon oxygen decarburization (AOD) converters using a roof canopy, collect and treat the off-gas from nodularization using a bag filter; and,
- make MgO dust available for recycling.

The following BAT elements apply to non-ferrous metal melting:

- for the operation of induction furnaces for melting Al, Cu, Pb and Zn, use good practice measures for charging and operation, use medium frequency power, evaluate the possibility of waste heat recuperation and implement if appropriate;
- for exhaust capture from induction furnaces for melting Al, Cu, Pb and Zn, minimize emissions, collect off-gas if needed, maximize off-gas collection during the full working cycle and apply dry flue-gas cleaning;
- for other furnace types, efficiently collect furnace off-gas and/or reduce fugitive emissions;
- for Al metal treatment, use an impeller station for degassing and cleaning;
- for Mg melting in large plants (≥500 tonnes of parts output/year), use SO2 as a covering gas; and,
- for Mg melting in small plants (<500 tonnes of parts output/year), use SO2 as a covering gas, or minimize the use of SF6 (consumption levels of <0.9 kg/tonne casting for sand casting and <1.5 kg/tonne casting for pressure die-casting).

The following BAT elements apply to lost mold casting:

- for green sand preparation, apply a primary regeneration of green sand (regeneration ratios of 98% for monosand or 90 to 94% for green sand with incompatible cores);
- for chemically-bonded sand, minimize binder and resin consumption and losses, minimize fugitive VOC emissions by capturing the exhaust gas from core-making and core handling, and use water-based coatings (or alcohol-based coatings, in specific applications where water-based coatings cannot be used, provided that exhaust is captured at the coating stand where feasible);
- for amine-hardened urethane-bonded (*i.e.,* cold-box) core preparation, minimize amine emissions and optimize amine recovery, use aromatic or non-aromatic solvents and minimize the amount of sand going to disposal, primarily by adopting a strategy of regeneration and/or reuse of chemically-bonded sand (as mixed or monosand; and,
- for pouring, cooling and shake-out, enclose serial pouring and cooling lines and provide exhaust extraction, enclose the shake-out equipment and treat exhaust gas using wet or dry dedusting for chemically-bonded

sand preparation, enclose the de-coring unit, treat the exhaust gas using wet or dry dedusting, and make the sand from de-coring available for recycling if a local market exists.

Table 4-3 Emission Levels Associated with BAT Measures Identified Activity Type

Activity	**Type**	**Parameter**	**Emission Level (mg/m^3)[a]**
Finishing of Castings	General	Dust	5 to 20
Ferrous metal melting	General	Dust[b] PCDD/F	5 to 20 ≤ 0.1 ng TEQ/Nm^3
	Hot blast cupola	CO SO_2 NO_x	20 to 1,000 20 to 100 10 to 200
	Cold blast cupola	SO_2 NO_x Non-methane VOC	100 to 400 20 to 70 10 to 20
	Cokeless cupola	NO_x	160 to 400
	Electric arc furnace	NO_x CO	10 to 50 200
	Rotary furnace	SO_2 NO_x CO	70 to 130 50 to 250 20 to 30
Non-ferrous metal melting	General	Dust	1 to 20
	Aluminum melting	Chlorine	3
	Shaft furnace for Al	SO_2 NO_x CO VOC	30 to 50 120 150 100 to 150
	Hearth type furnace for Al	SO_2 NO_x CO TOC	15 50 5 5
Molding and casting using lost molds	General	Dust	5 to 20
	Core shop	Amine	5
	Regeneration units	SO_2 NO_x	120 150
Permanent mold casting	General	Dust Oil mist[c]	5 to 20 5 to 10

[a] Normal cubic metres of gas, *i.e.*, the quantity of dry gas that occupies a volume of 1 m^3, at standard temperature and pressure (273 K and 101.3 kPa).
[b] The emission level of dust depends on the dust components (ie heavy metals, PCDD/F) and mass flow.
[c] Oil mist measured as total carbon.

4.3.2 United Kingdom

Emissions limits for the U.K. foundry sector as a whole were not identified, with the exception of a requirement under the Clean Air Act. In place of a regulation setting emission limits, air pollution from foundries is controlled on a site-by-site basis through various licensing processes. Under the Environmental Protection Act of 1990 and its regulations, foundries are "prescribed processes" and must be licensed by the appropriate regulatory body (the Environment Agency/Scottish Environment Protection Agency (SEPA) for larger operations, or the local authority/SEPA for smaller operations). Such licenses include site-specific emission limit values.

The Pollution Prevention and Control Act of 1999, provides the primary legislation for implementation of the EU Council Directive on Integrated Pollution Prevention (96/61/EC), and replaces the licensing process for larger "prescribed processes" required under the Environmental Protection Act (1990). As such, Pollution Prevention and Control licences are required to replace licenses under the Environmental Protection Act and are based on BAT.

Additional requirements are imposed on foundries by the 1993 Clean Air Act and the 1997 Air Quality Regulations. Under the Clean Air Act, any new heating boilers installed at foundries must be capable of operating continuously without emitting smoke. Burning of waste on site is prohibited under the Clean Air Act. The Air Quality Regulations are intended to control PM, sulphur dioxide, nitrogen oxides, carbon monoxide, lead, benzene and butadiene, by giving the authorities the power to restrict emission sources where pollution problems relating to these seven substances arise. Foundries must be prepared to provide release estimates for each of these substances, and chimneys should be high enough to ensure dispersion of the pollutants such that ground-level air quality standards are met. Also under the Environmental Protection Act, foundries must meet their "Duty of Care" obligations in regards to their waste management.

5.0 TECHNICAL METHODS TO REDUCE EMISSIONS FROM ADDITIONAL SOURCES

5.1 Identification of Technically Feasible Methods

Add-on controls, material substitution, and process change are different types of methods which may be employed, either in isolation or in combination, for the development of an air pollution control strategy. Each method will be considered as they may be applied to the newly addressed sources which are now part of the amended FIS and are described in this rationale report.

5.2 Material Substitution

Material substitution is a technical method that identifies how to substitute ingredients that would emit a particular contaminant downstream in the process (e.g. using a non-lead alloy, and therefore removing lead and the resulting lead emissions from the process).

In some cases, material substitution may not require substantial changes, and may be implemented with relative ease as compared to other methods. Material substitution may be the most effective option from an environmental point of view. However, material substitution is not always an option as product quality may be compromised through the implementation of such changes.

Spray Operations – There are a wide variety of products available for spraying operations, and it may be possible to substitute coatings currently used for low volatile organic compound (VOC) coatings, where applicable. However, price and availability may not make this option viable.

Thermal Sand Reclamation – Material substitution is not typically applicable to this type of process. However, if a foundry were to eliminate the use of chlorinated or fluorinated binder the potential for certain hazardous and acidic gas emissions would be removed entirely. Again, the price and technical feasibility of this option may not be viable.

EAF / AOD – Material substitution is not typically applicable to this type of air pollution control method. However, the emissions from an EAF can be directly related to the quality of scrap used. If a foundry were to eliminate the use of hazardous material-containing scrap metal (e.g. eliminate the of use automobile scrap containing mercury switches), hazardous emissions would be significantly reduced.

Table 5-2: Summary of Material Substitution Options Available

	Material Substitution
Spray Operations	Low VOC coatings
Thermal Sand Reclaimer	Use binder that does not contain chlorides or fluorides
EAF / AOD	Reduce hazardous materials from scrap before melting

5.3 Process Change

Process change is a technical method that is achieved through the incorporation of a new process step or the alteration of an existing process step prior to the finished product which results in an environmental benefit.

Spray Operations – Emissions from spray operations can be reduced through switching to a high efficiency applicator. For example, using a high volume low pressure (HVLP) spray gun helps reduce the amount of paint used. Confining all spray operations to a dedicated, ventilated room (e.g. spray booth), and the use of dry filters pads would also help capture overspray. Minimizing the amount of coating also reduces the VOC emission rate.

Thermal Sand Reclamation – Hazardous emissions can be avoided if this equipment is operated at a sufficiently high temperature and gas residence time in order to achieve appropriate thermal destruction efficiency. The thermal destruction efficiency depends on the substrates used to bind the sand into a mold.

EAF / AOD – Process change is not applicable to this process / equipment.

Table 5-3: Summary of Process/Equipment Change Options Available

Spray Operations	Use HVLP spray gun, dry filters, dedicated spraying room.
Thermal Sand Reclaimer	Operate thermal sand reclaimer with a suitably high internal combustion temperature depending on the residence time and substrates in the sand.
EAF / AOD	N/A

5.4 Add-on Controls

This method refers to an air pollution control device installed in series after a process.

Spray Operations - For spray operations greater than one litre per minute, the impact of the pollutants are lessened by using an enclosed spray booth with arrest filters. Proper dispersion of coating emissions (i.e. exhausted through a vertical unimpeded exhaust stack at an exhaust flow rate of no less than 12 meters per second) can also assist in reducing the off-property impact. It may also be beneficial to use dry arrest filters to capture overspray. There are many add-on controls available to control VOC emissions (e.g. thermal oxidation), but due to the intermittent usage, and costs associated with the add-on controls, this option is typically not economical.

Thermal Sand Reclamation – Add-on controls are needed when chlorinated or fluorinated sand is recovered by heating which may emit hazardous emissions and acid gases. An afterburner can be incorporated that increases the temperature of the exhaust to at least 870 degree Celsius and up to 1200 degrees Celsius where needed. This approach is consistent with Environmental Compliance Approvals issued for Thermal Sand Reclaimers recovering sand that was formerly binded chlorinated or fluorinated species. In the event that 1200 degrees Celsius is not feasible, the lower value of 870 degrees Celsius in addition to a lime scrubber is required. Both of the above noted pathways must include a baghouse before the exhaust streams is released to air to capture SPM.

EAF / AOD - Emissions from EAFs and AODs are typically captured by a primary exhaust hood which is directed to a baghouse before discharge. There are other SPM control equipment, such as electrostatic precipitators, that can be used; however, baghouses are most common.

In some cases, secondary ventilation hooding (directed to a baghouse) is also constructed in the form of a larger canopy hood over the EAF / AOD area which captures emissions that escape the primary hooding, especially during charging and tapping processes. This type of secondary capture is beneficial when the primary ventilation is insufficient, otherwise, a secondary canopy could be needlessly drawing in large volumes of relatively low fume bearing air. Secondary capture is suitable to capture the intermittent emissions when the primary ventilation control is overwhelmed. However, secondary capture is not always cost effective.

Table 5-4: Summary of Add-On Controls Options Available

Spray Operations	Ventilated fume hood with arrest filters to capture overspray exhausting to a vertical unimpeded stack at a rate of at least 12 meters per second.
Thermal Sand Reclaimers	For chlorinated or fluorinated sand, hazardous and acidic emissions are addressed with an afterburner, possibly a lime scrubber, followed by a baghouse to capture residual SPM.
EAF / AOD	Primary local exhaust capture which direct fumes and particulate to a baghouse.

The following sub-chapters discuss one process changes and two add-on controls. The add-on controls were developed by information received during the comment period.

5.5 Mold Vent Gas Light-Off

In researching the impact from foundry operations, benzene emissions were identified resulting from the degradation of binding substrates in green sand. When molten metal is poured into a green sand mold made with sea coal, the sand is subjected to intense heat which decomposes the saturated organic chemicals naturally found in sea coal into their chemical constituents. This causes emissions of VOCs which normally auto-ignite and can be seen flaring where the metal is being poured. Most molds auto-ignite during pouring. However, this does not always occur. As such, the United States Environmental Protection Agency (US EPA) "Maximum Achievable Control Technology" rule for iron and steel foundries requires "Mold Vent Light-Off", which requires operators to develop procedures to ignite mold vents during pouring when spontaneous ignition does not occur. As a result, the use of "mold vent gas light-off or flaring" is included as an option as part of the analysis to minimizing VOCs in Section 12 (3) of the FIS.

5.6 Aluminum Reverberatory Furnaces – Scrap Metal Requirements-NEW!

A new requirement has been developed and included for reverberatory furnaces. The requirement is scoped to when *scrap aluminum* is used in charging the furnace. If certain criteria are met (reverberatory furnace, aluminum, and scrap) then the requirement is to capture and convey these fumes by means of a baghouse. This requirement was designed as a minimum requirement that is important when reverbatory furnaces are being charged with scrap. Scrap metal may have a higher likelihood of introducing other non-metal residues in the metal that give rise to greater SPM emissions than aluminum ingots. Hence, a requirement for the capture and conveyance of these fumes to a baghouse was deemed reasonable. For more details, see section 10.9 of the amended FIS.

5.7 Torch Cutting Metal for Charging Furnace Requirements-NEW!

Torch cutting operations are inherently a source of emissions due to the intense heat of the torch. In particular, this rule is scoped to a practice associated with charging the furnace that may be carried out at a rate that reflects a regular operation. Hence, when torch cutting is employed for the preparation of metal to be used for charging a furnace, the emissions must be captured and conveyed to a baghouse. For more details, see section 10.8 of the amended FIS.

6.0 OVERVIEW OF ADDITIONAL REQUIREMENTS

This chapter provides additional details pertaining to the types of emissions which warrant significant additional measures. If there is a conflict between these details of this rationale document and the FIS amendments, the FIS amendments will prevail. See also Appendix A of this document for further information.

FIS now includes new controls for three additional sources which may be occurring at a substantive frequency or have the potential to cause significant or hazardous emissions. These sources are not necessarily common to the sector at this time, but if they are present, they must be controlled so as to mitigate the environmental risk. The sources that have been identified for inclusion in the amendment to the FIS are: (1) Liquid Spray Coating Process, (2) Thermal Sand Reclamation (TSR) Equipment, (3) Electric Arc Furnaces (EAF) and/or Argon Oxygen Decarburizers (AOD).

Liquid spray coating applications (also referred to as spray operations) are common in the foundry sector for a variety of applications from facilitating mold release to customized painting for aesthetic appeal. TSRs are more common and also used to recover sand that contains chlorinated or fluorinated substrates. EAFs and AODs are typically applicable to iron and steel foundries and need control due to their potential to generate significant amounts of SPM and associated metals. Torch cutting for furnace charging and scrap metal in aluminum reverberatory furnaces were recently discovered activities during the comment period, however may pose significant emissions and needed to be addressed. All of the above noted sources are included in the FIS amendment and are accompanied by specific air pollution control requirements and are further discussed below.

6.1 Liquid Spray Coating Process

Spray operations in the foundry sector are often employed to either coat a sand mold (binders, release agents, etc.), or to coat a finished product (anti-rust, paint, etc.). For example, molds are sprayed with a silicon finish to facilitate the release of castings, and some custom orders require the application of a rust inhibitor on the finished product. In smaller operations, coatings can be applied using spray cans, whereas larger operations typically occur in dedicated spray booths equipped with mist arrestors and an exhaust stack. Due to the potential savings in cost, coatings are sometimes applied using High Volume Low Pressure (HVLP) spray guns. In the amendment to the FIS, liquid spray coating processes are included in a new section (see FIS section 10.6). However, the appropriate emission controls for coating operations are only triggered for spray applications that are carried out at a rate that is greater than one litre per hour. This approach was chosen to include those facilities that should require a dedicated spray booth or that spray on a more regular basis and over longer periods of time, while not inadvertently capturing smaller incidental coating application activities (e.g. the use of spray cans).

These requirements for spray operations are similar to those that would have otherwise been required in other compliance instruments issued by the ministry for paint spray booths. The liquid coating application process will require the use of HVLP spray guns, be equipped with spray arrestors and exhaust through an unimpeded stack that discharges at a velocity of at least 12 meters per second.

There are other add-on controls available to control VOC emissions (e.g. thermal oxidation), but due to the intermittent usage and high capital cost, these types of add-on controls are not cost effective for this sector.

It should also be noted that section 12 of the FIS “Operational Practices – minimization of VOCs” aims to address sources of VOCs from liquid spray coating process. The amendment includes liquid spray coating processes in the list of applicable activities for which operators must develop written procedures to minimize their discharge and odour impacts. Furthermore, the use of low VOC coatings is included as a technology to potentially address odour impacts. For more details, see section 12 of the FIS amendments.

6.2 Thermal Sand Reclamation (Chlorinated/Fluorinated Sand)

The foundry sector uses heat-based equipment such as ovens and autoclaves for a variety of applications. This equipment is used for preheating raw materials, preparing surfaces for painting, heat-treating finished products, reclaiming sand, and to drive off residual oil and moisture from scrap metal prior to melting. The air emissions from such activities are often not significant in comparison, and hence do not likely require a rule on a sector basis. However, unlike heat-treating ovens which may simply be used to anneal or destress castings, thermal sand reclamation can, in some cases, result in hazardous emissions and thus warrants greater attention.

Reclaiming spent sand which was bound with fluorinated or chlorinated compounds by the application of heat requires an afterburner with an elevated temperature of 1200 degrees Celsius. Alternatively, the afterburner operating temperature may be as low as 870 degree Celsius provided that a lime scrubber is also used. However, in both cases a baghouse is required. For more details, see section 10.1 of the FIS amendments.

During the public comment period, the following questions were posed. Below are responses to these questions. See also chapter 7 for highlights of other comments and ministry responses.

QUESTION 6.2A: The ministry is seeking input on the requirement to install a baghouse following an afterburner which is operating at the elevated temperature of 1200^{o}C. In particular, the ministry would like to gain a better understanding on the availability and cost-effectiveness of high temperature filter bags that would need to be installed in this control scheme.

RESPONSE to Question 6.2A: No comments received.

QUESTION 6.2B: The ministry is seeking input on the requirement set out in section 10.1 of the FIS including the minimum temperature 870^{o}C.

RESPONSE to Question 6.2B: Discussions with the foundry sector during the comment period revealed that in some cases the minimum temperature of 870^{o}C was not technically feasible. New provisions have been included to allow the director to permit the use of a lower temperature in some cases.

Furthermore, subsequent discussions with a Thermal Sand Reclamation manufacturer determined that the exhaust gases are subject to a high residence time inherent in the design of this equipment. Hence, this equipment is capable of sufficiently combusting VOCs and the installation of an additional dedicated afterburner is not required.

6.3 Electric Arc Furnace and Argon Oxygen Decarburizer

EAFs are used to melt very large quantities of scrap metal using electricity to form an intense arc. Refinement of the molten metal then occurs in the AOD by reducing the carbon in molten iron by blowing argon, oxygen or nitrogen from a lance or submerged tuyeres. EAFs and AODs are not commonly used in the foundry sector. They are usually found in non-integrated mini-mills or ferrous foundries that make large castings in large quantities. Nevertheless, they are included in the FIS because this type of melt furnace may potentially generate significant sources of SPM emissions.

In the amendment to the FIS, EAFs and AODs are included, and will now require primary exhaust ventilation connected to a baghouse. Primary ventilation for these devices is crucial to mitigate significant emissions of SPM during steady state operations and to some extent during intermittent operations such as charging and blowing. This rule is consistent with a review of existing controls permitted in Ontario in this sector. The new requirements will ensure registered facilities with any new EAFs or AODs installed will have the same level of control.

It is noted in the final rule for the US EPA's NESHAP for Iron and Steel foundries that foundries are to minimize, to the extent possible, scrap being charged in the electric arc furnace that would cause increased emissions of HAPs. If a foundry were to eliminate the use of hazardous material-containing scrap metal, hazardous emissions would be significantly reduced. This is consistent section 3 of the FIS which requires a written procedure be developed by the facilities to reduce emissions of all priority metals where possible. As such, this requirement is now applicable to EAFs and AODs at Foundries who are registered, to the FIS for relevant contaminants. For more details, see section 10.7 of the amended FIS.

6.4 New Contaminants for Registration in FIS

Originally, there were 111 contaminants available for registration in the FIS. A new list of totaling 306 contaminants has been compiled. The list has been categorized in eight appendices located at the end of the amended FIS. The eight *List of Contaminants* appendices are categorized according the type of air emission and associated control as follows:

Appendix 1: All Contaminants
Appendix 2: Priority Metals
Appendix 3: Suspended Particulate Matter
Appendix 4: Volatile Organic Compounds
Appendix 5: Hydrogen Chloride and Fluorides (as HF)
Appendix 6: Total Amines
Appendix 7: Sulphur Dioxide
Appendix 8: Lead and Lead Compounds

The type of activities that are carried out at foundries is very well understood and appropriate emission control for most sources typically involves the use of fume capture via local ventilation followed by a baghouse or other SPM control device. Fugitive emissions may also be reduced through improved housekeeping and pollution prevention activities. If a facility registers under the FIS and meets the requirements, the facility is essentially following the required best practices. Furthermore, the new rule in section 17 titled, *Requirement to Continue the Management of Sources*, ensures, that if a source is currently controlled, for example with an air pollution control device, this practice must continue.

Finally, the registration of all of a foundry's contaminants could eliminate the need for an annual ESDM report thereby reducing the regulatory burden for these small to medium sized enterprises. This is consistent with the preamble of the technical standard which states:

> "*In accordance with 38(3) of O.Reg.419/05, compliance with this industry standard in accordance with subsection 42(5) or subsection 44(3) may reduce the regulatory burden applicable to facilities in this class.*"

6.5 Addition of Beryllium to Priority Metals

Beryllium has been added to the list of contaminants denoted as 'priority metals' in the updated FIS. As such, beryllium would be categorized as a priority metal in addition to lead, chromium (including hexa-, di-, and tri-valent), cadmium, manganese, nickel, arsenic, mercury, and vanadium compounds. The impact of this change is that beryllium will now be considered under section 3 of the FIS "Reduction of Priority Metals". Therefore, "for each raw material that contains a priority metal that is a registered contaminant, the owner and operator of the foundry shall ensure that a written procedure is developed and implemented to reduce, where feasible, the weight percent of the priority metal in the raw materials and related products". In some applications, beryllium is cast with copper to manufacture non-static charging tools and is required for its electrically insulating property. For more details, see section 3 of the amended FIS.

6.6 Foundries located in Multi-Tenant Buildings

New requirements are being included to help ensure that foundries operating in multi-tenant building (i.e. buildings which also house commercial or industrial tenants that have no business relationship with the foundry) do not impact the non-foundry related tenants through the air make up unit supply air ducts.

Subsequent discussions with the foundry sector have changed the originally drafted rule. These changes are expressed in the response below. For more details, see section 5.5 of the FIS amendments.

During the public comment period, the following question was posed. Below is the response to the question. See also chapter 7 for highlights of other comments and ministry responses.

QUESTION 6.6 A: The ministry is seeking input on multi-tenant requirements in section 5.5 of the FIS and other possible methods for reducing impacts from foundries in multi-tenant buildings.

RESPONSE to Question 6.6A: Further discussions with the foundry sector during the FIS comment period determined that this section could be simplified and made more protective. The new requirement for foundries that operate in multi-tenant buildings is a semi-annual filter change for the air make up units that supply air to the non-foundry tenants and on an annual basis clean all ducts that supply air to the non-foundry tenants. These requirements are limited to only the air supply equipment that is associated with non-foundry related tenants and may requires permission from the tenant or landlord for entry into the rental unit.

6.7 Change Management: Ventilation

Portions of section 17 of the original version of the FIS, titled *Change Management-SPM, VOCs, and Sulphur Dioxide*, such as section 17(3), (4) and (5), have been incorporated in section 5.4 of the FIS titled, Change Management - *Proposed Changes to Ventilation*.

This section continues to apply to sources of SPM, VOCs, and sulphur dioxide from metal melting, furnace tapping, metal molten pouring, casting cooling, finishing, sand reclamation, materials handling, mold and core production, and shakeout processes. However, the requirements are now generalized with no specific reference to foundry processes. This method of managing changes to a foundry's ventilation systems helps ensure that any proposed changes will not have a detrimental effect on the system's performance. The requirement to assess the impacts from changes to a ventilation system has been preserved and expanded in the amended version of the FIS based on work conducted at three Ontario foundries during the 2011 implementation pilot project.

Proposed changes to the ventilation are subject to the change management requirements. The proposed change is recorded and subject to an evaluation of the possible impacts on the ventilation system's capability to capture contaminants under anticipated operating scenarios.

The evaluation of the impact of the proposed change to the ventilation system includes an assessment of disturbances to the balance of volumetric flow rates entering and exiting the enclosed area in which the ventilation system and anticipated change is located. The evaluation may also include information such as an analysis of volumetric flow rates or an analysis of building differential pressures.

Most importantly, if an evaluation indicates that the capture of the ventilation system would be reduced a record of the proposed change to the ventilation system may not be implemented without a written record indicating that the highest-ranking individual at the foundry facility has reviewed the proposal. However, changes that result in reduced capture of fumes are subject to the requirement to continue the management of sources rule. For more details, see section 5.4, 17.1, and 17.2(2) of the amended FIS.

The broader objective of this section is to ensure that prior to implementing ventilation changes the foundry operators determine if they have adequate capacity in that system. This particular consideration is related to a building's air balance, the difference in volume of the air exiting and entering a building, and relevant to combustion devices that are equipped with fans. Multiple changes of this nature can progressively undermine the fume capturing capabilities of the local exhaust ventilation.

As such, the rule is broader and specifies that all ventilation systems in a foundry must be assessed because a new make-up air system could change the building pressure from negative to positive or the addition of a new grinding station with local exhaust ventilation to an existing system may reduce the system's capture efficiency. Understanding there are limited resources, an exception has been included so that changes of flow which are not greater than five percent of the difference between the incoming and outgoing air from a building are not assessed. Such changes would not need to be evaluated to determine their effect on ventilations systems operating in the vicinity.

In addition, many small combustion devices like ladle heaters, unit heaters, and dock door heaters emit oxides of nitrogen but move negligible volumes of air. As such, an evaluation of the potential for small combustion devices to affect the ventilation system at foundry is not warranted. For more details, see section 5.4(5) of the amended FIS.

During the public comment period, the following question was posed. Below is the response to the question. See also chapter 7 for highlights of other comments and ministry responses.

QUESTION 6.7 A: The ministry is proposing to allow an exception to the requirement to evaluate the impacts of changes to a ventilation system before implementation. For details, see subsection 5.4(5) of the amended FIS.

RESPONSE to Question 6.7A: No comments were received regarding the above noted provision in subsection 5.4(5). However, a new provision has been included which allows for the use of electronic building pressure monitors instead of preparing a volumetric flow table. See chapter 6.10 for more details.

6.8 Outdoor Activities: Requirement to Maintain Written Record

For a variety of operational or logistical reason, a foundry may need to carry out fume and SPM generating activities outside. This may occur for a high volume production order where cooling and recovery of castings cannot be done inside within the allotted indoor work space and thus may need to be done outside.

New requirements are included to mitigate the impact of outdoor activities. For example, a written log of outdoor activities is required for registered foundries which would include the date, time, and particulate mitigation efforts employed. This date-stamped log will be available for inspection to help determine if a complaint may be associated with an outdoor activity.

In addition, this requirement has been modified to address the main activities that may occur outdoors and give rise to consider air emissions of SPM. The activities that are specifically addressed in this requirement are: molten metal pouring, casting cooling within a mold, mold breakout, and casting finishing operations.

If any of the aforementioned activities are conducted outdoors, a written procedure must be developed and implemented to minimize the discharge of SPM. The written procedures are not required for foundries that have instead adopted the use of a three sided enclosure with a roof. For more details, see section 4.1 of the amended FIS.

6.9 Air Pollution Control-Requirement to Continue-NEW!

A new section (section 17 of the FIS) has been added to the FIS to ensure that any air pollution control device or other technical method that was formerly approved as part of an Environmental Compliance Approval are not removed from service. These activities which are controlled are now referred to as *Managed Sources*. This requirement includes the preparation of a table which records all of the air pollution control or methods, including the local exhaust ventilation, available at a foundry at the time of registration. The table should list each source present at the foundry that discharges a contaminant for which the foundry has been registered. Adjacent to the list of sources, the foundry must indicate each corresponding local exhaust ventilation system and general ventilation associated with the source. Finally, the air pollution control equipment or operational practices that are employed to mitigate the discharge of a registered contaminant from the source would also be recorded. For more information, please see section 17 of the amended FIS.

6.10 Building Differential Pressure Monitor-NEW!

The amendments include the ability for a registered facility to choose to use electronic building differential pressure monitoring devices as part of the ventilation program instead of the preparation of preparing a volumetric flow table. The use of a building differential pressure monitor is useful in understanding when a building becomes positively pressured and when it may be negatively pressured. The ventilation program originally required the preparation of a volumetric flow table of the air in and out from a building which was used to indicate whether a foundry was operating at a slightly negative pressure. However, an option has been included for registered facilities to use of a building differential pressure monitor to measure this value. This information can also be used when proposed changes to the local ventilation system are being considered.

The requirement to maintain negative pressure in the melting and pouring areas is still only applicable to *non-ferrous foundries that use lead* and are registered for lead and lead compounds. If the building differential pressure is monitored, it will be assessed over a 30-minute block average. If more than one block average indicates a positive pressure, notification and action is required. For more information please refer to section 7 of the amended FIS.

Foundries that are not required to operate their melting and pouring areas at negative pressure may also use a building differential pressure monitor to assess if values are positive. Similar to the volumetric flow tables, this information may be used to determine how to improve the building pressure if the building pressure monitor indicates that they are positively pressured.

6.11 Notice Authority for Director to Require Ventilation Assessment-NEW!

This amendment allows for a Director to require the preparation of a ventilation assessment with respect to a ventilation system associated with a particular area of a foundry that may not be operating effectively.

The Director may give such notice to a foundry if two or more complaints related to a matter addressed in the FIS are made within 12 months, or if an area of the foundry that contains melting or pouring areas is not likely operating at negative pressure, or a static pressure measurement associated with local exhaust ventilation is outside of the normal operating range cited in the Operating Parameter Summary Table.

The requirement for a ventilation assessment by the means of such a notice may be issued to any foundry regardless of the type. Additionally, it is important to have this ability to identify and address possible deficiencies. The type of assessment required by this notice would be similar to the ventilation requirements for non-ferrous foundries that use lead. It would likely include gathering appropriate ventilation data such as face and duct velocity in order to determine the efficacy of the local exhaust ventilation system.

7.0 PUBLIC CONSULTATION

The foundry sector is comprised of mostly small to medium sized businesses that are generally located in southern Ontario. Therefore, the ministry is taking a more generalized approach to engagement and consultation on this proposal.

Similar to other technical standards, the ministry used a technical committee with members from the Canadian Foundry Association (CFA) and ministry staff to engage the sector on various technical questions regarding contaminants, processes and environmental methods to better control or manage emissions. Meetings were held between 2012 and 2014. It is also our understanding that CFA conducted outreach with its Ontario membership regarding the proposed updates to the FIS.

The ministry also participates on the Air Standards/Local Air Quality External Working Group (EWG) which includes members from various industry sectors, public health agencies, environmental non-governmental organizations and some First Nations. The EWG provides general feedback and recommendations to the ministry on issues related to the Local Air Quality Regulation (O.Reg.419/05). Status updates were given to the EWG regarding the development of proposed updates to the FIS. Input from the EWG is at a general program level. In addition, every application for registration to a technical standard is posted on the Environmental Bill of Rights Environmental Registry (EBR) for public comment. In some cases, enhanced public outreach may be requested.

The proposed amendments were posted for a 60 day public comment period from May 19, 2015 to July 18, 2015 (see EBR # 012-3538). In June 2015, the ministry held another stakeholder consultation meeting in Toronto and by teleconference by means of the EWG forum. This meeting was attended by industry, public health and environmental organizations and provided an opportunity for stakeholders to provide comments and ask questions of government representatives. Additional meetings were also held with the Canadian Foundry Association.

Two comments were received: one (1) from industry and one (1) from public health.
In addition, in June 2015, the ministry hosted a stakeholder meeting which included industry, public health units and environmental non-government organizations. An overview of the proposed Foundries – Industry Standard was provided with an opportunity for stakeholders to provide comments and ask questions of the ministry.

1. Eliminating the requirement for an Emission Summary and Dispersion Modelling (ESDM) report for a larger number of contaminants

Comment: Concerned with the availability of a large number of contaminants to which prospective applicants may register and that those contaminants would no longer be evaluated via an Emission Summary and Dispersion Modelling (ESDM) report.

Response: The technical standard can reduce regulatory burden by not requiring ESDM reports. If a foundry is registered for all the contaminants it emits, they would no longer need to have an ESDM report. The ministry has maintained the authority to request an ESDM report (under section 24 of the regulation) at any time, if warranted.

It is important to understand that under the FIS, actions taken to reduce emission of contaminants such as suspended particulate matter will have the co-benefit of reducing other contaminants like chromium and chromium compounds (metallic, divalent and trivalent), lead and lead compounds, manganese and manganese compounds, and nickel and nickel compounds as well. If these sources are being better controlled, the need for an ESDM report is diminished. The money that would have been spent to update these reports annually could be redirected to complying with the technical standard requirements and reducing emissions.

Additionally, the ministry continues to seek out better information on emissions data.

2. Industry clarification on various requirements

Comment: Industry requested clarification on various technical aspects of the proposal. However, in general, industry representatives support the sector-based approach and some see it as a way to reallocate resources to prevention and process improvement.

Response: The ministry considered industry's comments on the FIS which is intended to focus on the prevention of pollution through technical requirements such as operational and management practices and pollution control technologies. One recommendation from the foundry sector was to reevaluate the validity of the proposed rules pertaining to the installation of an afterburner when foundries are recycling used sand. Subsequent discussions with a manufacturer of sand reclamation devices revealed that this rule was not practical since the sand reclamation device has a suitably high operating temperature and adequate residence time for the safe combustion of volatile organic compounds.

3. Building Differential Pressure

Comment: Adding an alternative approach to assess building differential pressure.

Response: Most foundries use a table of volumetric air flows into and out of the building to assess building differential pressure. FIS will now have the same options as the Metal Finishers – Industry Standard which includes the following two options:
To prepare and update a table of volumetric air flows into and out of the building; or
To take and record measurements of building differential pressure in 30 minute block averages.

4. Facilities should be required to demonstrate continuous improvement over time

Comment: The ministry should include a mechanism to assess continuous improvement over time.

Response: More stringent requirements are included for new facilities and facilities that undergo a major modification. This approach will ensure continuous improvements over time.

A technical standard can also be updated if new cost-effective technology becomes available in the future. The ministry is currently considering when and how to ensure technical standards in general continue to be kept up to date. The Technical Standards Publication (see chapter 1.4 Updating of Technical Standards) acknowledges that updates to technical standard should be considered if new technically and/or economically feasible approaches become commercially available.

8.0 Conclusions and Recommendations

Version 1.0 of FIS was published on December 4, 2009 and addressed several important issues. Since the driver for the FIS was the lead and lead compounds air standard that took effect February 1, 2010, additional requirements were developed for non-ferrous foundries with lead. The amendments to this FIS were developed according to the same principles namely, evaluating the impact to air emissions from foundry activities. These sources of air emissions were assessed according to their potential for offsite impacts and resulted in requirements included in the amended FIS by administering operational or add-on controls.

Requirements for new sources are also included because they are commonly used by this sector or because of the magnitude of their emissions. For example, EAFs and AODs generally operate at high volumes and hence can be a large source of SPM and metal emissions. As such, EAFs and AODs will be required to be equipped with primary local exhaust ventilation that direct fumes to a baghouse. As well, thermal sand reclamation and liquid spray coating operations are now included in the FIS which will help mitigate hazardous and acidic emissions, and VOCs, respectively. In particular, the processing of fluorinated or chlorinated sand must now be accompanied by an afterburner and possibly a lime scrubber before going to a baghouse. Liquid spray coating applications operating at rates greater than one litre per hour will have the necessary ventilation and control so that emissions are adequately dispersed thus minimizing the local impact.

A major finding from the ministry's FIS Implementation pilot project was the need to allow facilities to consider different maintenance schedules and specific manufacturer's recommendations. To address these items, new provisions allow for a professional's recommendation. If a professional's recommendation is not available, the value in the tables applies.

The idea of continuous improvement is also important. In version 1.0 of the FIS, any new or modified sources of SPM or lead for many foundry activities required a ventilation balancing, fugitive assessment, and air pollution control equipment, respectively. The findings of the significance analysis suggest the need for additional work to determine the potential impacts from other contaminants by deriving higher quality emission rates from the source testing project.

8.1 Review of Priority Metals Emissions

The FIS was initially developed in response to a request by the sector because two or more foundries could not technically or economically meet the ministry's new air standard for lead and lead compounds (phased in on February 1, 2010) as per O. Reg. 419/05. Version 1.0 of the FIS placed an emphasis on managing emissions from a "non-ferrous metal foundry that uses lead" and requires these sources of lead to be controlled by a baghouse which is equipped with a bag leak detection and alarm system. These sources of lead are also subject to a ventilation assessment (as well as other administrative requirements) which is useful in determining whether there is adequate flow to effectively capture the lead fumes and SPM at the source.

The ministry is reviewing the results from a source testing study that was done to obtain higher quality emission information on Manganese and Manganese Compounds, Nickel and Nickel Compounds, and Chromium and Chromium Compounds (Metallic, Divalent and Trivalent) and Chromium Compounds (Hexavalent) emitted by this sector. This information could be considered in the future, depending on additional emission information collected through the ministry study.

8.2 Potential for benzene air emissions

Presently, the impact of benzene from foundry operations on the local community is not well characterized. The new benzene air standard of 0.45 microgram per cubic meter (annually) will take effect July 1, 2016. The ministry will continue to consider this issue as more information becomes available with respect to the origin and magnitude of such emissions.

Appendix A: Highlights and Rationale of Amendments to FIS by Section

The summary below highlights the most significant amendments to the ministry's Foundries-Industry Standard (FIS) and is accompanied by a brief explanation of the changes. This amendments and rationale are a reflection of the findings from the ministry's FIS Implementation Project, discussions with various industry stakeholders, the jurisdictional review, and a general revisiting of sources in light of any new emission information. For the specific details of the amendments, please refer to the amended Foundries – Industry Standard posted in the Environmental Registry (EBR 012-3538).

Section 1 – Definitions

The changes to the definitions section were made to help clarify the requirements of the FIS. For example, the first version of the FIS made reference to oxidizers but did not specifically define afterburners since the two devices differ in regards to residence time.

Additionally, there are many coating activities that take place in foundries. However, most of these processes are carried out in small quantities and administered by portable non-refillable spray cans, such as mold release agents. Others coating applications, such as core and mold washes, are applied to improve the surface finish of a casting but may be administered by brushing, dipping, or spraying. Finally, foundries that engage in painting finished castings on behalf of their clients may emit significant quantities of VOCs. Hence, for spray painting activities in excess of one litre per hour, High Volume Low Pressure (HVLP) spray equipment is a method that may be used to minimize emissions. As such, a definition is needed for HVLP spray equipment to draw attention to this type of technique which is also a requirement for new or modified paint spray operations.

A new definition for bag leak detection in now included which allows a foundry the option of using a variety of techniques to determine if bag are leaking whereas the prior definition referred to only pressure differential. Finally, subsequent discussions during the comment period gave rise to two more definitions: (1) block averages, and (2) building differential pressure. These definitions have been included to allow for the use of building differential pressure monitors and to help define the average value of the building pressure over a specific duration of time.

Section 2 – Application (and section 2.1)

The contaminants typically emitted by foundry operations can be classified as groups given that they are similar with respect to the nature of emission, control, and capture. Hence, the requirements contained in these sections would only be applicable if a foundry is registered for a contaminant cited in one or all of the appendices listed in the FIS. Thus, the applicability of each section is depicted in a table depending on the registered contaminants. In addition, almost one year is allowed from the time that the FIS is published for registered and newly registered foundries to the transition to the new or modified requirements of the amended FIS. Up to 36 months is provided for changes that may require capital expenditures for equipment. For more information, see amended FIS.

***Section 3* – Reduction of priority metals**

This section contains requirements for the preparation and implementation of written procedures to reduce air emissions of priority metals. Although this section does not change in principle, the definition for priority metals now includes beryllium compounds.

It should also be noted that beryllium and compounds currently has a 24 hour air standard of 0.01 micrograms per cubic meter which is more stringent than the 24 hour air standard for lead and lead compounds. Even though beryllium is typically not found in high quantities in foundry products, adding it to the list of priority metals will help ensure that these potential emissions are better managed. This is because beryllium may be used for the preparation of specialty alloys such as non-sparking tools which are made from copper-beryllium alloy. Hence, it is recommended that foundries endeavor to minimize any indiscriminate use of beryllium metal where possible.

By adding beryllium to the list of priority metals in Appendix 2 of the FIS this metal will be considered in the work carried out by registrants as per section 3, *Reduction of Priority Metals*. Particularly, this sections calls for operators to develop and implement plans to reduce the use of these designated metals where possible. For example, where appropriate, melting of scrap containing these metals may be curtailed unless the presence of a priority metal has a definite function in the alloy being prepared. Although the use of these metals is not likely widespread, this provision is intended to further reduce their emissions where possible.

Section 4 – Operational Practices – Minimization of SPM (and section 4.1)
These sections of the FIS were originally developed for foundry operators to implement written procedures that include methods to minimize the discharge of fugitive dust from roadways and outdoor storage piles (i.e. scrap, charge, sand, and slag). This section now includes specific requirements pertaining to the mitigation of particulate emissions from outdoor foundry activities in a similar manner. Following the publication of the original FIS it was determined that some foundries carry out cooling operations outside the building envelope with no enclosure, or at best, a partial enclosure. The requirement is for the development of written procedures to minimize the offsite impacts from emissions of SPM during outdoor foundry activities and the preparation and use of a written log. The written procedures are not required if the foundry adopts the use of a partial enclosure. The concept of a using a three sided enclosure with a roof instead of the development and implementation of written procedures is to encourage best management practices when outdoor foundry activities are taking place. Additionally, the reason why a three sided enclosure is appropriate, as opposed to a four sided enclosure, was to allow forklift access to the enclosure and the roof is needed to shelter the molten metal from exposure to precipitation. Finally, the written log is required for all activities that take place outside the building envelope regardless of whether a partial enclosure is employed. This log may assist in determining the source of subsequent complaints and helps track the frequency and duration of such occurrences.

***Section 5* –Reducing Fugitive Emissions etc. (and sections 5.1, 5.2, 5.3, 5.4, 5.5)**
These sections of the FIS are largely devoted to the requirement to develop and implement a ventilation program. This is a responsibility that must be fulfilled by all foundries registered to the FIS.

Subsection one requires that written procedures be developed to minimize SPM emissions from foundry activities that are specifically listed, namely, metal melting, furnace tapping, casting cooling, breakout or shakeout, and finished.

The subsequent requirements of a ventilation program are intended to characterize the basic aspects of the ventilation system in the foundry through a compilation of information including general descriptions, volumetric flow rates, and process flow diagrams. Another requirement of the ventilation program includes either, (1) the preparation of a table that contains the volumetric flow rates of the make-up air system in comparison to the local and general exhausts, or (2) the installation and use of a building differential pressure monitors to measure the building differential pressure near the melting and pouring areas of the foundry compared to the outside of the building.

For starters, by no longer making reference to specific sources in the ventilation program, all components of the ventilation system are included in the ventilation program. It is anticipated that this change include ventilation systems associated with coating operations (includes spray paint booth), shakeout (i.e. breakout and casting recovery) and sand reclamation processes (includes mechanical sand reclaimers and thermal sand reclamation devices). These activities merit this attention since they may be carried out in large quantities, or due to their nature of their emissions, produce high intensities of VOCs or SPM. The information in the table or the measurements acquired by the building pressure monitors are important to ensure negative pressure in the melting and pouring areas of non-ferrous metal foundries that use lead. Furthermore as stipulated in section 5.4, either source of information may be used to evaluate the effect of changes to ventilation systems prior to the implementation.

Since the publication of the original version of the FIS, the ministry determined that some foundries operate in multi-tenant buildings which are now addressed as part of section 5.5. As such, a new rule is included to help reduce exposure to non-foundry related tenants that share a building with a foundry. Foundries that operate in multi-tenant buildings must ensure that the filters in the air make up units that supply air to the non-foundry tenants are changed or cleaned on a semi-annual basis. Furthermore, the ducts that supply air to the non-foundry tenants must be cleaned on an annual basis. These requirements are limited to the air supply equipment that is associated with non-foundry related tenants and is contingent on the foundry gaining permission to access the relevant make-up air units and foundry tenant air supply ducts. However, in the event that access is not granted, a record is retained and no further steps are required to be taken by the foundry.

***Section 6* – Ventilation Assessment – Optimizing Capture of Lead (and section 6.1)**
These sections of the FIS defines what needs to be carried out by 'non-ferrous foundries that use lead' to fulfill the requirements of a ventilation assessment. The original version of the FIS omitted finishing and sand operations in the ventilation assessment by not referring to these operations specifically. The ventilation assessment is now applicable to all ventilation system and the associated foundry processes. Finishing is the final step in the production of castings and is referred to in the FIS as "a process that involves trimming, grinding, cutting, finishing, or media blasting of castings". This step is used to 'finish' the metal cast (e.g. polish the metal, grind off imperfections, and remove the runners, gates and risers from the casting). This amendment to the FIS ensures that finishing operations be included in a ventilation assessment.

It is also important to note that section 6(8) of the FIS includes a provision that allows the ministry to deem ventilation reports that have already been prepared as substantially having met the ventilation assessment requirements if, in the opinion of the Director, the information contained in the report substantially meets the information requirements set out in subsections 6(2) to 6(5) of the FIS.

Face velocity is a new measurement that must also be acquired as part of a ventilation assessment. This term is used to denote the speed of the air being drawn into an open formed local ventilation exhaust duct. The face velocity is used to characterize the speed of air flowing into a hood and can help to determine if there is adequate momentum for a fume particle to be accelerated into the duct for transport to exhaust or other air pollution control such as a baghouse. The magnitude of this parameter is dictated by the particle size which is dependent on the particular foundry activity that is being carried out. For example, large particles generated by shakeout would need more momentum than fumes from molten metal and hence a greater face velocity for conveyance. The shape of the hood and its proximity to a source of emissions also governs the critical minimum face velocity that would be required. The face velocity, if applicable (e.g. fume hood), can be a good indication of the system's fume capture efficiency. Moreover, a recommendation concerning this aspect of hood design is provided in industrial ventilation manuals and can be referred to in order to ascertain when gross inadequacies are present in the local exhaust ventilation for critical sources.

Due to the complex nature of ventilation systems it is difficult to identify one variable to assess ventilation deficiencies. Hence, a provision is to give the Director the authority to ask for an action plan to address deficiencies identified in a ventilation assessment. The Director may also request that a ventilation report be prepared again, entirely or in part, where deficiencies are evident. This amendment allows for a Director to require the preparation of a ventilation assessment with respect to a ventilation system associated with a particular area of foundry that may not be operating effectively. The notice for the preparation of a ventilation assessment may be issued if one of the three criteria is triggered: (1) If two or more complaints related to a matter addressed in the FIS are made within the past 12 months, or (2) if an area of the foundry that contains melting or pouring areas in not likely operating at negative pressure, or (3) a static pressure measurement associated with local exhaust ventilation is outside of the normal operating range cited in the Operating Parameter Summary Table.

The requirement for a ventilation assessment by the means of such a notice may be issued to any foundry regardless of the type. For more information see section 6.1 of amended FIS.

***Section 7* – Ventilation and Pollution Control – Optimizing Capture of Lead**

This section has been reorganized for clarity but remains unchanged in its objective. Non-ferrous foundry that uses lead must still carry out melting and pouring activities in areas of the foundry that are maintained under negative pressure. However, the foundry can now choose to maintain a table or air flows entering and exiting the building or use monitors to measure building differential pressure. The building differential pressure measurements taken in the melting and pouring areas of the foundry must be compiled in thirty minute block averages. Only one block average in a day may be positive, and operational adjustments are expected to restore the pressure in these areas back to negative. Any subsequent positive block average is considered a contravention and requires notification to the ministry. Alternatively, a notification to the ministry is required if an update to the above-mentioned table indicates that more air will be entering the building than is exiting.

Finally, in accordance with the original FIS, melting, tapping, pouring, and cooling operations must still be equipped with local exhaust ventilation that is connected to a baghouse. The baghouse must be fitted with (1) bag leak detection, (2) audio and visual alarms, and (3) mechanized cleaning of bags or cartridges. However, the new definition for bag leak detection allows a foundry options to use a variety of techniques to determine bag leaks – not just by the assessment of pressure differential.

Section 8 **– Ventilation and Pollution Control – Optimizing Capture of SPM – New or Modified Facilities**

Section 8 outlines the requirements for Ventilation and Pollution Control – Optimizing Sources of SPM. This section requires any new or modified process be subjected to ventilation balancing, as well as a visual assessment and record updating.

These sections are applicable during a new installation or major modification and it requires that the associated local ventilation exhaust is balanced. In addition to the original list of sources any new shakeout or breakout operations are also included in this practice. Ventilation balancing is important to ensure that the local exhaust ventilation system fitted to a newly installed process is able to capture and convey particulate and fume generated by the particular foundry activity that is being controlled.

Section 9 – Ventilation and Pollution Control – Optimization Capture of Lead – New or Modified Facilities ***(and section 9.1)***

These sections remain unchanged in principle, however the term ‘bag leak detection’ no longer makes reference to pressure drop. This provision was included to allow for greater flexibility in determining if there was bag break. There are several methods presently available to monitor bag leaks in a baghouse. For example, apart from pressure drop, optical and triboelectric methods are also quite reliable to meet the requirements stipulated in this section. Hence, this provision allows a facility to choose from other commercially available techniques to satisfy this requirement to trigger alarms when bag breaks.

The newly introduced section 9.1 requires that new air pollution stacks are installed vertically and without any impediments. This practice can reduce local exposure from these stacks by improving dispersion which may also reduce ground level concentrations.

Section 10 – Coke-Fired Cupola Furnaces, Thermal Sand Reclaimers ***(and section 10.2 to 10.9)***

The requirements for coke-fired cupolas remain unchanged and stipulated at the outset of section ten. However, since chlorinated and fluorinated contaminants have been added to the list of contaminants available for registration, new requirements have been included for some thermal sand reclaimers.

Two new requirements are included in 10.4 and 10.5 which require that the minimum residence time for exhaust gases from thermal and catalytic oxidizers is 0.75 seconds; their minimum operating temperatures remain unchanged at 760 and 400 degrees Celsius respectively, or a temperature cited in an existing Environmental Compliance Approval.

A variety of heat application practices are used in the foundry sector. For example, propane torches and ovens may be used to preheat ladles and charge metal. The heating a finished casting in an oven may be helpful in preventing thermal stress fatigue. Preheating charge metal to remove moisture prior to contact with molten metal is a safety precaution to prevent the formation of superheated steam and spattering of molten metal. Heating a ladle, charge metal, and finished castings do not typically present a significant source of emissions that warrant the development of an air pollution control rule. However, another heat application process, thermal sand reclamation, does merit greater attention especially when recovering sand that was bonded with fluorinated or chlorinated substrates.

Hence, new requirements have been included in sections 10.1, 10.2, and 10.3 to control chlorinated or fluorinated emissions, VOCs, and SPM. Section 10.3 requires that all thermal sand reclamation processes must be connected to a baghouse to capture the SPM generated by this process. To control emissions of VOCs, section 10.2 requires that a thermal sand reclaimer must operate at 760^{o}C with a residence time of 0.75s or in accordance with the requirements stipulated in the Environmental Compliance Approvals for these devices. Finally, section 10.1 requires that exhaust gases from the thermal sand reclamation of fluorinated and chlorinated sand, be treated with an afterburner that is capable of reaching 1200 degrees Celsius. Since this temperature may not be feasible to achieve in all cases, a lower temperature of 870 degrees Celsius may also be acceptable in certain cases. However, a lime scrubber must be used whenever the temperature of the afterburner is below 1200 degree Celsius. See amended FIS for details.

Finally, it was determined through discussions with the foundry sector that several coating operations are carried out for foundry products. Most of these coating application practices are applied in small quantities; such as brushing release agent to a mold which helps remove the cooled castings. However, some foundries carry out production painting services that are applied with pneumatic spray aerosol applicator guns. A one liter per hour threshold is now included to help differentiate between low volume coating applications versus production coating operations. Furthermore, this requirement as expressed in section 10.6 is only applicable to refillable applicators, and as such, does not include coating applications via disposable spray cans.

The application of a liquid coating at a rate of greater than one litre per hour, triggers the use of a spray booth equipped with arrest filters, which are typically capable of approximately 95 percent SPM capture. The remaining particulate which passes through the filter would must be exhausted at a velocity of 12 meters per second through a vertical and unimpeded stack. Finally, the liquid spray coating must be applied using High Volume, Low Pressure (HVLP) spray gun, electrostatic spraying device, or any other application method capable of at least a 65% coating transfer efficiency.

Section 10.7 requires a foundry to ensure that the discharges from each EAF and AOD that was installed at a foundry on or after a July 1, 2019 are captured by a local exhaust ventilation system that is connected to at least one baghouse. EAFs are often used in the preparation of large batches of iron and steel which are melted using the intense heat of an electric arc. The large quantities of molten metal are then treated in an AOD to remove impurities by blowing oxygen into molten metal via a lance or tuyeres.

Based on discussions with the foundry experts and a review of existing Environmental Compliance Approvals, the minimum requirement for EAFs and AODs is primary control via local exhaust ventilation that is also connected to a baghouse. This requirement for new EAFs and AODs is reasonable and consistent with current industry practice and regulatory air approval requirements, particularly the US EPA's NESHAP for electric arc furnaces used in steelmaking.

Finally, section 10.8 restricts torch cutting activities that are intended for the preparation of furnace charging material unless the fumes are captured and conveyed to a baghouse. Uncontrolled torch cutting may be a source of concern for neighbours living in the vicinity of a foundry. Section 10.9 includes a new requirement for reverberatory furnaces that are charged with scrap aluminum sourced from outside the foundry. If certain criteria are met (reverberatory furnace, aluminum, and scrap) then the requirement is to capture and convey these fumes by means of a baghouse. This requirement was designed as a minimum requirement that is important when reverberatory furnaces are being charged with scrap. Scrap metal may have a higher likelihood of introducing other non-metal residues in the metal that give rise to greater SPM emissions than pure aluminum ingots. Hence, a requirement for the capture and conveyance of these fumes to a baghouse was deemed reasonable.

Section 11 – Operational Practices – Local Exhaust Ventilation Equipment and Pollution Control Equipment (and section 11.1 to 11.8)

These sections contain the requirements for the Operator Parameter Summary Table (OPST) and Inspection and Maintenance Summary Table (IMST). The preparation of these tables is not a new requirement however the format has changed and been rewritten for clarity. This section still includes two sample tables that facilities may refer to for their site.

It was observed during the ministry's 2011 FIS implementation pilot project that baghouses may be operating in accordance with the manufacturer's specification, and yet the operating pressure drop value was outside of the normal operating ranges originally cited in the OPST of version 1.0 of the FIS. This discrepancy was also found to occur when a baghouse was fitted with new bags which can result in pressure drops below one inch of water for a significant amount of time. It is expected for the baghouse pressure drop to be quite low when new bags are installed until a sufficient amount of particulate builds-up on the bags which raises the pressure drop and increases capture efficiency. Another finding from the implementation project was that many foundries had implemented customized preventative maintenance and inspection programs that were more relevant than what was prescribed by the IMST of the original FIS. The amendments discussed below address the aforementioned project's findings.

11.1 describes how the Operating Parameter Summary Table (OPST) must be prepared and now includes four new columns. The first column title Equipment no longer refers to air pollution control devices but instead refers to foundry equipment or processes like furnaces, pouring stations, cooling tunnels, shakeout tables, or finishing stations. Adjacent to the first column is Column 2-Associated Ventilation Systems, Column 3-Associated Method, Column 5-Monitoring Frequency, and Column 6-Monitoring Location.

The method that is referred to in column two is defined in section 17 and includes, for example, an air pollution control device, using foundry equipment or operating a process to reduce the fume emitted, or using an elevated air pollution exhaust stack, or the use of an additive like adding flux to molten metal.

In principle, section 11 continues to fulfill the intended objectives in the original FIS. For example, section 11.2 regarding deviations from operating parameters, and section 11.3 the notifications of some deviations remain conceptually the same apart from a few changes. A non-ferrous foundry that use lead does not need to notify the ministry for pressure drop deviations during bag cleaning cycles or 31 days after the installation of new filter bags. This was an important amendment since scheduled bag replacement is necessary for the proper maintenance of a baghouse but does immediately require a notification. If notification is triggered, the foundry needs to notify the ministry only once for a 24 hour period. Finally, under section 11.4, new air pollution control devices and local exhaust ventilation systems are not subject to the OPST for a period of six months after the installation of the aforementioned equipment.

The greatest change to the OPST is the inclusion of a provision which allows registered foundries to make changes to this table by means of a professional's recommendation. A professional's recommendation includes and is limited to, the operating and maintenance manual, written instructions from the supplier, a letter from the manufacturer, or a letter from a professional engineer which includes a detailed rationale.

An important aspect that was maintained and not subject to change are the notification requirements for non-ferrous foundries that use lead even when using substituted values. Hence, if a new normal operating range is adopted by a non-ferrous foundry that uses lead and is registered for lead by means of a professional's recommendation, the same range must also be adopted as the range outside which notification is required.

Similar to the OPST, the principle intent of section 11.5 is consistent with the original FIS. Section 11.5 describes how the inspection and maintenance summary table should be prepared and provides a table that is populated with maintenance objectives and frequencies. Recording maintenance and inspection activities, deviations thereof, and addressing malfunctions remain conceptually the same as was originally required by the FIS. However, the professional's recommendation provision was also incorporated here also which allows foundries to alter the frequency of the prescribed activities. Additionally, foundries may choose to add maintenance objectives that are not cited in the table provided in this section. Although these changes must be qualified on the basis of a professional's recommendation, the ministry may yet order a foundry to change the inspection frequency where such a change is warranted.

Section 12 – Operational Practices – Minimization of VOCs

Section 12 – Operational Practices – Minimization of VOCs – has been amended to include other technologies to address odour, namely: 6.1 Mold Gas Vent Light-off; 8.1 HVLP spray equipment; and 8.2 Low VOC coatings.

Mold gas vent light off refers to a practice whereby a baton or fixed pilot light is used to ignite the volatile emissions being driven off from molds during pouring. It is referred to the in the US EPA's NESHAP for Iron and Steel Foundries. These emissions typically auto-ignite due to the extremely high temperatures, but if ignition does not occur will emit

VOCs from the sea coal and binders in the molds. Depending on the temperature of the metal melted, and the type of sand used, significant VOC emissions can be emitted from molds if the vent gases do not auto-ignite. As a result, the use of “mold vent gas light-off or flaring” was included as a technology to be considered.

The use of low VOC coatings and HVLP spray equipment are two new options that must be considered in the plan to minimize VOC emissions due to the inclusion of liquid spray coatings in the amended FIS. Low VOC coating use solvents that are less volatile and HVLP spray equipment conserving the volume of paint used by controlling overspray, high transfer efficiency spray equipment, such as a HVLP spray guns or electrostatic painting, can reduce the VOC emissions. These items have been added due to the potential for painting emissions to cause odour complaints.

Section 13 – Operational Practices - Minimization of Total Amines
The requirements for this section remain mostly unchanged except for a new requirement to monitor continuously the relevant operating parameter in column five opposite wet scrubbers in the operating parameter summary table. This requirement is consistent with the ministry’s *Pulp and Paper* industry standard.

Section 14 – Operational Practices - Minimization of Sulphur Dioxide
The requirements for this section remain unchanged.

Section 15 – Pollution Control - Minimization of Sulphur Dioxide
The requirements for this section remain unchanged.

Section 16 – Complaint Procedure
This section now includes a new requirements for the written record associated with a complaint. The record must also include a consideration of ‘any relevant information regarding the possible causes of the incident including any outdoor activities’. The purpose of this requirement is to draw attention that outdoor foundry activities have the potential for causing complaints and to take appropriate action.

Section 17 – Identifying Managed Sources, etc. (and 17.1 to 17.4)
This section is included to ensure that no air pollution control device, LEV or other method that was approved under a prior instrument of compliance is removed from service. It requires the preparation of a table which is consistent with the original FIS however the evaluation of proposed changes to the ventilation system has been moved to section 5.4. A table records all of the methods employed at a foundry to reduce fume emissions from foundry processes including local exhaust ventilation and air pollution control devices. This section ensures the continued operation of existing air pollution control devices and also ensures that any new sources are similarly controlled.

Section 18 – Summary Reports
The requirement to prepare summary reports pertaining to complaints, deviations, and implementation remain unchanged including the implementation of a procedure to inform the highest ranking individual of the summary reports. However, there are some new summaries included, for example, a plan to address any inadequacies that were discovered as part of a ventilation assessment. Additionally, a new requirement is that the *Implementation Summary Table* and the *Performance Summary Table* are now publicly available upon request without charge and within 15 days of making such a request. The Performance Summary Table includes all notifications made to the

ministry, in addition to the notices and orders issued by the ministry to the facility. The Implementation Summary Table is comprised of the requirements that apply to the registered facility, when the requirements phase-in and the date the facility implemented the requirements. . All summaries reports, as well as the ventilation assessment action items, must also be certified by the highest ranking individual as being accurate.

Section 19 – Records

This requirement for this section remains largely unchanged. One minor change is the new requirement to make records available in electronic format. Finally, documents relating to recommendations from manufacturers must also be retained while equipment is employed at the foundry.