MEMORANDUM

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TO: Integrated Iron and Steel (II&S) Residual Risk and Technology Review (RTR) Project File

SUBJECT: Ample Margin of Safety Analysis for Nonpoint Sources in the II&S Industry

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1.0 BACKGROUND AND INTRODUCTION

This memorandum describes the ample margin of safety (AMOS) analysis of the nonpoint processes and practices in the Integrated Iron and Steel Manufacturing (II&S) industry for the Residual Risk and Technology Review (RTR) of the National Emission Standards for Hazardous Air Pollutants (NESHAP) for the Integrated Iron and Steel Manufacturing (II&S) industry (40 CFR, part 63, subpart FFFFF).[1] In accordance with section 112(f)(2) of the Clean Air Act, the EPA considers whether the existing emissions standards provide an ample margin of safety (AMOS) to protect public health in consideration of all health information, including the number of persons at risk levels equal to or greater than 1-in-1 million, as well as other relevant factors, including costs and economic impacts, technological feasibility, and other factors relevant to each particular decision.

In accordance with section 112 of the Clean Air Act (CAA), on May 20, 2003, the U.S. Environmental Protection Agency (EPA) established a NESHAP for the II&S industry (68 FR 27646). Under section 112(f)(2) of the CAA, the EPA is required to perform a residual risk analysis of MACT standards within eight years of promulgation. For purposes of the RTR, the EPA sent an information collection request (ICR) to the II&S industry in 2011 that included a questionnaire and a source test request. The II&S ICR was sent under the authority of section 114 of the CAA (42 U.S.C. 7414) to acquire the necessary data for the RTR and to evaluate certain regulatory reconsideration efforts described above. Copies of the II&S ICR and responses received by EPA are included in docket for this action (Docket ID #EPA-HQ-OAR-2002-0083).

As part of the AMOS analysis for the II&S RTR, the EPA identified seven unmeasurable fugitive and intermittent particulate (UFIP) emission sources of HAP emissions (also called “nonpoint” sources) at II&S facilities. These nonpoint sources were identified primarily from the extensive experience of regional EPA inspectors of II&S facilities in EPA Region V where nine of the 11 total II&S facilities in the current industry are located. The nonpoint sources reviewed under AMOS consist of the following sources: blast furnace (BF) bleeder valve unplanned openings (also known as slips); BF bleeder valve planned openings; BF bell leaks; BF casthouse fugitives; BF iron beaching; BF slag handling and storage operations; and basic oxygen process furnace (BOPF) shop fugitives. Two of these emission sources, BF casthouse fugitives and BOPF shop fugitives, are currently regulated under the NESHAP by opacity limits, as a surrogate for metal HAP. As part of the AMOS review, work practices were identified that could achieve HAP reductions in emissions and risk from the seven nonpoint sources. A description of these nonpoint sources and their estimated HAP emissions; description of the work practices as potential control measures; reductions in emissions and risk with the control measures; and costs and cost-effectiveness of the control measures are discussed below.

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[1] The other facet of the AMOS analysis for the II&S RTR is the analysis of further control of point sources to reduce risk. A description of the HAP emissions and risk reductions, and costs with additional control devices to reduce risks for the point sources are discussed in the technical memorandum titled *Ample Margin of Safety Analysis for Point Sources in the II&S Industry*. (2019c)

2.0 DESCRIPTIONS OF THE UFIP (NONPOINT) EMISSION SOURCES

The seven UFIP emissions sources identified for the II&S industry are listed below and discussed in this section. Note that two of the seven sources (BOPF Shop Fugitives and BF Casthouse Fugitives) are currently regulated by opacity standards in the NESHAP, where opacity is a surrogate for metal HAP.

- BF Unplanned Openings, i.e., Slips (intermittent, via bleeder valve exhaust)
- BF Planned Openings (intermittent, via bleeder valve exhaust)
- BF Bell Leaks (fugitive)
- BF Casthouse Fugitives (regulated fugitive)
- Beaching of Iron from BFs (fugitive)
- BF Slag Handling and Storage (fugitive)
- BOPF Shop Fugitives (regulated fugitive)

Appendix A shows photographs of some of the UFIP sources observed at II&S facilities by EPA regional enforcement staff.

The following are definitions of some II&S equipment and processes used in the discussion of the seven UFIP sources below:

- BF is a key II&S process unit where molten iron is produced from raw materials such as iron ore, lime, sinter, and coke.
- BF casthouse is the structure that houses the lower portion of the BF and encloses iron and slag transport operations.
- BOPF is a key II&S process where steel is made from molten iron, scrap steel, and alloys.
- BOPF Shop is the structure that houses the entire BOPF and auxiliary activities, such as hot iron transfer, skimming and desulfurization of the iron.
- Bleeder valve is a device at the top of the BF that, when open, relieves BF internal pressure to the ambient air. The bleeder valve can operate as both a self-actuating safety device to relieve excess pressure and as an operator-initiated instrument for process control.
- Bleeder valve opening means any opening of the BF bleeder valve, which allows gas and/or particulate matter (PM) to flow past the sealing seat. For purposes of this rule, any multiple openings and closings of a bleeder valve that occur within a 30-minute period shall be considered a single bleeder valve opening.
- Planned bleeder valve opening means a bleeder valve opening that is initiated by an operator as part of a furnace startup, shutdown, or temporary idling for maintenance action.
- Unplanned bleeder valve opening means a bleeder valve opening that is not planned.

2.1 BF Bleeder Valves - Unplanned Openings

A BF makes iron and operates under positive pressure. When the furnace is at pressures above standard operation, the pressure is automatically relieved out of bleeder valves that exhaust uncontrolled BF gas to the atmosphere. Bleeder valves also can be opened manually when operators wish to release internal pressure, such as when the furnace is taken out of service for maintenance (see separate discussion below under planned openings). The exhaust from bleeder valves are released from points located on the BF “uptake” ductwork that rises over 100 feet higher above the top of the BF casthouse, the structure that surrounds the bottom sections of the BF where opacity is measured to fulfill the NESHAP requirements.

The most common cause of unplanned overpressure in a BF is a “slip”. A slip is when raw materials loaded in the top of the furnace fail to descend smoothly in the furnace and bind together to form a “bridge” which than "hangs" (i.e., accumulates) in one position in the furnace. When a "hang" eventually falls, or "slips," it creates a pressure surge that opens the bleeder valves, releasing emissions in the form of a large dust cloud. A bleeder valve opening can last anywhere between 3 seconds and 10 minutes. These bleeder valve openings can result in significant PM that includes HAP metal emissions, and are the subject of numerous public complaints. Part of the reason for the public concern is the visibility of these releases because even a 3-second openings can cause alarmingly large amounts of visible emissions (see photographs in **Appendix A**).

Table 2-1. Examples of Rates of Unplanned BF Bleeder Valves Openings (from EPA Region V)

Furnace Code	Average Unplanned Openings per Month	Averaging Time Period
1	0.5	2010 - 1stQ 2015
2	0	2010 (12 months)
	0.03	1/2012 - 5/2014
	0.4	2015 (8 months)
3	2.5	2012 - 2013 (13 months)
4	2.1	2014 – 2015 (10 months)
5	3.1	2014 – 2015 (8 months)
6	2.5	2014 – 2015 (11 months)
7	6.1	2014 – 2015 (10 months)
8	3.7	2014 – 2015 (11 months)

In a 1976 study (EPA, 1976), the EPA determined that the average number of unavoidable "slips" for a BF was about four per month. According to data provided by various companies to Region V enforcement staff, some furnaces are still above the 1976 average, and some are as high as 10 slips per month. **Table 2-1** below shows examples of past performance of five II&S facilities in EPA Region V in regard to the average number of slips per month over various time periods. The range in average monthly slips per BF was from zero to over 6, with averaging time periods ranging from 8 months to over 2 years.

2.2 BF Bleeder Valves - Planned Openings

BF planned openings are similar to BF unplanned openings, but because they are planned, the furnace conditions can be prepared before the bleeder valves are opened and emissions can be minimized. The most common reason to open bleeder valves is for repair of pipes (called "tuyeres") used for cooling or for injecting oxygen. Some steel companies have policies to immediately shut down the furnaces with water leaks in order to repair the leak; however, this is not universal. Operators also may open the bleeder values prior to other maintenance on the furnace or the stoves. In these procedures, the furnace is turned down to low idle before the relief valves are opened, hence the lower emissions during planned openings.

The planned BF outages occur approximately twice per week and result in opening of bleeder valves for approximately 15 hours each week. The opacity during these open valve periods has been as high as 85 percent in the experience of EPA Region V staff, but also can be 5 percent or lower. The EPA Region V has numerous inspection records of BF operation where little to no opacity was recorded from bleeder valves during planned openings.

2.3 Bell Leaks

BF bells (large and small) are part of raw material hoppers for some BFs. The typical double bell systems are arranged in a type of lock system on top of the BF so that raw materials can be charged into the BF without allowing the solid raw material or furnace gas to escape into the atmosphere. The bells look like inverted cones with flat tops and, hence, appear like bells. The raw material or "charge" is first placed in the small bell's open hopper. The small bell is on top of the large bell, and the large bell's hopper is closed during filling of the small bell hopper. After filling the small bell hopper, its top is closed to the atmosphere, then its bottom opens into the top of the large bell. After the charge material is transferred to the large bell, its top is closed and its bottom is opened to allow the charge to enter the furnace. Exhaust air from the furnace is released into the large bell hopper when the top of the furnace is opened to prepare for charging. The exhaust air exits through "uptake" ducts prior to the opening of the small bell.

The large BF bell contacts the top of the furnace via a metal seal so that most of the BF gas and PM emissions evacuated into the uptakes are cleaned of PM by control devices. However, there is typically a narrow gap between the bell seal and the furnace that has been estimated to be about 50 micrometers (µm). A proper seal does not allow visible particulate to escape to the atmosphere. Proper sealing lasts for many weeks if not months before the surfaces wear enough to emit visible particulate. Thus, when the seals have degraded enough to emit visible PM, there is clear indication that the seals are no longer operating as designed and planning for repairs to those seals should commence. In a 1978 EPA study (EPA, 1978), it was estimated that "normally" operating bells releases many tons of PM as invisible leaks and that PM emissions increase significantly when the bells wear down and the gaps in the sealing surface start to become so large that opacity is visible from the furnace top. See photos in **Appendix A** of a leaking large bell causing opacity to be released through the gaps in the bell seals.

2.4 BF Casthouse Fugitives

The BF produces iron from raw materials of iron ore, limestone, dolomite, sinter, and coke. The casthouse encloses the area around the base of the furnace that includes multiple processes where PM can be released. The majority of the PM emissions from BFs occur during tapping when molten iron and slag are removed from the furnace and transported from the furnace to points outside the casthouse. PM is emitted at the taphole, from iron and slag troughs, from runners that transport iron and slag, and from the ladle that receives the molten iron. These emissions include flakes of graphite (carbon) called "kish" that is released as the metal cools (because the solubility of carbon in the metal decreases as it cools) and metal oxides that form when the reduced metal (e.g., iron, manganese) reacts with oxygen in the air. Factors affecting these emissions include the duration of tapping, exposed surface area of metal and slag, length of runners, and the presence/absence of runner covers and flame or fume suppression, which reduce contact of the iron with air.

Most II&S facilities use local capture of PM and other emissions, with subsequent routing to a baghouse located outside the casthouse. These emissions are called primary emissions and considered point sources when emitted from the control device stacks. A few facilities use fume or flame suppression to reduce generation of emissions from the runners that transport the iron and slag outside the casthouse. These emissions are mostly emitted via roof vents at the top of the casthouse and also considered point sources. The fume/flame suppressant control process is described below in **Section 3.0** in more detail. The current NESHAP has PM-related limits for both controlled emission sources from the BF casthouse, BF control device or opacity for secondary emissions from any opening, that applies to both casthouse vent.

The regulated UFIP fugitives from the BF casthouse result from less than 100 percent capture by the systems in place at various emission points within the buildings. The casthouses at II&S facilities are similar to gigantic barns with multiple openings for emissions to escape to the atmosphere. These openings can be the roof monitor (vent), windows, general exhaust fans, and/or missing wall sheeting. The UFIP emissions from the BF casthouse can be significant and are considered an under-regulated emission source.

2.5 Beaching of Iron from BFs

Beaching of iron occurs when the steelmaking process at the BOPF stops suddenly and cannot receive the molten iron produced in the BF. In this situation, the iron is dumped into an open air sand pit, in a process known as "pooling" or "beaching." The ensuing dust and fumes constitute an environmental hazard and the resultant pool or beached iron takes a long time to solidify before it can be crushed into usable material. Beaching typical occurs near the BF. Fugitive PM emissions result from the impact of the iron on the ground as well as the initial high temperature of the iron, which causes fumes to be emitted from the pile of molten iron until it cools in ambient temperature. Most, if not all, of the emissions are expected to be metal particulate with some gaseous sulfur dioxide emissions.

2.6 BF Slag Handling and Storage

Slag is the substance skimmed from the surface of the metal produced in BFs and BOPFs that contains impurities as well as components of the raw materials. Slag is a molten liquid solution of (mostly) silicates and metal oxides with some elemental metal HAP that solidifies upon cooling. The slag leaves the furnaces in open ductwork (called “runners”) and is transported to receiving locations directly outside the buildings. The slag is typically dumped from the runners into front-end loaders that transport the slag to pits located near the BF. Sometimes the slag pit is immediately adjacent to the BFs and the runners empty directly into the slag pit. Emissions from slag is thought to consist of three distinct steps that can generate fugitive PM (and metal HAP) emissions: (1) dumping of slag into pits (note that almost all current II&S facilities report using water spray to cool the hot slag when it leaves the BF to minimize PM fumes and other PM emissions1); (2) slag storage in open pits where wind and weather conditions can disturb the slag surface in the open pits and generate fugitive PM emissions (because the slag becomes solid soon after delivery to the slag pit, no fuming PM emissions are expected on a long term basis); and (3) slag removal from the slag pit with front-end loaders to be processed for recycling or removal from the facility.

2.7 BOPF Shop Fugitives

The BOPF is the steel making furnace at II&S facilities. One or more BOPF are housed in a structure called the BOPF Shop. The BOPF Shop includes both iron and steel operations that can generate emissions. The BOPF Shop receives the hot iron metal from the BF that is transported via “torpedo” cars to the BOPF shop ladle. The reladling generally takes place under a hood to capture these emissions. Desulfurization of the hot iron metal may occur in the BOPF Shop using various reagents such as soda ash, lime, and magnesium. Desulfurization may take place at various locations at an II&S facility; however, if the location is the BOPF shop, then it is most often done at the reladling station to take advantage of the fume collection system at that location. Skimming of slag from the molten iron also removes sulfur from the steelmaking process and is normally done occurs in the ladle, under a hood.

The emissions from steelmaking in the BOPF are from charging of molten iron, metal scrap, and alloys to the furnace; introducing oxygen into the furnace to refine the iron (called oxygen blow), tilting the BOPF vessel to obtain a sample and check temperature, tapping of the molten steel into a ladle, and pouring residual slag into a slag pot. Exhaust PM and gases from the steelmaking furnace itself are captured at the opening to the BOPF and routed to PM control devices. These emissions are called primary emissions and are considered point sources after emission from the control device stacks. Numerous capture systems within the BOPF Shop collect emissions from the iron and steel processes done in open ladles, from material transfer, or charging and tapping. These captured emissions also are routed to PM control devices. These emissions are called secondary emissions and are considered point sources after emission from the control device stacks. The current NESHAP has PM limits for both primary and secondary emissions from the BOPF Shop.

The unregulated UFIP fugitives from the BOPF Shop result from less than 100 percent capture by the systems in place at various emission points within the buildings. The BOPF Shops at II&S facilities are similar to gigantic barns with multiple openings for emissions to escape to the atmosphere. These openings can be the roof monitor (vent), windows, general exhaust fans, and/or missing wall sheeting. The UFIP emissions from the BOPF Shop can be significant and are considered an under-regulated emission source.

3.0 ESTIMATED EMISSIONS FROM UFIP SOURCES

Emissions of PM were estimated for the UFIP sources using PM emission factors developed by EPA from the literature, first principles, discussions with the II&S industry, or a combination of all three. Activity factors of continuous nonpoint sources were based on industry production values. The frequency of emissions for noncontinuous (i.e., intermittent) nonpoint sources were estimated by EPA or the II&S industry. In order to estimate UFIP risk for II&S nonpoint sources, the EPA first developed emission estimates for an example plant based on a real facility in the industry. The profile of the example facility was developed to enable an assessment of the uncertainty in the risk from point source emissions due to omission of the UFIP sources. The example facility has the highest steelmaking production compared to other sources in the industry and was chosen because the method used to estimate emissions from nonpoint sources is based on production. Therefore, the example facility has the highest potential nonpoint emissions in the industry and, likely, risk from UFIP emissions. For the AMOS analysis, emissions for the 10 other II&S facilities in the industry were estimated using an "average" facility profile developed using information from the other 10 facilities in the industry. The resulting PM estimated emissions from the seven nonpoint sources in the II&S industry are shown in **Table 3-1.** The PM emission factors used to estimate emissions from II&S nonpoint sources at the example and average facilities are shown in **Appendix B**. Derivation of the estimates of PM emissions for the seven UFIP sources are discussed in detail in the technical memorandum titled *Development of Emissions Estimates for Fugitive or Intermittent HAP Emission Sources for an Example II&S Facility for Input to the RTR Risk Assessment*. (EPA, 2019a)

Facility-wide emissions for both the example and average facilities were estimated by multiplying the number of emission units by emissions per unit. **Appendix C** shows the current number of emission units and production at each facility in the II&S industry; the number of emission units at the example and average facilities used in the AMOS analysis, and the total units in the industry. The estimate of emission units and emissions for the example and average facilities and in the II&S industry as a whole are discussed in detail in the technical memorandum titled *Cost Estimates and Other Impacts for the Integrated Iron and Steel Risk and Technology Review.* (EPA, 2019b)

The HAP emitted from the nonpoint sources were metal HAP that included antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, and selenium. To estimate metal HAP emissions, a ratio of HAP-to-PM was developed from the point source data from the 2011 II&S ICR. The PM estimates for each UFIP source were multiplied by the HAP-PM ratio for the appropriate sources (i.e., from the BF for all BF-related UFIP sources and from the BOPF for the BOPF UFIP source. For slag UFIP sources, a combination of literature information and ICR data for the BF were used to develop HAP/PM factors for each HAP emitted from slag UFIP sources. The development of the HAP-PM factors also are described in the technical memorandum for the example facility cited above. (EPA, 2019a) The resulting HAP estimated emissions from the seven nonpoint sources in the industry are shown in **Table 3-1** along with the HAP-to-PM ratios used to estimate HAP emissions from PM emissions. Derivation of the HAP-PM factors are described in detail in the memorandum cited above for the Example II&S facility. (EPA, 2019a)

4.0 CONTROL MEASURES FOR REDUCING HAP EMISSIONS FROM UFIP SOURCES

This section discusses the control measures that were identified for the seven UFIP sources, described in **Section 2.0** above. The following are definitions of II&S processes used in this discussion:

- Corrective Action means the design, operation and maintenance changes that are taken, consistent with good engineering practice, to reduce or eliminate the likelihood of the recurrence of the primary cause and any other contributing cause(s) of an event identified by a root cause analysis as having resulted in a discharge of pollutants from an affected facility in excess of specified thresholds.

Table 3-1. Total Estimated HAP Emissions for Nonpoint Sources in the II&S Industry

Nonpoint Source	PM Emissions (TPY)	HAP/PM Factor	HAP Emission (TPY)
BF Unplanned Openings	119	0.037	4.4
BF Planned Openings	77	0.037	2.9
BF Bell Leaks	163	0.037	6.1
BF Casthouse Fugitives	1,379	0.037	51
BOPF Shop Fugitives	7,014	0.032	226
Beaching	1.6	0.037	0.059
Slag Handling & Storage	978	0.0042	4.1
Total	**9,730**		**295**

Note: PM emissions are estimated from emissions factors obtained from the literature and EPA reports. HAP emissions are developed from the estimated PM emissions and the ratio of HAP to PM at the example facility.

- Root Cause Analysis are actions taken to determine the cause of an exceedance in emissions and to determine appropriate corrective action. The root cause analysis and initial corrective action analysis should be completed and initial corrective actions taken in a timely manner after determining there is an exceedance.

The control efficiency of the work practices are expected to range from 50 to 80 percent based on EPA estimates of the efficiency of work practices in general. An average value of 70 percent efficiency was used to estimate impacts of the work practices for all nonpoint sources except BOP Shop. Because of the difficulty in implementing BOPF Shop work practices, a slightly lower control efficiency of 65 percent was used for this source.

4.1 Control of HAP UFIP Emissions from BF Unplanned Openings

Most BF slips are preventable and many of the practices to avoid slips have no or minimal cost. Documents as old as 1917 (Wilcox, 1917) have prescribed operating practices that reduce or eliminate slips. Slip avoidance actions that have minimal cost include screening raw materials for very small particles (called "fines") and enhancing instrumentation on the furnace to be sufficiently precise in the monitoring of temperature and pressure so that operators can take early action to avoid a slip. Temperature and pressure changes in the furnace can be used to identify when a hang has started and furnace operation has become abnormal. Setting a limit on the number of BF unplanned openings has reduced unplanned openings in at least one area of the U.S. with II&S facilities. Allegheny County (PA) previously imposed a limit on the number of slips, but after several years the slip limit was removed because slips at II&S facilities in the county had been eliminated through effective management of BF operations spurred by the limit (Allegheny, 1989).

Operator attentiveness to BF conditions is central to avoiding unplanned openings. Standard operating plans (SOPL) with appropriate documentation and recordkeeping can be used to ensure a facility takes certain actions, such as proper damper positions in pollution collection systems and use of better quality raw materials, to minimize slips. See **Appendix D** for an example SOPL to prevent unplanned openings (USOPL). The USOPL would enable facilities to achieve emission reductions in any number of ways to meet a specified number of unplanned openings.

Most companies now have instrumentation, programming and procedures that reduce the likelihood of unplanned openings. The few facilities that do not have preventive procedures and warning devices are outliers in the number of openings experienced by BFs in the II&S industry. Stockline monitoring devices also are used to alert operators when the BF burden stops descending naturally which indicates a slip could be imminent. Many II&S facilities currently have one or two of these devices.

For extra control of unplanned openings, a number of II&S facilities have installed what is termed a "clean" or "semi-clean" gas bleeder valve. These devices are installed after the BF dust collector and Bischoff scrubber (i.e., variable throat scrubber that allows BF top pressure to be adjusted and maintained in response to furnace conditions). If a slip or sudden surge of pressure occurs, the clean gas bleeder valve opens allowing the cleaner BF gas to be vented to the atmosphere first rather than opening the dirtier gas bleeder valves on the BF uptakes. Most existing furnaces have clean gas bleeders and all new furnaces have them. For older furnaces, the clean gas bleeder valve can be retrofit. However, the cost could be considerable to install clean gas valves on older existing furnaces.

4.2 Control of HAP UFIP Emissions from BF Planned Openings

A procedure for establishing the lowest possible internal pressure before opening bleeder valves was developed by EPA Region 5 to ensure visible emissions are minimized to the greatest extent possible. See **Appendix E** for example language for planned opening standard operating plan (PSOPL). Some II&S facilities have used a similar procedure to reduce the pressure before they open the bleeder valves and this practice has significantly reduces emissions. It may be possible for all II&S facilities to perform this evaluation or a similar evaluation at each of their furnaces to minimize emissions during dirty gas bleeder valve planned openings. If opacity levels are already too high, operators should reevaluate the sequence and timing of steps when bringing a BF down for maintenance via a planned bleeder valve opening. Based on EPA enforcement experience, the most critical points in opening dirty gas bleeder valves are when the fuel is stopped, the input air is stopped, and/or when there is high internal BF pressure.

Work practices that can be done by facilities to avoid excess emissions during shut down and before planned openings of dirty gas bleeder valves include the following:

- Tap as much liquid (iron and slag) out of the furnace as possible;
- Remove fuel and/or stop fuel injection into furnace;
- Reduce air/wind to 5 pounds per square inch (psi) bottom pressure; and
- Add steam into system at various places when there is insufficient draft, mostly near the scrubber and dust catcher (PM control)

4.3 Control of HAP UFIP Emissions from BF Bell Leaks

It is estimated that the small and large bell seals are repaired or replaced regularly, with large bells replaced about every 5 years with a number of small bell repairs during this time period. Significant leaks can occur if the seals on both bells are not repaired or replaced in a timely manner, and as needed for high wear situations. Leaking of large bell seals at the furnace/bell seal interface can be visible to an observer. Therefore, one control technique would be to monitor the furnace/bell seal interface for visible emissions (VE) on a regular basis with the plan to replace the bell seals as soon as leaks are visible.

Based on EPA Region V experience with the II&S industry, an additional repair of at least one small bell seal every 10 years would reduce PM and HAP metal emissions from a BF. For large bells, replacing the seals at least 3 months sooner would reduce PM and HAP metal emissions from a BF. This replacement rate results in 4.2 large bells seals every 20 years or 1 additional large bell seal every 100 years.

4.4 Control of HAP UFIP Emissions from BF Casthouse

The opacity limit in the II&S NESHAP for monitoring fugitive PM and HAP emissions BF casthouse is less than 20 percent during thirty 6-minute tests, as 6-minute averages, from any opening in the casthouse, and between the casthouse and the furnace shell during tapping (once per Title V permit cycle, e.g., 5 years or every 2.5 years without a Title V permit). To better monitor fugitive emissions, opacity could be measured more often during events expected to produce high opacity, such as tapping, where opacity could be monitored 4 taps per week from casthouse roof vents. In order to determine the true emissions, all other openings to the casthouse should be closed. Use of EPA Method Alt-082 (DOCS) rather than EPA Method 9 would ensure accurate emissions are measured and would reduce the amount of facility labor needed to take the measurements.

In addition, preventive measures can be done to reduce generation of emissions that contribute to opacity. These measures include keeping iron and slag runner covers in place at all times except when runner or cover is being repaired or removed for inspection purposes (2-hour repair limit).

To identify all potential opacity sources and measures to reduce fugitive emissions, the facility could develop and operate according to a “BF Casthouse Operating Plan” to minimize fugitive emissions, to include:

- Identification of each opening in casthouse;
- Number of opacity readers needed and method of making observations;
- Locations and status of each runner cover;
- Schedule for inspection of casthouse for openings and leaks above 12 feet high, where all openings are closed (except for roof monitor) during the opacity observations;
- Procedures to ensure all doors and other openings are closed during all transfer operations; and
- Procedures to ensure that runner covers are in place on top of runners at all times except when runner or cover is being repaired or removed for inspection purposes (specify a repair or observation limit, such as 2 hours).

4.5 Control of HAP UFIP Emissions from Beaching of Iron from BFs

Methods of controlling beaching emissions include enclosing the process, using fume suppressants, or granulation. Granulation[2] of the excess hot metal produces a by-product, granulated pig iron, that can readily be used internally; for example, as BOPF coolant, or sold to third parties as feedstock for electric arc furnaces, cupolas and induction furnaces. (IIMA, 2019). Granulation is also used for slag processing. Application of

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[2] In granulation, liquid iron is rapidly quenched in water, and then discharged as solidified and cooled particles. Dewatering is then done before transport to storage.

granulation has capital and operating costs that can be offset by proceeds from sale of the granulated product. No air emissions result from the use of a granulator.

Enclosures that prevent beached iron fumes from being mixed with the atmosphere are used at many current II&S facilities. (AISI, 2017). These enclosures need only three sides to be effective. Due to the heat of the beached iron, having one side open to air allows for a better worker environment. Use of fume suppressants, such as atomized CO_2, can be used alone or in conjunction with enclosures.

4.6 Control of HAP UFIP Emissions from BF Slag Handling and Storage

Slag handling has multiple points of potential fugitive emissions during slag handling operations. Measuring opacity during these events will identify points in the process where attention is need and where methods to reduce fugitives are warranted. An opacity action level can be set, such as 10 percent opacity, as 3-minute average. Various methods are available to reduce methods of slag emissions. Because the slag emissions are emitted from an open outdoor area, most methods of control involve purchase of equipment, some more expensive than others. The equipment used to reduce or eliminate slag emissions includes wind screen, foggers, and granulation. These are discussed below.

Dry Fog Water Spray System--Another method is the use of (dry) fog spray systems over the pit area, where the spray is applied after each dump of slag and during all digging activities to extent feasible and safe. Dry fogging is particularly successful at controlling dust where the use of ultrasonic nozzles (and compressed air) produce a plume of very small low-mass droplets. Dry fogging controls droplet size by utilizing a special nozzle design that allows water to pass through high-frequency sound waves produced by a highly accelerated mixture of water and compressed air. The speed of the compressed air and water mixture hitting a small cup in front of the nozzle reflects the energy back into itself and creates a sonic shock wave that produces very small droplets in a cloud dispersion. (NIOSH, 2019)

The very small droplets of dry fog nozzles make this system particularly effective at knocking down respirable airborne dust because the water droplets need to be in similar size ranges to the dust particles to be effective. The intent is to have the droplets collide and attach themselves (agglomerate) to the dust particles, causing them to fall from the air. If the droplet diameter is much greater than the diameter of the dust particle, the dust particle simply follows the air stream lines around the droplet. If the water droplet is of a size comparable to that of the dust particle, contact occurs as the dust particle follows the stream lines and collides with the droplet. Therefore, for optimal agglomeration, the particle and water droplet sizes should be roughly equivalent. Water droplets in the range of 2 to 20 micrometers have been shown to be most effective.(NIOSH, 2019)

One dry fogger can control dust in a 20 ft. x 20 ft. slag pit. The dry foggers need water and compressed air, and can be equipped with a freeze protected system. Each fogger has three manifolds, with 10 nozzles per manifold for a total of 30 nozzles. A slag pit would be fogged for at minimum about 1 minute during a slag dump. Assuming there are 15 minutes between dumps, four dumps per hour, that equates to 96 dumps per day and 96 minutes of fogging per day.(DSI, 2018)

Slag Granulation--Slag can be sent to a granulator that turns slag into granules that can be used for other purposes. No air emissions result from the use of a granulator. The granulator takes the slag and blasts it with water that turns the slag into granules that have the appearance of beach sand. The slag granules are used to make concrete. Although use of slag granulation has capital and operating costs, these can be offset by proceeds from sale of the granulated product. Two current II&S facilities use granulation for one of their BFs' slag. A separate company typically owns and runs the granulator.

Wind Screens--One method to reduce slag pit fugitive PM is the use of wind screens that block the prevailing wind from disturbing the surface of the slag pit or the surface of the slag as it is dumped or removed from the pit. See photos of wind fencing from one vendor[3] of wind fences in **Appendix F**. Unlike other forms of fugitive dust control, wind fences provide continuous control of dust without the operational and maintenance costs of other methods. Once installed, there are no additional requirements for wind fences. The fence support structures are custom designed to withstand the forces of wind specific for the area located. One vendor, offers wind fabric that is designed to "break away" on the bottom and sides while still remaining attached at the top during an extraordinary wind event. This prevents, in most cases, the fabric from being damaged due to higher than specified wind speeds. The exact wind shear speed that it takes to break the wind fabric loose from the frame is custom tailored to each end users requirements and geographical location and is designed to protect the entire wind fence system from critical support failure. After the weather event has passed the wind fabric can simply be reattached to the support structure and the wind fence can be put back into service. By being designed to release part of the fabric during a high wind event the fabric is better protected from ripping and tearing if wind exceeds its maximum designed operational limits.

4.7 Control of HAP UFIP Emissions from BOPF Shop

The opacity limit in the II&S NESHAP for monitoring fugitive PM and HAP emissions BF casthouse is less than 20 percent during thirty 3-minute tests, as 3-minute averages, from any opening in the casthouse, and between the casthouse and the furnace shell during tapping (once per Title V permit cycle, e.g., 5 years or every 2.5 years without a Title V permit). To better monitor fugitive emissions, opacity could be measured more often during events expected to produce high opacity, such as tapping, where opacity could be monitored 4 taps per week from casthouse roof vents. In order to determine the true emissions, all other openings to the casthouse should be closed. Use of EPA Method Alt-082 (DOCS) rather than EPA Method 9 would ensure accurate emissions are measured and would reduce the amount of facility labor needed to take the measurements.

In addition, preventive measures can be done to reduce generation of emissions that contribute to opacity. These measures include keeping iron and slag runner covers in place at all times except when runner or cover is being repaired or removed for inspection purposes (2-hour repair limit). To identify all potential opacity sources and measures to reduce fugitive emissions, the facility could develop and operate according to a "BOPF Shop Operating Plan" to minimize fugitive emissions, to include:

- List all events that generate visible emissions (including slopping) and state the steps the company will take to reduce the incidence rate.
- Minimum hot iron pour/charge rate (minutes).
- Schedule of regular inspections of BOP Shop for openings and leaks above 12 feet high with all openings closed (except for roof monitor).
- Optimize positioning of hot metal ladles with respect to the hood face and furnace mouth.
- Optimize furnace tilt angle during charging.
- Prohibit burning material, such as bags, pallets and other material in the shop.

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[3] Dust Control Technologies, Inc. Brush Prairie, WA 98606. sales@dustcontroltech.com

- Keep all openings closed except when in use, especially during transfer operations. (Does not include roof monitors.)
- Continuously monitor opacity from all openings with EPA Method Alt-082 (camera); re-evaluate use of monitor every two years (alternative is Method 9).
- Use higher draft velocities to capture more fugitive emissions at a given distance from the hood.
- Perform a ventilation study to maximize secondary (fugitive) emissions capture by hooding.
- Install additional equipment to minimize fugitive emissions:
    - Add extension (flanges) from primary hood into charging and tapping aisles for better draft and to shorten distance to emission source.
    - Add extension of pouring spout on hot metal charging ladle to move emission point closer to or under hood.
    - Add small openings in furnace doors to allow monitoring of temperature and other parameters to avoid opening doors.
    - Add wall partitions or ducts to direct air into local hoods to prevent escape from building.
    - Add canopy hoods to enhance fugitive collection for local hoods.

4.8 Opacity Issues

4.8.1 Opacity Monitoring

Given the history of numerous opacity violations at II&S facilities at BF casthouses and the BOPF shop roof monitors, the use of a camera to measure opacity, as in EPA Alternative Method 082 (digital opacity camera system (DOCS)), taken from ASTM D7520-13, is an alternate to EPA Reference Method 9 and an improvement in the reliability and accuracy of opacity monitoring. The recently promulgated Ferromanganese RTR rule, published on June 30, 2015 (80 FR 37366), required opacity monitoring to be conducted according to ASTM D7520-13.[4] For II&S facilities, the DOCS also could be used to determine the opacity from bleeder valve openings which are difficult to observe because they are either unplanned or occur during shutdown activities. The DOCS method provides reliable, unbiased opacity readings and is an improvement in the transparency of opacity monitoring results.

4.8.2 Location of Opacity Measurements

It is commonly known to EPA inspectors that II&S facilities only read opacity at BF casthouse roof monitors and ignore emissions from openings on the sides of the casthouse and from the gap between the casthouse and the furnace. To improve the opacity monitoring from casthouses, a facility's standard operating procedures (SOP) can include identification of all openings in the casthouse that could emit opacity, identifying which openings typically have the highest opacity, and specifying which openings to be observed for opacity concurrently as a group of openings. The II&S facility SOP can identify the openings and groups of openings to be measured for opacity on a casthouse drawing; the SOP could then be reviewed and approved by their management and delegated permit authority.

When conducting Method 9 for visible emission observations of a group of openings, the reader must look at the point of highest opacity. Therefore, the EPA Method 9 or visible emission (VE) report for a group of openings might contain a "mixture" of 15-second readings, where each 15-second reading may indicate the instantaneous opacity from a location on the casthouse several feet away from other readings. It is important to note that most often there are many openings in a casthouse and it would be necessary to perform any required

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[4] For the Ferroalloys Final RTR rule (80 FR 37366), the EPA required facilities to use the DOCS once per week for one entire furnace cycle (about 90 minutes), for each furnace building. One facility had three buildings; therefore, the rule requires them to use the DOCS about 270 minutes per week for the entire facility. The EPA also stated in the rule that after 26 weeks of compliant weekly opacity readings, facilities can reduce to monthly readings.

readings in series or to use several readers for the different groups being read at the same time. While this may increase costs above the current practice, this practice will ensure opacity is measured from any and all opening in the casthouse.

The alternative method to Method 9, EPA Alt-082 (DOCS), could be used to monitor the opacity from these sources. One of the benefits of EPA Alternative 082 is that many more openings can be viewed at one time, possibly saving the company money in the long term. Also, when a DOCS is used, the images of one observation can be reanalyzed if EPA or delegated authority believes the point of highest opacity was not used in calculating the opacity. The ability to reanalyze opacity readings provides the opportunity for better agreement of observations and the casthouse opacity limit. The DOCS provides a more objective, better substantiated opacity readings compared to Method 9 and would improve transparency of opacity monitoring results.

4.9 Reductions of PM and HAP With Work Practices for II&S Nonpoint Sources

The control efficiency of the work practices at the nonpoint sources are expected to range from 50 to 80 percent based on engineering judgement and EPA experience with work practices in general. Therefore, an average value of 70 percent efficiency was used to estimate impacts of the work practices for all nonpoint sources except BOPF Shop. Because of the difficulty in implementing BOPF Shop work practices, a slightly lower control efficiency of 65 percent was used for this source. **Table 4-1** shows the estimated HAP emissions for the nonpoint sources before and after implementation of the work practices using estimates of control efficiency described above, with 295 TPY HAP before control, 100 TPY HAP after control, and 195 TPY HAP reduced

5.0 COSTS OF CONTROL MEASURES FOR UFIP EMISSIONS FROM NONPOINT SOURCES

The control measures for UFIP sources that were selected for AMOS analysis are discussed below along with the costs and emission impacts, and cost-effectiveness.

5.1 Selected Control Measures for UFIP Sources for AMOS Analysis

The following are the control measures discussed above that were selected for analysis as part of the AMOS review for nonpoint sources. Control measures that were not selected were either not well-developed or not expected to be viable for the entire II&S industry.

5.1.1 Work Practices for BF Unplanned Openings ("slips")

- Limit four slips/month. Many of the BFs in the II&S industry now operate with essentially no slips; therefore, it is not unreasonable to set a numerical limit.
    - If exceed this limit (5th slip, 1st exceedance), develop and operate according to a "Slip Avoidance Plan;"
    - Perform root cause analysis for 2nd and 3rd exceedance of monthly limit (6th and 7th slip); modify plan as appropriate and safe to decrease occurrence of slips; and
    - At 4th exceedance of monthly limit (8th slip), install additional devices to continuously measure/monitor material levels in furnace (*i.e.*, stockline), at a minimum of three locations, with alarms to inform operators of static (*i.e.*, not moving) stockline conditions which increase the likelihood of slips. Also install/use instruments on furnace to monitor temperature and pressure to help determine when a slip has occurred. This information can help operators identify potential problems and, therefore, adjust controls/actions to avoid unplanned slips. These installations and monitoring would be required within three months of 8th slip.

Table 4-1. Estimated HAP Emissions Before and after Control Using Work Practices at Nonpoint Sources at 11 II&S Facilities

Nonpoint Source	HAP Emissions (TPY)			
	Before Control	% Control	After Control	Reductions
BF Unplanned Openings	4.4	70%	1.3	3.1
BF Planned Openings	2.9	70%	0.9	2.0
BF Bell Leaks	6.1	70%	1.8	4.3
BF Casthouse Fugitives	51	70%	15	36
BOPF Shop Fugitives	226	65%	79	147
BF Iron Beaching	0.059	70%	0.018	0.042
Slag Handling & Storage	4.1	70%	1.2	2.9
Overall Total	**295**		**100**	**195**

Note: Totals may not appear to sum correctly due to rounding.

5.1.2 Work Practices for BF Planned Openings

- Limit opacity to 10 percent, as 3-minute average;
- Develop and operate according to a “Dirty Gas Bleeder Valve Opening Plan” to meet opacity limit;
- Idling preparation activities:
    - Tap as much liquid (iron and slag) out of furnace as possible;
    - Remove fuel and/or stop fuel injection into furnace; and
    - Establish and use lowest bottom pressure possible, according to EPA-specified procedures.

5.1.3 Work Practices for BF Bell Leaks (defined as opacity >10 percent for > 45 seconds total)

- Limit opacity to 10 percent, as average of three consecutive observations made 15 seconds to 5 minutes apart at any location at the top of the furnace (*i.e.*, small bell or inter-bell relief valve);
- Observe BF top for VE monthly to identify beginning of leaks; measure opacity if VE positive;
- Maintain metal seats of large and small bells to minimize wear on seals; and
- Repair/replace seals within 4 months if fail to meet limit.

5.1.4 Work Practices for BF Casthouse Fugitives

- Develop and operate according to a “BF Casthouse Operating Plan” to minimize fugitive emissions and detect openings and leaks;
- Measure opacity frequently during the tapping operation (*e.g.*, during four taps per month) with all openings closed (except for roof monitor) using EPA Method Alt-082 (camera) or Method 9;
- Keep doors and other openings, except roof monitors, closed during all transfer operations to extent feasible and safe; and
- Keep runner covers in place at all times except when runner or cover is being repaired or removed for inspection purposes (2-hour repair or observation limit).

5.1.5 Work Practices for BF Iron Beaching

- Limit opacity to 20 percent, as 6-minute averages continuously measured during entire beaching event;
- Minimize height, slope, and speed of beaching; and
- Use carbon dioxide shielding during beaching event; and/or use full or partial (hoods) enclosures around beached iron.

5.1.6 Work Practices for BF Slag Handling and Storage Operations

- Limit opacity to 10 percent, as 3-minute average; and
- Use of fog spray systems over pit area, applying spray after each dump of slag and during all digging activities to extent feasible and safe.

5.1.7 Work Practices for BOPF Shop Fugitives

- Develop and operate according to a "BOPF Shop Operating Plan" to minimize fugitive emissions and detect openings and leaks;
- BOPF Shop Operating Plan may include:
    - List of all events that generate visible emissions (VE), including slopping, and steps company will take to reduce incidence rate;
    - Minimize hot iron pour/charge rate (minutes).
    - Schedule of regular inspections of BOPF shop structure for openings and leaks to the atmosphere;
    - Optimize positioning of hot metal ladles with respect to hood face and furnace mouth;
    - Optimize furnace tilt angle during charging;
    - Keep all openings, except roof monitors, closed, especially during transfer, to extent feasible and safe;
    - Use higher draft velocities to capture more fugitives at a given distance from hood, if possible; and
- Monitor opacity periodically (*e.g.*, once per month) from all openings with EPA Method Alt-082 (camera) or with EPA Method 9.

5.2 Costs of Work Practices for UFIP Sources

Equipment and operating costs for the work practices to control UFIP emissions were obtained from vendors of equipment, as available, or were estimated using good engineering judgement (GEJ) along with experience with the industry. Similarly, labor estimates were based on EPA experience with the tasks needed to be performed to either operate equipment or perform VE and opacity tests. **Table 5-1** shows the estimated labor, capital, and annual costs of the work practices for the II&S industry based on the unit costs and the number of units at the facilities in the industry (shown in **Appendix C).** The labor, capital, and annual costs for the work practices for one emission unit used to develop the industry estimates in **Table 5-1** are shown in **Appendix G** along with individual cost factors used in the estimates. Details of the costs for the identified control measures for the seven UFIP sources are discussed in the technical memorandum cited above and titled *Cost Estimates and Other Impacts for the Integrated Iron and Steel Risk and Technology Review*, available in the docket to this rule. (EPA, 2019b)

The estimated effectiveness of the work practices for each nonpoint source to reduce HAP emissions and the costs are combined in a ratio to produce a cost-effectiveness factor. **Table 5-2** shows the cost-effectiveness (CE) of control of HAP emissions at each nonpoint source using the work practices described above and the HAP emission reductions shown in **Table 4-1**. The CE values ranged from $3,412 per ton HAP removed (BOPF Shop Fugitives) to $2,392,592 per ton HAP removed (BF Iron Beaching) with an overall cost-effectiveness for all seven nonpoint sources at $15,643/ton HAP. **Table 5-3** shows the breakdown of costs

Table 5-1. Total Costs of the Work Practices for Nonpoint Sources in the II&S Industry

Nonpoint Source	Total Industry Costs		
	Labor	Capital	Annual
BF Unplanned Openings	$53,456	$1,200,000	$197,747
BF Unplanned Openings	$59,205	--	$59,205
BF Bell Leaks	$24,734	$5,000,000	$555,771
BF Casthouse Fugitives	$348,548	$960,000	$1,183,981
BOPF Shop Fugitives	$82,825	$480,000	$500,541
BF Iron Beaching	$29,680	--	$99,494
Slag Handling & Storage	$238,309	$1,100,000	$451,602
Total Costs	**$836,757**	**$8,740,000**	**$3,048,342**

Table 5-2. Cost-Effectiveness of Work Practices at Nonpoint Sources at 11 II&S Facilities

Nonpoint Source	Annual Costs	HAP Reductions (TPY)	Cost Effectiveness $/ton HAP removed
BF Unplanned Openings	$197,747	3.1	$63,962
BF Planned Openings	$59,205	2.0	$29,605
BF Bell Leaks	$555,771	4.3	$130,680
BF Casthouse Fugitives	$1,183,981	36	$32,960
BOPF Shop Fugitives	$500,541	147	$3,412
BF Iron Beaching	$99,494	0.042	$2,392,592
Slag Handling & Storage	$451,602	2.9	$157,167
Overall Total	**$3,048,342**	**195**	**$15,643**

Table 5-3. Costs and Impacts of Control Scenarios for Nonpoint Sources at II&S Facilities

Item	Labor	Capital	Total Annual Costs	HAP Reductions (TPY)	CE $/ton HAP[c]
Two UFIP[a]	$431,373	$1,440,000	$1,684,522	183	9,225
Five UFIP[b]	$405,384	$7,300,000	$1,363,819	12	111,248
All Seven UFIP	$836,757	$8,740,000	$3,048,342	195	15,643

[a] BF Casthouse fugitives and BOPF Shop fugitives.

[b] Other five UFIP: BF unplanned openings, BF planned openings, BF bell leaks, and BF iron beaching, and BF slag handling and storage.

[c] See **Tables 5-1 and 5-2** above for the individual values used in these combined estimates.

Table 6-1. Inhalation Risk Results for Point and Nonpoint Sources at the Example Facility

Emission Source	HAP Emissions Before Control (TPY)	Estimated Inhalation Cancer Risk	
		MIR	Percent Total MIR
BF Casthouse (fugitives)	8.6	12	50%
BOF Shop (fugitives)	39	5	21%
BF Bell Leaks	0.45	2.1	9%
BF Planned Openings)	0.48	1.2	5%
BF Unplanned Openings/Slips	0.74	0.9	4%
BF Slag Handling	0.58	0.6	2%
BF Beaching	0.0099	0.5	2%
Subtotal UFIP Sources	50	22	92%
Subtotal Point Source	53	1.9	8%
Total Facility UFIP+Point	103	24	100%

Note: Totals may not appear exact due to rounding. MIR is in-a-million.

under two control options: Option 1 for control of currently regulated sources, the BF Casthouse and BOPF Shop, at $9,225/ton HAP to reduce 183 tons of HAP; and Option 2 for control of 12 tons of HAP from the other 5 UFIP sources, at $111,248/ton HAP.

6.0 RISK ASSESSMENT OF NONPOINT SOURCES AT AN EXAMPLE FACILITY

Because of the difficulty of assessing risk at nonpoint sources at all II&S facilities, risk and reductions from work practices were assessed for an example facility, which had the highest production in the II&S industry. The example facility was considered the worst case for assessing risk from nonpoint sources because the emission factors used to estimate emissions from the nonpoint sources were in most cases based on production,. As discussed above, details of the development of emissions estimates for nonpoint sources at the example facility are described in detail in the technical memorandum cited above titled *Development of Emissions Estimates for Fugitive or Intermittent HAP Emission Sources for an Example Integrated Iron and Steel Manufacturing Facility for Input to the RTR Risk Assessment*. (EPA, 2019a)

Table 6-1 above shows the emissions and inhalation cancer risk estimated for each of the seven UFIP sources at the example facility, with risk from the point sources included for comparison. Note that the example facility has sinter plants that are 94% of the HAP emissions from this facility. Total inhalation cancer risk was 22 MIR for the seven UFIP sources at the example facility compared to approximately 2 MIR for the point sources. The risk for the seven UFIP sources ranged from 0.5 MIR (BF beaching) to 12 MIR (BF Casthouse for a total of 24 MIR as compared to the approximately 2 MIR for point sources.

Table 6-2 shows the risk before and after control for three control options for the UFIP sources: (1) all seven UFIP, (2) two regulated UFIP sources (BF casthouse and BOPF Shop), and (3) the five remaining UFIP sources. In every modeling scenario, the point source emissions and risk were included. The reductions with these three control options for nonpoint sources are 63 percent (7 UFIP), 50 percent (2 UFIP), and 13 percent (5 UFIP), respectively, for actual emissions; and 32 percent (7 UFIP), 26 percent (2 UFIP), and 6 percent (5 UFIP), respectively, for allowable emissions. The allowable emissions from the nonpoint sources are the same as actual emissions because there is no regulation for UFIP emissions, whereas the point source emissions increase under allowable scenario

7.0 CONCLUSIONS

There are many uncertainties in the baseline UFIP emissions, the estimated reductions from the work practices, and the control costs. There are also uncertainties regarding the effect the WPs would have on facility operations, economics and safety. After considering all the information described above, the EPA has not proposed any standards for these nonpoint sources under ample margin of safety. However, we are asking for comments in the proposed rule on the various control options on this issue that we will consider before finalizing the rule.

Table 6-2. Risk Results with Various Control Scenarios for Nonpoint Source

Emissions	Example Facility Emission Sources[a]	Inhalation Risk[b]							
		Chronic Cancer				Chronic Noncancer		Acute Noncancer	
		MIR	Incidence	Pop >1	Pop >10	MIR (HI)	Target Organ	Max (HQ)	HAP
Actual	Point Sources Only	2	0.010	3,000	0	0.03	Developmental	0.3	Arsenic
	7 Nonpoint & Point Sources	24	0.12	4,000,000	9,000	0.3	Developmental	3.3	Arsenic
	5 NP *Controlled*	21	0.11	4,000,000	4,000	0.3	Developmental	1.7	Arsenic
	2 NP *Controlled*	12	0.058	1,500,000	800	0.2	Developmental	1.7	Arsenic
	7 NP *Controlle*d	9	0.044	800,000	0	0.1	Developmental	0.9	Arsenic
Allowables	Risk for Point Sources Only	25	0.13	4,000,000	11,000	0.3	Developmental	-	-
	7 Nonpoint & Point Sources	47	0.24	4,000,000	90,000	0.7	Developmental	-	-
	5 NP *Controlled*	44	0.23	4,000,000	70,000	0.6	Developmental	-	-
	2 NP *Controlled*	35	0.18	4,000,000	40,000	0.5	Developmental	-	-
	7 NP *Controlle*d	32	0.17	4,000,000	30,000	0.4	Developmental	-	-

[a] The seven nonpoint sources are as follows: BF Unplanned Openings (Slips); BF Planned Openings; BF Bell Leaks; BF Casthouse Fugitives; Beaching of Iron from BFs; BF Slag Handling and Storage; BOPF Shop Fugitives. The two nonpoint sources in one control scenario are the BF Casthouse Fugitives and BOPF Shop Fugitives; the 5 nonpoint sources controlled in the other scenario are the remaining five nonpoint sources from the above lists.

[b] MIR = in-a-million.

8.0 REFERENCES

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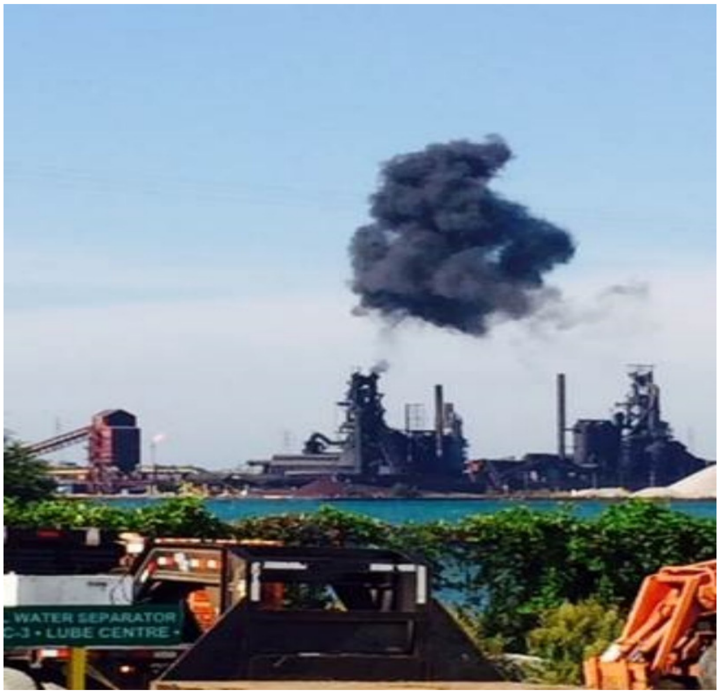
APPENDIX A:
PHOTOGRAPHS OF UFIP EVENTS

Bell Leaks

Beaching

BF Slips



APPENDIX B:
PM EMISSION FACTORS USED TO ESTIMATE EMISSIONS FROM II&S NONPOINT SOURCES

Table B-1. PM Emission Factors for II&S Nonpoint Sources and Estimated Nonpoint Emissions by Source and Facility Type

Nonpoint Source	PM Emissions per Emission Unit and Total Facility								Frequency[b]		Activity Factors		
	Emission Factors[a]		Example Facility (TPY)			Average Facility (TPY)							
	Factor	Units of Measure	Per Unit	No. Units	Total Facility	Per Unit	No. Units	Total Facility			Example Facility	Average Facility	Units (TPY)
BF Unplanned Openings	206	lb/slip	4.9	4	20	4.9	2	9.9	48	slips/yr	by unit (4)		
BF Planned Openings	41	lb/opening	3.2	4	13	3.2	2	6.4	156	open/yr	by unit (4)		
BF Bell Leaks	0.012	lb/ton iron	7.8	2	16	7.8	1.9	15	continuous		5,121,867	2,555,619	iron
BF Casthouse Fugitives	0.10	lb/ton iron	64	4	256	64	2	128	continuous		5,121,867	2,555,619	iron
BOPF Shop Fugitives		lb/ton steel	607	2	1,214	571	1	571					
BOPF Top Fugitives	0.29	lb/ton steel	418	2	837	431	1	431	continuous		5,871,382	3,026,608	steel
Tapping Steel	0.046	lb/ton steel	68	2	135	70	1	70	continuous		5,871,382	3,026,608	steel
Iron Sources	0.095	lb/ton iron	121	2	242	121	1	121	continuous		5,121,867	2,555,619	iron
Charging	0.030	lb/ton iron	38	2	77	38	1	38	continuous		5,121,867	2,555,619	iron
Hot Metal Transfer	0.0095	lb/ton iron	12	2	24	12	1	12	continuous		5,121,867	2,555,619	iron
Desulfurization	0.055	lb/ton iron	70	2	141	70	1	70	continuous		5,121,867	2,555,619	iron
BF Iron Beaching	0.19	lb/ton	0.067	4	0.27	0.067	2	0.13	700	TPY[b]	by unit (4)		
Slag Handling & Storage	0.29	lb/ton slag	57	3	172	45	1.8	81	continuous		1,580,467	617,442	slag

[a] The derivation of these emission factors are described in the memorandum entitled *Development of Emissions Estimates for Fugitive or Intermittent HAP Emission Sources for an Example II&S Facility for input to the RTR Risk Assessment*. (EPA, 2019a)

[b] Unplanned openings were estimated at an average of 4 slips/mo, 48 slips/yr. Planned Openings were estimated at 3 per week, 156 per year. The amount of iron beached was the annual average of industry data over seven years: 2003-2009, 4,827 tons (AISI, 2017).

APPENDIX C:
INDUSTRY EMISSION UNIT COUNTS AND PRODUCTION

Table C-1. Number of Nonpoint Emission Units per Facility Type and Total Industry

Nonpoint Source	Number of Emission Units			
	Example Facility[a]	Average Facility[b]	10 Average Facilities[b]	Total 11 II&S Facilities[c]
BF Unplanned Openings	4	2	20	24
BF Planned Openings	4	2	20	24
BF Bell leaks	2	1.8	18	20
BF Casthouse Fugitives	4	2	20	24
BOPF Shop Fugitives	2	1	10	12
BF Iron Beaching	4	2	20	24
Slag Handling & Storage	3	1.9	19	22

[a] The Example Facility has one BF with a granulator instead of a slag pit and two BF without bells therefore the number of physical units were reduced appropriately to estimate nonpoint emission units.

[b] The Average Facility is based on the average number of installed units in the industry, excluding the Example Facility, and adjusting for two BFs without bells and one BF with a granulator for its slag (and, therefore, no slag handling and storage).

[c] The total II&S industry includes the example facility and ten other II&S facilities represented by the average facility.

Table C-2. II&S Industry Units per Facility (from 2011 II&S ICR)

Facility		No. BOPF Shops	No. BF
Facilities Included in "Average" Facility	AKS-Ashland-KY	1	1
	AKS-Middleton-OH	1	1
	AM-BurnsHarbor-IN	1	2
	AM-Cleveland-OH	2	2
	AM-IndianaHarbor-E	2	1
	AM-IndianaHarbor-W	1	2
	Sev-Dearborn-MI	1	1
	USS-Braddock-PA	1	2
	USS-Ecorse-MI	1	2
	USS-GraniteCity-IL	1	2
	Total of Average Facilities	**12**	**16**
	Average Facility	1.2	1.6
	RTR Average Facility	1	2
Example Facility	USS-Gary-IN	2	4
	RTR Example Facility	2	4

Table C-3. II&S Industry Production (2011 II&S ICR) for Average and Example Facilities

Facility[a]	Production Reported in ICR (TPY)		
	Steel	**Iron**	**Slag[b]**
AKS-Dearborn-MI	2,352,571	1,985,570	398,921
AM-BurnsHarbor-IN	5,086,692	4,511,898	702,427
AM-Cleveland-OH	2,549,770	2,259,884	587,835
AM-IndianaHarbor-E	4,410,788	3,925,597	1,140,254
AM-IndianaHarbor-W	1,209,884	2,004,807	536,434
USS-Braddock-PA	2,701,327	2,253,630	470,994
USS-Ecorse-MI	3,212,678	2,678,997	638,471
USS-GraniteCity-IL	2,689,151	2,229,682	468,233
Average 8 facilities	**3,026,608**	**2,731,258**	**617,946**
Example Facility			
USS-Gary-IN	5,871,382	5,121,867	1,580,467

[a] Production for two AK Steel facilities was claimed as confidential; therefore, the average facility is based on only eight facilities.

[b] Two facilities, AM-Indiana Harbor -E and USS-Gary, have slag from one of their BFs sent to a slag granulator that does not generate emissions. Therefore, the PM emissions from Slag Pits for these facilities reflect the remaining slag in pits, at 0 and 1,071,844 tons slag, respectively.

APPENDIX D:
COMPONENTS IN A STANDARD OPERATING PLAN TO REDUCE UNPLANNED BLEEDER OPENINGS (USOPL)

Alarms, Operational and Maintenance Procedural Changes

- Create acceptable ranges and alarms for top temperature (minimum temperature assumed to be above 212°F), pressure differential across the burden, stockline movement (descent rate), and rate of charges (how many charges over a one hour period).
- Revise SOPs to dictate the steps to address alarms and potential bridging in burden, including when to, and how to, check the furnace.
- Create or review an USOPL that instructs operators how to change burden distribution when burden descent problems are found, such as changing charging sequence, armor position, bell opening speed, and/or bell opening depth.

Raw Material Practices

- Review effectiveness of the screening equipment for raw materials.
- Ensure weighing systems for coke, pellets and PCI are calibrated and accurate.
- Ensure there is a moisture sensor in the cold blast and measurement of all sources of moisture into the furnace and that these instruments are accurate and maintained.
- Review purchasing specifications of raw materials to ensure purchasing department purchases quality materials, and take a larger number of samples to confirm actual delivered material meets specs.
- Develop or review the SOP for raw material selection (e.g. from where in the pile given atmospheric conditions), raw material blending procedures for raw materials that do not meet minimum specifications or are of poor quality, and screening procedures. Include actions to take when using Destock coke.
- Review the number and appropriateness of instruments and alarms in the gas cleaner system to reduce the number of instances of high back pressure and thus high top pressure.

BF Monitoring and Control Equipment

- Install modern (microwave) stockline monitoring equipment. Several microwave monitors ensure accurate reading of entire top of burden.
- Install “profile meter” and “in-burden probe” to gather data necessary to assess conditions in the furnace.
- Develop and install furnace software/models to analyze meter and probe data and make changes to charging sequence to mitigate furnace conditions that lead to instability.
- Install clean gas bleeder valve.
- Upgrade or install variable throat venturi system to ensure it can quickly adjust to furnace top pressure changes.
- Install “movable armor” to allow for accurate burden distribution.
- Install “bell-less top” to allow for accurate burden distribution.

Table D-1. Example Components of a Standard Operating Plan To Reduce Unplanned Bleeder Openings (USOPL)

Category	Components of Unplanned Opening Standard Operating Plan (USOPL)
Furnace Top	Two bell system
	Bell-less top
Normal Operations	Normal range of top temperature
	Normal range of burden pressure differential (dP)
	Normal burden descent pattern
	Normal charge rate (number of charges per hours)
	Charging (e.g., speed of large bell opening, how far open)
Alarms for Abnormal Conditions	Alarms for top temperature deviations
	Alarms for burden dP deviations
	Alarms for stockline movement (e.g., failure to descend at normal rate, ft/min)
	Alarms if skip car cannot dump (waiting for burden to descend)
	Alarm for permeability deviations
Correcting Abnormal Conditions	Top temperature deviations
	Burden dp deviations
	Stockline movement alarms
	Skip car not dumping issues
	Permeability deviations
	Documenting/investigating causes of abnormal condition
Monitoring Instruments	Electronic (microwave) stockline measurement
	Burden distribution instruments (profile meter or in-burden probe)
Raw Materials	Raw material handling during rain/snow (selection, screening, blending)
	Sampling pellets upon delivery
	Sampling coke upon delivery
Equipment/Computer Models	Burden distribution model
	Charging sequence model
	Permeability model
	Manufacturer of operating software
	Movable armor for burden distribution
	Variable throat venturi
	Bischoff scrubber
	Clean gas bleeder

APPENDIX E:
EXAMPLE OPERATING PLAN FOR PLANNED OPENINGS OF BF BLEEDER VALVES (PSOPL)

The purpose of the planned opening standard operating plan (PSOPL) is to minimize visible emissions during BF (BF) bleeder valve (BV) planned openings. Records should be kept on-site for 5 years and made available for inspection at any time.

1. The following items shall be recorded before, during, and after the BV planned openings as part of the PSOPL to minimize emissions:

    a. Record the time and duration of BV planned openings.
    b. Record BF operating parameter data during the period that the facility is preparing for a planned opening and during the time of the BV opening itself, including which bleeder opened, top pressure and hot blast pressure leading up to and during the opening;
    c. Identify and record the primary operational reason for each BV planned opening (i.e., scheduled maintenance, production adjustments, burden adjustments);
    d. Evaluate and record operationally acceptable ranges of top pressure and hot blast pressure such that visible emissions performance is optimized during BV planned opening without incurring adverse effects on safety and furnace operations. The facility will determine what it deems adverse effects and operationally acceptable.
    e. Perform visible emission (VE) readings according to Method 9, 22, or EPA Alternative Method 082 (DOCS[1]) protocol during all BV planned openings (regardless of duration) that occur Monday through Friday 7:00 am – 3:00 pm, excluding holidays. The facility should begin VE readings at least 15 minutes in advance of the initiation of the BV planned opening.
    f. The facility shall commence the visible emission observations upon opening of the BV and continue such observations for at least 10 minutes. At the end of the ten-minute period, if there are visible emissions greater than 10 percent in a six-minute average, the facility shall continue to take the observations for at least one hour or until visible emissions are less than or equal to 10 percent for three continuous minutes.

2. As part of the recordkeeping for the PSOPL, the facility also should state its findings and conclusions, including, but not limited to, the items outlined below:

    a. Detailed description of process variables that could have a material impact on opacity from bleeders during BV planned openings, including, the blast pressure at which the bleeders open, the period between ceasing fuel input and opening the bleeders, and the period between opening the bleeders and isolating the stoves/blast; and
    b. Detailed description of the operationally acceptable ranges of top pressure and hot blast pressure such that visible emission performance is reduced to the greatest extent practicable. The facility should state with specificity the basis for the lowest pressure in the operationally acceptable range and why an even lower pressure is not operationally acceptable.

(continued)

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[1] Digital opacity camera system (DOCS).

c. In the event that a 10 percent, 6-minute average opacity is exceeded, facilities should submit a compliance demonstration report that includes the information stated above and results of all VE readings. On the occasion of the third BV planned opening that results in visible emissions greater than 10 percent in a six-minute average, the facility is required to use the DOCS prior to any BV planned opening, during the planned opening, and to continue until opacity is less than or equal to 10 percent in a six-minute average. On the occasion of the fifth BV planned opening that results in visible emissions greater than 10 percent in a six-minute average, the facility shall install a DOCS in the area of the BV for 24-hour observations for a 6-month period. At the end of this period, if no exceedances of the 10 percent six-minute averages occur, the DOCS can be removed.

APPENDIX F:
PHOTOS OF WIND FENCES FOR SLAG PIT DUST CONTROL

The following are photographs of wind fences in various applications for dust control from one vendor of wind fences. http://dustcontroltech.com/products/industrial-wind-fences

DCT
Dust Control Technologies, Inc.

360-256-2479 | **sales@dustcontroltech.com**

Home Products About Us Blog Contact Us

Industrial Wind Fencing

Wind Fences for the control of fugitive dust

Wind Fencing

DCT has been a distributor with WeatherSolve Structures, Inc. since 1998. We design, sell and install the Wind Fences. Wind fencing controls windblown fugitive dust and stockpile degradation for the mining and bulk material handling industries.

WeatherSolve™ Structures
PRODUCTIVE ENVIRONMENTS FOR ALL WEATHERS

Each wind fence system is custom engineered, designed, built and installed for your specific geographical area and wind patterns. This maximizes their effectiveness for your exact situation and control requirements. Whether you are trying to prevent product loss, airborne dust pollution, protecting process transfer points or virtually any other wind driven problems. Right down to protecting people, crops or processes like welding and cutting from exposure to the wind driven elements.

Why use Wind Fences?

Unlike other forms of fugitive dust prevention tools in the industry, wind fences provide reliable control of dust and product loss without all of the operational and maintenance costs. Once installed they require no power, compressed air, water, daily maintenance and, in most cases, no spare parts to keep the Wind Fence operating 24/7 every day, 365 days a year. Wind fences just work all day, every day.

The support structures are custom designed to withstand the forces of wind for your specific area. The Wind fabric is designed to “break away” on the bottom and sides, while still remaining attached at the top during an extraordinary wind event. This prevents, in most cases, the fabric from being damaged due to higher than specified wind speeds. The exact wind shear speed that it takes to break the wind fabric loose from the frame is custom tailored to each end users requirements and geographical location and is designed to protect the entire Wind Fence system from critical support failure. After the weather event has passed the wind fabric can simply be reattached to the support structure and the Wind Fence can be put right back into service. By being designed to release part of the fabric during a high wind event the fabric is better protected from ripping and tearing as the wind exceeds its maximum designed operational limits.

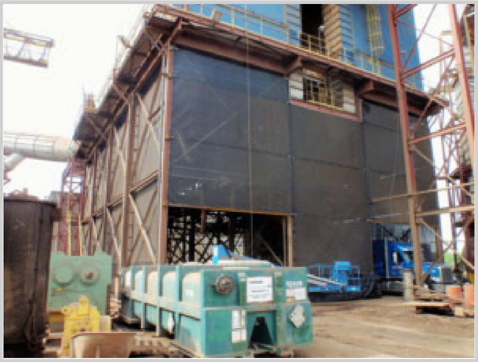
Other Wind Control Options

In addition, **DCT** has developed a temporary welding screen as well as a screen that can be stretched between the receiver hitches of two pickup trucks for job-site wind control. These systems are easy to setup and transport from site to site and have proven invaluable for keeping personnel and processes sheltered from the wind while working in the field.

These Wind Fence systems have been proven to work very well in conjunction with **DCT** Dry Fog based systems, for the drastic reduction or elimination of fugitive dust in conveyor/process transfer points, loading/unloading areas as well as many other process and operating areas.

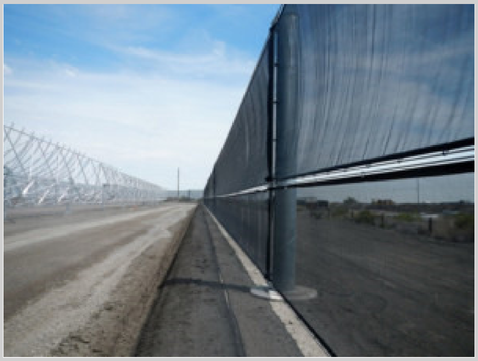
Please see our section on **DCT** Dry Fog and Water Spray systems for more information on these types of applications and how they can fix your Fugitive Dust Issues.

Wind Fencing Gallery



Building Protection

Complete Stockpile Enclosure



Facility Protection

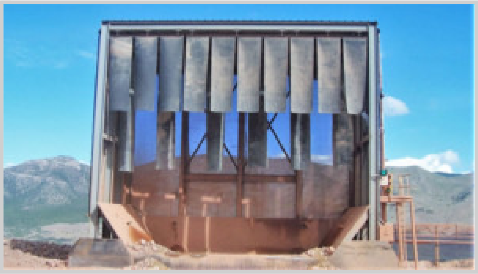
Floating Wind Fence

Port Handling Facility

Process Area Application

Process Area Application

Quarry Hopper

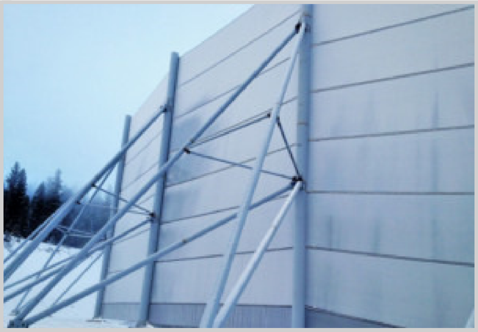


Quarry Hopper

Quarry Hopper

Stockpile Application


Stockpile Wind Fence


Wind Fence


Wind Fence Installation

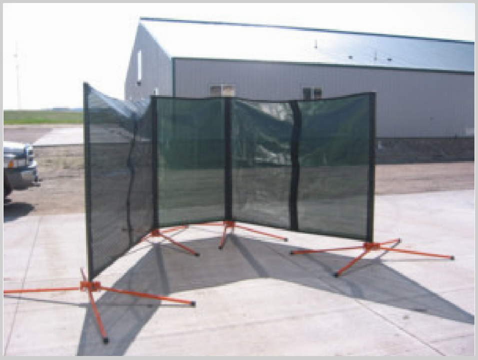

Wind Fence Port Facility

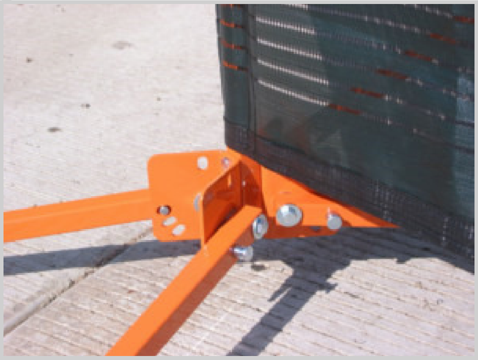

Wood Waste

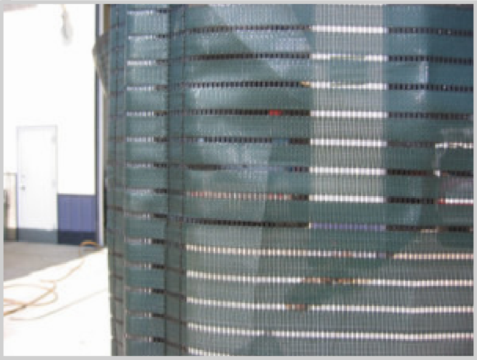

Wood Waste Dump Pocket


GIIC-Bahrain

Portable Welding Jobsite Wind Screens


Portable Welding Screen


Welding Screen Stand


Wind Fabric

APPENDIX G:
COST FACTORS AND ESTIMATES FOR NONPOINT SOURCES

Estimated Emission Unit Costs of Work Practices at Nonpoint Sources

Nonpoint Source	Emission Unit Costs[a]			
	Annual Labor	Capital	Annual Operating and Annualized Capital[b]	Total Annual[c]
BF Unplanned Openings	$2,227	$50,000	$6,012	$8,239
BF Planned Openings	$2,467	--	--	$2,467
BF Bell Leaks	$1,237	$250,000	$26,552	$27,789
BF Casthouse	$14,523	$40,000	$34,810	$49,333
BOPF Shop	$6,902	$40,000	$34,810	$41,712
BF Iron Beaching	$1,237	--	$2,909	$4,146
Slag Handling & Storage	$10,832	$50,000	$9,695	$20,527
Total Emission Unit Costs	**$39,425**	**$430,000**	**$114,787**	**$154,212**

[a] See **Appendix G** for details of unit cost estimates, including capital, operating and labor costs.

[b] Includes equipment operating and annualized capital costs.

[c] Total annual costs are the sum of annual labor, and annual operating and annualized capital costs**.**

Summary of Annualized Capital & Annual Operating Costsfor Nonpoint Work Practices at One Unit[a]

Cost Item[b]	Nonpoint Source									Comments[d]
	Unplanned Openings	Planned Openings	Bell Leaks		BF Casthouse	BOP Shop	Beaching		Slag	
			Small	Large			Enclosure[c]	Fume Control		
Capital Costs										
Total Capital Investment (TCI)	$50,000	$0	$50,000	$200,000	$40,000	$40,000	$0	$0	$50,000	See individual worksheets for details of cost items.
Capital Recovery Factor (CRF)	0.080243	NA	0.129505	0.050383	0.080243	0.080243	NA	NA	0.080243	[(IN*(1+IN)^LIF)/((1+IN)^LIF-1)]*TCI,[e] 5% interest (IN)[f]
Total Capital Recovery (TCR)	$4,012	$0	$6,475	$10,077	$3,210	$3,210	$0	$0	$4,012	TCI*CRF
Administrative charges (ADM)	$1,000	$0	$1,000	$4,000	$800	$800	$785	$0	$1,000	2%*TCI.
Property taxes (TAX)	$500	$0	$500	$2,000	$400	$400	$392	$0	$500	1%*TCI
Insurance (INS)	$500	$0	$500	$2,000	$400	$400	$392	$0	$500	1%*TCI
Annualized Capital Cost, $/yr	$6,012	$0	$8,475	$18,077	$4,810	$4,810	$1,569	$0	$6,012	TCR+ADM+TAX+INS
Operating Costs										
Control device specific costs	NA	NA	NA	NA	NA	NA	NA	$947	$3,683	See individual worksheets for cost items.
Consulting Costs, $/yr.	NA	NA	NA	NA	$30,000	$30,000	NA	NA	NA	See individual worksheets for cost items.
Total Annual O&M Cost, $/yr[a]	$0	$0	$0	$0	$30,000	$30,000	$0	$947	$3,683	Control device + consulting.
Total Annualized Capital Costs, $/yr	**$6,012**	**$0**	**$8,475**	**$18,077**	**$34,810**	**$34,810**	**$1,962**	**$947**	**$9,695**	Annualized capital + Annual O&M
			$26,552				**$2,909**			

[a] NA = Not applicable. Complete description of costs located in the individual worksheets. Labor is addressed separately in Labor Worksheet.

[b] No maintenance (or overhead), electricity, or waste disposal are needed and, therefore, are not shown.

[c] Administrative costs, taxes, and insurance for beaching enclosure built from on-site materials are based on costs for a purchased unit.

[d] Cost procedures from EPA Cost Manual at https://www.epa.gov/sites/production/files/2017-12/documents/epaccmcostestimationmethodchapter_7thedition_2017.pdf

[e] See individual worksheets for lifetime (LIF) of capital investment.

[f] Interest rate taken from https://fred.stlouisfed.org/series/PRIME. December 31, 2018.

Worksheet for Capital Costs of Nonpoint Source Work Practices for Blast Furnace Unplanned Openings at One Unit

Cost Item	Cost per Unit	No. Units	Total Capital Cost	Reference
Blast Furnace Stockline (burden) Detector	$50,000	1	$50,000	Scott P. Davis, Paul Wurth Inc., Valparaiso, IN.
				TMT (Germany) radar stockline probe.
				https://www.tmt.com/measuring-technology/radar-stockline-

Note: Many facilities have some burden detectors already installed. The nonpoint source work practice is to have at least three burden detectors; therefore, some facilities may need to buy one or more additional detectors.

Worksheet for Capital Costs of Nonpoint Source Work Practices for Blast Furnace Bell Leaks at One Unit

Unit	Cost Item	Per Unit	Total	Comment
Small Bells	Small bell seal replacements	$50,000	$50,000	Basis for estimate is one additional seal replacement every 10 years.
Large Bell	Large bell seal repair	$200,000	$200,000	Current practice is one repair every 5 years, 4 repairs in 20 years. Work practice is to repair 3 months earlier for one repair every 4.75 years. New replacement rate is 4.2 replacements in 20 years; 1 additional seal in 100 years.
Total Capital Investment			**$250,000**	Bell seal repair

Worksheet for Capital and Annual Costs of Nonpoint Source Work Practices:
Measuring Opacity of Fugitives at BF Casthouse or BOPF Shop (EPA Method Alt-082 Opacity)

Cost Item	Unit Cost	Quantity	Total Cost	Frequency	One Time Costs	Annual Costs
Start-up Costs						
User Subscription (# users)	$4,995	1	$4,995	Annual	--	$4,995
Data Collection Training (# users)	$495	3	$1,485	Once	$1,485	--
User web training and online support (12 months)	$4,995	1	$4,995	Annual	--	$4,995
Site survey for camera placement	$5,000	1	$5,000	Once	$5,000	--
Travel for site survey and training	$2,500	2	$5,000	Once	$5,000	
Subtotal Start-up Cost			**$21,475**		**$11,485**	**$9,990**
Software Services						
Storage and Retrieval/100 records (# users)	$49	3	$147	Annual	--	$147
ALT 082 Certified Opacity (# images)	$25	20	$500	Annual	--	$500
Annual Opacity Lab Service Fee, one building (480 images/wk[a])	$0.75	24,960	$18,720	Annual	--	$18,720
NESHAP report with rolling high 6 minute average	$15,000	1	$15,000	Once	$15,000	
Subtotal Software Services			**$34,367**		**$15,000**	**$19,367**
Hardware						
Video camera with weather dome[b]	$3,750	2	$7,500	Once	$7,500	$0
Miscellaneous installation costs[c]	$5,000	1	$5,000	Once	$5,000	--
General purpose hand-held camera & tripod (off-shelf), as spare	$895	1	$895	Once	$895	$0
Subtotal Hardware			**$13,395**		**$13,395**	**$0**
Total Startup Capital and One-time Costs (one building)					**$39,880**	
Total Annual Service Cost (one building)						**$29,357**

[a] Based on opacity assessments for one hour twice a week, with observation @15 seconds (240 images per day). Facility worker labor assessed elsewher

[b] Assumes 20-yr life of video camera based on vendor-provided estimate.(Virtual Technology, 2019)

[c] Estimate that includes wiring, installation of network configuration and linkage from facility computers to vendor.

Worksheet for Annualized Capital Costs of Nonpoint Source Work Practices for Blast Furnace Beaching at One Unit

Part 1. Metal Shed

Cost Item	Sheet Metal Material Costs & Labor		Comments	
	In-House Metal[a]	Purchased Metal		
Capital Investment				
Total Purchased Equipment Cost (PEC)	$0	$2,382	900 sq. ft. metal, $2.45/sq.ft. (2017$)	See detailed costs in Table A.
Total Direct Installation Cost	$0	$16,848	900 sq.ft. metal, $18.72/sq.ft. (2017$)	See detailed costs in Table A.
Total Indirect Installation Cost	$0	$20,000	See detailed costs in Table 1-A.	
Total Capital Investment	$0	$39,230	See detailed costs in Table 1-A.	
Total Direct Annual Cost	**$393**	**$393**	See detailed costs in Table 1-A.	
Total Indirect Annual Cost	$1,569	$4,717	See detailed costs in Table 1-A.	
Total Annualized Capital Costs	**$1,962**	**$5,110**	See detailed costs in Table 1-A.	

Part 2. Fume Control

Cost Description	Unit Cost	Number	Total Cost	Comment
CO2 Fire Extinguisher - 20 lbs.	$307	3	$920	Local vendors.[b] No shipping costs.
Taxes	$9.20	3	$28	National average of 3 percent.
Total Annual Costs[a]	**$316**	**3**	**$947**	**Based on one event per BF.**

[a] Assumes all labor and materials for building the shed provided by the facility, with little or no maintenance needed. Labor to perform fume control assessed elsewhere under Labor Costs.

[b] Supplier for popular brand: https://www.grainger.com/product/KIDDE-Carbon-Dioxide-Fire-Extinguisher-6T548. Vendor statement: "Carbon Dioxide is an effective and clean gaseous extinguishing agent that does not leave any residue to clean up or damage equipment."

Table A. Capital Cost Assessment for Purchased Metal

Cost Item	Costs[a]	Assumptions
Capital Investment		
Purchased Equipment Cost		
Walls	\$2,205	900 sq. ft. sheet metal (15x15 ft panels: 3-sides & roof) at \$2.45/sq. ft (2017\$[b]). See Table 3.3.[a]
Total equipment cost (TEC)	\$2,205	
Freight	\$110	National average values for freight are 5 percent of the total equipment cost.
Taxes	\$66	National average values for taxes are 3 percent of the total equipment cost.
Total Purchased Equipment Cost (PEC)	**\$2,381**	
Direct Installation Cost		
Walls	\$16,848	900 sq. ft. sheet metal at \$18.72/sq. ft (2017\$[b]). See Table 3.10.[a]
Total Direct Installation Cost	**\$16,848**	
Indirect Installation Cost		
Engineering	\$5,000	See Table 3.14.[a]
Contractors	\$15,000	See Table 3.14.[a]
Compliance Test	N/A	
Total Indirect Installation Cost	**\$20,000**	
Total Capital Investment (TCI)	**\$39,229**	
Direct Annual Cost	**\$393**	Labor, 8 hr construction worker (\$23.37/hr. \$49.08/hr loaded). No costs for operating materials or waste disposal allocated to a PTE.[a]
Total Direct Annual Cost	**\$393**	
Indirect Annual Cost		
General & Administrative	\$785	2% * TCI (Included in In-house Metal costs)
Property taxes	\$392	1% * TCI (Included in In-house Metal costs)
Insurance	\$392	1% * TCI (Included in In-house Metal costs)
Subtotal Indirect Costs	**\$1,569**	**Total included in In-house Metal costs**
Capital Recovery Factor (CRF)	0.08024	((IN*(1+IN)^LIF)/((1+IN)^(LIF-1)) 20-year equipment life (LIF) and 5% interest (IN)
Capital Recovery	\$3,148	TCI x CRF
Total Indirect Annual Cost	**\$4,717**	
Total Annual Costs	**\$5,110**	

[a] Estimated using 1997\$ from EPA Cost Manual EPA/452/B-02-001. September, 2002. Chapter 3: Permanent Total Enclosures (PTEs).

Table 3.3: Cost for Different Construction Materials	Uses GDP (See Table 1-B).
Table 3.10: Cost of Wall Installation Based on Material	Uses GDP (See Table 1-B).
Table 3.14: Indirect Installation Costs	Uses GDP (See Table 1-B).

[b] Using a cost escalation factor of 1.5 from BEA (Table 1.1.9). U.S. Bureau of Economic Analysis. Accessed 12/31/18. See Table 1-B. https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey).

Worksheet For Capital and Operating Costs for Nonpoint Source Work Practices for Slag Handling and Storage at One Unit

Cost Description		Comments
Slag Pit Fogger	20 ft. x 20 ft. pit	Estimated from Google Earth.
	$50,000 per fogger	"DSI Dry Fog Dust Suppression System"
	3 manifolds, 10 nozzles per manifold (30 total)	David Gilroy, Sales Manager, Dust Solutions, Inc., Vancouver, WA. www.nodust.com. 3/27/18. Email.
	30 nozzles total	
	Freeze protected system	
	$1,000/10 nozzles maintenance per year	David Gilroy, Sales Manager, Dust Solutions, Inc., Vancouver, WA. www.nodust.com. 2/27/19. Email.
Water Use Rate	1 slag pit dump is fogged for about 1 minute. Assume 15 minutes between dumps, 4 dumps per hour 96 dumps per day 96 minutes of fogging per day 6.5 gallons water per minute for 30 nozzles 624 gallons water per day (96 min * 6.5 gal/min)	
Commercial Water Rate	$3.00/1,000 gal	Assume average commercial water rates from DOE study:[a] range $2.09 to $4.68 per 1,000 gallons.
Water Costs	$1.87/day (624 gallons) $683/yr	(624*$3)/1,000 = $1.87 $1.87*365 = $683
Other Water Costs	No customer setup fee, no water filters.	Assume already a water customer; do not need water filters because water is potable.
Electricity	No power costs.	Assume power available onsite.
Total Costs		
Capital Investment	**$50,000**	Fogging unit with three manifolds (10 nozzles per manifold)
Operating Costs	**$3,683**	Water (as a maximum cost because already using manual water spray).[b] Nozzle replacement 30 nozzle

[a] U.S. Department of Energy. "Water and Wastewater Annual Price Escalation Rates for Selected Cities Across the United States." September 2017. Figure 8: Average Commercial Water Rates by Region (2015). Accessed at:
https://www.energy.gov/sites/prod/files/2017/10/f38/water_wastewater_escalation_rate_study.pdf

[b] Assumed no additional labor to operate fogger because facilities already using manual water spray during dumping (may be labor savings).

Annual Labor Hours Breakdown for Nonpoint Source Work Practices by Worker Type per *Emission Unit*

Nonpoint Source	Hours by Work Practice Element (per year-unit)							
	Plan[a]	Oversight/Review		VE Tests[b]	Opacity Tests[a,b]	Totals		
		Manager	Workers[a]			Manager	Workers[a]	Overall
BF Unplanned Openings	20	8				8	20	28
BF Planned Openings	20	4		12		4	32	36
BF Bell Leaks		4		12		4	12	16
BF Casthouse Fugitives	20	4			208	4	228	232
BOPF Shop Fugitives	20	8	24		52	8	96	104
BF Iron Beaching		4			12	4	12	16
Slag Handling & Storage		4	12		156	4	168	172
Total Hours	**80**	**36**	**36**	**24**	**428**	**36**	**568**	**604**

[a] All hours for ”workers” are evenly distributed between the two types: industrial and environmental, for 234 hours each.

[b] VE = visible emissions tests (EPA Method 22). Opacity tests are EPA Method 9, except for BF Casthouse and BOPF Shop fugitives, which is the “camera method” (ASTM 7520-09, EPA Alternative Method 082).

Annual Cost of Labor for Work Practices at Nonpoint Sources per *Emission Unit*, by Source Type and Labor Category

Nonpoint Source	Emission Unit Annual Labor Cost ($)			Total Emission Unit Labor	
	Industrial	Environmental	Manager	Relative Hours	Cost
BF Unplanned Openings	$575	$655	$997	28	$2,227
BF Planned Openings	$920	$1,049	$499	36	$2,467
BF Bell Leaks	$345	$393	$499	16	$1,237
BF Casthouse Fugitives	$6,553	$7,472	$499	232	$14,523
BOPF Shop Fugitives	$2,759	$3,146	$997	104	$6,902
BF Iron Beaching	$345	$393	$499	16	$1,237
Slag Handling & Storage	$4,828	$5,505	$499	172	$10,832
Total Costs	**$16,324**	**$18,613**	**$4,487**	**604**	**$39,425**

Note: Detailed labor hours breakdown among labor categories are shown in tables above and below.

Annual Labor Hours by Employee Type and Task Estimated For Work Practices at II&S Nonpoint Sources per Emission Unit

Nonpoint Source	Task	Hours by Employee Type (per year-emission unit)			
		Industrial	Environmental	Manager	Total
BF Unplanned Openings	Plan	10	10		20
	Review/Oversight			8	8
	Subtotal	**10**	**10**	**8**	**28**
BF Planned Openings	Plan	10	10		20
	Review/Oversight			4	4
	VE Tests	6	6		12
	Subtotal	**16**	**16**	**4**	**36**
BF Bell Leaks	Review/Oversight			4	4
	VE Tests	6	6		12
	Subtotal	**6**	**6**	**4**	**16**
BF Casthouse Fugitives	Plan	10	10		20
	Review/Oversight			4	4
	Opacity Tests	104	104		208
	Subtotal	**114**	**114**	**4**	**232**
BOPF Shop Fugitives	Plan	10	10		20
	Review/Oversight	12	12	8	32
	Opacity Tests	26	26		52
	Subtotal	**48**	**48**	**8**	**104**
BF Iron Beaching	Review/Oversight	2	2	4	8
	Opacity Tests	4	4		8
	Subtotal	**6**	**6**	**4**	**16**
Slag Handling & Storage	Review/Oversight	6	6	4	16
	Opacity Tests	78	78		156
	Subtotal	**84**	**84**	**4**	**172**
Overall Total Hours		**284**	**284**	**36**	**604**

Notes: VE = visible emissions. Industrial and environmental employees share all tasks.