THE
DOE RUN
COMPANY

Primary Smelting Division
ISO 9002:2000 Certified

May 18, 2009

James L. Kavanaugh
Director
Air Pollution Control Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

RE: Ventilation Study Final Report per 2.A.20. of 2007 Consent Judgment

Dear Mr. Kavanaugh:

Please note submission of the Doe Run Company's Herculaneum Smelter Ventilation Study Results submitted electronic format to the Missouri Air Pollution Control Programs Joe Winkelmann.

Again, Doe Run has and will continue to work cooperatively with the agency to timely resolve any concerns regarding the implementation of the 2007 SIP.

Sincerely,

Gary J. Hughes

Gary Hughes
General Manager Primary Smelting

Doe Run Herculaneum Smelter

Ventilation Study Final Report
Per 2.A.20. of 2007 Consent Judgment

submitted to
the Missouri Department of Natural Resources'
Air Pollution Control Program

May 18, 2009

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Doe Run Herculaneum Smelter

Ventilation Study Final Report
Per 2.A.20. of 2007 Consent Judgment

In paragraph 2.A.20. of the 2007 Consent Judgment (CJ) which formed the basis of the 2007 Revision to the Missouri State Implementation Plan for The Herculaneum Lead Nonattainment Area, Doe Run agreed to conduct a building ventilation study for the purposes of establishing enforceable limits used to ensure that particles emitted within the Sinter Plant Building, Blast Furnace Building and Refinery Building are appropriately captured, contained or controlled by these buildings and their associated industrial process and hygiene ventilation systems. The establishment of these enforceable limits is required by the state's implementation plan for the Herculaneum Lead area adopted by the Missouri Air Conservation Commission at its April 2007 meeting and submitted to the U.S. Environmental Protection Agency (EPA) in May of that same year. The EPA proposed conditional approval of this SIP revision on October 8, 2008 contingent upon the establishment of the enforceable building ventilation requirements**.** To obtain final SIP approval, we are proposing the enforceable building ventilation system limits in this report be adopted. Much of the work on this project, and the entire SIP revision, was done in conjunction, consultation and cooperation with the Missouri Department of Natural Resources' (MDNR) Air Pollution Control Program.

In July 2007, Doe Run submitted to the MDNR a work plan **[See Attachment A]** designating the major ventilation system and lead-bearing particle capture and control components within the Sinter Plant, Blast Furnace and Refinery identifying the major particle egress apertures (doorways) within these buildings. The purpose of the study is to correlate the inflow velocities (hereafter "inflows") in feet per minute (fpm) at each of these doorways under the negative pressure created by the major ventilation systems within these three buildings during typical periods of normal plant operations to the corresponding volume flow rates in actual cubic feet per minute (acfm) of the buildings' major ventilation systems. The concept of the study is to find the minimum actual volume flow rate for each building's major ventilation system at which particle containment and capture can be ensured under normal plant scenarios. By agreement with the MDNR, the appropriate level of particle capture was established to be an inflow of 200 fpm measured at an open doorway. This number has been demonstrated to be effective at another Doe Run lead facility in Glover, Missouri. Alternately, if it is not technically appropriate to continuously measure a flow rate for a given building ventilation system component, the study shall empirically establish a minimum electrical current in amps for each corresponding fan of the building's major ventilation system. This fan amperage limit shall be a surrogate for flow rates and shall similarly correspond to the appropriate minimum inflow of 200 fpm at each door of these buildings. The Consent Judgment already establishes some required flows. Per 2.A.5., the Sinter Plant's #3 baghouse trail flow rate has been set to be operated continuously at 225,000 acfm. Since this rate is to be continuously measured at a point where the flow exits the baghouse, this rate includes the flow from the Acid Plant as well. For optimum

performance of the Acid Plant (a major Sulfur Dioxide control device), the flow rates between the Sinter Machine and Acid Plant must be balanced accordingly. 2.A.11. of the CJ establishes the minimum continuous operating flow rate for the Blast Furnace's #5 baghouse to be 300,000 acfm. Lastly, the Sinter Wheel Tunnel ventilation shall be operated continuously at 15,000 acfm per 2.A.4. of the CJ. This provision also allows the Sinter Wheel Tunnel ventilation limit to be set at a corresponding fan amperage.

In a letter [**Attachment B]** dated August 12, 2008, the MDNR approved Doe Run's work plan and drafted a document with likely necessary requirements for implementation of the enforceable limits once established. Furthermore, this letter and its attachments served as guidance on how this ventilation study would be conducted. Due to a variety of unforeseen technical reasons and the greater-than-originally conceived challenges of the ventilation study concept, changes to the draft building ventilation requirements became necessary and are incorporated into the proposed Work Practices Manual (WPM) amendments found in **Attachment E**. All upgrades to the testing campaigns and ventilation requirements proposal were made with the advice and consent of the MDNR in numerous meetings and phone conversations that have taken place over the course of this project.

The protocol for the door inflow measurements using a handheld anemometer is contained in **Attachment E** (proposed WPM amendment) **Section 2.** This Standard Operating Procedure (SOP) document was adhered to during all door inflow measurement surveys taken during the course of this study. Furthermore, it is the test method that will be followed during any future required inflow evaluations. For all door inflow velocity measurements taken during the course of this study, Doe Run and its contractors used a turbine-type remote probe handheld anemometer: Extech Anemometer Model # 407113. All manufacturer instructions and specifications were adhered to, a copy of which is found in **Attachment G**.

Once adopted, the ventilation system major component minimum flow rates or fan amperages (whichever is appropriate), outlined in the table immediately below, shall become an enforceable amendment to the 2007 CJ as provided for in paragraph 2.A.20. **Attachment M** shall serve as this amendment.

Table 1. Proposed Minimum Flow Rates and Fan Amperages

• Sinter Plant Combination Trail Production period minimum =	169,000 acfm
• Sinter Plant Combination Trail Non-Production minimum =	100,000 acfm
• #6 Baghouse Fan =	70 amps
• #7 Baghouse Fan =	205 amps
• #8 Baghouse Fan =	68 amps
• #9 Baghouse Fan =	153 amps
• Sinter Wheel Tunnel Fan =	58 amps

The Justification summary for the limits proposed by Doe Run via the study results can be found in **Attachment D.** Once approved, the implementation provisions for these proposed limits and the requirements for future flow–inflow verification testing are to

become an enforceable amendment to the most recent version of the Doe Run Herculaneum Work Practices Manual (WPM). **Attachment E** is a draft of this WPM revision. Paragraph I.a and I.b. of this document briefly outline the procedures used during the course of this study and to be followed in future flow testing / verification campaigns. If adopted as proposed, the Doe Run Company's *January 2007 Work Practices Manual For Control of Lead Emissions* will be modified by Attachment E. Doe Run's compliance with, and adherence to, the procedures in the WPM are a requirement of 10 CSR 10-6.120, the 2007 Consent Judgment and the *2007 Revision to the Missouri State Implementation Plan for the Herculaneum Lead Nonattainment Area* (SIP).

Also, in conjunction with this study, the sinter machine wheel tunnel minimum fan amperage was determined as allowed by paragraph 2.A.4. of the CJ. As previously mentioned, this provision in the CJ, requires that the sinter machine wheel tunnel ventilation be continuously operated at 15,000 ACFM. In the absence of continuous flow monitoring, this paragraph allows Doe Run to establish a relationship between this fans' flow rate and its electrical current draw for purposes of compliance verification. Using a calibrated instantaneous flow probe, this relationship was established. Doe Run adhered to all applicable EPA test methods. These Sinter machine Wheel Tunnel ventilation results are summarized in **Attachment H**. The minimum fan amperage limit for the sinter machine wheel tunnel is hereby proposed, as a result of this determination, to be 58 Amps. If adopted, this limit will become enforceable as an amendment to paragraph 2.A.4. of the 2007 Consent Judgment. All corresponding operating procedures, continuous real-time amperage measurement / alarm trigger recording requirements and compliance provisions proposed for the three buildings' ventilation systems as detailed in WPM amendment (**Attachment E**) shall apply to the Sinter Machine Wheel Tunnel as well.

On June 3, 2008, prior to MDNR's approval of the work plan, a proof-of-concept or feasibility study was conducted by several members of the MDNR and EPA's Region VII Air staff. Their efforts were a scaled down version of this ventilation study. Scott Postma of the EPA wrote a report of his site visit during this trip (**Attachment I**). As this group expected, and as Doe Run later discovered during the course of this study, the Sinter Plant Building would prove to be the most tricky to accurately characterize. Flows from the Sinter Machine and the Sinter Plant Combination Trail experience great variations of temperature especially during periods of transition from Sinter thoughput to Sinter machine non operation making the establishment of a flow rate based upon an Actual Cubic Feet per minute flow very difficult.

Actual volume flow rates, upon the measurement of which Doe Run's computerized datalogger system is based, are not standardized to correlate directly to mass air flow, and thus two vastly different volume flow rates measured in actual CFM might really represent very similar amounts of mass air flow transfer depending on the process operating parameters at the time the two measurements were taken. This becomes a problem because the purpose of this study is to correlate the ventilation system actual volume flow rates to incoming air. To further explain how a large change in actual flow

rates (due to temperature) can correspond to similar inflow velocities, theories of fluid dynamics were applied. For the purposes of this study, and because its size yields a lack of significant airflow boundary layer effects, the Sinter Plant can be considered a theoretical Control Volume. The mass of air leaving the building via the baghouses must be matched by the mass of inflow air. Assuming very little energy is lost in this transfer of air, and applying the principles of Conservation of Momentum, we see that during periods of sinter machine operation, the moderately fast existing gases are hot and have a relatively low density (low mass ratio) and thus the relatively high density (high mass ratio) door inflow make-up air will travel considerably slower. Similarly, the outgoing hot sinter gases will have a higher actual volume flow rate than the incoming air (if all the flows through all the openings to this control volume could be summed.) The incoming air is climatically ambient and of a fairly consistent quality over time when you consider that the temperature and humidity changes due to weather experienced at the plant are not nearly as significant as the potential 1000° F temperature swing that Sinter machine process air might undergo. The main variable effecting the correlation between Sinter combo trail air versus non sinter machine operation air is temperature but other variables include: changes in humidity (both affecting the air's density) and the change in molecular weight of the air due to the addition of Carbon and Sulfur to the combustion / sintered air. Initial Sinter Plant flow-inflow surveys highlighted this problem. In consultation with the MDNR, the solution proposed here is to establish two sets of actual volume flow rate limits for the Sinter Plant Combination trail: one for periods of Sinter Machine operation, and one for periods of Sinter Machine Non-Operation. This is especially important because Sinter Plant, and indeed all primary lead smelting operations, tend to be very intermittent batch oriented. These two proposed limits on the combination trail are 100,000 ACFM when sinter machine is down and 169,000 ACFM when sinter machine is operating per **Attachment D**. The loggable trigger for determining when the sinter machine is on or off will be the amperage to the motors on both the sinter machine and the feed belt. Proposed limits were established using statistical analyses of raw datalogged flow measurements to sigma 3 during periods representative of normal Sinter Plant on-off operations and then verified through inflow testing. The inflow verification process will be described in more detail later.

Similarly, the proposed limits for the Blast Furnace and Refinery major ventilation systems (Baghouse #'s 6,7,8,9) were based upon a statistical analysis of each fan's electrical current draw under typical operating parameters and then verified using door inflow testing. During these surveys, instantaneous probe flow readings were taken to demonstrate the volume flow rates corresponding to these fan amperages. The ventilation units in the Blast Furnace and Refinery (with the exception of the #5 baghouse) have their incoming air and outgoing air at virtually the same temperature making this determination considerably easier. The Blast Furnace's #5 baghouse's minimum actual volume flow rate has already been established by the CJ and thus the dilemma encountered in the study by the sinter machine did not arise here.
The proposed minimum fan amperage limits for the Blast Furnace & Refinery building baghouse fans are outlined in Table 1 above.

The raw data of flow rates typical of normal operations used in the statistical analysis can be found in **Attachment D2.** Sample data was collected that represents normal periods of operation. The data collected demonstrates that sinter machine off periods can be effectively logged. The logger data is representative yet random. Doe Run Herculaneum's Assistant Operations Manager, Francis Rozzano, conducted the sigma calculations used to determine the typical operating flow averages upon which these proposed limits are based. A justification of his data sample selection and summary of the statistical analyses may be found in **Attachment O.**

The field test conducted by the state and federal regulators in June 2008 uncovered another situation: how to typify the doors on the second floor of the mix room that go to the outside but are not really on the exterior of the Sinter Plant because the mixing room is adjacent to the Sinter Plant and acts as a "drop-out" or settling chamber much in the same way that the double-door airlock doors proposed in this project for some doorways that fail inflow testing are. These upper mix room doors obviously cannot be characterized as interior because they go to the outside, but also "see" almost no ventilation from the Sinter Plant because they are isolated from it by walls, the outside, and a thick metal floor where the mix room hoppers are. In light of this and after consenting discussions with the MDNR, Doe Run proposes that doors S12, S13, S14, S15, S17 and S18 be exempt from future inflow evaluations. For the purposes of making this ventilation study a comprehensive evaluation, inflow surveys were taken for these doors wherever possible and are included in the corresponding results summaries in the attachments. From the surveys conducted and the data collected, these doors generally demonstrated good inflows despite only receiving minimal drafting from the Sinter Plant ventilation systems. Only one door tested (S14) recorded an inflow velocity below 200 fpm and that was 145 fpm. To make all this clearer, please review the Sinter Plant floor diagram in **Attachment J** and cross section **Attachment J2.** These upper mix room doors that separate the Sinter Plant from the outside via the mix room are designated with their number surrounded by a diamond. To further justify the characterization of these doorways as "non lead-bearing particle egressive", it should be noted that for the attainment modeling demonstration conducted by the MDNR as part of the 2007 SIP revision submittal, it was established that the Mixing Room is indeed a settling chamber with a 90% particle capture and containment control efficiency. Doors #S10 and S16 are the only doors on the second floor of the Sinter Plant that connect directly to the upper floor of the mix room providing direct inflow ventilation from the settling chamber / mix room and by extension to the outside via the "diamond" designated doors. Thus S10 and S16 are considered to be exterior doors (even though they appear to be on the interior) and their number designations have a circle around them to indicate they are applicable to the ventilation study. Using this same reasoning, doors S20, S22 and S23 going to the outside from the lower level of the Sinter Plant are considered to be exterior and relevant to this and future inflow evaluations because there is a considerable "air connection" to the Sinter Plant via the breezeway designated by a dashed line where a wall and S26 used to be. This breezeway as stated above does <u>not</u> provide ventilation to the upper mix room because the "ceiling" of the lower level mix room is the solid concrete side-walls of the hoppers.

In the building floor diagram maps of **Attachments J & K,** Sinter Plant doors are designated with an"S", Blast Furnace building doors with a "B" and the Refinery doors are indicated by "R", followed by the door number. Door number designations match the text descriptions of the original approved work plan with the exception that an additional door, B27, was added to the map at the North end of the Sinter Plant Building. B23 and B27 are on the Sinter Plant map, not the Blast Furnace/Refinery building map because these doors provide access to the #9 conveyor belt (CV-9) tunnel starting at the Blast Furnace. Because these tunnel access doors are partitioned from the Sinter Plant, their inflow air draws primarily from the Blast Furnace. Doe Run in coordination with the MDNR, deemed it appropriate to label these doors with a "B" on the Sinter Plant building diagram. The floor diagram maps of the Sinter Plant, Blast Furnace and Refinery designate doors that are relevant to this and future ventilation / door inflow evaluations with a circle surrounding their number designation.

Doors whose numbers are enclosed in a triangle are doors which we propose to be exempt from future inflow evaluations because Doe Run has agreed to complete door projects at these doors as detailed in the proposed WPM amendment of **Attachment E** paragraphs III.e and III.f. Doe Run agreed to this concession as a continual improvement project and because these doors either have already failed an inflow test or it is felt that they are likely to fail in the future. Doe Run decided to be proactive and preemptive in not waiting for these questionable doors to be deemed out of compliance by future door inflow evaluations. For example S11, should be characterized as a special mix room settling chamber door (as with the ones mentioned above designated with a diamond) but will be permanently sealed or walled over by July 30, 2009 in an effort to maximize particle containment in the upper level of the mix room. Door project options proposed, in the WPM amendment attached, for man doors include, removing the door by permanently sealing it up, installing double door air lock chambers, or installing quality doors with effective weatherstrip seals and lockout procedures. For equipment doors, proposed project options include installing heavy duty industrial clear vinyl strip curtains as a secondary barrier or installing motorized roll up doors similar to the one installed on the Railcar Tippler building. The decision about which door project should be chosen for a particular door was made in close coordination with the MDNR. Criteria included the feasibility & appropriateness of a given style project considering traffic patterns and locations.

As mentioned earlier, door designations encircled are viable doors for this and future inflow evaluations. Doors designated by a square on the floor diagrams are doors that are not relevant to this ventilation study or future inflow surveys because they were either mistakenly placed on the original work plan as exterior when they are really interior or have been deleted since the drafting of the work plan. Doors could have been deleted by being walled over or by another construction project. Once again,, please see the floor diagrams for further details. Also an explanation of the status each door at the time of the writing of this report can be found in **Attachments C**.

On May 12, 2009, Joe Winkelmann, an environmental engineer for the Missouri Department of Natural Resources' Air Pollution Control Program visited the facility in

conjunction with the finalizing of this report and verified the location of each and every door on the maps. The diagrams in Attachments J & K were the final edits made as the result of his visit. Moreover, Mr. Winkelmann inspected and verified every opening deleted from the work plan (marked with a square). Lastly, Joe Winkelmann confirmed the accuracy of the mix room / sinter plant separation layout described above. Door B27 was added to the map and a couple of new door projects were agreed to as a result of his visit.

Numerous sets of ventilation study data has been collected for each building by various surveys conducted over the course of this project. A summary of all the door inflow measurements taken may be found in **Attachments C1, C2, & C3**. This data compilation tabulates the lowest inflow reading as well as the highest inflow measurement that each door has exhibited during all survey periods representative of normal operations. These results show generally good inflows over a wide range of typical operating conditions. Any door that failed the 200 fpm inflow standard has been proposed for a continual improvement door project. Initial ventilation study surveys and door inflow evaluations were conducted during by Doe Run staff on September 9, 2008; September 19, 2008; October 21, 2008; November 21, 2008; December 3, 2008; and February 5-9, 2009. Much insight about the flows and inflows in these buildings was gained during these initial surveys. Also, as a result of these surveys the difficulty in characterizing the sinter combination trail ventilation flow rates was uncovered. The data obtained from these surveys corroborate well with the data collected during the final verification testing that occurred on March 26 and May 12-13, 2009.

As a final piece to the puzzle, the 3rd sigma flow rates calculated by Francis Rozzano needed to be checked versus door inflows at each building. Aeromet Engineering of Jefferson City, Missouri, the stack testing contractor for Doe Run, was hired to conduct this final inflow verification. Due to uncooperative weather that lasted for several days, Aeromet Engineering was only able to test the door inflows at the Blast Furnace and Refinery Buildings. The amperage of each fan was held as close as possible to the 3rd Sigma limit by the control room operator who was in contact with the Aeromet crew via two-way radio. This survey clearly demonstrated that the proposed minimum amperages of each of these two building's major ventilation system units created adequate door inflow at each relevant door. A summary of their results can be found in **Attachment L.** Also during this visit, Aeromet crews used instantaneous flow probes to calibrate / verify the continuous flow meter in the Sinter Plant's combination trail. The two readings were within a 2% tolerance.

The final door inflow verification test for the Sinter Plant building took place on May 12-13, 2009. Mr. Joseph Winkelmann of the MDNR participated in, observed and supervised this inflow evaluation. The proposed scenario for periods of Sinter machine operation was conducted on May 12. As with the final survey conducted at the Blast Furnace and Refinery buildings, the proposed 3rd Sigma flow rate of 172,000acfm was held to very tight tolerances during the course of this survey. As a matter of fact, the survey was conducted at a somewhat lower average rate of 169,000. The next day, the

sinter machine was shut down all morning so that the non-production scenario for the sinter plant combination trail ventilation system could be verified. On both days the Sinter Plant control operator was in communication with the survey crew via radio. For the non-production scenario, a flow rate of 100,000 acfm was proposed. This number falls between the second and third sigma values. This rate was maintained as closely as possible during the course of the testing, ranging approximately only from about 99,000 to 101,000 acfm. The results of this survey confirmed the proposed flow rate as all relevant doors met the 200 fpm standard. A summary of results from both days' testing may be found in **Attachments C4 & C5.**

In conclusion, Doe Run would like to thank all of its staff and contactors who aided in the completion of this project. A special acknowledgement goes out to the many staff member's of the MDNR's Air Pollution Control Program for their many hours of assistance, cooperation, consultation and technical expertise during the course of this study.