MEMORANDUM

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TO: Integrated Iron and Steel (II&S) Response to Louisiana Environmental Action Network (LEAN) Decision Project File

SUBJECT: Unmeasured Fugitive and Intermittent Particulate Emissions and Cost Impacts for Integrated Iron and Steel Facilities under 40 CFR Part 63, Subpart FFFFF

1.0 BACKGROUND AND INTRODUCTION

This memorandum describes the final standards and associated costs and emission estimates for seven unmeasured fugitive and intermittent particulate (UFIP) sources in the Integrated Iron and Steel Manufacturing (II&S) industry in the amendments to the National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR, part 63, subpart FFFFF) in response to the 2020 Louisiana Environmental Action Network (LEAN) decision. On April 21, 2020 a decision was issued in LEAN v. EPA, 955 F. 3d. 1088 (D.C. Cir. 2020) in which the Court held that the EPA has an obligation to set standards for unregulated pollutants as part of technology reviews under CAA section 112(d)(6). To comply with the LEAN decision, U.S. Environmental Protection Agency (EPA) examined the known UFIP sources for the II&S industry and is finalizing a combination of opacity limits and work practice standards to control emissions from these sources.

In accordance with section 112 of the Clean Air Act (CAA), on May 20, 2003, the 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 maximum achievable control technology (MACT) standards within eight years of promulgation. For purposes of the RTR, the EPA sent an information collection request to the II&S industry in 2011 that included a questionnaire and a source test request. The II&S information collection request was sent under the authority of section 114 of the CAA (42 U.S.C. 7414) to acquire the necessary data for the RTR. Copies of the II&S section 114 collection request and responses received by EPA are included in docket for the RTR (Docket ID #EPA-HQ-OAR-2002-0083). The EPA sent out two additional section 114 collection requests in 2022 (one in January 2022 and another in September 2022), including another questionnaire and source test requests to acquire the additional necessary data to comply with the LEAN decision. Copies of the 2022 section 114 collection requests and responses received by the EPA are included in the docket for this action (Docket ID #EPA-HQ-OAR-2002-0083).

As part of the analysis for the II&S RTR in 2019, the EPA identified seven 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 seven of the eight total II&S facilities in the current industry are located. The nonpoint sources reviewed consist of the following sources: blast furnace (BF) bleeder valve unplanned openings; 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 this effort, work practices were identified that could achieve reductions in HAP emissions and associated risks from the seven nonpoint sources. A comment request was published for these work practice standards (Docket item #EPA-HQ-OAR-2002-0083-0030), but no work practice standards were incorporated to the rule at that time. For this LEAN review, new work practices were identified based on the previous 2019 efforts, the comments received in response to the publication, new data from the 2022 section 114 collection, and public comments on the proposed rule. A description of these nonpoint sources and their estimated HAP emissions; description of the work practices as potential control measures; estimated reductions in emissions with the control measures; and costs and estimated cost-effectiveness of the control measures are discussed below.

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) were previously regulated by opacity standards in the NESHAP, where opacity is a surrogate for metal HAP.

- BF Unplanned Openings (intermittent, via bleeder valve exhaust)
- BF Planned Openings (intermittent, via bleeder valve exhaust)
- BF Bell Leaks (fugitive)
- BF Casthouse Fugitives (previously regulated fugitive)
- Beaching of Iron from BFs (fugitive)
- BF Slag Handling and Storage (fugitive)
- BOPF Shop Fugitives (previously 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. Public comments on the proposed rule indicated that unplanned bleeder valve openings occur more frequently in smaller furnaces than larger ones. 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**).

In a 1976 study (EPA, 1976), the EPA determined that the average number of unavoidable unplanned bleeder valve openings for a BF was about four per month. According to data collected from the 2022 section 114 request, some furnaces are still above the 1976 average. **Table 2-1** below shows the past performance of each of the eight II&S facilities in regard to the average number of unplanned BF bleeder valve openings per month. The range in average monthly unplanned openings per BF was from zero to over seven, with an averaging time period of one year.

Table 2-1. Rates of Unplanned BF Bleeder Valves Openings (from the 2022 Section 114 Collection)

Facility	Furnace ID	Furnace Size	Average Unplanned Openings per Month	Year
CC-BurnsHarbor-IN	C	Large	0	2021
	D	Large	0	2021
CC-Cleveland-OH	C-5	Small	4.5	2021
	C-6	Small	3.8	2021
CC-Dearborn-MI	C	Small	7.1	2021
CC-IndianaHarbor-IN	IH4	Small	0.8	2021
	IH7	Large	0.3	2021
CC-Middletown-OH	No. 3	Small	2.3	2021
USS-Braddock-PA	1	Small	2.8	2021
	3	Small	2.1	2021
USS-Gary-IN	No. 4	Small	0.9	2021
	No. 6	Small	1.3	2021
	No. 8	Small	0	2021
	No. 14	Large	0	2021
USS-GraniteCity-IL	B	Small	0.9	2019

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 release 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 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 and BOPF 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 emissions; (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 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 EMISSIONS FROM UFIP SOURCES

3.1 Opacity

Opacity data were requested through Method 9 testing for which there was no data available between 2015 and the time the 114 collection request was received. Opacity data were requested for the following sources:

- BF bleeder valve planned openings
- BF casthouse fugitives
- Beaching of iron from BFs
- BOPF shop fugitives
- BF and BOPF shop slag processing, handling, and storage

The opacity data are typically measured at every 15 seconds within a minute for the duration of testing. Tests lasted anywhere from a few minutes to a few hours. From this testing, one-minute averages, six-minute averages,[1] maximum six-minute averages, and average opacity were derived for each unit. A summary of each facility and source's count of tests, maximum six-minute average, maximum 3-minute averages for BOPFs and average opacity are provided in **Appendix B**.

Several of the facilities also submitted "previous" opacity data files per our recent 114 collection, but not all of the previous data was evaluated in this rulemaking due to the large number of previous opacity data files (most of which were PDF files and would take a long time to pull data from). Data was evaluated and reviewed from 37 of the opacity tests for BOPF shops presented in PDF files or Excel spreadsheets at Indiana

[1] Three-minute averages were calculated in place of six-minute averages for BOPF shop fugitives.

Harbor, Gary, Burns Harbor and Dearborn facilities, and 28 of the opacity tests for BF casthouses presented in PDF files or Excel spreadsheets at Indiana Harbor, Gary and Dearborn facilities. A summary of the opacity data and the number of previous opacity data files submitted by 5 facilities are provided in **Appendix B**. The remaining previous opacity data files for BOPF shops and BF casthouses will be further evaluated at a later date and opacity limits for these UFIP sources will be revised in a future rulemaking.

This opacity data was used to determine best performing facilities for each UFIP source, to set opacity limits for UFIP sources, and to calculate estimated emission reductions necessary for each facility to meet these opacity limits.

3.2 Particulate Matter and HAP Emissions

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 BF planned openings were estimated from responses to the 2022 section 114 collection, and the frequency of other noncontinuous (i.e., intermittent) nonpoint sources were estimated by EPA or the II&S 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 developed in 2019 and discussed 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) were used in this analysis for each of the UFIP sources except for bell leaks. The emission factor estimate that was provided by EPA Region V in 2019 (0.60 lb/ton iron) was based on a 1975 study (Batelle, 1975) and a 1978 EPA study (EPA, 1978), assuming a leak rate of 12 percent, Japanese BF particle sizes, 50 µm seal gaps, 1975 PM loading, and a flow at the upper end of the estimated range (30 gr/ft^3). The authors of these studies state that their estimates are based on “few available data;” that “some data has not been verified;” that “emission estimates cannot be accepted as accurate;” and that it “needs further research.” The American Iron and Steel Institute (AISI) on EPA’s 1978 task force suggested that the results from these studies were significant overestimates. Industry input on the PM emission factor for bell leaks indicated that bell leaks are rare. Subsequently, another 2019 estimate of 0.050 lb/ton iron was calculated based on this feedback by substituting a 1 percent leak rate in place of EPA Region V’s 12 percent leak rate. For the purpose of this analysis, an average of EPA Region V’s emission factor and the emission factor calculated from industry feedback (0.325 lb/ton iron) was used as the PM emission factor for bell leaks.

Additional emission reduction factors were developed by UFIP source for each facility based on work practices that are already utilized to reduce emissions at each facility. 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. Therefore, emission reduction values by work practice were developed so that the minimum achievable emission reduction factor is 0.5 for each UFIP source. Emission reduction values were estimated using engineering judgement at a low confidence level. Facilities reported information about the work practices they currently use in response to the 2022 section 114 collection, which was then used to determine the factors that were applied to each UFIP source at each facility to calculate baseline PM emissions.

Facility-wide emissions for each facility were estimated by multiplying the emission factors by the activity of each source and by the emission reduction factors. **Appendix C** shows the activity, emission reduction factors, and estimated emissions for each facility by UFIP source.

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 section

114 collection data. 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 section 114 collection 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 (EPA, 2019a).

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	79	0.037	2.9
BF Planned Openings	51	0.037	1.9
BF Bell Leaks	2,302	0.037	85
BF Casthouse Fugitives	1,240	0.037	46
BOPF Shop Fugitives	5,434	0.032	174
Beaching	0.9	0.037	0.034
Slag Handling & Storage	1,198	0.034	41
Total	**10,305**		**351**

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 in the 2019 analysis.

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.

- 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.

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 E** 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 F** 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, or is above some level of opacity (e.g., 10%).

Based on EPA Region V experience with the II&S industry, repair or replacement of the small bell seal periodically based on site-specific conditions would reduce PM and HAP metal emissions from a BF.

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 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. It is our understanding that emissions can also be reduced by minimizing the height, slope, and speed of beaching.

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 limit or action level can be set, such as 5 percent or 10 percent opacity, as 3-minute average, or 6-minute averages. 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 μm 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).

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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.

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 G**. 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 BOPF shop is less than 20 percent during thirty 3-minute tests, as 3-minute averages, from any opening in the BOPF shop, and between the BOPF shop 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 BOPF shop roof vents. To help ensure accurate opacity readings from the roof vents, all other openings to the BOPF shop should be closed. Use of EPA Method Alt-082 (DOCS) rather than EPA Method 9 could help ensure accurate opacity readings 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.

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

- Prohibit burning material, such as bags, pallets and other material in the shop.
- Keep all openings closed except when in use, especially during transfer operations. (Does not include roof monitors.)
- 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

[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.

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 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 are expected to range from 50 to 80 percent based on EPA estimates of the efficiency of work practices in general. In EPA’s 2019 estimates of the impacts of UFIP work practices for the II&S industry, an average value of 70 percent efficiency was used for most of the nonpoint sources (except for BOPF shop work practices, which was estimated at a 65 percent efficiency). However, in response to the EPA’s request for comment on those work practice standards, some comments were received that indicated these efficiency estimates were likely an overestimation. Therefore, in this analysis, the lower end of the expected control efficiency range as a sum of control efficiency from work practices already in use and control efficiency from work practices that will be implemented to comply with this rule (50 percent) was used as a default value for each source. The submitted public comments can be found in Docket ID #EPA-HQ-OAR-2002-0083. Since some of these emissions reductions are already factored into baseline emission where facilities are already implementing work practices, the emissions reductions that would be experienced as a result of work practices implemented to comply with the rule were calculated to be (Emission Reduction Factor – 0.5)*100 for BF unplanned openings, BF bell leaks, BOPF shop fugitives, BF iron beaching, and BF slag handling and storage at each facility. See **Section 3.2** for more details on the emission reduction factors that were calculated for baseline PM emissions.

More specific control efficiencies were developed for BF planned openings using opacity data that was collected in the 2022 section 114 collection request as well as the 2011 section 114 collection request. For sources that already have a maximum 6-minute opacity average that is below the proposed opacity limit, a control efficiency of zero was applied. For sources with a maximum 6-minute average above the proposed opacity limit, the percent reduction that would be needed to meet the proposed opacity limit was applied as the control efficiency, except where the percent reduction was higher than the default control efficiency value of 50 percent. Sources with a maximum 6-minute opacity average that would need greater than 50 percent reduction to meet the proposed limit were assigned the default control efficiency value of 50 percent. See **Appendix D** for the control efficiency values that were applied for each of these sources.

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 278 TPY HAP before control, 213 TPY HAP after control, and 64 TPY HAP reduced.

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

Nonpoint Source	Average % Reduction	HAP Emissions (TPY)		
		Before Control	After Control	Reductions
BF Unplanned Openings	23%	2.1	1.6	0.50
BF Planned Openings	27%	1.6	1.2	0.41
BF Bell Leaks	42%	76	45	31
BF Casthouse Fugitives	0%	46	46	0
BOPF Shop Fugitives	20%	123	97	25
BF Iron Beaching	20%	0.022	0.018	0.0035
Slag Handling & Storage	25%	30	22	7.4
Overall Total	**26%**	**278**	**213**	**64**

5.0 COSTS OF CONTROL MEASURES FOR UFIP EMISSIONS FROM NONPOINT SOURCES

The finalized control measures for UFIP sources are discussed below along with the costs and emission impacts, and cost-effectiveness.

5.1 Selected Control Measures for UFIP Sources

The following are the control measures discussed above that are being finalized. Control measures that were not selected were either not well-developed or not expected to be viable for the entire II&S industry. Additionally, opacity data for BF casthouse fugitives and BOPF shop fugitives will be further evaluated at a later date and the current opacity limits for those sources will be revised in a future rulemaking.

5.1.1 Work Practices for BF Unplanned Openings

- Develop and operate according to a “Slip Avoidance Plan” to minimize slips and submit it to EPA for approval;
- Install devices to continuously measure/monitor material levels in the 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;
- Install and use instruments on the furnace to monitor temperature and pressure to help determine when a slip is likely to occur;
- Install a screen to remove fine particulates from raw materials; and
- Limit the number of unplanned openings to 4 per year for each large blast furnace and 15 per year for each small blast furnace.
    - *Large blast furnace* means a blast furnace with a working volume of greater than 2,500 m^3.
    - *Small blast furnace* means a blast furnace with a working volume of less than 2,500 m^3.

5.1.2 *Work Practices for BF Planned Openings*

- Limit opacity to 8 percent, as 6-minute average. We received opacity data from six of the eight operating facilities for planned openings. We reviewed the maximum six-minute opacity readings for all six facilities. The average of the maximum six-minute opacity values for the best performing five facilities is 7.75 percent (rounded to 8 percent). We did not apply the standard UPL approach because that method has not been used in the past when calculating opacity limits. The current UPL approach was designed around run-by-run data, usually for 3 runs per test, and could not directly be applied to opacity 6-minute averages. We estimate that the "MACT floor" is the average of the maximum 6-minute opacity levels, which is 8 percent.

5.1.3 *Work Practices for BF Bell Leaks*

For large bells:

- Maintain metal seats to minimize wear on seals;
- Observe BF top for VE monthly to identify beginning of leaks; measure opacity if VE positive;
  - If VE are positive, conduct opacity testing monthly;
  - If opacity exceeds 20 percent, initiate corrective action within 5 business days; and
  - If the opacity exceeds 20 percent again 10 days after the initial opacity exceedance, repair/replace the seal within 4 months.

For small bells:

- Maintain metal seats to minimize wear on seals; and
- Repair or replace seals prior to the metal throughput limit that has been proven and documented to produce no opacity from the small bell.

5.1.4 *Work Practices for BF Casthouse Fugitives*

- Measure opacity frequently during the tapping operation (*e.g.*, during two taps per month) with all openings closed (except for roof monitor) using EPA Method Alt-082 (camera) or Method 9; and
- Keep doors and other openings, except roof monitors, closed during all transfer operations to extent feasible and safe.

5.1.5 *Work Practices for BF Iron Beaching*

- Minimize height, slope, and speed of beaching;
- Use carbon dioxide shielding during beaching event; and/or use full or partial (hoods) enclosures around beached iron; and
- Conduct annual opacity testing using EPA Method 9 in 6-minute blocks for 4 hours.

5.1.6 *Work Practices for BF Slag Handling and Storage Operations*

- Limit opacity to 10 percent, as 6-minute average.

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. The 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) and set a maximum pour rate in tons/second.
    - 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 and set a maximum 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.*, twice 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 H).** 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 also shown in **Appendix H** 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 $19,636 per ton HAP removed (BOPF Shop Fugitives) to $15,788,388 per ton HAP removed (BF Iron Beaching) with an overall cost-effectiveness for all seven nonpoint sources at $43,971/ton HAP.

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	$42,387	$1,468,841	$197,402
BF Unplanned Openings	$54,604	--	--
BF Bell Leaks	$12,326	$2,138,542	$922,229
BF Casthouse Fugitives	$63,005	$765,373	$676,890
BOPF Shop Fugitives	$58,967	$495,241	$437,988
BF Iron Beaching	$16,674	--	$37,955
Slag Handling & Storage	$190,731	$562,774	$117,087
Total Costs	**$438,694**	**$5,430,771**	**$2,389,551**

Table 5-2. Cost-Effectiveness of Work Practices at Nonpoint Sources at 8 II&S Facilities

Nonpoint Source	Total Annual Costs	HAP Reductions (TPY)	Cost Effectiveness $/ton HAP removed
BF Unplanned Openings	$239,789	0.50	$478,845
BF Planned Openings	$54,604	0.41	$134,359
BF Bell Leaks	$934,555	31	$30,392
BF Casthouse Fugitives	$739,895	0	N/A
BOPF Shop Fugitives	$496,955	25	$19,636
BF Iron Beaching	$54,629	0.0035	$15,788,388
Slag Handling & Storage	$307,818	7.4	$41,874
Overall Total	**$2,828,245**	**64**	**$43,971**

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APPENDIX A:
PHOTOGRAPHS OF UFIP EVENTS

Bell Leaks

Beaching

BF Unplanned Openings

APPENDIX B: SUMMARY OF NEW OPACITY DATA COLLECTED FROM II&S FACILITIES

Table B-1: Count of New Opacity Tests Analyzed by Facility and Source Type

Facility	BF Bleeder Valves – Planned Openings	BF Casthouse Fugitives	Beaching of Iron from BFs	BOPF Shop Fugitives	BF Slag Handling and Storage
CC-BurnsHarbor-IN	0	0	0	0	13
CC-Cleveland-OH	1	6	0	0	3
CC-Dearborn-MI	0	0	0	0	25
CC-IndianaHarbor-IN	1	0	3	0	26
CC-Middletown-OH	6	0	0	0	0
USS-Braddock-PA	5	12	0	3	54
USS-Gary-IN	2	12	3	6	14
USS-GraniteCity-IL	1	8	5	3	196

Table B-2: Maximum Six-Minute Average by Facility and Source Type Based on New Data

Facility	BF Bleeder Valves – Planned Openings	BF Casthouse Fugitives	Beaching of Iron from BFs	BOPF Shop Fugitives[a]	BF Slag Handling and Storage
CC-BurnsHarbor-IN	[no data]	[no data]	[no data]	[no data]	7.92
CC-Cleveland-OH	6.25	7.25	[no data]	[no data]	27.71
CC-Dearborn-MI	[no data]	[no data]	[no data]	[no data]	2.50
CC-IndianaHarbor-IN	8.33	[no data]	16.46	[no data]	14.58
CC-Middletown-OH	13.75	[no data]	[no data]	[no data]	[no data]
USS-Braddock-PA	25.42	3.54	[no data]	0.00	15.42
USS-Gary-IN	0.00	4.17	3.33	6.25	5.00
USS-GraniteCity-IL	10.42	7.50	31.38	2.50	19.17

[a] Three-minute averages were calculated in place of six-minute averages for BOPF shop fugitives.

Table B-3: Average of All New Opacity Readings by Facility and Source Type

Facility	BF Bleeder Valves – Planned Openings	BF Casthouse Fugitives	Beaching of Iron from BFs	BOPF Shop Fugitives	BF Slag Handling and Storage
CC-BurnsHarbor-IN	[no data]	[no data]	[no data]	[no data]	1.21
CC-Cleveland-OH	6.25	0.96	[no data]	[no data]	7.99
CC-Dearborn-MI	[no data]	[no data]	[no data]	[no data]	0.19
CC-IndianaHarbor-IN	6.35	[no data]	12.58	[no data]	1.26
CC-Middletown-OH	9.90	[no data]	[no data]	[no data]	[no data]
USS-Braddock-PA	3.39	0.20	[no data]	0.00	0.96
USS-Gary-IN	0.00	0.04	0.33	0.06	0.47
USS-GraniteCity-IL	8.08	0.24	6.33	0.13	2.22

Table B-4. Number of “Previous” Opacity Files Received per the 2022 114 Collection

Facility	BF casthouse fugitives	BOPF shop fugitives
CC-BurnsHarbor-IN	202	2
CC-Cleveland-OH	-	-
CC-Dearborn-MI	3	5
CC-IndianaHarbor-IN	51	6
CC-Middletown-OH	1	1

Table B-5. "Previous" Opacity Data for BOPF Shop at Gary, Burns Harbor, Dearborn and Indiana Harbor (IH) facilities

Facility	Date	Duration of test (minutes)	BOF Shop ID	Total minutes opacity = 0%	Total minutes Opacity was >0%	**Max 6-minute Opacity During test unless indicated otherwise**	Comments
IH	8/3/17	74 min	BOF 4SP	74 min	0	0%	
IH	8/4/17	255 min	BOF 4SP	255 min	0	0%	
IH	6/7/19	44 min	BOF 3SP	44 min	0	0%	
IH	6/7/19	109 min	BOF 3SP	109 min	0	0%	
IH	6/7/19	108 min	BOF 3SP	109 min	0	0%	
Burnsharbor	1/8/22	140 min	BOF	140 min	0 min	0%	
Burnsharbor	1/8/22	126 min	BOF	138 min	2 min	2.1%	
Dearborn	5/14/18	240 min	BOF	202 min	37 min	17.7% (6-min), 17.9% (3-min)	
Dearborn	11/17/21	130 min	BOF	127.5	2.5 min	2.1% (3-min)	
Dearborn	11/17/21	130 min	BOF	129 min	3 min	3.75% (3 min. avg)	
Gary	2/11/22	120 min	BOF #1	120 min	0 min	0%	
Gary	2/14/22	120 min	BOF #1	118.5 min	1.5 min	4.2% (6-min), 8.4% (3-min)	
Gary	2/22/22	120 min	BOF #1	120 min	0 min	0%	
Gary	4/15/22	120 min	BOF ?	118 min	2 min	6% (6-min), 12% (3-min)	
Gary	4/18/22	90 min	BOF ?	116.875 min	3.25 min	5.6% (6-min), 11% (3-min)?	
Gary	4/20/22	120 min	BOF #1	120 min	0 min	0%	
Gary	4/22/22	120 min	BOF #1	120 min	0 min	0%	
Gary	4/25/22	120 min	BOF #1	120 min	0 min	0%	
Gary	4/27/22	30 min	BOF ?	28 min	2 min	16.25% (6-min), 32.5% (3-min)?	
Gary	4/27/22	60 min	BOF	57 min	3 min	2.7%	
Gary	4/29/22	60 min	BOF ?	60 min	0 min	0%	
Gary	5/2/22	60 min	BOF ?	57 min	3 min	17.9% (6-min), 35.8% (3-min)	
Gary	5/4/22	120 min	BOF	120 min	0 min	0%	
Gary	5/6/22	120 min	BOF	120 min	0 min	0%	
Gary	5/9/22	120 min	BOF	120 min	0 min	0%	
Gary	5/11/22	120 min	BOF	120 min	0 min	0%	
Gary	5/16/22	120 min	BOF	120 min	0 min	0%	
Gary	5/18/22	60 min	BOF	60 min	0 min	0%	
Gary	5/20/22	60 min	BOF	60 min	0 min	0%	
Gary	5/23/22	60 min	BOF	60 min	0 min	0%	
Gary	5/24/22	120 min	BOF	120 min	0 min	0%	
Gary	5/25/22	120 min	BOF	120 min	0 min	0%	
Gary	5/26/22	120 min	BOF	120 min	0 min	0%	
Gary	5/27/22	120 min	BOF	120 min	0 min	0%	
Gary	5/31/22	120 min	BOF	120 min	0 min	0%	
Gary	5/31/22	120 min	BOF	118 min	2 min	5.6% (6-min), 11.2% (3-min)	
Gary	6/1/22	120 min	BOF	120 min	0 min	0%	

Table B-6. Opacity Data for BF Casthouse at the US Steel Gary and Indiana Harbor Facilities

Facility	Date	Duration of test (minutes)	BF Casthouse	Total minutes that opacity = 0%	Total minutes opacity was > 0%	**Max 6-minute Opacity During test**	Comments
Gary	3/16/22	136 min	BF #14	136	0	0%	
Gary	3/15/22	118 min	BF	118 min	0	0%	
Gary	2/28/22	149 min	BF	149 min	0	0%	
Gary	2/21/22	121 min	BF #4	119.75 min	1.25 min	3.13%	
Gary	2/18/22	120 min	BF #4	119.25 min	0.75 min	2.5%	
Gary	2/10/22	120 min	BF #4	120 min	0	0%	
Gary	2/7/22	120 min	BF #6	119.25 min	0.75 min	1.7%	
Gary	2/22/22	120 min	BF #8	120 min	0	0%	
Gary	2/11/22	102 min	BF #8	102 min	0	0%	
Gary	2/8/22	234 min	BF #8	232.5 min	1.5 min	4.17%	
Indiana Harbor (IH)	6/7/19	44 min	BOF 3SP	44 min	0	0%	
IH	6/7/19	109 min	BOF 3SP	109 min	0	0%	
IH	6/7/19	108 min	BOF 3SP	109 min	0	0%	
IH	8/3/17	74 min	BOF 4SP	74 min	0	0%	
IH	8/4/17	255 min	BOF 4SP	255 min	0	0%	
IH	4/29/19	179 min	BF IH3	179 min	0	0%	
IH	4/29/19	130 min	BF IH3	179 min	0	0%	
IH	5/4/19	239 min	BF IH3	179 min	0	0%	
IH	10/25/16	? min	BF IH4	? min	?	1.9%	
IH	9/10/21	74 min	BF IH4	74 min	0	0%	
IH	9/10/21	164 min	BF IH4	164 min	0	0%	
IH	9/10/21	219 min	BF IH4	219 min	0	0%	
IH	10/9/18	179 min	BF IH7	179 min	0	0%	
IH	10/11/18	150 min	BF IH7	?? min	?	1%	
IH	10/11/18	136 min	BF IH7	?? min	?	1.7%	
IH	2/20/19	145 min	BF IH7	145 min	0	0%	
IH	2/20/19	205 min	BF IH7	205 min	0	0%	
IH	2/21/19	185 min	BF IH7	185 min	0	0%	

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

Table C-1. Standard Emissions Reduction Values by Work Practice

Source	Work Practice	Estimated Emissions Reduction Value	Calculated Emissions Reduction Factor
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0.1	Apply a factor of 1-[sum of values presented in column to the left (max 0.5)]
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	
	Conduct raw material screening.	0.15	
	Develop a plan that explains how the facility will implement these requirements.	0.15	
BF Bell Leaks	Replace or repair small bell seals every 6 months.	0.75	Assume 50% of emissions come from the large bell and 50% of emissions come from the small bell. No facilities provided information on changing their large bell seals, so no adjustment is needed regarding large bell work practices. Apply a factor as low as 0.75 for one furnace based on how often small bell seals were reported to be replaced. Furnaces repairing their small bell seal every 6 months or less have a factor of 0.75. The furnace with the lowest reported frequency of repairing the bell seal has a factor of 1. Furnaces with a frequency of x which is between 6 months and the max frequency have a factor of 1-0.25*(max frequency – x)/(max frequency).

Source	Work Practice	Estimated Emissions Reduction Value	Calculated Emissions Reduction Factor
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0.125	Apply a factor of 1-[sum of values presented in column to the left (max 0.5)]
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0.03	
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0.03	
	Set a maximum furnace tilt angle during hot metal charging.	0.03	
	Create an outline of procedures to attempt to reduce slopping.	0.03	
Beaching	Have full or partial enclosures for the beaching process.	0.125	Apply a factor of 1-[sum of values presented in column to the left]
	Use CO_2 to suppress fumes.	0.125	
	Minimize the height, slope, and speed of beaching.	0.25	
Slag Handling	Use a water system over pit areas.	0.25	Apply a factor of 1-[sum of values presented in column to the left]
	Use water fog spray systems.	0.25	

Table C-2. Emissions Reduction Values by Source and Facility

CC-BurnsHarbor-IN			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0.1	Work practice is currently in use by facility
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0.15	Work practice is currently in use by facility
	Develop a plan that explains how the facility will implement these requirements.	0	Work practice is not currently in use by this facility
BF Bell Leaks	Replace or repair small bell seals every 6 months.	0.75	Small bell seals are replaced every 6 months for both furnaces
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0	Work practice is not in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	0.125	3-sided enclosure
	Use CO_2 to suppress fumes.	0.125	Work practice is currently in use by facility
	Minimize the height, slope, and speed of beaching.	0.25	Work practice is currently in use by facility
Slag Handling	Use a water system over pit areas.	0.25	Work practice is currently in use by facility
	Use water fog spray systems.	0.25	Work practice is currently in use by facility

CC-Cleveland-OH			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0	Work practice not in use by facility
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0	Work practice is not currently in use by this facility
	Develop a plan that explains how the facility will implement these requirements.	0	Work practice is not currently in use by this facility
BF Bell Leaks	Replace or repair small bell seals every 6 months.	1	Only 1 of 2 BFs has a two-bell top. Seals are replaced every 3-4 years. This is the lowest frequency of replacing small bell seals reported by facilities.
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0.03	Work practice is currently in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	--	No beaching at this facility
	Use CO_2 to suppress fumes.	--	
	Minimize the height, slope, and speed of beaching.	--	
Slag Handling	Use a water system over pit areas.	0.25	Work practice is currently in use by facility
	Use water fog spray systems.	0	Work practice is not currently in use by this facility

CC-Dearborn-MI			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0.1	Work practice is currently in use by facility
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0.15	Work practice is currently in use by facility
	Develop a plan that explains how the facility will implement these requirements.	0	Work practice is not currently in use by this facility
BF Bell Leaks	Replace or repair small bell seals every 6 months.	--	BF does not have bells
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0.03	Work practice is currently in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	0.125	3-sided enclosure
	Use CO_2 to suppress fumes.	0.125	Work practice is currently in use by facility
	Minimize the height, slope, and speed of beaching.	0.25	Work practice is currently in use by facility
Slag Handling	Use a water system over pit areas.	0.25	Work practice is currently in use by facility
	Use water fog spray systems.	0	Work practice is not currently in use by this facility

CC-IndianaHarbor-IN			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0	Work practice not in use by facility
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0	Work practice is not currently in use by this facility
	Develop a plan that explains how the facility will implement these requirements.	0	Work practice is not currently in use by this facility
BF Bell Leaks	Replace or repair small bell seals every 6 months.	0.964	Only 2 of 3 BFs have a two-bell top. Seals are replaced approximately every 3 years or 5 MM NTHM production.
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0	Work practice is not in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	0	No enclosure
	Use CO_2 to suppress fumes.	0	Work practice is not in use by facility
	Minimize the height, slope, and speed of beaching.	0.25	Work practice is currently in use by facility
Slag Handling	Use a water system over pit areas.	0.25	Work practice is currently in use by facility
	Use water fog spray systems.	0	Work practice is not currently in use by this facility

CC-Middletown-OH			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0.05	Stockline monitor but no alarm
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0.15	Work practice is currently in use by facility
	Develop a plan that explains how the facility will implement these requirements.	0	Work practice is not currently in use by this facility
BF Bell Leaks	Replace or repair small bell seals every 6 months.	0.75	Seals are replaced every 8 weeks
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0	Work practice is not in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	0	Facility did not provide this information - no beaching at this facility in 2019, 2020, or 2021
	Use CO_2 to suppress fumes.	0	
	Minimize the height, slope, and speed of beaching.	0	
Slag Handling	Use a water system over pit areas.	0	Facility did not provide this information
	Use water fog spray systems.	0	Facility did not provide this information

USS-Braddock-PA			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0.1	Work practice is currently in use by facility
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0.15	Work practice is currently in use by facility
	Develop a plan that explains how the facility will implement these requirements.	0	Facility did not provide this information
BF Bell Leaks	Replace or repair small bell seals every 6 months.	1	Frequency of seal repairs/replacements was claimed as CBI
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0	Work practice is not in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	0.125	2-sided enclosure
	Use CO_2 to suppress fumes.	0	Work practice is not in use by facility
	Minimize the height, slope, and speed of beaching.	0.25	Work practice is currently in use by facility
Slag Handling	Use a water system over pit areas.	0.25	Work practice is currently in use by facility
	Use water fog spray systems.	0	Work practice is not currently in use by this facility

USS-Gary-IN			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0.1	Work practice is currently in use by facility
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0.15	Work practice is currently in use by facility
	Develop a plan that explains how the facility will implement these requirements.	0	Work practice is not currently in use by this facility
BF Bell Leaks	Replace or repair small bell seals every 6 months.	1	Frequency of seal repairs/replacements was claimed as CBI
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0	Work practice is not in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	0.125	Fully enclosed
	Use CO_2 to suppress fumes.	0.125	Work practice is currently in use by facility
	Minimize the height, slope, and speed of beaching.	0.25	Work practice is currently in use by facility
Slag Handling	Use a water system over pit areas.	0.25	Work practice is currently in use by facility
	Use water fog spray systems.	0	Work practice is not currently in use by this facility

USS-GraniteCity-IL			
Source	**Work Practice**	**Estimated Emissions Reduction Value**	**Notes**
BF Unplanned Openings	Install and operate devices to continuously measure/monitor material levels in the furnace, using alarms to inform operators of static conditions.	0.05	Stockline monitor but no alarm
	Install and operate instruments on the furnace to monitor temperature and pressure.	0.1	Work practice is currently in use by facility
	Conduct raw material screening.	0.15	Work practice is currently in use by facility
	Develop a plan that explains how the facility will implement these requirements.	0	Work practice is not currently in use by this facility
BF Bell Leaks	Replace or repair small bell seals every 6 months.	1	Frequency of seal repairs/replacements was claimed as CBI
BOP Shop Fugitives	Keep all openings closed during tapping and material transfer events.	0	Work practice not in use by facility
	Optimize positioning of hot metal ladles with respect to hood face and furnace mouth.	0.03	Work practice is currently in use by facility
	Set a maximum hot iron pour/charge rate (pounds/second) for the first 20 seconds of hot metal charge.	0.225	Work practice is currently in use by facility
	Set a minimum flowrate of the secondary emission capture system during hot metal charge.	0.03	Work practice is currently in use by facility
	Set a minimum number of times the furnace should be rocked between scrap charge and hot metal charge.	0	This information was not collected by the 114 questionnaire
	Set a maximum furnace tilt angle during hot metal charging.	0.03	Work practice is currently in use by facility
	Create an outline of procedures to attempt to reduce slopping.	0	This information was not collected by the 114 questionnaire
Beaching	Have full or partial enclosures for the beaching process.	0	No enclosure
	Use CO_2 to suppress fumes.	0	Work practice is not in use by facility
	Minimize the height, slope, and speed of beaching.	0.25	Work practice is currently in use by facility
Slag Handling	Use a water system over pit areas.	0.25	Work practice is currently in use by facility
	Use water fog spray systems.	0	Work practice is not currently in use by this facility

Table C-3. Estimated Nonpoint Emissions by Source and Facility

Source	PM Emissions (TPY)	Frequency[a]		Activity[b]		Emissions Reduction Factor
CC-BurnsHarbor-IN						
BF Unplanned Openings	6	48	events/yr	by unit (2)		0.65
BF Planned Openings	13	654	events/yr	by unit (2)		--
BF Bell Leaks	488	continuous		4,007,423	TPY iron	0.75
BF Casthouse Fugitives	200	continuous		4,007,423	TPY iron	--
BOPF Shop Fugitives	664	continuous		4,470,258	TPY steel	--
BOPF Top Fugitives	455	continuous		4,470,258	TPY steel	0.715
Tapping Steel	74	continuous		4,470,258	TPY steel	0.715
Iron Sources	135	continuous		4,007,423	TPY iron	0.715
Charging	60	continuous		4,007,423	TPY iron	--
HM Transfer	19	continuous		4,007,423	TPY iron	--
DeSulf	110	continuous		4,007,423	TPY iron	--
Beaching	0.07	700	TPY	by unit (2)		0.5
Slag Pits	102	continuous		1,407,335	TPY slag	0.5
Total	**1,475**					
CC-Cleveland-OH						
BF Unplanned Openings	9	48	events/yr	by unit (2)		0.9
BF Planned Openings	5	266	events/yr	by unit (2)		--
BF Bell Leaks	205	continuous		1,260,588[c]	TPY iron	1
BF Casthouse Fugitives	122	continuous		2,437,140	TPY iron	--
BOPF Shop Fugitives	398	continuous		2,813,021	TPY steel	--
BOPF Top Fugitives	275	continuous		2,813,021	TPY steel	0.685
Tapping Steel	44	continuous		2,813,021	TPY steel	0.685
Iron Sources	79	continuous		2,437,140	TPY iron	0.685
Charging	37	continuous		2,437,140	TPY iron	--
HM Transfer	12	continuous		2,437,140	TPY iron	--
DeSulf	67	continuous		2,437,140	TPY iron	--
Beaching	0.00[d]	700	TPY	by unit (2)		1
Slag Pits	110	continuous		1,009,563	TPY slag	0.75
Total	**849**					

Source	PM Emissions (TPY)	Frequency[a]		Activity[b]		Emissions Reduction Factor
CC-Dearborn-MI						
BF Unplanned Openings	3	48	events/yr	by unit (1)		0.65
BF Planned Openings	3	133	events/yr	by unit (1)		--
BF Bell Leaks	0	continuous		2,031,843	TPY iron	--
BF Casthouse Fugitives	102	continuous		2,031,843	TPY iron	--
BOPF Shop Fugitives	353	continuous		2,536,194	TPY steel	--
BOPF Top Fugitives	248	continuous		2,536,194	TPY steel	0.685
Tapping Steel	40	continuous		2,536,194	TPY steel	0.685
Iron Sources	66	continuous		2,031,843	TPY iron	0.685
Charging	30	continuous		2,031,843	TPY iron	--
HM Transfer	10	continuous		2,031,843	TPY iron	--
DeSulf	56	continuous		2,031,843	TPY iron	--
Beaching	0.03	700	TPY	by unit (1)		0.5
Slag Pits	87	continuous		799,126	TPY slag	0.75
Total	**548**					
CC-IndianaHarbor-IN						
BF Unplanned Openings	9	48	events/yr	by unit (2)		0.9
BF Planned Openings	4	193	events/yr	by unit (2)		--
BF Bell Leaks	251	continuous		1,600,000[c]	TPY iron	0.964
BF Casthouse Fugitives	235	continuous		4,700,000	TPY iron	--
BOPF Shop Fugitives	656	continuous		4,200,000	TPY steel	--
BOPF Top Fugitives	428	continuous		4,200,000	TPY steel	0.715
Tapping Steel	69	continuous		4,200,000	TPY steel	0.715
Iron Sources	159	continuous		4,700,000	TPY iron	0.715
Charging	71	continuous		4,700,000	TPY iron	--
HM Transfer	22	continuous		4,700,000	TPY iron	--
DeSulf	129	continuous		4,700,000	TPY iron	--
Beaching	0.10	700	TPY	by unit (2)		0.75
Slag Pits	172	continuous		1,580,000	TPY slag	0.75
Total	**1,326**					

Source	PM Emissions (TPY)		Frequency[a]		Activity[b]		Emissions Reduction Factor
CC-Middletown-OH							
BF Unplanned Openings		3	48	events/yr	by unit (1)		0.7
BF Planned Openings		0	6	events/yr	by unit (1)		--
BF Bell Leaks		246	continuous		2,020,451	TPY iron	0.75
BF Casthouse Fugitives		101	continuous		2,020,451	TPY iron	--
BOPF Shop Fugitives		124	continuous		472,744	TPY steel	--
BOPF Top Fugitives	48		continuous		472,744	TPY steel	0.715
Tapping Steel	8		continuous		472,744	TPY steel	0.715
Iron Sources	68		continuous		2,020,451	TPY iron	0.715
Charging	30		continuous		2,020,451	TPY iron	--
HM Transfer	10		continuous		2,020,451	TPY iron	--
DeSulf	56		continuous		2,020,451	TPY iron	--
Beaching		0.07	700	TPY	by unit (1)		1
Slag Pits		96	continuous		660,634	TPY slag	1
Total		**571**					
USS-Braddock-PA							
BF Unplanned Openings		6	48	events/yr	by unit (2)		0.65
BF Planned Openings		3	150	events/yr	by unit (2)		--
BF Bell Leaks		366	continuous		2,253,630	TPY iron	1
BF Casthouse Fugitives		113	continuous		2,253,630	TPY iron	--
BOPF Shop Fugitives		396	continuous		2,701,327	TPY steel	--
BOPF Top Fugitives	275		continuous		2,701,327	TPY steel	0.715
Tapping Steel	44		continuous		2,701,327	TPY steel	0.715
Iron Sources	76		continuous		2,253,630	TPY iron	0.715
Charging	34		continuous		2,253,630	TPY iron	--
HM Transfer	11		continuous		2,253,630	TPY iron	--
DeSulf	62		continuous		2,253,630	TPY iron	--
Beaching		0.08	700	TPY	by unit (2)		0.625
Slag Pits		51	continuous		470,994	TPY slag	0.75
Total		**935**					

Source	PM Emissions (TPY)	Frequency[a]		Activity[b]		Emissions Reduction Factor
USS-Gary-IN						
BF Unplanned Openings	13	48	events/yr	by unit (4)		0.65
BF Planned Openings	10	476	events/yr	by unit (4)		--
BF Bell Leaks	322	continuous		1,978,609[e]	TPY iron	1
BF Casthouse Fugitives	256	continuous		5,121,867	TPY iron	--
BOPF Shop Fugitives	868	continuous		5,871,382	TPY steel	--
BOPF Top Fugitives	598	continuous		5,871,382	TPY steel	0.715
Tapping Steel	97	continuous		5,871,382	TPY steel	0.715
Iron Sources	173	continuous		5,121,867	TPY iron	0.715
Charging	77	continuous		5,121,867	TPY iron	--
HM Transfer	24	continuous		5,121,867	TPY iron	--
DeSulf	141	continuous		5,121,867	TPY iron	--
Beaching	0.13	700	TPY*	by unit (4)		0.5
Slag Pits	172	continuous		1,580,467	TPY slag	0.75
Total	**1,640**					
USS-GraniteCity-IL						
BF Unplanned Openings	7	48	events/yr	by unit (2)		0.7
BF Planned Openings	5	246	events/yr	by unit (2)		--
BF Bell Leaks	169	continuous		1,042,769[c]	TPY iron	1
BF Casthouse Fugitives	111	continuous		2,229,682	TPY iron	--
BOPF Shop Fugitives	377	continuous		2,689,151	TPY steel	--
BOPF Top Fugitives	262	continuous		2,689,151	TPY steel	0.685
Tapping Steel	42	continuous		2,689,151	TPY steel	0.685
Iron Sources	72	continuous		2,229,682	TPY iron	0.685
Charging	33	continuous		2,229,682	TPY iron	--
HM Transfer	11	continuous		2,229,682	TPY iron	--
DeSulf	61	continuous		2,229,682	TPY iron	--
Beaching	0.10	700	TPY	by unit (2)		0.75
Slag Pits	82	continuous		750,594	TPY slag	0.75
Total	**752**					

[a] The number of BF planned openings was estimated using facility responses to the 2022 section 114 collection. The frequency of all other estimates are described 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)

[b] Production in the most recent typical year for U.S. Steel facilities was claimed as confidential in the 2022 section 114 collection; therefore, the production values reported in the 2011 section 114 collection were used for U.S. Steel's active units.

[c] One of the active BFs for this facility was reported to have a bell-less top in the 2022 section 114 collection. The activity recorded is that of any active BFs with two-bell tops.

[d] Responses to the 2022 section 114 collection indicated that there was no beaching at the CC-Cleveland-OH facility.

[e] Responses to the 2022 section 114 collection indicated that two of the active BFs have bell-less tops.

APPENDIX D:
EMISSION REDUCTION FACTOR DETERMINATION FOR PROPOSED BF CASTHOUSE FUGITIVE, BOPF SHOP FUGITIVE, AND SLAG PROCESSING, HANDLING, AND STORAGE LIMITS

Table D-1. Emission Reduction Factor Determination for BF Planned Openings

Facility	Max 6-Minute Opacity (%)	Source	Emission Reduction	Emission Reduction Basis
CC-BurnsHarbor-IN	[no data]	[no data]	50%	Default value
CC-Cleveland-OH	6.25	2022 114 data	0%	Max is already below 8% limit
CC-Dearborn-MI	[no data]	[no data]	50%	Default value
CC-IndianaHarbor-IN	8.33	2022 114 data	4%	(max - 8%)/max
CC-Middletown-OH	13.75	2022 114 data	42%	(max - 8%)/max
USS-Braddock-PA	25.42	2022 114 data	50%	Default value; (max - 8%)/max > 50%
USS-Gary-IN	0	2022 114 data	0%	Max is already below 8% limit
USS-GraniteCity-IL	10.42	2022 114 data	23%	(max - 8%)/max

APPENDIX E:
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 E-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 F:
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)

[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 G:
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

APPENDIX H:
COST FACTORS AND ESTIMATES FOR NONPOINT SOURCES

Table H-1. Summary of Annualized Capital & Annual Operating Costs for Nonpoint Work Practices at One Unit[a]

Cost Item[b]	Nonpoint Source									Comments[f]
	Unplanned Openings[c]	Planned Openings	Bell Leaks		BF Casthouse	BOP Shop	Beaching		Slag[e]	
			Small	Large			Enclosure[d]	Fume Control		
Capital Costs										
Total Capital Investment (TCI)	$169,958	$0	$56,277	$225,110	$45,022	$45,022	$0	$0	$56,277	
Capital Recovery Factor (CRF)	0.094393	NA	2.104408	0.070081	0.094393	0.094393	NA	NA	0.094393	[(IN*(1+IN)^LIF)/((1+IN)^LIF-1)]*TCI,[g] 7% interest (IN)[h]
Total Capital Recovery (TCR)	$16,043	$0	$118,431	$15,776	$4,250	$4,250	$0	$0	$5,312	TCI*CRF
Administrative charges (ADM)	$3,399	$0	$1,126	$4,502	$900	$900	$883	$0	$1,126	2%*TCI.
Property taxes (TAX)	$1,700	$0	$563	$2,251	$450	$450	$442	$0	$563	1%*TCI
Insurance (INS)	$1,700	$0	$563	$2,251	$450	$450	$442	$0	$563	1%*TCI
Annualized Capital Cost, $/yr	$22,841	$0	$120,682	$24,780	$6,051	$6,051	$1,766	$0	$7,563	TCR+ADM+TAX+INS
Operating Costs										
Control device specific costs	NA	NA	NA	NA	NA	NA	NA	$1,066	$4,145	
Consulting Costs, $/yr.	NA	NA	NA	NA	$33,766	$33,766	NA	NA	NA	
Total Annual O&M Cost, $/yr[a]	$0	$0	$0	$0	$33,766	$33,766	$0	$1,066	$4,145	Control device + consulting.
Total Annualized Capital Costs, $/yr	**$22,841.12**	**$0.00**	**$120,681.74**	**$24,780.24**	**$39,817.08**	**$39,817.08**	**$1,961.84**	**$1,065.99**	**$11,708.68**	Annualized capital + Annual O&M
			$145,461.98				**$3,027.83**			

[a] NA = Not applicable.

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

[c] Raw material screens were estimated to have a capital cost of $1,000 based on engineering judgement with a low confidence level.

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

[e] Assuming a dry fog system would be installed for facilities that currently exceed the proposed opacity limit.

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

[g] Small bell seals were estimated to last 6 months, and dry fog systems were estimated to last 20 years. See the memo *Cost Estimates and Other Impacts for the Integrated Iron and Steel Risk and Technology Review* (EPA, 2019b) for the lifetime (LIF) of capital investment for other UFIP sources.

[h] Interest rate taken from https://fred.stlouisfed.org/series/PRIME. December 7, 2022.

Table H-2. Labor Costs for Nonpoint Source Work Practices for One Unit

Nonpoint Sources	Labor for Nonpoint Work Practices at One Unit						Total Labor	
	Steel Worker		Environmental Worker		Manager			
	Hours	Cost	Hours	Cost	Hours	Cost	Hours	Cost
BF Unplanned Openings	10	$619	10	$732	8	$1,142	28	$2,493
BF Planned Openings	26	$1,609	26	$1,904	4	$571	56	$4,084
BF Bell Leaks	6	$371	6	$439	4	$571	16	$1,382
BF Casthouse Fugitives	24	$1,485	24	$1,758	4	$571	52	$3,814
BOP Shop Fugitives	34	$2,103	34	$2,490	8	$1,142	76	$5,736
BF Beaching	4	$247	4	$293	4	$571	12	$1,112
Slag Handling	84	$5,197	84	$6,153	4	$571	172	$11,921
Total Cost ($)	**188**	**$11,631**	**188**	**$13,771**	**36**	**$5,140**	**412**	**$30,541**

Note: Labor rates from "BLS National Occupational Employment and Wage Estimates," at link below, with 110 percent markup to produce "loaded" wages. https://www.bls.gov/oes/current/oes_nat.htm. See Wage Rate table.

Table H-3. II&S Industry Units per Facility for which Work Practices Apply (from 2022 II&S Section 114 Collection)

Facility	Number of Emission Units for which Work Practices Apply						
	BF Unplanned Openings	BF Planned Openings	Bell Leaks	BF Casthouse Fugitives	BOPF Shop Fugitives	Beaching of Iron from BFs	Slag Handling and Storage
CC-BurnsHarbor-IN	2	2	2	2	1	2	2
CC-Cleveland-OH	2	2	1[a]	2	2	0[b]	2
CC-Dearborn-MI	1	1	0[a]	1	1	1	1
CC-IndianaHarbor-IN	3	3	2[a]	3	2	3	3
CC-Middletown-OH	1	1	1	1	1	1	1
USS-Braddock-PA	2	2	2	2	1	2	2
USS-Gary-IN	4	4	0[c]	4	2	4	3[d]
USS-GraniteCity-IL	2	2	1[a]	2	1	2	2
Total for II&S Industry	**17**	**17**	**9**	**17**	**11**	**15**	**16**

[a] Facility has one BF with a bell-less top.
[b] CC-Cleveland-OH does not conduct beaching.
[c] USS-Gary-IN has two BF with bell-less tops, two BF without replaceable seals, and already conducts visual emission inspections of bells every 2 weeks.
[d] USS-Gary-IN has a granulator instead of a slag pit for one BF.

Table H-4. Total Annual Emission Unit Costs for Work Practices at II&S Nonpoint Sources

Nonpoint Source	Emission Unit Costs			
	Annual Labor	Capital	Annual Operating and Annualized Capital	Total Annual
BF Unplanned Openings	$2,493	$169,958	$22,841	$25,334
BF Planned Openings	$4,084	$0	$0	$4,084
BF Bell Leaks	$1,382	$281,387	$145,462	$146,844
BF Casthouse	$3,814	$45,022	$39,817	$43,631
BOPF Shop	$5,736	$45,022	$39,817	$45,553
BF Iron Beaching	$1,112	$0	$3,028	$4,139
Slag Handling & Storage	$11,921	$56,277	$11,709	$23,629
Total Emission Unit Costs	**$30,541**	**$597,666**	**$262,674**	**$293,215**

Table H-5. Total Costs for Work Practices at II&S Nonpoint Sources by Facility

CC-BurnsHarbor-IN				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$225,110[a]	$30,253	$4,987	$35,240
BF Planned Openings	$0	$0	$8,168	$8,168
BF Bell Leaks	$450,219[b]	$49,457	$2,764	$52,221
BF Casthouse	$90,044	$79,634	$7,628	$87,262
BOPF Shop	$45,022	$39,817	$5,736	$45,553
BF Iron Beaching	$0	$3,924[c]	$2,223	$6,147
Slag Handling & Storage	$0[d]	$0	$23,841	$23,841
Total Costs	**$810,395**	**$203,085**	**$55,347**	**$258,432**

[a] Facility already has at least one stockline detector per furnace and performs raw material screening.
[b] Facility already replaces small bell seals every 6 months.
[c] Facility already uses fume suppressants.
[d] Facility already has a dry fog system.

CC-Cleveland-OH				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$2,251[a]	$303	$4,987	$5,289
BF Planned Openings	$0	$0	$8,168	$8,168
BF Bell Leaks	$281,387	$145,462	$1,271[b]	$146,733
BF Casthouse	$90,044	$79,634	$7,628	$87,262
BOPF Shop	$90,044	$79,634	$11,472	$91,106
BF Iron Beaching	$0	$0	$0	$0
Slag Handling & Storage	$112,555	$23,417	$23,841	$32,132
Total Costs	**$576,281**	**$328,450**	**$57,367**	**$385,818**

[a] Facility already has three stockline monitors on each furnace.
[b] Facility already has an operating plan for BF bell leaks.

CC-Dearborn-MI				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$56,277[a]	$7,563	$2,493	$10,057
BF Planned Openings	$0	$0	$3,553[b]	$3,553
BF Bell Leaks	$0	$0	$0	$0
BF Casthouse	$45,022	$39,817	$3,814	$43,631
BOPF Shop	$45,022	$39,817	$5,736	$45,553
BF Iron Beaching	$0	$1,962[c]	$1,112	$3,073
Slag Handling & Storage	$0[d]	$0	$11,921	$11,921
Total Costs	**$146,321**	**$89,159**	**$28,629**	**$117,788**

[a] Facility already has at least two stockline detectors per furnace and performs raw material screening.
[b] Facility already conducts quarterly emissions testing.
[c] Facility already uses fume suppressants.
[d] Facility already meets the 5% opacity limit.

CC-IndianaHarbor-IN				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$172,209[a]	$23,144	$7,480	$30,624
BF Planned Openings	$0	$0	$12,252	$12,252
BF Bell Leaks	$562,774	$290,924	$2,764	$293,688
BF Casthouse	$135,066	$119,451	$11,442	$130,893
BOPF Shop	$90,044	$79,634	$11,472	$91,106
BF Iron Beaching	$0	$9,083	$3,335	$12,418
Slag Handling & Storage	$168,832	$35,126	$35,762	$70,888
Total Costs	**$1,128,925**	**$557,363**	**$84,507**	**$641,869**

[a] Facility already has at least two stockline detectors per furnace.

CC-Middletown-OH				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$112,555[a]	$15,127	$2,493	$17,620
BF Planned Openings	$0	$0	$2,042[b]	$2,042
BF Bell Leaks	$0[c]	$0	$1,382	$1,382
BF Casthouse	$45,022	$39,817	$3,814	$43,631
BOPF Shop	$45,022	$39,817	$5,736	$45,553
BF Iron Beaching	$0	$3,028	$1,112	$4,139
Slag Handling & Storage	$56,277	$11,709	$11,921	$23,629
Total Costs	**$258,876**	**$109,497**	**$28,499**	**$137,997**

[a] Facility already has at least one stockline detector and performs raw material screening.
[b] Facility already has an operating plan for BF planned openings.
[c] Facility already replaces the small bell seal every 8 weeks. The large bell does not have a seal.

USS-Braddock-PA				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$225,110[a]	$30,253	$4,987	$35,240
BF Planned Openings	$0	$0	$8,168	$8,168
BF Bell Leaks	$562,774	$290,924	$2,764	$293,688
BF Casthouse	$90,044	$79,634	$7,628	$87,262
BOPF Shop	$45,022	$39,817	$4,704[b]	$44,521
BF Iron Beaching	$0	$6,056	$2,223	$8,279
Slag Handling & Storage	$112,555	$23,417	$23,841	$47,259
Total Costs	**$1,035,504**	**$470,101**	**$54,314**	**$524,416**

[a] Facility already has one stockline monitors per furnace and performs raw material screening.
[b] Facility already has an operating plan for BOPF shops.

USS-Gary-IN				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$450,219[a]	$60,506	$9,973	$70,480
BF Planned Openings	$0	$0	$8,168[b]	$8,168
BF Bell Leaks	$0	$0	$0	$0
BF Casthouse	$180,088	$159,268	$14,035[c]	$173,303
BOPF Shop	$90,044	$79,634	$9,407[d]	$89,041
BF Iron Beaching	$0	$7,847[e]	$4,446	$12,294
Slag Handling & Storage	$0[f]	$0	$35,762	$35,762
Total Costs	**$720,351**	**$307,256**	**$81,792**	**$389,048**

[a] Facility already has at least one stockline detector per furnace and performs raw material screening.
[b] Facility already has an operating plan for BF planned openings.
[c] Facility already has an operating plan for BF casthouses.
[d] Facility already has an operating plan for BOPF shops.
[e] Facility already uses fume suppressants.
[f] Facility already meets the 5% opacity limit.

USS-GraniteCity-IL				
Source	**Equipment Costs$**		**Labor**	**Overall Annual Costs**
	Capital	**Annualized**		
BF Unplanned Openings	$225,110[a]	$30,253	$4,987	$35,240
BF Planned Openings	$0	$0	$4,084[b]	$4,084
BF Bell Leaks	$281,387	$145,462	$1,382	$146,844
BF Casthouse	$90,044	$79,634	$7,017[c]	$86,652
BOPF Shop	$45,022	$39,817	$4,704[d]	$44,521
BF Iron Beaching	$0	$6,056	$2,223	$8,279
Slag Handling & Storage	$112,555	$23,417	$23,841	$47,259
Total Costs	**$754,117**	**$324,639**	**$48,238**	**$372,878**

[a] Facility already has one stockline detector per furnace and performs raw material screening.
[b] Facility already has an operating plan for BF planned openings.
[c] Facility already has an operating plan for BF casthouses.
[d] Facility already has an operating plan for BOPF shops.

Table H-6. Reduction Cost Effectiveness for Work Practices at Nonpoint Sources by Facility

Nonpoint Source	% Reduction	Total Annual Costs	
		PM ($/ton removed)	HAP ($/ton removed)
CC-BurnsHarbor-IN			
BF Unplanned Openings	15%	$36,553	$987,915
BF Planned Openings	50%	$1,218	$32,932
BF Bell Leaks	25%	$428	$11,559
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	22%	$319	$9,966
BF Iron Beaching	0%	--	--
Slag Handling & Storage	0%	--	--
All UFIP Sources		**$948**	**$27,574**
CC-Cleveland-OH			
BF Unplanned Openings	40%	$1,486	$40,159
BF Planned Openings	0%	--	--
BF Bell Leaks	50%	$1,433	$38,720
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	19%	$1,238	$38,688
BF Iron Beaching	50%	N/A	N/A
Slag Handling & Storage	25%	$1,722	$50,641
All UFIP Sources		**$1,864**	**$53,515**

Nonpoint Source	% Reduction	Total Annual Costs	
		PM ($/ton removed)	HAP ($/ton removed)
CC-Dearborn-MI			
BF Unplanned Openings	15%	$20,863	$563,857
BF Planned Openings	50%	$2,606	$70,443
BF Bell Leaks	--	--	--
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	19%	$697	$21,781
BF Iron Beaching	0%	--	--
Slag Handling & Storage	25%	$549	$16,138
All UFIP Sources		**$1,325**	**$40,639**
CC-IndianaHarbor-IN			
BF Unplanned Openings	40%	$8,603	$232,512
BF Planned Openings	4%	$77,418	$2,092,390
BF Bell Leaks	46%	$2,523	$68,190
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	22%	$646	$20,193
BF Iron Beaching	25%	$497,973	$13,458,724
Slag Handling & Storage	25%	$1,650	$48,536
All UFIP Sources		**$2,111**	**$61,613**
CC-Middletown-OH			
BF Unplanned Openings	20%	$25,456	$688,012
BF Planned Openings	42%	$39,700	$1,072,982
BF Bell Leaks	25%	$22	$607
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	22%	$1,706	$53,310
BF Iron Beaching	50%	$124,493	$3,364,681
Slag Handling & Storage	50%	$493	$14,510
All UFIP Sources		**$1,008**	**$28,813**

Nonpoint Source	% Reduction	Total Annual Costs	
		PM ($/ton removed)	HAP ($/ton removed)
USS-Braddock-PA			
BF Unplanned Openings	15%	$36,553	$987,915
BF Planned Openings	50%	$5,313	$143,584
BF Bell Leaks	50%	$1,604	$43,349
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	22%	$523	$16,350
BF Iron Beaching	13%	$796,756	$21,533,959
Slag Handling & Storage	25%	$3,691	$108,547
All UFIP Sources		**$1,850**	**$52,304**
USS-Gary-IN			
BF Unplanned Openings	15%	$36,553	$987,915
BF Planned Openings	0%	--	--
BF Bell Leaks	50%	$0	$0
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	22%	$477	$14,913
BF Iron Beaching	0%	--	--
Slag Handling & Storage	25%	$832	$24,479
All UFIP Sources		**$992**	**$28,923**
USS-GraniteCity-IL			
BF Unplanned Openings	20%	$25,456	$688,012
BF Planned Openings	23%	$3,491	$94,344
BF Bell Leaks	50%	$1,733	$46,843
BF Casthouse Fugitives	0%	--	--
BOPF Shop Fugitives	19%	$638	$19,946
BF Iron Beaching	25%	$331,982	$8,972,483
Slag Handling & Storage	25%	$2,316	$68,113
All UFIP Sources		**$2,101**	**$60,570**