AP42 Section:	9.9.1
Title:	Comments and letters to updated section 1996 - 2003

National Grain and Feed Association

August 12, 2002

Mr. Dallas Safriet
U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards (MD-14)
Research Triangle Park, North Carolina 27711

Dear Mr. Safriet:

This letter is a follow-up to the May 24, 2002 letter from Dr. Gregory Muleski, Midwest Research Institute (MRI) that addressed new emission factors for barge, vessel and other grain handling operations for incorporation into AP-42 Section 9.9.1, ***Grain Elevators and Grain Processing Plants***. We support Dr. Muleski's recommendations and urge the Agency to incorporate them into AP-42 at the earliest opportunity.

In a separate but related matter, we recommend that the Agency consider amending Section 9.9.1 so that the written text: 1) is consistent with the proposed new barge and vessel emission factors for Table 9.9.1-1; 2) includes recent research on size distribution of dust emissions from grain facilities; 3) reflects current industry operating practices and equipment; 4) accurately reports EPA's air pollution regulatory requirements for grain dryers; and 5) avoids reporting questionable information on the chemical composition of grain dust. A more detailed explanation of these issues and our suggested changes to Section 9.9.1 are presented in **Attachments One (showing proposed changes and original text) and Two (with changes included in the text).**

Furthermore, we recommend that the Agency amend Table 9.9.1-1 to provide a "PM" emission factor for bin vents based on data gathered in earlier research on dust emission rates from grain elevators but excluded from the 1998 edition of AP-42. We believe including this information in AP-42 would be beneficial to users, as no other more reliable information on such emissions is available at this time. In addition, the "PM" emission factor could be augmented to provide bin vent emission factors for PM-10 and PM-2.5 using the scaling factors suggested in Dr. Muleski's May 24, 2002 letter (i.e., 25% of PM for PM-10, and 17% of PM-10 as PM-2.5). To further improve the informational content of the table, a footnote should be provided to inform users that the bin vent emission factors are based upon measurements at the inlet of a cyclone device and, thus, are conservatively high estimates of uncontrolled emissions.

We also believe providing further guidance on use of the emission factors in Table 9.9.1-1 would be helpful in establishing greater consistency in the application of these factors and hope to forward some suggestions on this issue for the Agency's consideration by mid-August 2002.

Thank you for considering these requests. Should you have any questions, please feel free to contact me at 202/289-0873.

Sincerely,

Thomas C. O'Connor
Director of Technical Services

cc: James E. Maness, Chairman, NGFA's Safety, Health and Environmental Quality Committee.
Dr. Gregory Muleski, Midwest Research Institute.

Attachment One
With Changes and Original Text

The following paragraphs from AP-42, Section 9.9.1 contain recommended changes (bolded and underlined type) to the written text that are designed to: 1) ensure consistency with the emissions data in Table 9.9.1-1; 2) reflect current industry equipment and operating practices; 3) correct an error in the reported air pollution performance standards for grain dryers; and 4) prevent AP-42 from fostering a unsubstantiated and potentially inaccurate misconception on the chemical composition of grain dust. The specific justification for each of these changes is provided immediately after each paragraph. Appendix Two presents each paragraph, as they would appear should the changes be made.

Change One

- Amend the fifth paragraph of Section 9.9.1.1 (pages 1/2) to read:

  "The first step at a grain elevator is the unloading of the incoming truck, railcar, or barge. A truck or railcar discharges its grain into a hopper, from which the grain is conveyed to the main part of the elevator. Barges are unloaded by a bucket elevator (**either a continuous barge unloader or** marine leg) that is extended down into the barge hold or by cranes using cl~~amshell buckets~~. The main building at an elevator, where grain is elevated and distributed, is called the "headhouse." In the "headhouse," grain is lifted on one of the elevator legs and**,** **at older facilities,** is typically discharged onto the gallery belt, which conveys the grain to the storage bins. A "tripper" diverts grain off the belt and into the desired bin. **At more modern grain handling facilities, o**ther modes of transfer include **enclosed conveyors, direct spouting,** augers and screw conveyors. Grain is often cleaned, dried, and cooled for storage. Once in storage, grain may be transferred one or more times to different storage bins or may be emptied from a bin, treated or dried, and stored in the same or a different bin. For shipping, grain is discharged from bins onto the tunnel **conveyor** **and then elevated by a leg or inclined conveyor to a weighing system and possibly load-out bin before being discharged to a truck, railcar or ship.** Figure 9.9.1-1 presents the major process operations at a grain elevator."

  Let us explain the difference between continuous barge unloader + marine leg

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  Deleted: scale garner

  Deleted: and to the desired load out location (possibly through a surge bin).

  Justification: These changes are designed to update this paragraph to reflect current industry practice.

Change Two

- Separate the fourth paragraph of Section 9.9.1.2.1 (page 13) into two sections for clarity purposes and amend several areas to read:

"Grain dust emitted from grain elevator handling operations comprises about 70 percent organic material. Dust may include particles of grain kernels, small amounts of spores of smuts and molds, insect debris, pollens, and field dust. Data recently collected on worker exposure to grain dust indicate that the characteristics of the dust released from processing operations to the internal elevator environment vary widely.[15] **Because these dusts have a high organic content and a substantial suspendible fraction, concentrations above the minimum explosive concentration (MEC) pose an explosion hazard. Housekeeping practices instituted by the industry have reduced explosion hazards so this situation is rarely encountered in work areas."**

"**Recent research on dust emissions from grain handling operations indicate that the** fraction of dust particles equal to or less than 10 μm in diameter **(PM-10) averages approximately 25 percent of PM and 2.5 μm in diameter average 17 percent of PM-10.**"

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Deleted: Because these dusts have a high organic content and a substantial suspendible fraction, concentrations above the minimum explosive concentration (MEC) pose an explosion hazard. Housekeeping practices instituted by the industry have reduced explosion hazards, and this situation is rarely encountered in work areas."

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Justification: As currently structured, the existing paragraph contains two distinct concepts that would be better conveyed in separate paragraphs. In addition, we think the reference to 17% percent free silica in the first sentence should be modified as we are not aware of nor does AP-42 provide any reference to support the 17% value. We believe the suggested revised language is more appropriate and consistent with what is known about the chemical composition of grain dust.

Because we are recommending that the existing paragraph be separated into two paragraphs that address separate issues, the last two sentences of the current paragraph ("Because these dusts have a high organic content ...") should be moved to the end of our proposed first paragraph as these sentences pertain to the composition of grain dust, the subject of the first paragraph.

We also believe that the references to industrial hygiene employee exposure research in the third and fourth sentences should be deleted because this information: 1) was obtained using sampling devices worn by personnel within different areas of a facility and thus cannot be correlated with potential emissions to the ambient environment; 2) could be confusing to users trying to match these written statements the data in Table 9.9.1-1; 3) could be misinterpreted as suggesting differences in emission rates among grains or between types of facilities that are not supported by recent research; and 4) does not conform with the background document to Section 9.9.1.

Finally, we have added some suggested language on PM-10 and PM-2.5 to be consistent with information found in other areas of AP-42, including reference to the recent research on PM-2.5 size fraction in grain dust.

Change Three

- Amend the tenth paragraph of Section 9.9.1.2.1 (page 14) to read:

"The loadout of grain from elevators into railcar, truck, barge, or ship is another important source of PM emissions and is difficult to control. Gravity is usually used to load grain from bins above the loading station or from the scale in the headhouse. The main causes of dust emissions when loading bulk grain by gravity into trucks or railcars is the wind blowing through the loading sheds and dust generated when the falling stream of grain strikes the truck or railcar hopper. The grain leaving the loading spout is often traveling at relatively high velocity and **the use of dead boxes, aspiration, socks, or other means are often used to reduce dust emissions.** Dust emitted during loading of barges and ships is comparable to levels generated during loading of trucks or railcars. The openings for the holds in ocean-going vessels **may also be covered with tarps if needed to meet air quality standards**."

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Justification: These changes are designed to reflect industry practice and make the written text consistent with data in Table 9.9.1-1.

Change Four

- Amend the twelfth paragraph of Section 9.9.1.2.1 (page 14) to read:

"Cross-flow column dryers have a lower emission rate than rack dryers because some of the dust is trapped by the column of grain. **In some cases, an enclosure may be built around the dryer that can act as a relatively effective settling chamber because of its moist environment.** New grain dryers being sold today do not require the use of enclosures. In rack dryers drying corn, the emission rate for larger particulate matter can be higher because the turning motion of the grain liberates more so-called "bees wings" from the kernel and the design facilitates dust escape. Some rack dryers are exhausted only from one or two points and are thus better suited for control device installation. The EPA's New Source Performance Standards (NSPS) for grain elevators established visible emission limits for grain dryers by requiring 0 percent opacity for emissions from column dryers and rack dryers. The NSPS zero opacity standard does not apply to column dryers with column plate perforations less than or equal to 2.4 mm diameter (0.094 in.) or to rack dryers with a screen filter with less than or equal to 50 mesh openings."

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Justification: The recommended changes to the second and third sentences are designed to more fairly characterize the ability of an enclosure around a column dryer to remove some types of particulate matter from emissions to the atmosphere. This efficiency results in large part from the moist environment within the enclosure that facilitates settling of particulate matter, particularly the coarser fractions, from the air.

The suggested changes to the fourth sentence ("In rack dryers …") are designed to clarify that the design of a rack dryer can lead to a larger percentage of bees wings and other large particles being emitted when such equipment is used to dry corn.

The remaining changes to the bottom portion of the paragraph are needed to ensure that the written text in AP-42 accurately characterizes the applicability of §60.302(a) to grain dryers.

Attachment Two
Paragraphs with Revised Text

<u>The fifth paragraph of Section 9.9.1.1 (pages 1/2) with changes</u>:

"The first step at a grain elevator is the unloading of the incoming truck, railcar, or barge. A truck or railcar discharges its grain into a hopper, from which the grain is conveyed to the main part of the elevator. Barges are unloaded by a bucket elevator (either a continuous barge unloader or marine leg) that is extended down into the barge hold or by cranes using clamshell buckets. The main building at an elevator, where grain is elevated and distributed, is called the "headhouse." In the "headhouse," grain is lifted on one of the elevator legs and, at older facilities, is typically discharged onto the gallery belt, which conveys the grain to the storage bins. A "tripper" diverts grain off the belt and into the desired bin. At more modern grain handling facilities, other modes of transfer include enclosed conveyors, direct spouting, augers and screw conveyors. Grain is often cleaned, dried, and cooled for storage. Once in storage, grain may be transferred one or more times to different storage bins or may be emptied from a bin, treated or dried, and stored in the same or a different bin. For shipping, grain is discharged from bins onto the tunnel conveyor and then elevated by a leg or inclined conveyor to a weighing system and possibly load-out bin before being discharged to a truck, railcar or ship. Figure 9.9.1-1 presents the major process operations at a grain elevator."

<u>The fourth paragraph of Section 9.9.1.2.1 (page 13) with changes</u>:

"Grain dust emitted from grain elevator handling operations comprises about 70 percent organic material. Dust may include particles of grain kernels, small amounts of spores of smuts and molds, insect debris, pollens, and field dust. Data recently collected on worker exposure to grain dust indicate that the characteristics of the dust released from processing operations to the internal elevator environment vary widely.[15] Because these dusts have a high organic content and a substantial suspendible fraction, concentrations above the minimum explosive concentration (MEC) pose an explosion hazard. Housekeeping practices instituted by the industry have reduced explosion hazards so this situation is rarely encountered in work areas.

Recent research on dust emissions from grain handling operations indicate that the fraction of dust particles equal to or less than 10 µm in diameter (PM-10) average approximately 25 percent of PM and 2.5 µm in diameter average approximately 17 percent of PM-10.

The tenth paragraph of Section 9.9.1.2.1 (page 14) with changes:

"The loadout of grain from elevators into railcar, truck, barge, or ship is another important source of PM emissions and is difficult to control. Gravity is usually used to load grain from bins above the loading station or from the scale in the headhouse. The main causes of dust emissions when loading bulk grain by gravity into trucks or railcars is the wind blowing through the loading sheds and dust generated when the falling stream of grain strikes the truck or railcar hopper. The grain leaving the loading spout is often traveling at relatively high velocity and the use of dead boxes, aspiration, socks, or other means are often used to reduce dust emissions. Dust emitted during loading of barges and ships is comparable to levels generated during loading of trucks or railcars. The openings for the holds in ocean-going vessels may also be covered with tarps if needed to meet air quality standards."

The twelfth paragraph of Section 9.9.1.2.1 (page 14) with changes:

"Cross-flow column dryers have a lower emission rate than rack dryers because some of the dust is trapped by the column of grain. Sometimes an enclosure is build around the dryer that can act as a relatively effective settling chamber because of its moist environment. New grain dryers being sold today do not require the use of enclosures. In rack dryers drying corn, the emission rate for larger particulate matter can be higher because the turning motion of the grain liberates more so-called "bees' wings" from the kernel and the design facilitates dust escape. Some rack dryers are exhausted only from one or two points and are thus better suited for control device installation. The EPA's New Source Performance Standards (NSPS) for grain elevators established visible emission limits for grain dryers by requiring 0 percent opacity for emissions from column dryers and rack dryers. The NSPS zero opacity standard does not apply to column dryers with column plate perforations less than or equal to 2.4 mm diameter (0.094 in.) or to rack dryers with a screen filter less than or equal to 50 mesh openings."

Clark
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January 29, 2002

Dallas Safriet
Environmental Protection Agency
Research Triangle Park, NC 27711

Re: Comments on MRI's Final Test Report on Emission Factors for Barges and Marine Vessels

Dear Mr. Safriet:

The Southwest Clean Air Agency (SWCAA) would like to submit comments on the November 2, 2001 final test report for Emission Factors for Barges and Marine Vessels submitted by Midwest Research Institute under contract with the National Grain and Feed Association.

SWCAA has three grain terminal elevators in our jurisdiction located along the Columbia River in southwestern Washington. SWCAA has reviewed the Emission Factors for Barges and Marine Vessels final test report in an effort to understand how the study and the resulting emissions factors could apply to these facilities. In doing so, SWCAA has concluded that more information about the facility operating parameters and study testing methodologies should be included in the final report in order to be able to attempt to use this new data for sources within our jurisdiction.

The comments that SWCAA would like to submit mainly pertain to the marine vessel, or ship loading portion of the study. SWCAA requests the report be clarified in the following areas:

1) Please explain whether deadboxes were used on all ship loading spouts.

The test report states that the control devices were deactivated during test periods, but does not elaborate on whether or not this deactivation only pertained to the air drawn to baghouses. SWCAA facilities are required to use deadboxes at the end of the loading spouts which significantly reduce particulate emissions and can be considered control devices even without any added aspiration.

2) Clarify whether any mineral oil was added to the grain used during the tests.

In the same topic of operation parameter documentation, there was no mention of whether or not any oiling was performed on the grain used in the study. This is a common particulate mater reduction practice for grain facilities including the three grain terminals in SWCAA's jurisdiction, however there was no mention of this factor in the report. There are sometimes two to three points along the grain handling process where mineral oil may be added to the grain. Also, the terminals in our jurisdiction generally do not have information on whether or not the grain has been oiled prior to reaching their facility. Is this the same for those facilities tested? Any emission factor development should consider this element.

3) Explain whether grain was cleaned in any way prior to its use in this study.

Grain cleaning after or prior to storage is a standard procedure for facilities on the West Coast whose exported commodities must meet certain dockage standards. There is no discussion in regards to the sampling/weighing/cleaning process that might have been employed to grain used in this study. Again, there are multiple opportunities for grain to be cleaned prior to export. Any emission factor development should consider this element.

4) Describe the distance between the spout and the piles of loaded grain during the ship loading tests.

The barge loading test description mentions the heights of the loading spout above the grain pile in the vessel during different loading tests, however there is no corresponding information for the ship loading test documentation. Although the report does show emission calculations at different points in the ship loading cycles, there is no discussion of how far the grain fell once the grain left the end of the loading spout. SWCAA has found that particulate emissions are less if the distance from the end of the spout to the loaded grain is kept to a minimum. It has also been SWCAA's experience that there can be some variability in the distance that different ship loading crews will use. In addition there is considerable variability in emissions between allowing grain to load in a fashion which causes steep, tall piles of grain in a vessel hold versus the loading spout operator continuously moving the spout to prevent pile formation. Again, this is a critical element in knowing how to develop and/or apply any emission factor.

On a more general note, it appears that the study evaluated PM_{10} and $PM_{2.5}$ with no discussion of TSP. TSP is still a regulated pollutant in Washington State. Should it be assumed that PM_{10} was 25 percent of the total filterable PM during this study as suggested in AP-42 Table 9.9-1 Particulate Emission Factors for Grain Elevators, or is there other guidance available?

In addition, there was no discussion of opacity in the report. Opacity is the major surrogate parameter that is helpful in the field to assess compliance with emission limits. An opacity correlation is also valuable for comparing tested emission data from one facility to the emission rates of another facility. Therefore, for the test data to be most useful, it is necessary to have opacity information correlated with emission test data. Please elaborate in the test report any observations of opacity.

In summary, SWCAA requests clarification on the above mentioned topics and recommends that any such clarification be included in the final report so that other persons wishing to use information from this study will better understand how to apply it.

If you have any questions or comments, please give me a call at (360) 574-3058 extension 30.

Sincerely,

Paul T. Mairose
Chief Engineer
Southwest Clean Air Agency

cc:

Steve Oakes, Plant Manager
Kalama Export Facility
2211 N. Hendrickson Drive
Kalama, WA 98625

Jim Veltum
United Harvest, LLC
1927 Elevator Way
Vancouver, WA 98660

cc: Project File, 310012.1.002

Comment Response Log, Letter of January 29, 2002 from Paul T. Mairose, Southwest Clean Air Agency (SWCAA), Vancouver, WA to Dallas Safriet, USEPA, Research Triangle Park, NC.

Comment	Response
1) Please explain whether deadboxes were used on all ship loading spouts. The test report states that the control devices were deactivated during test periods, but does not elaborate on whether or not this deactivation only pertained to the air drawn to baghouses. SWCAA facilities are required to use deadboxes at the end of the loading spouts which significantly reduce particulate emissions and can be considered control devices even without any added aspiration.	Only aspirated controls were deactivated during test periods. Deadboxes were not removed from spouts.
2) Clarify whether any mineral oil was added to the grain used during the tests. In the same topic of operation parameter documentation, there was no mention of whether or not any oiling was performed on the grain used in the study. This is a common particulate matter reduction practice for grain facilities including the three grain terminals in SWCAA's jurisdiction, however there was no mention of this factor in the report. There are sometimes two to three points along the grain handling process where mineral oil may be added to the grain. Also, the terminals in our jurisdiction generally do not have information on whether or not the grain has been oiled prior to reaching their facility. Is this the same for those facilities tested? Any emission factor development should consider this element.	No mineral oil was added to any grain handled during the tests. None of the host facilities routinely oil grain upon receipt or at any other point in the handling process. Because the host sites are export facilities that can receive grain from hundreds of other elevators, it is possible that some fraction of the grain had been oiled at some time (i.e., between farm and arrival at the host export facility). However, it is impossible to strictly determine what fraction had been oiled or when it had been oiled. This is essentially equivalent to retracing the exact path for every kernel of corn prior to its receipt at the host site. The important point to remember is that the grain handled is representative of typical commodities exported. Material from many different elevators is blended numerous times to the typical grade (e.g., No. 2 yellow corn) exported.

3) Explain whether grain was cleaned in any way prior to its use in this study. Grain cleaning after or prior to storage is a standard procedure for facilities on the West Coast whose exported commodities must meet certain dockage standards. There is no discussion in regards to the sampling/weighing/cleaning process that might have been employed to the grain used in this study. Again, there are multiple opportunities for grain to be cleaned prior to export. Any emission factor development should consider this element.	No special cleaning was performed specifically for these tests. In addition, no special effort was made to select grain or oilseeds for testing based upon a predetermined quality factor but were accepted as they routinely occurred at the facility and in commercial markets. As noted previously, the important point to remember is that the quality of the grains and oilseeds sampled and loaded during these tests were representative of typical commodities exported.
4) Describe the distance between the spout and the piles of loaded grain during the ship loading tests. The barge loading test description mentions the heights of the loading spout above the grain pile in the vessel during different loading tests, however there is no corresponding information for the ship loading test documentation. Although the report does show emission calculations at different points in the ship loading cycles, there in no discussion of how far the grain fell once the grain left the end of the loading spout. SWCAA has found that particulate emissions are less if the distance from the end of the spout to the loaded grain is kept to a minimum. It has also been SWCAA's experience that there can be some variability in the distance that different ship loading crews will use. In addition there is considerable variability in emissions between allowing grain to load in a fashion which causes steep, tall piles of grain in a vessel hold versus the loading spout operator continuously moving the spout to prevent pile formation. Again, this is a critical element in knowing how to develop and/or apply any emission factor.	Facility operators loaded the ships in the same manner that they always use. Other than removing the tarps used by one facility as a part of its dust control practices, the only modification to loading practice was the intermittent starts/stops corresponding to individual test periods. Consistent with normal procedures and equipment limitations, facility operators extended the spout into the ship hold as close as possible to the top of the grain pile throughout loading operations. Field-testing followed the test protocol previously approved by EPA and gathered data to support development of reliable emission factors for ship loading. The test protocol used during the test program is more fully described in the test report.
On a more general note, it appears that the study evaluated PM_{10} and $PM_{2.5}$ with no discussion of TSP. TSP is still a regulated pollutant in Washington State. Should it be assumed that PM_{10} was 25 percent of the total filterable PM during this study as suggested in AP-42 Table 9-9.1 Particulate Emission Factors for Grain Elevators, or is there other guidance available?	No tests of TSP were conducted during the test program.
In addition, there was no discussion of opacity in the report. Opacity is the major surrogate parameter that is helpful in the field to assess compliance with	No opacity observations were made during the test program.

emission limits. An opacity correlation is also valuable for comparing tested emission data from one facility to the emission rates of another facility. Therefore, for the test data to be most useful, it is necessary to have opacity information correlated with emission test data. Please elaborate in the test report any observations of opacity.	

cc: Project File, 310012.1.002

National Grain and Feed Association

September 17, 1997

Mr. Dallas Safriet
Environmental Engineer
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

Dear Mr. Safriet:

The National Grain and Feed Association appreciates the opportunity to review the draft version of Section 9.9.1, Grain Elevators and Grain Processing Plants, dated July 1997. We could have effectively utilized more time to review and analyze the document but understand the Agency's desire to complete the review and finalize the report to meet certain deadlines. We have restricted our comments to the Chapter 5, Proposed AP-42 Section 9.9.1 in order to meet the EPA's deadlines while concentrating on the section most likely to directly affect our industry.

I. Chapter 2 - Industry Description

A. We recommend that the ratios on page 2-4 be deleted as they appear out-of-date with current industry practice.

B. We recommend that the first sentence in the second paragraph on page 2-5 be changed to read: "Animal feed manufacturing facilities process grains, grain milling byproducts, oil extraction byproducts and <u>other non-grain ingredients</u> to produce ..."

C. The word "steel" should be added in the first sentence of the second paragraph on page 2-6 (Section 2.2.1) to read: "A grain elevator normally consists of a series of upright concrete <u>or steel bins</u> ..."

D. We recommend that the following sentence be added after the first sentence in the third paragraph on page 2-7: "... that can be lowered into the holds of the barges. <u>Cranes using clam shell buckets can also be used to unload grain into hoppers for discharge onto a conveyor belt</u>. Once elevated to the top ..."

E. Many variables, such weather during growing and harvesting, agronomic practices of individual farmers, and pre-cleaning, can affect the dustiness of

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soybeans between areas, years and facilities. Thus, the fourth sentence in the last paragraph on page 2-23 (i.e., "Field run soybeans ... amount of visible emissions") cannot be made as an unqualified statement. We recommend that this sentence be eliminated.

F. The last sentence in the first paragraph on page 2-34 should be amended to read, "Some rack dryers are ..."

G. The fourth paragraph on page 2-34 presents the false impression that legs are always sources of dust emissions to the atmosphere. It also suggests that vents installed on the top of legs must always be open to the atmosphere (and, thus, a source of emissions) in order to relieve air pressure and remove dust from the leg. We disagree with both statements. For example, totally enclosed legs are not sources of emissions to the atmosphere. Also, many operators have sealed the vents at the top of the leg specifically to prevent dust emissions to the atmosphere (the seal is designed to relieve pressure buildup for safety reasons) since sufficient air can flow into and out of the leg through the boot and head sections. Further, many operators have found that air actually flows into the leg through the vent under some operating conditions. Thus, we recommend that the paragraph be changed to read: "The leg may be aspirated to remove dust created by the motion of the buckets and the grain flow. A variety of techniques are used to aspirate elevator legs. For example, some are aspirated at both the top and bottom. Others are fitted with ducting from the top to the bottom in order to equalize the pressure, sometimes including a small blower to serve this purpose. The collected dust is discharged to a cyclone or filter. Leg vents may emit trace amounts of dust under some operating conditions. However, these vents are often capped or sealed to prevent dust emissions. The sealing or capping of the vent is designed to act as an explosion relief vent after a certain internal pressure is reached to prevent damage to the atmosphere."

H. The technique of "total/partial enclosure" should be added to the list of potential control mechanisms in Table 2-10.

I. Bullets 2 and 4 on Figure 2-12 should be changed to read, "Pivoting baffle" and "Air duct pickup along the length of each side," respectively.

J. We recommend that the second sentence in the top paragraph on page 2-42 be changed to read, "It then falls onto the grain pile."

II. Chapter 4 AP-42 Section Development

A. Footnote f seems to be missing from the bottom of Table 4-15.

III. Section 9.9.1.1, Process Description

A. General

1. The Agency makes the distinction between "country" and "terminal" grain elevators in the draft document. We do not believe this is a useful distinction to the reader, particularly since Table 9.9.1 does not make this distinction. Therefore, we recommend that this section simply contain a general description of the types of operations that can occur at a grain elevator, such as truck and rail receiving and shipping; grain cleaning; grain drying; blending; and storage. Reference to "country" and "terminal" facilities should be dropped. It is not a useful distinction.

2. We also recommend that the information in our June 30, 1997 letter to you describing the differences between a traditional and modern grain elevator be incorporated into this section.

B. Specific Comments

1. In the third sentence in the second paragraph on page 9.9.1-1 which begins "Terminal elevators" add the word "may" so that the sentence will read, "Terminal elevators <u>may</u> ..."

2. In the third paragraph on page 9.9.1-1, add the words "or turn-head device" after the word "tripper" and eliminate the phrase "off the belt and" since it is unnecessary to convey the meaning sentence.

3. In the fifth sentence in the third paragraph on page 9.9.1-1 reference is made to grain being discharged onto a gallery belt which in turn conveys the grain to a storage bin. Although this is true for some facilities, elevators are increasingly using enclosed conveyors to move grain to storage. Therefore, we recommend that the term "gallery belt" be replaced with the term "conveyor" to make the sentence more applicable to a wider range of facilities.

4. In the last sentence in the third paragraph on page 9.9.1-1, we suggest that it be replaced with the following wording, "For shipping, grain may be discharged from bins onto a conveyor which may convey the grain to a scale garner and to the desired loadout location (possibly through a surge bin). Sometimes, trucks may be loaded directly from a bin through a side draw-off spout."

IV. Section 9.9.1.2, Emissions and Controls

A. Introductory Paragraph

1. At the end of the paragraph at the top of page 9.9.1-12, we question the utility of the sentence which reads "However, potential sources of VOC and SO_2 are also identified even though no data are currently available to quantify the emission of these pollutants." The Agency has already pointed out that grain dryers can emit small quantities of VOCs and other combustion products in the previous sentence, so this additional phrase seems redundant. It may also confuse the reader by inadvertently implying that grain drying may cause the grain being dried to emit detectable levels of VOCs and SO_2. We recommend that this sentence be deleted.

B. Section 9.9.1.2.1 Grain Elevators

1. We do not believe that grain cleaners, garners, scales, transfer points and elevator legs sources are significant sources of emissions to the atmosphere. We recommend that the paragraph on page 9.9.1-12 beginning, "Potential PM emission sources in grain elevators are: ..." and the list of eight sources either be eliminated or rephrased to say, "The following uncontrolled operations are likely to emit small quantities of PM: Grain unloading (receiving); Grain loading (shipping); Grain dryers; and Bin vents"

2. We recommend that the first sentence in the second paragraph on page 9.9.1-13 be changed to read, "The amount of dust emitted during ... the speed of the belt conveyors used to transport the grain, the efficiency of the dust collection system, and the extent of equipment enclosure used (e.g., enclosed conveyors, enclosed equipment, etc.) in the elevator.

3. In the third paragraph on page 9.9.1-13, first sentence states that grain dust contains herbicides. We are not aware of any data which shows that grain dust contains detectable levels of any herbicide. Retaining this reference to herbicides in this sentence may raise unwarranted concerns and questions from state regulators and other readers of this section of AP-42. Unless the Agency has credible data confirming the presence of herbicides in grain dust, we urge that the reference to herbicides be removed from this sentence.

4. In the second sentence on page 9.9.1-14, we think the reference to and description of the "wind-tunnel" effect at the unloading area may not be accurate at many facilities. For example, many facilities have equipped the unloading area with either roll down or bi-fold doors to eliminate the wind tunnel effect. The orientation of the unloading facility to the prevailing winds can also affect the wind velocity through the unloading area. We recommend that this sentence be re-worded to read, "The drive-through access can act as a "wind-tunnel" in that the air may blow through the unloading area at speeds greater than the wind in the open areas away form the elevator. However, the orientation of the facility to the prevailing wind

direction can moderate this effect. Importantly, many facilities have installed either roll-down or bi-fold doors to eliminate this effect. The use of these doors virtually eliminates the "wind tunnel" effect and greatly enhances the ability to contain and capture the dust."

5. We recommend that the term "aspiration" in the third sentence of the second paragraph on page 9.9.1-14 be changed to "flow" or a similar term. The industry usually uses the term "aspiration" to mean the use of equipment (e.g., cyclones and fabric filters) to control dust emissions.

6. In the first sentence in the last paragraph on page 9.9.1-14, please add the words, "or vacuum system" after the phrase "retractable bucket type elevator." Also, as we noted in Section I above, the sentence "Cranes using clam shell buckets can also be used to unload grain into hoppers for discharge onto a conveyor belt," should be added.

7. We recommend that the following sentence be added after the last sentence in the first paragraph on page 9.9.1-15, "The use of deadboxes, aspiration, socks, tents or other means are often used to substantially reduce dust emissions."

8. As noted in Section I above, the beginning of the last sentence in the third paragraph on page 9.9.1-15 should be changed to read, "Some rack dryers are ..." Further, we suggest adding the following sentence at the end of the third paragraph on page 9.9.1-15, "The EPA's New Source Performance Standards for grain elevators established visible emission limits for grain dryers by requiring zero percent opacity for emissions from column dryers with column plate perforations not to exceed 2.4 mm diameter (0.094 inches) or rack dryers with a screen filter not to exceed 50 mesh openings."

9. We recommend that the last paragraph on page 9.9.1-15 be replaced with the following, "Equipment used to clean grain varies from stationary screening (gravity) devices to mechanical (vibrating) cleaners. Totally enclosed cleaners, whether stationary or mechanical, are not sources of emissions to the atmosphere. Additionally, unaspirated cleaners located within the headhouse do not emit visible emissions to the ambient atmosphere. The use of cleaners serves to reduce emissions from down stream operations."

10. The concluding paragraph should be changed to read, "At terminal elevators, however, unloading <u>can be</u> a year round operation."

11. As noted in Section I above, we suggest the following changes to the second paragraph on page 9.9.1-16, "<u>The leg may be aspired to remove dust created by the motion of the buckets and the grain flow. A variety of</u>

techniques are used to aspirate elevator legs. For example, some are aspirated at both the top and bottom. Others are fitted with ducting form the top to the bottom in order to equalize the pressure, sometimes including a small blower to serve this purpose. The collected dust is discharged to a cyclone or filter. Leg vents may emit trace amounts of dust under some operating conditions. However, these vents are often capped or sealed to prevent dust emissions. The sealing or capping of the vent is designed to act as an explosion relief after a certain internal pressure is reached to prevent damage to the equipment."

V. Table 9.9.1-1 Particulate Emission Factors for Grain Elevators

A. We are concerned over the lack of emission factors for barge and vessel loading and unloading operations in the proposed emission factor table. While we agree that basing emission estimates on dust concentrations measured at the inlet of a control device overstates uncontrolled emissions, these type of data can provide an indication -- albeit high - of emissions from barge and ship operations until more reasonable data become available. Also, by not providing emissions estimates for barge and ship operations, the Agency place industry and state regulators in the position of not having data upon which to determine which facilities should be required to obtain an operating permit and/or estimate annual operating fees. Therefore, until better data becomes available, the Agency should include existing AP-42 emission factors for these operations in Table 9.9.1-1.

B. The draft table only contains an emission factor for emissions from a cyclone controlling a grain cleaner. We are concerned that state regulators will use this factor to estimate emissions from any cleaner at a facility regardless of its design, location or type of control. As you know, this factor will grossly overstate the likely emissions from the typical grain cleaner. For example, many facilities use totally enclosed cleaners, whether stationary (gravity) or enclosed mechanical (vibrating), which do not emit visible amounts of dust during normal operation. Furthermore, facilities typically have enclosed the cleaner within the headhouse virtually eliminating potential dust emissions to the atmosphere. To help guide state regulators on the proper use of the emission factor for grain cleaning, we recommend that the Agency list the following types of cleaners below the current factor for grain cleaning controlled by a cyclone or filter: stationary (gravity) enclosed cleaners and mechanically (vibrating) enclosed cleaners. The table can note that no data is available for these types of cleaners (i.e., NA) but provide a footnote indicating that these type devices are not considered sources of emissions since they are enclosed units.

C. In situations where no test data is available with PM-10 emissions, we believe it is imperative that the Agency provide guidance on this issue. In this regard, we believe current testing and recently provided information from NGFA clearly establish the relationship between TP and PM-10 between 17.8% and 29.8%, with an overall average for all grains (i.e., corn, soybeans and wheat) **at 21.6%** -- see Table 3-13 of reference 15 in Chapter 5 of the draft report. Without this type of estimate, we are concerned that, in situations where no data on PM-10 is given, state regulators will use the TP emission factors to estimate likely emissions from grain elevators. This would have the effect of regulating grain elevators based upon TP and not PM-10, as established by Agency policy.

D. Although we understand the EPA's rationale for listing separate emission factors for straight and hopper trucks (i.e., data indicate that emissions from straight and hopper trucks are significantly different, warranting separate emission factors), we remain concerned that the presence of separate factors for each type truck will encourage state regulators to require elevator operators to maintain precise records of the number of the two types of trucks received during the operating year. We have discussed this possibility with the Agency in the past and been assured that EPA agrees that this type of record keeping would be excessive and unnecessary. We take this opportunity to reiterate our concern and the Agency's promise to include guidance to state regulators in Section 9.9.1 that maintaining precise records of the two different types of trucks received is not needed. Rather, for purposes of estimating emissions, operators need only provide an estimate of the number of the two types of trucks normally received during the operating year.

E. We have attached an example of the Table 9.9.1-1 that includes our suggested changes.

Thank you again for the opportunity to provide input on the draft Section 9.9.1,GrainElevators and Grain Processing Plants, dated July 1997. If you have any questions, please feel free to call me at 314/994-6389, or Tom O'Connor, NGFA Director of Technical Services, at 202/289-0873.

Sincerely,

Jim Maness

James E. Maness, Chairman
Safety, Health and Environmental Quality Committee

Proposed Table 9.9.1
Particulate Emissions for Grain Elevators

Emission Source	Type of Control	Type of Grain	PM	Emission Factor Rating	PM-10	Emission Factor Rating
Grain Receiving						
Straight Truck	none	mixed	0.180	C	0.0590	C
Hopper Truck	none	mixed	0.035	C	0.0078	C
Railcar	none	mixed	0.032	C	0.0078	C
Barge			0.900*		(j)	
Grain Cleaning						
Aspirated	cyclone	mixed	0.075	C	(j)	
Stationary Enclosed	none	mixed	(i)	(i)	(i)	
Mechanical Enclosed	none	mixed	(i)	(i)	(i)	
Grain Drying						
Column	none	corn	0.220	E	(j)	
Rack	none	corn	3.000	E	(j)	
	self-cleaing screens (<50 mesh)	corn	0.47	E	(j)	
Headhouse and Internal Handling	none	mixed	0.061	C	0.034	C
Bin Loading	none	mixed	0.020*		(j)	
Grain Shipping						
Truck	none	mixed	0.086	C	0.029	C
Railcar	none	mixed	0.027	C	0.0022	C
Barge	none	mixed	0.300*		(j)	
Ship	none	mixed	1.000*		(j)	

* Data being retained from previous research until new data or information is available to give better guidance.

Additional footnotes:
(i) Unaspirated modern stationary and mechanical cleaners, whether located outdoors or inside the headhouse, are enclosed equipment and not expected to be sources of emissions to the atmosphere.
(j) Test data suggest that PM-10 is typically 21.6% of total particulates. This is a reasonable relationship to use when a specific PM-10 emission factor is not provided.

National Grain and Feed Association

6/30/97

Mr. Dallas Safriet
Environmental Engineer
Emission Factor and Inventory Branch
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Safriet:

As per your request on April 30, 1997, the National Grain and Feed Association (NGFA) is pleased to submit the following descriptions of "Traditional" and "Modern" grain elevators and guidelines for applying oil to grain for effective dust control.

I. Traditional vs. Modern Grain Elevators

Traditional Elevator

Traditional grain elevators - both country and terminal - are typically designed so that most grain handling equipment (such as cleaners, conveyors, and legs) is located inside a building or structure which prevents all but minute amounts of visible dust from reaching the ambient atmosphere. This structure is normally referred to as the headhouse. This type of facility often employs belt conveyors, equipped with a mobile tripper, to transfer grain to storage in concrete silos. The belt and tripper arrangement is located in an enclosed structure above the silos called the gallery or bin deck. Grain is often moved from storage using open belt conveyors located in an enclosed tunnel underneath the concrete silos. Further, legs and cleaners are totally enclosed with little to no dust emissions.

Dust emissions from equipment inside the elevator structure are commonly controlled using one or more of the following equipment: cyclones; fabric filters; oil-based dust suppression; dust covers with skirting and belt wipers on belt conveyors; and enclosure. These dust control measures are used to reduce dust accumulations and the potential for catastrophic dust explosions and protect employee health.

Dust control equipment is also commonly used at unloading and loading areas to reduce product loss and emissions to the atmosphere. This control equipment may include: cyclones; fabric filters; oil-based dust suppression; enclosure; specially designed spouts which concentrate the grain stream to reduce dust turbulence; baffles in unloading pits; the use of tarpaulins; socks at the end of spouts; choke unloading; and dead-boxes at the end of spouts to reduce the velocity of the grain stream and minimize the quantity of air that can travel with the grain during loading.

Traditional elevator design is associated with facilities built before 1980. Industry sponsored research in the late 1970's and new technology resulted in improved design techniques for grain elevators.

Modern Grain Elevators

Facilities built in recent years - both country and terminal - have moved away from the traditional design discussed above. Most of these facilities do not have the traditional enclosed headhouse or bin deck. Modern grain facilities employ an open structural design, including locating equipment -- such as legs, conveyors, cleaners, and scales -- outside of any enclosed structure. This design technique reduces the potential for a catastrophic dust explosion and eliminates dust emissions by using equipment that is enclosed by design. In some cases, equipment - such as cleaners and screening equipment - may be located in separate buildings.

In the modern facility, grain is normally moved using enclosed belt or drag conveyors. The movable tripper has been replaced with enclosed distributors or turn-heads and direct spouting to storage bins and tanks, where feasible. These facilities are generally more automated.

Some traditional grain facilities have been partially retrofitted or reconstructed to employ these modern techniques of outside legs and other equipment. This outside equipment is also fully enclosed and not normally a source of emissions. Another technique to reduce emissions from open belt conveyors is to deepen the trough of the belt and slow the conveyor's speed. Leg belts can also be modified by increasing the size of the buckets on the leg and slowing the leg velocity, which reduces grain breakage and potential emissions when the grain is subsequently handled.

Although modern grain facilities use enclosed equipment to eliminate dust emissions, dust control techniques may also be employed, where needed. For example, mechanical aspiration can be used at unloading and loading areas, baffled unloading pits are commonly employed, oil-based dust suppression can be used, and specially designed spouts and dead-boxes to control dust emissions during load-out can also be found. Depending on the commodity, aspiration may be found at transfer points.

II. Proper Oil Application

The following are our suggested guidelines for applying oil for effective dust control:

"The effectiveness of an oil additive system depends largely on how well the oil mixes and disperses with the grain once it is applied. Several basic approaches can be used to apply oil additives to the grain stream to reduce airborne dust concentrations:

- As a top dressing before grain enters the bucket elevator or at other grain transfer points.
- From below the grain stream at a grain transfer point using one or more spray nozzle(s), if inadequate grain turbulence is available between conveyor and leg. This provides for better dispersion of the oil.
- In the boot of the bucket elevator leg.
- At the discharge point from a receiving pit onto a belt or into other type conveyor. Oil can also be applied to grain in a screw conveyor.

When choosing the type of nozzle to use:

- Evaluate the pump pressure and flow rate
- Make certain it will apply the necessary quantity and coverage of oil for the grain being handled. Research tests have demonstrated that spray nozzles give coverage equivalent to mist and atomizer nozzles, provided they are properly maintained with consistent oil viscosity and system pressure.

Generally, the amount of oil applied should vary with the dustiness of the grain being handled. Research tests and actual experience in operating elevators have shown that usually oil additives applied at a rate of 60 to 200 parts per million by weight of grain or 0.5 to 1.7 gallons per thousand bushels will provide effective dust control. The U.S. Food and Drug Administration has approved food grade mineral oil and vegetable oil for use on grains."

Thank you for allowing us the opportunity to provide this input. If you have any questions on the information in the letter, please feel free to call me at 202/289-0873.

Sincerely,

Thomas C. O'Connor
Director of Technical Services

cc: Dr. Tom Lapp, MRI

Gave original
To Tom Lapp
7-8-97

National Grain and Feed Association

5/28/97

Mr. Dallas Safriet
Environmental Engineer
Emission Factor and Inventory Group
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Safriet:

On behalf of the National Grain and Feed Association's (NGFA) Safety, Health and Environmental Quality Committee, we want to extend our sincere thank you to Dr. Tom Lapp and you for meeting with the committee on April 30, 1997 to discuss the status of new emission factors for grain handling facilities. We appreciate your willingness to travel from your office in Research Triangle Park and believe the meeting was very productive.

As a result of the April 30 meeting, it is our understanding that the following actions will take place:

A. NGFA will provide a suggested description, including common characteristics, of a "traditional" and "modern" grain elevator.
B. EPA will provide a copy of draft language describing proper techniques for applying oil for dust suppression to NGFA for review and comment. NGFA will then suggest changes to reflect proper techniques to be used to get effective oil application.
C. EPA will publish a draft revision of Section 9.9.1, Grain Elevators and Processes, to AP-42 by the end of June for review and comment.

Thank you again for taking the time from your busy schedule to meet with us and look forward to working with you on the revisions to Section 9.9.1. We appreciate the Agency's willingness to work with the industry to get a usable and effective document regarding emission factors

Sincerely,

Thomas C. O'Connor
Director of Technical Services

National Grain and Feed Association

December 19, 1996

Mr. Dallas Safriet
Environmental Engineer
Emission Factor and Inventory Group
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Safriet:

As per your request, the National Grain and Feed Association (NGFA) has reviewed the study submitted by the National Cattleman's Beef Association (NCBA) entitled, "Emission Factors for Grain Receiving & Feed Loading Operations at Feed Mills." Although NGFA is encouraged that the data on emissions from hopper truck unloading confirm findings similar to those in the recently completed National Grain and Feed Foundation (NGFF) research project, we have some concerns with some aspects of the NCBA report which are discussed below.

The NGFA is the national nonprofit trade association of more than 1,000 grain, feed and processing firms comprising 5,000 facilities that store, handle, merchandise, mill, process and export more than two-thirds of all U.S. grains and oilseeds utilized in domestic and export markets.

The NCBA report presents data on both TSP and PM-10 emission when unloading grain from hopper trucks at feed mills associated with cattle feed yards. Much like the NGFF research, these data also confirm that emissions from grain unloading and handling are much lower than the data relied on in the past to establish emission factors.

However, as we will discuss below, the NCBA report contains several problems which severely diminish its usefulness and accuracy beyond cattle feed yards.

I. General Comments

A. Facility Equipment and Operating Characteristics

The NCBA report states that the typical grain handling capacity at a country elevator is 10,000 bu/hr, whereas the typical grain handling capacity of the facilities tested by Texas A&M ranged from 3,000 to 6,000 bu/hr. We do not believe that this broad characterization of the handling capacity found at the typical country grain elevator is correct. In reality, our members report that the range of leg sizes found at country elevators can and often do include the sizes found at the facilities discussed in the NCBA report.

The NCBA report also states that, because country grain elevators are "seasonal" operations, the average particulate emission rate per unit time will be significantly higher at grain elevators than feed mills. There are two problems with NCBA's comparison between country grain elevators and feed mills. First, this characterization assumes that domestic feed mills do not increase truck receipts during harvest to take advantage of attractive raw material pricing and storage premiums associated with storage. In fact, increasing receipts during harvest season is a common business practice at feed mills as it is at country grain elevators. Second, it projects the image that feed mills only operate as feed mills and never as country grain elevators. In reality, many feed mills have an elevator associated with them which is used not only to receive raw material but also to function as a grain elevator to receive, condition and ship grain during harvest and non-harvest periods.

It is also important to recognize that grain receipts at country elevators during the non-harvest periods do not arrive in a relatively steady daily stream as implied in the case with the facilities in the NCBA report. Rather, grain receipts at country grain elevators on a per unit time basis during non-harvest periods tend to be sporadic and very low. As a result, the emission rate on a per unit time basis at grain elevators during the non-harvest periods can be either lower than or similar to those at feed mills depending on relative size and market conditions. Thus, the annual average emission rate on a per unit time basis at country elevators is not necessarily different from feed mills.

B. Choke Unloading

We believe the NCBA report makes two mistakes when it states that "it is likely that the unloading operation at country elevators do not encounter choke flow" when unloading hopper bottom trucks.

First, the Texas A&M researchers are mistaken when they improperly characterize receiving pits at feed mills as "typically" smaller than those at country elevators. In fact, country elevators can and often do have receiving pits similar in size to those mentioned in the NCBA report.

Furthermore, we think the NCBA report leaves the misconception that country elevators only receive grain in hopper bottom trucks. In reality, country elevators typically receive grain directly from producers in the same size and type of trucks unloaded at feed facilities.

Second, we believe the NCBA report is in error when it states that choke flow conditions are not encountered when unloading hopper bottom trucks at country grain elevators. In addition to the fact that the pit sizes and leg capacity at country elevators can be comparable to those discussed in the NCBA report, the recently completed NGFF research project found that unloading hopper trucks at grain elevators normally takes place under choke conditions resulting in reduced emissions. In fact, choke conditions are common when unloading hopper bottom trucks and hopper bottom rail cars at grain handling facilities.

C. Relative Dustiness

The NCBA report concludes that laboratory procedures to determine expected emissions from different grains do not provide results that are useful in predicting emissions from grain elevators. The NGFF research report reached a similar conclusion that it is not useful to use the concept of relative dustiness to predict emissions from grain handling facilities. Importantly, both testing programs have determined that, under actual field testing conditions, it is hard to detect any significant difference in the emissions from different grains.

Yet, after concluding that laboratory results comparing the dustiness of grains yields little useful information, the NCBA report endorses the concept of adjusting emission factors for each grain (the so-called Free Fine Dust - FFD - of each grain). This recommendation (see page ii and Appendix F) is supposedly justified by citing 1986 research performed by Texas A&M which reported FFD levels for corn, soybeans and wheat. We question this recommendation for the following reasons:

1. The FFD values for corn, wheat and soybeans reported in Table F-2 are significantly different from EPA's DR values. For example, the EPA DR value for corn is 2.5 lbs per ton while the values for corn in Table F-2 range from 1.3 to 8.1 lbs per ton. Soybeans, which EPA also assigned a DR value of 2.5 lbs per ton, has values of 0.5 to 1.9 lbs per ton in Table F-2. Lastly, EPA assigned a DR value of 1.0 lbs per ton to wheat, while the data in Table F-2 range from 0.4 to 0.7 lbs per ton. Additionally, the fact that Texas A&M does not present any data in Table F-2 for milo would seem to make it difficult for Texas A&M to draw valid conclusions on the appropriate FFD for that grain;

2. Rather than demonstrating significant differences in emission rates between corn and milo, the data in the NCBA report seem to support the conclusion that no significant difference in emissions exist between grains. As can be seen in Table B-1, the fact that the three data points for milo are contained within the distribution of the 13 data points for corn suggests that there is probably no significant differences in emissions between these grains. [See Table B-1, the reported emission factors related to corn range from 0.0033 to 0.0196 lbs/ton while those related to milo range from 0.0038 to 0.0156 lbs/ton.];

3. The NCBA report only provides emission data on corn and milo. As

noted previously, these data tend to confirm that there is little detectable difference in emissions between these commodities under actual field conditions. Importantly, the NCBA report does not provide data for wheat and soybeans upon which to base reasonable conclusions on appropriate FFDs for these products; and

4. On page ii of the Executive Summary, the NCBA report cites Parnell (1988) as the basis for the recommendation endorsing the use of the FFD concept. However, the References section (pages 61-62) does not mention work performed by Parnell in 1988. The closest work cited is by Parnell, et.al in 1986. Presumably, this is a typographical error since the 1986 work is cited on page 56 of the Summary and Conclusion section and again in Table F-2 in the Appendix. If true, the researchers should correct this error to avoid further diminishing the credibility of the report.

D. Emission Factor Development

The NCBA report suggests that the FFD of each grain be multiplied by another factor - F - to account for the amount of FFD entrained during a specific grain handling operation. The report seems to recommend an F value of 0.016 for hopper truck unloading, which appears to be a forced number determined by dividing the proposed emission factor by the FFD value's proposed by Texas A&M. NCBA is also proposing that emission factors be based upon the average of the data plus one standard deviation.

We are not persuaded by the NCBA recommendations for the following reasons:

1. The accuracy of any F value is dependent on whether the FFD value for each commodity is accurate. As noted above, the validity of the FFD values endorsed NCBA - upon which the F value so critically depends - is not clearly established in the NCBA report;

2. It is inconsistent with the results of both the NGFF and the attached NCBA report which conclude that no significant relationship exists between laboratory results showing a difference in emissions among grains and actual emissions at a grain elevator. In reality, actual field data from both reports support the conclusion that similar amounts of dust can be expected, regardless of the grain being handled, during specific grain handling operations. Thus, one emission factor for each operation is justified by the data;

3. The factors suggested by NCBA - 2.5 lbs/ton for corn and soybeans, 1.75 lbs/ton for milo and 1.0 lbs/ton for wheat - perpetuate the myth that grain handling can be a significant source of dust, i.e., lbs/ton rather than

fractions of a lb/ton as shown by the NGFF and NCBA research. Additionally, the NCBA report does not establish the validity of these numbers;

4. The use of different emission factors for each grain make the tables in AP-42 unnecessarily complicated. As noted above, the data clearly support combining grains into one emission factor for each operation;

5. The NCBA report only suggests an F value for one operation while F values for other operations are not available; and

6. Based upon our experience with the current revision to AP-42, EPA emission factors are average values. So, adoption of NCBA's proposal to base emission factors on the average value plus one standard deviation would be a major departure from typical agency procedure and require revising the emission factors in all chapters of AP-42, a monumental undertaking. We urge EPA to reject this recommendation.

E. Test Protocol

While the protocol took into account and made adjustments for the dust that may have collected on the cyclone and sampling ducts, the Texas A&M researchers do not appear to have taken into consideration the dust that could have adhered to the plastic enclosure. If so, this oversight could have introduced a downward bias in the proposed emission factors.

F. Applicability

As noted previously, this study is only applicable to a select group of operations. Other types of feed mills receive grain in the types of trucks encountered at country elevators and ship feed into trucks, railcars or barges from spouts.

II. Other Comments

A. On page one, the NCBA report states that Title V fees are approximately $30 per ton of emissions. In reality, permit fees vary from state to state and can be lower.

The report also uses the term "criteria pollutant" when discussing emission fees and the determination of whether a facility is a "major source" of air pollution. In this context, we believe the correct term should be "regulated pollutant."

B. On page six, the statement is made that "any particulate that settles out prior to crossing the property line is not subject to air pollution regulations." In theory, this may be true. However, in reality, regulatory agencies require compliance tests to measure emissions or opacity at the stack, not the property line.

C. On page 44, the NCBA states that 0.071 lbs per ton was the highest recorded emission rate found in the study and that if wind velocity had been 100 feet per minute instead of 478 feet per minute, the emission rate would have been 0.0149 lbs per ton. We question whether emission rates are always directly correlated with wind velocity, i.e., is it possible that a lower wind velocity could be associated with a higher emission rate?

D. On page 55, the statement is made that the emission factor for feed loading is ten times less that the EPA factor for corn shipping due to an FFD for 1 for corn and 0.2 for feed. This seems to contradict the findings presented in Table 12, Summary of Drop Test Results, which shows an FFD of 0.3807 for corn.

Thank you for the opportunity to comment. If you would like to discuss the views expressed in this letter, please feel free to call me at 314/994-6389 or Tom O'Connor, NGFA Director of Technical Services, at 202/289-0873.

Sincerely,

James E. Maness

James E. Maness, Chairman
Safety, Health and Environmental Quality Committee

November 8, 1996

Dallas W. Safriet
U.S. Environmental Protection Agency
Emission Factor and Inventory Group (MD-14)
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

Dear Mr. Safriet:

AFIA appreciates the opportunity to comment on the study conducted by Texas A&M University on behalf of the National Cattleman's Beef Assn. entitled; "Emission Factors for Grain Receiving & Feed Loading Operations at Feed Mills".

AFIA is the national trade association for commercial feed and pet food manufacturers, and ingredient suppliers. AFIA members represent more than 70% of the primary formula poultry and livestock feed sold annually in the U.S. AFIA's membership includes more than 730 companies, and 3,000 individual establishments in all 50 states.

Introduction

As mentioned in our correspondence to you dated July 23, 1996, AFIA applauds EPA's work to revise AP-42 to better represent air emissions and current technologies used in feed manufacturing. The interim emission factors released last November helped industry and state EPAs to properly consider most feed mills in the U.S. as minor sources of air pollution, avoiding the costly and unnecessary burden of Title V permitting.

In general, AFIA is impressed with the study conducted by Texas A&M. It, along with data submitted by AFIA over this past year, can be used to further improve AP-42 as relates to feed mills. As we move forward, it is important to remember, as with any regulation, one size does not fit all. AP-42 must be designed to provide a comprehensive list of air emission test results categorized so the user can select emission factors best representing his or her operation. All feed mills are different, and, generally, none are "typical". To that end, the results of the Texas A&M study must be properly categorized to allow optimum use.

It is not AFIA's intent to criticize the results obtained by Texas A&M, but to recommend how best to incorporate these results into EPA's interim emission factor document dated November, 1995.

1501 Wilson Blvd., Suite 1100, Arlington, VA 22209
Tel: 703/524-0810 FAX: 703/524-1921

Below are some general comments to put the report into perspective, followed by recommendations how EPA should incorporate the results.

Discussion

1. In various places, the report states there are two operations resulting in emission of particulate matter -- ingredient receiving and feed shipping. AFIA wants to emphasize that as this may be typical for feed mills located at cattle feedlots, it is not the case for most commercial feed mills in the U.S. Processing operations, such as grain cleaning, grinding, flaking, cracking and pelleting can be point sources with external emissions through bag filters or cyclones.

2. On pages 4 and 5, five bullets summarize the differences between a country grain elevator and a feed mill regarding levels of emissions. AFIA contends the third item, which describes feed mill receiving operations, also accurately describes receiving operations at most commercial feed mills.

   Choke Flow
   In comments submitted to the agency on October 12, 1994, AFIA suggested changes be made to AP-42 adopting two new categories under receiving operations: Platform dumps and hopper bottoms. Platform dumps and large capacity pits are used at many elevators for speed in unloading. This is not necessary at commercial feed mills. Most receiving pits are small and fill quickly once the unloading operation has begun. And, as described in the third item on page 4, the choke flow of the grain entrains the dust greatly reducing emissions as compared to receiving operations at elevators.

3. AFIA would like to suggest a sixth item be added to those listed on pages 4 and 5: Many feed mills, particularly commercial mills, purchase raw grain from local country elevators as opposed to straight from the farm. These grains have been subjected to a cleaning process, further reducing dust emissions as compared to elevator receiving operations.

4. Similarly, a seventh item could be added to those listed on pages 4 and 5, differentiating feed mills, in particular commercial feed mills, from elevators. Commercial mills utilize grain and animal byproducts, such as wheat midds, soybean meal, sunflower meal, distiller dried grains, feather meal, meat and bone meal, etc, as protein, fiber and energy sources to produce protein supplements. Many of these carry higher moisture levels than do raw grains due to oil, fat and blood content. As with high-moisture feeds, these types of ingredients inherently have lower free dust content available for emission.

5. On page 8, paragraph 2, the report suggests typical dimensions for an unloading pit and shed. Although AFIA agrees with the general differences between feed mills and elevators, EPA should not assume these dimensions are typical. Receiving pits and sheds can vary greatly in size, capacity, and shape. And in some cases, a commercial feed mill may not have a shed enclosing or covering the receiving operation.

6. On page 8, paragraphs 3 and 4, the report suggests typical dimensions for a loadout shed, and references the use of clam shells. Clam shells are not commonly used in commercial feed mills, and, again, the dimensions of loadout sheds can vary greatly.

7. On pages 44-46, Tables 6, 8 and 10 (grain receiving) should note for future reference that corn was the grain received. Future studies may determine there is a correlation between the type of grain and the amount of measured emissions.

8. On pages 44-46, Tables 7, 9 and 11 (feed loading) should note for future reference the type of feed shipped, i.e., high-moisture mash. AFIA believes a large difference exists in particulate emissions, for example, between low-moisture mash feed, low-moisture pelleted feed, and high-moisture mash and pelleted feed. If the Texas A&M study specifically looked at high-moisture mash feeds as mentioned on pages 4 and 5, then AFIA believes more conservative emission factors should be used when considering the loading of low-moisture feed.

9. On page 50, the second paragraph summarizes PM-10 emissions conservatively at 15% of TSP emissions for grain unloading, and 35% of TSP for feed loading. These are important results, as only estimates were used in the November, 1995 interim document. Last fall, AFIA suggested, and EPA agreed, to use a conservative 50% PM-10-to-TSP ratio until better numbers were obtained via testing.

10. On page 57, the report suggests correlating the type of grain used in feed manufacturing to feed emission factors. This may be appropriate for feed mills associated with feedlots, but AFIA's experience doubts its universal applicability to commercial mills. As mentioned earlier, commercial mills utilize grain and animal byproducts, such as wheat midds, soybean meal, sunflower meal, distiller dried grains, feather meal, meat and bone meal, etc, as protein, fiber and energy sources to produce protein supplements. Most commercial mills actually use a very small percentage of raw grain, unlike feed mills associated with feedlots or integrated poultry, turkey and swine mills. For commercial mills, a more appropriate distinction of varying emission levels would be in comparing low-moisture formulated feeds, both mash and pellets, and high-moisture formulated feeds.

Recommendations

AFIA makes the following recommendations for incorporating the Texas A&M results into EPA's interim AP-42 document dated November, 1995. When incorporating new data, or when establishing new categories EPA should be careful not to create an emission factor that is too low. As stated in Texas A&M's report, state permit authorities use AP-42 emission factors to calculate maximum allowable emission rates. If emissions are understated and a facility exceeds those rates, it would be in violation of its permit and be subject to monetary penalties.

1. As explained earlier, AFIA believes the data collected by Texas A&M for grain receiving accurately represents grain and ingredient receiving operations at most commercial feed mills in the U.S. Like feed mills associated with cattle feedlots, commercial feed mills predominately receive grain via hopper bottoms choke-flowing into small pits. These pits fill quickly, greatly reducing the amount of free dust that can become entrained in the air and be carried away.

   In addition, many feed ingredients received at commercial feed mills are grain and animal byproducts, such as wheat midds, soybean meal, sunflower meal, distiller dried grains, feather meal, meat and bone meal, etc. Many of these carry higher moisture levels than do raw grains due to oil, fat and blood content. As with high-moisture feeds, these types of ingredients inherently have lower free dust content available for emission. For these reasons, AFIA believes the grain receiving emission data obtained by Texas A&M, if used to calculate emissions at receiving operations for commercial mills, would be very conservative, but more accurate than the current AP-42 reference strictly using elevator receiving emission factors which incorporate platform dumps.

   AFIA recommends EPA make the following changes to Table 9.9.1-3, in the November, 1995, interim AP-42:

<u>Animal feed mills</u>	Control	Grain	PM	PM-10
Grain receiving and handling				
-- platform dumps	(h)	(h)	(h)	(h)
-- hopper bottom	none	corn	0.04	0.006

   Footnotes should be added explaining that the platform dumps emission factor represents flow into a large capacity pit, and hopper bottom represents choke flow into a small pit.

   The Texas A&M PM and PM-10 emission factors (found on page 57, Table 17) of 0.04 and 0.006 lbs/ton respectively, as mentioned in the report, are conservative using an average of the data received plus one standard deviation. Others may argue, and EPA may choose to expand the above revised table to account for the relative dustiness of various grain or grain byproducts.

(h) may change with the receipt of additional test results from grain elevator studies. In any event, the above recommendation provides conservative emission factors, and allows the user to choose those which best represent his/her operation.

2. AFIA believes the feed loading data obtained by Texas A&M, although representing loading operations at feed mills associated with cattle feedlots, may not represent all feed loading situations at commercial mills. Two primary differences exist: The use of clam shells, and the relative dustiness of various feeds, i.e., low-moisture mash, low-moisture pellets, and high-moisture mash or pellets.

Most commercial feed mills do not use clam shells for loading. Generally, feed is drawn from an overhead bin, and allowed to free fall a short distance into a truck. AFIA mentions this difference, not because it believes large differences exist in emission levels, but to bring attention to differences in terminology and process. During the loading process both allow feed to free flow into the truck. And in both, feed only falls a short distance.

AFIA believes the feed type and formulated moisture has much more of an effect on emission levels than does comparisons between loading with or without clam shells.

Therefore, AFIA recommends EPA make the following changes to Table 9.9.1-3, in the November, 1995, interim AP-42:

<u>Animal feed mills</u>	Control	Grain	PM	PM-10
Bulk loading				
-- low moisture feed	(h)	(h)	(h)	(h)
-- high moisture feed	none	feed	0.005	0.002

This creates two new categories. The interim AP-42 document, dated November, 1995, listed ND (no data) for bulk loading operations. However, in the absence of data, industry and state permit authorities use "grain shipping" emission factors found on Table 9.9.1-2 of the interim document to calculate loading emissions from feed mills.

In the above revised table, AFIA suggests EPA use the (h) reference to draw the user to Table 9.9.1-2 to utilize the grain shipping factors. This is a <u>very</u> conservative approach, as AFIA believes most feed contains less free dust than raw grain. During processing, many feeds have moisture added in the form of water, molasses or fat, or are formulated using grain or animal byproducts containing oil, fat or blood. Also, a high percentage of commercial feed is pelleted, further "locking in" fine dust. In that regard, the use of grain elevator shipping emission factors to represent most feed loadout operations is very conservative.

To take advantage of the testing performed by Texas A&M on high-moisture feed, EPA should provide the second category suggested above -- *high-moisture feed*. This allows, not only feed mills at cattle feedlots to use the data, but commercial mills shipping high-moisture mash or pelleted feed will be able to choose this emission factor for that portion of its volume.

3. The Texas A&M study determined conservative PM-10-to-TSP ratios for grain unloading and feed loading to be 15% and 35%, respectively. AFIA has incorporated those values in Recommendations 1 and 2.

4. Last fall, AFIA and EPA agreed to use a PM-10-to-TSP ratio of 50% in the interim document to assist the user in calculating PM-10 emissions from various processing cyclones. AFIA feels confident that ratio, which was conservative at the time and now supported with the Texas A&M results, can remain in place. An argument could be waged that the ratio should now be lowered to 35% or 15%. AFIA must point out that the Texas study was not conducted on control units, and that emissions from cyclones may, or may not, contain a higher percentage of fine particulates. In that regard, AFIA recommends the 50% PM-10-to-TSP ratio remain in effect until testing performed on cyclone control units proves changes be made.

5. In the interim AP-42, dated November, 1995, Table 9.9.1-3 lacks providing a PM-10 emission factor for <u>Grain cleaning</u>; Oats and Wheat. The PM factor references (h), directing the user back to Table 9.9.1-2. AFIA recommends EPA extend the (h) reference across Table 9.9.1-3, providing the user a PM-10 emission factor for this process.

6. As mentioned earlier, the Texas A&M report determined the PM-10-to-TSP ratio for grain unloading be 15%. When additional grain elevator test results are finalized, AFIA recommends EPA incorporate this value with the value determined by those studies, and list as a revised PM-10 emission factor for the various operations listed on Table 9.9.1-2 of the interim AP-42 dated November, 1995.

Conclusion

The Texas A&M study, conducted at feed mills at cattle feedlots, has meaningful information which can be used to calculate emissions from many commercial feed mills. AFIA encourages EPA to adopt the above recommendations as outlined, and incorporate them into the interim AP-42 document as suggested. This will enhance AP-42 by offering a comprehensive list of air emission test results, while allowing the user to "pick and choose" emission factors best representing his or her operation.

AFIA appreciates the opportunity to comment on Emission Factors for Grain Receiving & Feed Loading Operations at Feed Mills. We are willing to meet with the agency to clarify any of AFIA's positions.

Sincerely,

Brian L. Bursiek
Director, Feed Production
AFIA

Rec'd 9/19/96
TL

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September 17, 1996

MEMORANDUM

Mr. Dallas Safriet
US EPA, MD14
Research Triangle Park, NC 27711

Subject: Report "Emission Factors for Grain Receiving & Feed Loading at Feed Mills"

Enclosed is the final report for the feed mill emission factors study conducted for the National Cattleman's Beef Association. Please consider these data as you revise the AP-42 emission factors for feed mills located at cattle feed yards.

Sincerely,

Bryan W. Shaw

Bryan W. Shaw, Ph.D.
Assistant Professor

Calvin B. Parnell Jr

Calvin B. Parnell, Jr., Ph.D., PE
Professor

Enclosure

xc: Tom Lapp, Midwest Research Institute

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

JAN 28 1997

Dr. Bryan W. Shaw
Department of Agricultural Engineering
303 Scoates Hall
Texas A&M University
College Station, Texas 77843-2121

Dear Dr. Shaw :

I have completed my review of your report entitled *Emission Factors for Grain Receiving and Feed Loading Operations at Feed Mills*. The report generally appears to be reasonably well presented and documented and contains some interesting results. However, I have a few questions and concerns that I would like to address:

1. In the "over the truck" and "under the truck" protocols that used barrel cyclone preseparators, it is not clear what size particulate matter (PM) was effectively captured by the enclosure. Did you make any measurements of the cut point for the cyclone?

2. I believe that a discussion of the quality assurance procedures used in this study would be appropriate in an appendix. For example, were field blank filters used to decide background dust in the air inside the unloading shed? How were the reference samplers and wind station sited? For some mills, the wind station was separated from the PM sampling sites by other buildings and the size and position of these buildings could affect the wind direction and velocity at the samplers compared to that at the wind station site.

3. Plastic sheeting commonly acquires a static charge that could result in the adherence of particulate to the inside of the plastic enclosure during the "under" and "over" test runs. Did any PM adhere to the inside of the plastic sheeting during these runs? If so, how was this quantity of PM quantified?

4. Throughout the report, reference is made to the high moisture content of the feed (>20% moisture) in the feed loadout runs. Was the actual moisture content measured for the feeds used in these tests? As stated in the report, PM emissions will vary with the moisture content of the feed. Therefore, for the EPA to provide guidance for feed

loading emission factors, it would be very helpful if the moisture contents of the feeds used in these studies were provided. Also, see comment 6.

5. On pages 43-44, emission factors for Mill B are given for grain receiving by "under truck" and "grid." However, on page 47 the report states that "prevailing wind conditions at Mill B during the time we were sampling was such that grid sampling was not an option." Can you explain?

6. For total suspense particulate TSP from feed loading on page 51, Mill B was loading dry ingredients into a truck that mixed the feed as it was distributed. An emission factor of 0.0033 lbs/ton was calculated. For feed loading at Mills C and D, using moist premixed feed, emission factors of 0.0028 and 0.0043 lbs/ton, respectively, were calculated. There appears to be no difference between the loading factors for dry ingredients and the moist feed. This is contrary to your conclusions.

7. On page 52, you discuss the results obtained using the "under/over truck" versus the grid method and conclude, correctly, that the enclosure method leads to more reproducible results (i.e., small relative standard deviation). However, the fact that the results are more reproducible does not necessarily mean that the results are more accurate; it only means that the influences of external factors impacting the results are better controlled. It would seem that additional studies would be required before it can be stated that the "under/over truck" method is more accurate.

I have several concerns in the Summary and Conclusions section beginning on page 53:

8. Your average emission factor for corn receiving from hopper-bottom trucks at the feed mills (0.017 lbs/ton) is stated to be eight times lower than the Interim emission factor of 0.15 (0.06 x 2.5DR for corn) for country elevators. A review of the references used to develop the Interim factor will show that only one set of test data were for hopper-bottom trucks (Oklahoma study) and the remainders were from straight trucks, which produce higher PM levels during unloading. The results of the forthcoming National Grain and Feed Association study may provide additional emission factor data for unloading from hopper-bottom trucks.

9. The results of your study are compared with the results of the Oklahoma study (Kenkel and Noyes) and are stated to be in very close agreement with the airborne particulate fraction (0.019 lbs/ton) of their emission factor for grain receiving from hopper-bottom trucks. On pages 55-56, there is considerable discussion of the dustiness ratios and what they represent. In comparing your results with those of Oklahoma, it should be stated that the Oklahoma results were obtained using wheat and yours are for corn.

10. Question the overall validity of comparing grain receiving emission factors for country elevators with the factors you developed for feed mills at cattle feedlots, considering the considerable difference in the size of the grain receiving facilities. As you have noted, the factors at feed mills should be lower. In addition, the grains at country elevators primarily come directly from the field during harvest. Those at feed mills may have been through country elevators, transported to other elevators (e.g., terminals), and then to the feed mill. During these operations, the grains would undergo PM loss and perhaps even a grain cleaning step. It would be more difficult to predict the previous operations for grains received at feed mills than for the grains received at country elevators. These previous operations would have an impact on the PM content of the grain being unloaded.

11. At the bottom of page 55 and on page 56, the report discusses the dustiness ratio (DR). The DR in the Interim AP-42 section is intended to be purely relative numbers that are rationed against the results for wheat. In your report, there may be an attempt to interpret the DR as the free fine dust content in lbs/ton. If this is an interpretation, it is not correct.

12. Your report concludes that there is no correlation of the relative dustiness between grain types as shown by the results of the laboratory drop tests. You have stated valid reasons for this conclusion; there are also other reasons that could be proposed. This result may be indicative that the wide variety of factors that can influence particulate formation from grain surfaces is sufficiently complex and variable that there is little real difference in relative dust content between grain types in "real world" conditions.

I also have a few minor comments:

a. On page 53, reference is made to the particle size analyses in Tables 9-12; these tables do not address particle size.

b. Of the 19 references listed in the report, only 10 are actually cited; nine are not cited. One reference is cited in Appendix C but listed in the references.

c. Although not stated, it is assumed that no particulate controls were in place at the mills for grain unloading, or if in place, they were not operating at the time of the testing.

I would like to thank you for the submission of this report for our review and consideration. The U.S. Environmental Protection Agency would appreciate your prompt responses to our comments and questions. The agency feels that the results of your study are informative and will be considered during the revision of the feed mill's portion of Interim AP-42 Section 9.9.1, Grain Elevators and Processes.

I have enclosed copies of the review comments on your report received from the American Feed Industry Association (Mr. Bursiek) and the National Grain and Feed Association (Mr. Maness). You will note that some of my comments are also reflected in the comments of these two associations. Your response to these sets of comments would be appreciated.

Sincerely,

Dallas W. Safriet
Environmental Engineer
Emission Factor and Inventory Group

Enclosures

cc: Dr. Calvin Parnell, Jr., DAE
B. Weinheimer, Texas Cattle Feeders Association

AFIA

AMERICAN FEED INDUSTRY ASSOCIATION

August 22, 1997

Dallas Safriet
U.S. Environmental Protection Agency
Emission Factor and Inventory Branch (MD-14)
Research Triangle Park, NC 27711

RE: Draft Section 9.9.1, Grain Elevators and Grain Processing Plants

AFIA appreciates the opportunity to comment on the draft Section 9.9.1, Grain Elevators and Grain Processing Plants, proposed to be published in AP-42, Compilation of Air Pollution Emission Factors.

INTRODUCTION

AFIA reviewed the draft document comparing it with AFIA comment submissions dating back to October, 1993, and is generally pleased that most AFIA recommendations have been incorporated. However, four main areas of concern must be addressed before the document is finalized. Those areas are as follows:

1. Technical changes in process description to better represent contemporary feed manufacturing processes.
2. Deletion of the *Grain Handling* category on Table 9.9.1-2.
3. Inclusion of PM-10 emission factors on Table 9.9.1-2 to provide industry and state permit authorities emission factors for calculating PM-10 emissions in accordance with the Clean Air Act of 1990.
4. Exclusion of questionable filterable and condensible PM data from Reference 18 contributing to emission factors on Table 9.9.1-2

DISCUSSION

AFIA's comments specifically address the feed manufacturing sections found in the draft document, i.e., test data, process descriptions, flow diagram, and emission factors, and are referenced by page number.

Pg. 2-26

Last paragraph, third sentence: Change the wording *"pellet extrusion"* to *"pelleting."* Extrusion is a different type of process, mostly associated with the pet food manufacturing, and not

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commonly used in feed mills. The machine is a pellet mill and the process is described as pelleting.

Pg. 2-27

First paragraph, second sentence: Change the wording *"scrap material such as meat scraps"* to read, *"by-products such as meat meal."* The term *"scrap"* has a negative connotation non-descriptive of the high nutrient value these types of ingredients possess. Members of the feed industry do not refer to this material as scraps.

First paragraph, third sentence: Using the words *"hopper bottom"*, restructure to read: *"Grain is usually received at the mill by <u>hopper bottom</u> truck and/or rail cars, or in some cases, by barge."* As the paragraph goes on to explain the advantages of choke flow, it all begins with the type of delivery unit commonly received.

Pg. 2-28

First paragraph, first sentence: Insert the words *"primarily corn"* to read, *"...transferred to the grinding area where whole grains, <u>primarily corn</u>, are ground..."* Corn is the most common grain ground in feed mills. Only a select few other grains are ground. There are, however, many grains which are never ground in feed mills.

Second paragraph, fourth sentence: Change to read, *"Whole and ground grain and other materials added..."* Some feeds are formulated using unground grain.

Pg. 2-29

First paragraph, first sentence: As previously mentioned, pelleting is not commonly referred to as an extrusion process. Delete the words *"making is an extrusion"* to read, *"Pelleting is a process in which..."*

First paragraph, third sentence: Restructure to read, *"After pelleting, pellets are cooled and dried..."*

Pg. 2-38

Second paragraph, second sentence: Change list so category 1 reads as follows:

1. Bulk Receiving
    a. Hopper rail car
    b. Hopper truck
    c. Straight truck

Pg. 2-39

AFIA disagrees with the statement "*The hammermill product conveying system is the primary dust problem.*" The next sentence is also inaccurate, "*Most hammermills are installed with a fan and cyclone collector as the finished product recovery system.*"

Modern feed mills utilize bag filters on hammermills systems reducing emissions to negligible levels. AFIA suggests the entire paragraph be reworded as follows:

> "*Hammermills, roller mills, cutters, and granulators are often used in the grain processing section of the feed mill and can be a potential source of PM emissions. Dust emissions will vary with the type of grinder (standard or full circle screens) used, the products being ground, the method of conveying finished product, and type of control equipment used for product recovery.*"

Table 4-16

The third data point under *Pellet Coolers, Cyclone* (0.074 lbs/ton) is an incorrect value. In comparing a summary of data from the October, 1993, draft document to the May, 1994, draft document, it appears a typo occurred. The value was 0.044 lbs/ton, and was changed to 0.074 lbs/ton. (Please review the three attached pages. The calculations reveal 0.044 lbs/ton is the correct value.) AFIA recommends EPA make this correction and recalculate the overall emission factor before finalizing the document.

Pg. 9.9.1-10

First full sentence at top of page: using the words "*hopper bottom*", restructure to read: "*Grain is usually received at the mill by hopper bottom truck and/or rail cars, or in some cases, by barge.*" This change is consistent with changes on page 2-27.

First full paragraph, first sentence: Insert the words "*primarily corn*" to read, "*...transferred to the grinding area, where selected whole grains, primarily corn, are ground...*" This change is consistent with changes on page 2-28.

Third full paragraph, first sentence: As previously mentioned, pelleting is not commonly referred to as an extrusion process. Delete the words "*making is an extrusion*" to read, "*Pelleting is a process in which...*" This change is consistent with changes on page 2-29.

Third full paragraph, third sentence: Delete the word "*extrusion*" and restructure to read, "*After pelleting, pellets are dried and cooled...*" This change is consistent with changes on page 2-29.

Last paragraph: Begin with two new sentences taken from page 2-27, second paragraph, fourth and fifth sentences; *"In modern feed mills, transport equipment is connected with closed spouting and turnheads, covered drag and screw conveyors, and tightly sealed transitions between adjoining equipment to reduce internal dust loss and consequent housekeeping costs. Also, many older facilities have upgraded to these closed systems."* Follow with the existing two sentences.

<u>Pg. 9.9.1-19</u>

Under section 9.9.1.2.2, AFIA disagrees with the wording of the fourth sentence. Hammermill operations are not necessarily a major source of dust emissions, and baghouses are also used to recover product. AFIA recommends EPA insert the words *"or baghouse"* and delete the phrase *"which can be a major source of dust emissions"* to simply read, *"Some product is recovered from the hammermill with a cyclone collector or baghouse."*

<u>Table 9.9.1-1</u>

Grain Shipping, Truck vs. Railcar: There is a large difference between emission factors when comparing grain shipping/truck and grain shipping/railcar. AFIA is at a loss as to why there should be an order of 10 magnitude difference between truck and railcar loading. The data relates to Reference 61. On page 4-26, EPA discusses oil suppression in country and terminal elevators. AFIA is interested to know if the large difference in truck vs. railcar emission factors on Table 9.9.1-1 relates to a particular type of elevator, and/or incorporates the use of oil suppression.

EPA states oil suppression will achieve a 60-80 percent reduction in emissions. Is the reader correct in assuming a 60-80 percent reduction can be applied to the factors listed on Table 9.9.1-1? AFIA believes clarity is needed in this area to help the reader understand the large difference in the emission factors, and how to factor in oil suppression as a means of emission reduction.

<u>Table 9.9.1-2</u>

Grain Handling, (f) reference: AFIA believes this category should be removed from Table 9.9.1-2 for the following reasons:

1. Table 9.9.1-2 now has its own categories: *Grain Receiving, Feed Shipping* and *Grain Cleaning*, no longer requiring the reader to reference Table 9.9.1-1 for those emission factors.

2. Relative to feed mill emissions, AFIA has long asserted internal emissions are insignificant as relates to external emissions. Feed mills are typically not constructed with same headhouse configuration as grain

elevators, reducing the potential escape of internal dust emissions.

3. Feed mills and grain elevators inherently operate different types of equipment, and handle different types of materials at significantly different volumes. For example, grain elevators utilize garners, scales, trippers and belt conveyors -- equipment not found in feed mills. The potential for internal dust emissions is much less in a typical feed mill as compared to a grain elevator.

4. In modern feed mills, transport equipment is connected with closed spouting and turnheads, covered drag and screw conveyors, and tightly sealed transitions between adjoining equipment to reduce internal dust loss and consequent housekeeping costs. Also, many older facilities have upgraded to these closed systems.

5. Emissions representing various internal grain handling processes are lumped into a single emission factor. If a feed mill does not have one or all of these operations, then calculated emissions become overstated when permitting requires the use of this emission factor.

6. The *Headhouse and Internal Handling* emission factor on Table 9.9.1-1 was derived specifically from testing conducted at grain elevators, not feed mills. The reader should not be directed to use an emission factor not representative of his/her operation.

For these reasons, AFIA feels EPA should not include the *Grain Handling* category or reference (f) on Table 9.9.1-2. If a feed mill operates a process similar to any grain elevator operation, then the reader can use both tables to obtain the emission factors representative of those operations. By comparison, if a grain elevator operates a feed mill process, the reader will use Table 9.9.1-2. A reference from one table to the other is not necessary.

Under *Pelletizing, Pellet Coolers, Triple Cyclone*: AFIA suggests EPA change this category description from *"Triple Cyclone"* to *"High Efficiency."* As noted in AFIA's comments submitted to EPA on Oct. 30, 1995, cyclones constructed today are designed to be more efficient. Also, many high volume facilities, if space permits, will install multiple cyclones operating in series in a single air stream serviced by a single fan. Such an arrangement is significantly more efficient than older installations of single cyclones.

Some new designs of more efficient cyclones do not even resemble the shape or "look" of older designs. Reduced emissions can result by either using single separators of notably higher efficiency, or by installing multiple cyclones in series. These arrangements are unique in performance from older single cyclones, just as baghouses are notably different in performance compared to cyclones.

Due to these advances in design technology, *"Triple Cyclone"* is not technically the correct way to describe higher efficiency installations. Yes, the references listed on Table 4-16 performed testing on triple cyclones. However, as EPA's AP-42 document moves into the future incorporating new test data, the categorization entitled, *"High Efficiency"* will better define these types of improved installations regardless of the type of control unit used.

PM-10 Emission Factors - Table 9.9.1-2

AFIA strongly recommends EPA include either estimated PM-10 emission factors on Table 9.9.1-2 for all processes, or add references in the PM-10 emission factor column providing the reader guidance for calculating PM-10 emissions.

This release of AP-42 will be used by industry and state permit authorities well into the future to determine major sources of air pollution as mandated by the Clean Air Act of 1990. No other document exists providing guidance on PM-10 emissions.

To date, limited testing has been performed determining PM-10 emissions from many feed manufacturing processes. As future testing is performed, particle size profiling will become common as the testing party attempts to determine the percentage of total PM emissions currently being regulated. Today, PM-10 is the regulated pollutant. EPA, by regulating PM-10 emissions, must also provide guidance for estimating and/or calculating those emissions from regulated facilities.

Leading up to the release of EPA's Interim AP-42 document in November, 1995, AFIA provided the agency a conservative rationale for adopting a 50% PM-10-to-TSP ratio for emissions from cyclones. At that time AFIA recommended EPA publish interim PM-10 emission factors based on this conservative approach, and that AFIA would continue to try to uncover additional information to support these numbers.

Comments submitted to EPA, dated Oct. 29, 1995, included two pages depicting equipment efficiencies of modern-day cyclones. In both, these units are 100% efficient in capturing air stream particulates larger than 30-35 microns. Based on the fact that cyclone efficiencies decrease as particle size decreases, AFIA continues to believe that a conservative estimate for PM emissions from cyclones would be as follows:

a) 50% are PM-10 or smaller, and
b) 50% are in the range PM-30 to PM-10.

Also, part of AFIA's Oct. 29, 1995, comments was a graph profiling typical poultry feed particle size suggesting that below 30-40 microns the distribution becomes very linear. This further supports the conservative recommendation that half of all PM exhausted from cyclones are PM-10 or smaller.

AFIA believes this continues to be an extremely conservative approach in estimating PM-10 emissions from cyclones. In the case of pellet cyclones, PM-10 emissions could be even smaller. During the pelleting process, many particles become encapsulated. Liquids, such as molasses and fat, as well as pellet binders, are added further sticking particles together.

During an Oct. 27, 1995, telephone conversation prior to release of the AP-42 Interim document, EPA agreed with AFIA that the rationale for using the 50% PM-10-TSP ratio was logical, and could be applied to all cyclone processes. AFIA recommends, once again, that the agency use this approach applying the ratio where PM-10 emission factors are lacking, before issuing its final report.

To further support the 50% PM-10-TSP argument, AFIA looked at Table 9.9.1-1, and calculated the percent ratio for every PM and corresponding PM-10 entry. Throughout Table 9.9.1-1, the PM-10-TSP ratio ranged from 8% to 56%. On Table 9.9.1-2, the PM-10-TSP ratio ranged from 15% to 24%. This recent test data suggests that a 50% PM-10-TSP ratio remains a conservative approach, and could be used until future testing produces real data.

AFIA recommends EPA finalize Table 9.9.1-2 in either of the following two ways:

1. Where PM-10 data is lacking, calculate 50% of the PM emission factor for each process (*Grain Cleaning, Grain Milling; Hammermill, Flaker,* and *Grain Cracker, Pelletizing; Pellet Cooler, Cyclone* and *High Efficiency*), and include these values in the PM-10 emission factor column. A footnote could be added to each explaining that this is an estimate based on industry knowledge, and that actual values will be published as soon as they become available.

   Or,

2. Simply add a footnote reference in the PM-10 emission factor column corresponding to each process. The footnote at the bottom of the table could read, "PM-10 test data does not exist at this time. Based on industry knowledge, PM-10 emission factors can be estimated by taking 50% of the PM emission factor."

AFIA believes it is <u>crucial</u> EPA make reference to PM-10 emission factors for each process on Table 9.9.1-2 as recommended above. At a time when the federal government and state permit authorities are regulating PM-10, EPA must provide guidance on PM-10 emission calculation. The AP-42 document is the most respected -- and only -- avenue to do so.

Exception: AFIA believes only PM-10 is emitted from filter material in baghouses. In that regard, under *Grain Milling, Hammermill, Baghouse*; the PM emission factor of 0.012 lbs/ton should also be used for the PM-10 emission factor. Or, EPA could choose to leave the PM-10 column blank for this process, and/or not reference a footnote suggesting the reader take 50% of the PM emission factor as suggested in the paragraph above.

Condensible PM - Table 9.9.1-2

Table 9.9.1-2 lists condensible PM for three processes: *Grain Cleaning, Hammermill Cyclones,* and *Pellet Cooler Cyclones*. AFIA is curious why grain cleaning would generate condensible PM.

AFIA believes inorganic condensibles at a feed mill are primarily products of incomplete combustion. Beyond that, AFIA is not aware of any feed ingredient or process that can significantly contribute to the emission of inorganic condensibles.

Organic condensibles may result as fatty acids are stripped from ingredients heated by friction in the grinding process, as feed is steam conditioned prior to pelleting, and possibly as the feed is formed into pellets while being forced through die holes by rollers.

AFIA is familiar with the protocol of Method 5. AFIA believes the heated probe and filter creates and captures condensible PM in air streams where condensible PM would not have naturally occurred.

Table 9.9.1-2 - Condensible PM - Grain Cleaning

After reviewing the available test data (Reference 18) contained in the draft document, AFIA is uncertain why inorganic and organic condensible data exists in the category *Grain Cleaning*. AFIA is not aware of any heating that occurs during grain cleaning in feed mills. Grain passes, generally, over a single deck screen at low rates separating large foreign materials. This should not be a source of condensible PM, especially inorganic condensible PM.

AFIA suggests EPA review Reference 18 to clarify what type of equipment was used in the cleaning process. Was heating involved? What was the source of the condensibles? Did the test method contribute to the generation of the condensibles? AFIA recommends that if this cleaning operation or the data produced was not representative of today's modern cleaning installations, then the condensible emission factors should be excluded from Table 9.9.1-2.

Table 9.9.1-2 - Condensible PM - Pelletizing

As mentioned above, AFIA believes condensible PM emissions may occur during the pelleting process. However, AFIA questions the presents of inorganic condensibles. Also, AFIA is concerned that some of the old test reports (some are 20 years old) may have combined filterable PM and condensible PM, reporting them as a single value. AFIA understands that it is customary to obtain and report these two types of PM separately, however, AFIA wants assurance they were not combine in the old reports.

AFIA recommends EPA review all the documentation for tests used to create the *Pellet Cooler Cyclone* PM emission factor, i.e., References 4, 18, 38, 41 and 53, to ensure data categorized as filterable PM does not include condensible PM. If it does, users of Table 9.9.1-2 will overstate feed mill emissions when adding filterable and condensible PM emission factors together. If some of the tests are found to contain both types of PM, then AFIA recommends EPA exclude the condensible emission factors from Table 9.9.1-2.

Table 9.9.1-2 - Reference 18 Outlier

One 20 year old test; Reference 18, detailed on page 4-5, produced abnormally high results for both filterable PM and condensible PM (see Tables 4-16 and 4-17). The filterable PM value -- 1.21 lbs/ton -- is the highest value used to create the PM emission factor. It alone raises the emission factor by more than 20 percent. If not incorporated, the PM emission factor would be 0.358 lbs/ton rather than 0.43 lbs/ton.

Similarly, the pellet test in Reference 18 produced the largest condensible PM data, in addition to the inorganic condensible PM data which AFIA questions being present. If the total condensible PM associated with this test -- 0.16 lbs/ton -- were not used, the new condensible PM emission factor would be 0.063 lbs/ton. This is a 34% reduction in the emission factor. AFIA questions the validity of allowing one test to so dramatically effect the overall emission factor.

AFIA recommends the pelleting test results of Reference 18 not be used. The data, filterable PM and condensible PM, are high outliers and significantly distort the emission factor.

It is important to note that the same site in Reference 18 also produced condensible PM data for *Grain Cleaning*, which AFIA believes was produced via test Method 5. As previously mentioned, AFIA recommends EPA not use the *Grain Cleaning* condensible PM data associated with Reference 18.

Condensible PM - Particle Size

AFIA assumes condensible PM is of size PM-10 or smaller. AFIA recommends EPA state the particle size of condensible PM either in the column headings on Table 9.9.1-2, as a footnote, or in Section 4 of the report. Industry and state permit authorities may find such information useful as environmental laws change regulating various particle sizes.

Footnotes - Table 9.9.1-2

While reviewing Table 9.9.1-2, AFIA found that none of the footnote references properly linked the emission factors to the tests contributing the data. AFIA suggests EPA review and correct all footnotes.

Conclusion

AFIA recommends EPA make the above changes to the draft document before finalizing. Specifically, technical changes in process description, deletion of the *Grain Handling* category on Table 9.9.1-2, inclusion of PM-10 emission factors on Table 9.9.1-2, and exclusion of questionable data from Reference 18 contributing to emission factors on Table 9.9.1-2, must all occur to bring AP-42, Compilation of Air Pollution Emission Factors, up-to-date with today's technologies providing industry and state permit authorities guidance in PM-10 emission calculations.

AFIA appreciates the opportunity to comment on Draft Section 9.9.1, Grain Elevators and Grain Processing Plants. AFIA is willing to meet with the agency to discuss any of our comments.

Sincerely,

Brian L. Bursiek
Director, Feed Production
AFIA

Attachments

TABLE 4-15. DATA USED TO DEVELOP FILTERABLE PM EMISSION FACTORS FOR GRAIN PROCESSING FACILITIES

Emission source	Type of control	Reference No.[a]	Average measured filterable PM emission factor[b] lb/ton	kg/Mg	Type of grain[c]	Data quality rating
Animal feed mills						
—Grain receiving and handling[d]	—	—	d	d	—	—
—Hammermills	Cyclone	38	0.121	0.0604	corn, wheat, soybeans	A
		41	0.01	0.005	corn	C
	Baghouse	37	0.022	0.011	oats, barley, alfalfa, corn	B
—Flaking	Cyclone	4	0.15	0.075	corn, barley	C
—Grain cracker	Cyclone	4	0.0242	0.0121	corn	C
—Pellet coolers	None	38	5.43	2.71	corn, wheat soybeans	A
		41	41	20	corn, wheat soybeans	C
		41	27	13	corn, wheat, cottonseed, soybeans	C
	Cyclones	4	0.833	0.416	NA	C
Oct 193			0.917	0.458	NA	C
			0.044	0.022	mixed feed	C
			0.50	0.25	NA	C
			0.28	0.14	NA	C
			0.32	0.16	NA	C
			0.49	0.24	NA	C
		18	1.21	0.604	mixed feed	A
		38	0.197	0.0984	corn, wheat, soybeans	A
		41	0.036	0.018	corn, wheat, soybeans	C
			~~6.1~~	3.0	corn, wheat, cottonseed, soybeans	C
Carob kibble roaster	None	11	6.0	3.0	carob	D
		(continued)				
Wheat mills						
—Receiving[d]	None	26	0.77	0.38	wheat	C
		33	0.202	0.101	wheat	B
	Cyclones	26	0.0094	0.0047	wheat	C
	Baghouse	33	0.0002	0.0001	wheat	B
—Grain handling[d]	None	26	0.488	0.244	wheat	C
	Cyclones	26	0.011	0.0055	wheat	C
—Cleaning house separators	Cyclones	36	0.0087	0.0043	wheat	C
			0.016[e]	0.0080[e]	wheat	C
—Roller mill	None	36[f]	70	35	wheat	C

TABLE 4-18. DATA USED TO DEVELOP FILTERABLE PM EMISSION FACTORS FOR GRAIN PROCESSING FACILITIES

Emission source	Type of control	Reference No.[a]	Average measured filterable PM emission factor[b]		Type of grain[c]	Data quality rating
			lb/ton	kg/Mg		
Animal feed mills						
—Grain receiving and handling[d]	–	–	d	d	–	–
—Grain cleaners	Cyclone	18	0.490	0.245	oats	A
			0.247	0.123	oats	A
			0.083	0.042	wheat	A
—Hammermills	Cyclones	38	0.121	0.0604	corn, wheat, soybeans	A
		41	0.01	0.005	corn	C
	Baghouse	37	0.022	0.011	oats, barley, alfalfa, corn	B
—Flaking	Cyclone	4	0.15	0.075	corn, barley	B
—Grain cracker	Cyclone	4	0.0242	0.0121	corn	C
—Pellet coolers	None	38	5.43	2.71	corn, wheat soybeans	A
		41	41	20	corn, wheat soybeans	B
	Cyclones	4	0.833	0.416	steer feed	B
May 94			0.917	0.458	poultry feed	C
			0.074	0.037	mixed feed	C
		?	0.50	0.25	poultry feed	C
			0.28	0.14	poultry feed	C
Typo?			0.32	0.16	steer feed	C
			0.49	0.24	steer	C
			0.16	0.081	mixed feed	B
		18	1.21	0.604	mixed feed	A
		38	0.197	0.0984	corn, wheat, soybeans	A
		41	0.037	0.018	corn, wheat, soybeans	B
Carob kibble roaster	None	11	6.0	3.0	carob	D
		(continued)				
Wheat mills						
—Receiving[d]	None	26	0.77	0.38	wheat	C
		33	0.202	0.101	wheat	B
	Cyclones	26	0.0094	0.0047	wheat	C
	Baghouse	33	0.0002	0.0001	wheat	B
—Grain handling[d]	None	26	0.488	0.244	wheat	C
	Cyclones	26	0.011	0.0055	wheat	C
—Cleaning house separators	Cyclones	36	0.0087	0.0043	wheat	C
			0.016[e]	0.0080[e]	wheat	C
—Roller mill	None	36[f]	70	35	wheat	C

COMPANY NAME: RALSTON PURINA COMPANY MILL 2

SOURCE IDENTIFICATION: Pellet Mill

SOURCE TEST FOR: Particulates

PROCESS WEIGHT RATE: 10 Tons/hr Mixed Feed

DATE:

May '94 Appendix

RUN	(STACK) OUTLET	SCF	ACFM	SCFM	%H2O	TEMP, °F	% ISOKINETIC	GRAINS/SCF	EMISSIONS, LBS/HR.
1		28.01	17830.62	16436.65	2.65	100	94.37	.0023	.3240
2		28.35	18,054	16832.07	3.25	90	93.20	.0044	.6281
3		29.13	17971.38	16938.85	2.86	86	95.11	.0025	.3691

0.4404 / 10 T/H = 0.044

AVG. PARTICULATE EMISSIONS: .4404 lbs./hr.

ALLOWABLE EMISSIONS: 14.97 lbs./hr.

STANDARD CONDITIONS: Dry, 70°F., 29.92 in. Hg

ALLOWABLE EMISSIONS BASED ON CHAPTER 17-2.04 of THE STATE OF

AMERICAN FEED INDUSTRY ASSOCIATION

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February 27, 1997

Dallas W. Safriet
U.S. Environmental Protection Agency
Emission Factor and Inventory Group (MD-14)
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

Dear Mr. Safriet:

AFIA appreciates the opportunity to comment on the study conducted by Midwest Research Institute (MRI) on behalf of the National Grain and Feed Foundation entitled; "Emission Factors for Grain Elevators".

AFIA is the national trade association for commercial feed and pet food manufacturers, and ingredient suppliers. AFIA members represent more than 70% of the primary formula poultry and livestock feed sold annually in the U.S. AFIA's membership includes more than 730 companies, and 3,000 individual establishments in all 50 states.

Introduction

In general, AFIA is impressed with the study conducted by MRI. It, along with study conducted by Texas A&M University and data submitted by AFIA last year, can be used to further improve AP-42 as relates to feed mills.

It is not AFIA's intent to criticize the results obtained by MRI, but to recommend how best to incorporate these results into EPA's interim emission factor document dated November, 1995.

Below are some general comments to put the report into perspective, followed by recommendations how EPA should incorporate the results.

Discussion

1. On page two of the report, the first paragraph states box cars are no longer used to ship grain by the grain industry. While this may be true as relates to country and terminal elevators, box cars are still used, to a small degree, to receive certain feed grains (ingredients) into feed mills.

   Where receiving operations can accommodate, some feed mills utilize box cars for receiving cottonseed hulls. Cottonseed hulls have a very low bulk density making them nearly

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impossible to unload using hopper bottom trucks or rail cars. In some cases, dumpers are used, or trailers with "walking" beds to move the material to the end of the trailer.

2. As discussed on page 10, AFIA questions the validity of the test method used to determine internal emissions. It seems difficult to simulate natural air breezes blowing through elevator windows by closing all windows and inducing forced air through fans. Also, how does this relate to natural air currents blowing in and around various pieces of machinery and their relative location to an open window. AFIA supposes confidence in the procedure comes from visiting the site.

   AFIA feels the test conducted by MRI does not represent that of feed mills. As described in the last paragraph on page 17, grain was discharged into a bucket elevator leg from the basement <u>belt</u> and elevated to the top of the headhouse. The grain was then discharged onto a gallery <u>belt</u> for storage in silos after first passing through a <u>garner</u>, <u>scale</u> and distributor system. The items underlined are typically not present in feed mills.

   Most conveyance equipment in feed mills, new and old, are enclosed. Typically, drag and screw conveyors, bucket elevators, screeners, turnheads and spouting are all enclosed. These pieces of equipment are not capable of producing the levels of internal emissions as found in elevators from open belt conveyors.

3. On page 31, the last paragraph states that final emission factor tables will not distinguish between country verses terminal elevators. It is further stated that this approach recognizes that there is no conceptual differences between specific operations (e.g., receiving, shipping, etc.) at country and terminal facilities.

   AFIA references this statement because, on page 32, it seems inconceivable that their would be a 10 fold difference in emissions from rail shipping (0.0022) and truck shipping (0.029). Logically, it seems rail shipping would produce more emissions from material falling a greater distance.

   AFIA believes the difference in emissions from truck verses rail shipping must relate to the system layout at the two separate facilities where the testing occurred. Truck shipping tests were conducted at the country elevator, whereas rail shipping tests were conducted at the terminal elevator.

4. As AFIA pointed out above, there appears to be a significant difference between the two test sites used to test shipping emissions. On page 26, a closer look shows grain loaded onto trucks at Terminal 1 revealed emission factors of 0.00211 and

0.00364 lbs/ton, for an average of 0.00288 lbs/ton. Rail shipments at the same location averaged 0.00224 lbs/ton -- a very comparable number.

Neither of the above emission factors, truck or rail, closely resemble the average truck shipping emission factor of 0.0425 lbs/ton found at the country elevator.

Should the final AP-42 report list separate shipping emission factors for these two types of facilities?

5. On page 32, AFIA is very pleased to see EPA required separate emission categories for straight trucks and hopper bottom trucks and rail cars. AFIA's comments, dating back to Oct. 12, 1994, have been substantiated by the MRI test results -- choke flow from hopper bottoms produces significantly fewer emissions. Today, most feed ingredients are received at feed mills via hopper bottom trucks and rail cars. This will now provide a more representative emission factor.

6. On page 32, AFIA agrees that hopper truck unloading is conceptually equivalent to that for hopper railcar unloading, and the emission factor tables should reflect the 0.0077 lb/ton emission factor for both.

Recommendations

AFIA makes the following recommendations for incorporating the MRI results into EPA's interim AP-42 document dated November, 1995.

1. EPA should recognize the MRI test results as valid, and incorporated them into, or use to replace, the emission factors found in the November 1995 interim AP-42 document. The various categories found on page 32 should be included in the final AP-42 document.

2. AFIA is very pleased that EPA created the new receiving category for hopper bottoms. This provides a more representative emission factor for determining actual emissions from those operations.

3. As stated earlier, box cars are still used a small percentage of the time to receive unique ingredients into feed mills. AFIA is not aware of any current emission factors that exist to represent this mode of receiving. Due to the fact that the overall volume of feed ingredients received by box cars is so small, AFIA suggests EPA not consider adding it to the emission tables. Due to the small percentage of ingredients received by box car, it does not merit research dollars being spent to determine emissions caused by that operations. Overall, those emissions do not contribute significantly to the total emissions of a facility.

4. AFIA feels internal emissions and their potential escape to the atmosphere via open windows is more unique to grain facilities than feed mills. Because open running belt conveyors are not used, any account of internal emissions from feed mills would be much less, and probably negligible.

   AFIA recommends EPA either include a footnote stating that internal handling emission factors were obtained from and represent grain elevator internal emissions, not feed mills. Or, as found on page 9.9.1-28 of the November 1995 interim AP-42 document, the first category, "grain receiving and handling" should be changed to simply read "grain receiving". This will draw the readers attention away from assuming the large internal emission factor for elevators should be used in feed mill emission calculations.

5. AFIA is troubled by the large, 10 fold variance between truck and rail shipping. As mentioned above, there appears to be a significant difference in truck shipping at country verses terminal elevators. Because one is drastically lower than the other, AFIA would like to see EPA list them separately in the final AP-42 report so the user can use the emission factor which best represents his/her operation.

   As found in AFIA's comments submitted to the agency on Nov. 8, 1996, regarding the Texas A&M study, the feed industry uses these grain shipping factors to calculate shipping emissions at feed mills. By listing separately the country verses terminal elevator shipping emission factors, the user will be able to choose the emission factor which best represents his/her operation. One size does not fit all.

6. AFIA recommends that after the agency incorporates the above comments to the November 1995 interim AP-42 document, the comments suggested by AFIA on Nov. 8, 1996, regarding the Texas A&M study, should also be incorporated. Another copy of those comments is attached.

Conclusion

The MRI study has meaningful information which can be used to calculate emissions from many commercial feed mills. AFIA encourages EPA to adopt the above recommendations as outlined, and incorporate them into the interim AP-42 document as suggested. This will enhance AP-42 by offering a comprehensive list of air emission test results, while allowing the user to "pick and choose" emission factors best representing his or her operation.

AFIA appreciates the opportunity to comment on Emission Factors for Grain Elevators. We are willing to meet with the agency to clarify any of AFIA's positions.

Sincerely,

Brian L. Bursiek
Director, Feed Production
AFIA

Attachment

November 8, 1996

Dallas W. Safriet
U.S. Environmental Protection Agency
Emission Factor and Inventory Group (MD-14)
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

Dear Mr. Safriet:

AFIA appreciates the opportunity to comment on the study conducted by Texas A&M University on behalf of the National Cattleman's Beef Assn. entitled; "Emission Factors for Grain Receiving & Feed Loading Operations at Feed Mills".

AFIA is the national trade association for commercial feed and pet food manufacturers, and ingredient suppliers. AFIA members represent more than 70% of the primary formula poultry and livestock feed sold annually in the U.S. AFIA's membership includes more than 730 companies, and 3,000 individual establishments in all 50 states.

Introduction

As mentioned in our correspondence to you dated July 23, 1996, AFIA applauds EPA's work to revise AP-42 to better represent air emissions and current technologies used in feed manufacturing. The interim emission factors released last November helped industry and state EPAs to properly consider most feed mills in the U.S. as minor sources of air pollution, avoiding the costly and unnecessary burden of Title V permitting.

In general, AFIA is impressed with the study conducted by Texas A&M. It, along with data submitted by AFIA over this past year, can be used to further improve AP-42 as relates to feed mills. As we move forward, it is important to remember, as with any regulation, one size does not fit all. AP-42 must be designed to provide a comprehensive list of air emission test results categorized so the user can select emission factors best representing his or her operation. All feed mills are different, and, generally, none are "typical". To that end, the results of the Texas A&M study must be properly categorized to allow optimum use.

It is not AFIA's intent to criticize the results obtained by Texas A&M, but to recommend how best to incorporate these results into EPA's interim emission factor document dated November, 1995.

Below are some general comments to put the report into perspective, followed by recommendations how EPA should incorporate the results.

Discussion

1. In various places, the report states there are two operations resulting in emission of particulate matter -- ingredient receiving and feed shipping. AFIA wants to emphasize that as this may be typical for feed mills located at cattle feedlots, it is not the case for most commercial feed mills in the U.S. Processing operations, such as grain cleaning, grinding, flaking, cracking and pelleting can be point sources with external emissions through bag filters or cyclones.

2. On pages 4 and 5, five bullets summarize the differences between a country grain elevator and a feed mill regarding levels of emissions. AFIA contends the third item, which describes feed mill receiving operations, also accurately describes receiving operations at most commercial feed mills.

   Choke Flow
   In comments submitted to the agency on October 12, 1994, AFIA suggested changes be made to AP-42 adopting two new categories under receiving operations: Platform dumps and hopper bottoms. Platform dumps and large capacity pits are used at many elevators for speed in unloading. This is not necessary at commercial feed mills. Most receiving pits are small and fill quickly once the unloading operation has begun. And, as described in the third item on page 4, the choke flow of the grain entrains the dust greatly reducing emissions as compared to receiving operations at elevators.

3. AFIA would like to suggest a sixth item be added to those listed on pages 4 and 5: Many feed mills, particularly commercial mills, purchase raw grain from local country elevators as opposed to straight from the farm. These grains have been subjected to a cleaning process, further reducing dust emissions as compared to elevator receiving operations.

4. Similarly, a seventh item could be added to those listed on pages 4 and 5, differentiating feed mills, in particular commercial feed mills, from elevators. Commercial mills utilize grain and animal byproducts, such as wheat midds, soybean meal, sunflower meal, distiller dried grains, feather meal, meat and bone meal, etc, as protein, fiber and energy sources to produce protein supplements. Many of these carry higher moisture levels than do raw grains due to oil, fat and blood content. As with high-moisture feeds, these types of ingredients inherently have lower free dust content available for emission.

5. On page 8, paragraph 2, the report suggests typical dimensions for an unloading pit and shed. Although AFIA agrees with the general differences between feed mills and elevators, EPA should not assume these dimensions are typical. Receiving pits and sheds can vary greatly in size, capacity, and shape. And in some cases, a commercial feed mill may not have a shed enclosing or covering the receiving operation.

6. On page 8, paragraphs 3 and 4, the report suggests typical dimensions for a loadout shed, and references the use of clam shells. Clam shells are not commonly used in commercial feed mills, and, again, the dimensions of loadout sheds can vary greatly.

7. On pages 44-46, Tables 6, 8 and 10 (grain receiving) should note for future reference that corn was the grain received. Future studies may determine there is a correlation between the type of grain and the amount of measured emissions.

8. On pages 44-46, Tables 7, 9 and 11 (feed loading) should note for future reference the type of feed shipped, i.e., high-moisture mash. AFIA believes a large difference exists in particulate emissions, for example, between low-moisture mash feed, low-moisture pelleted feed, and high-moisture mash and pelleted feed. If the Texas A&M study specifically looked at high-moisture mash feeds as mentioned on pages 4 and 5, then AFIA believes more conservative emission factors should be used when considering the loading of low-moisture feed.

9. On page 50, the second paragraph summarizes PM-10 emissions conservatively at 15% of TSP emissions for grain unloading, and 35% of TSP for feed loading. These are important results, as only estimates were used in the November, 1995 interim document. Last fall, AFIA suggested, and EPA agreed, to use a conservative 50% PM-10-to-TSP ratio until better numbers were obtained via testing.

10. On page 57, the report suggests correlating the type of grain used in feed manufacturing to feed emission factors. This may be appropriate for feed mills associated with feedlots, but AFIA's experience doubts its universal applicability to commercial mills. As mentioned earlier, commercial mills utilize grain and animal byproducts, such as wheat midds, soybean meal, sunflower meal, distiller dried grains, feather meal, meat and bone meal, etc, as protein, fiber and energy sources to produce protein supplements. Most commercial mills actually use a very small percentage of raw grain, unlike feed mills associated with feedlots or integrated poultry, turkey and swine mills. For commercial mills, a more appropriate distinction of varying emission levels would be in comparing low-moisture formulated feeds, both mash and pellets, and high-moisture formulated feeds.

Recommendations

AFIA makes the following recommendations for incorporating the Texas A&M results into EPA's interim AP-42 document dated November, 1995. When incorporating new data, or when establishing new categories EPA should be careful not to create an emission factor that is too low. As stated in Texas A&M's report, state permit authorities use AP-42 emission factors to calculate maximum allowable emission rates. If emissions are understated and a facility exceeds those rates, it would be in violation of its permit and be subject to monetary penalties.

1. As explained earlier, AFIA believes the data collected by Texas A&M for grain receiving accurately represents grain and ingredient receiving operations at most commercial feed mills in the U.S. Like feed mills associated with cattle feedlots, commercial feed mills predominately receive grain via hopper bottoms choke-flowing into small pits. These pits fill quickly, greatly reducing the amount of free dust that can become entrained in the air and be carried away.

   In addition, many feed ingredients received at commercial feed mills are grain and animal byproducts, such as wheat midds, soybean meal, sunflower meal, distiller dried grains, feather meal, meat and bone meal, etc. Many of these carry higher moisture levels than do raw grains due to oil, fat and blood content. As with high-moisture feeds, these types of ingredients inherently have lower free dust content available for emission. For these reasons, AFIA believes the grain receiving emission data obtained by Texas A&M, if used to calculate emissions at receiving operations for commercial mills, would be very conservative, but more accurate than the current AP-42 reference strictly using elevator receiving emission factors which incorporate platform dumps.

   AFIA recommends EPA make the following changes to Table 9.9.1-3, in the November, 1995, interim AP-42:

Animal feed mills	Control	Grain	PM	PM-10
Grain receiving and handling				
-- platform dumps	(h)	(h)	(h)	(h)
-- hopper bottom	none	corn	0.04	0.006

   Footnotes should be added explaining that the platform dumps emission factor represents flow into a large capacity pit, and hopper bottom represents choke flow into a small pit.

   The Texas A&M PM and PM-10 emission factors (found on page 57, Table 17) of 0.04 and 0.006 lbs/ton respectively, as mentioned in the report, are conservative using an average of the data received plus one standard deviation. Others may argue, and EPA may choose to expand the above revised table to account for the relative dustiness of various grain or grain byproducts.

(h) may change with the receipt of additional test results from grain elevator studies. In any event, the above recommendation provides conservative emission factors, and allows the user to choose those which best represent his/her operation.

2. AFIA believes the feed loading data obtained by Texas A&M, although representing loading operations at feed mills associated with cattle feedlots, may not represent all feed loading situations at commercial mills. Two primary differences exist: The use of clam shells, and the relative dustiness of various feeds, i.e., low-moisture mash, low-moisture pellets, and high-moisture mash or pellets.

Most commercial feed mills do not use clam shells for loading. Generally, feed is drawn from an overhead bin, and allowed to free fall a short distance into a truck. AFIA mentions this difference, not because it believes large differences exist in emission levels, but to bring attention to differences in terminology and process. During the loading process both allow feed to free flow into the truck. And in both, feed only falls a short distance.

AFIA believes the feed type and formulated moisture has much more of an effect on emission levels than does comparisons between loading with or without clam shells.

Therefore, AFIA recommends EPA make the following changes to Table 9.9.1-3, in the November, 1995, interim AP-42:

<u>Animal feed mills</u>	Control	Grain	PM	PM-10
Bulk loading				
-- low moisture feed	(h)	(h)	(h)	(h)
-- high moisture feed	none	feed	0.005	0.002

This creates two new categories. The interim AP-42 document, dated November, 1995, listed ND (no data) for bulk loading operations. However, in the absence of data, industry and state permit authorities use "grain shipping" emission factors found on Table 9.9.1-2 of the interim document to calculate loading emissions from feed mills.

In the above revised table, AFIA suggests EPA use the (h) reference to draw the user to Table 9.9.1-2 to utilize the grain shipping factors. This is a <u>very</u> conservative approach, as AFIA believes most feed contains less free dust than raw grain. During processing, many feeds have moisture added in the form of water, molasses or fat, or are formulated using grain or animal byproducts containing oil, fat or blood. Also, a high percentage of commercial feed is pelleted, further "locking in" fine dust. In that regard, the use of grain elevator shipping emission factors to represent most feed loadout operations is very conservative.

To take advantage of the testing performed by Texas A&M on high-moisture feed, EPA should provide the second category suggested above -- *high-moisture feed*. This allows, not only feed mills at cattle feedlots to use the data, but commercial mills shipping high-moisture mash or pelleted feed will be able to choose this emission factor for that portion of its volume.

3. The Texas A&M study determined conservative PM-10-to-TSP ratios for grain unloading and feed loading to be 15% and 35%, respectively. AFIA has incorporated those values in Recommendations 1 and 2.

4. Last fall, AFIA and EPA agreed to use a PM-10-to-TSP ratio of 50% in the interim document to assist the user in calculating PM-10 emissions from various processing cyclones. AFIA feels confident that ratio, which was conservative at the time and now supported with the Texas A&M results, can remain in place. An argument could be waged that the ratio should now be lowered to 35% or 15%. AFIA must point out that the Texas study was not conducted on control units, and that emissions from cyclones may, or may not, contain a higher percentage of fine particulates. In that regard, AFIA recommends the 50% PM-10-to-TSP ratio remain in effect until testing performed on cyclone control units proves changes be made.

5. In the interim AP-42, dated November, 1995, Table 9.9.1-3 lacks providing a PM-10 emission factor for Grain cleaning; Oats and Wheat. The PM factor references (h), directing the user back to Table 9.9.1-2. AFIA recommends EPA extend the (h) reference across Table 9.9.1-3, providing the user a PM-10 emission factor for this process.

6. As mentioned earlier, the Texas A&M report determined the PM-10-to-TSP ratio for grain unloading be 15%. When additional grain elevator test results are finalized, AFIA recommends EPA incorporate this value with the value determined by those studies, and list as a revised PM-10 emission factor for the various operations listed on Table 9.9.1-2 of the interim AP-42 dated November, 1995.

Conclusion

The Texas A&M study, conducted at feed mills at cattle feedlots, has meaningful information which can be used to calculate emissions from many commercial feed mills. AFIA encourages EPA to adopt the above recommendations as outlined, and incorporate them into the interim AP-42 document as suggested. This will enhance AP-42 by offering a comprehensive list of air emission test results, while allowing the user to "pick and choose" emission factors best representing his or her operation.

AFIA appreciates the opportunity to comment on Emission Factors for Grain Receiving & Feed Loading Operations at Feed Mills. We are willing to meet with the agency to clarify any of AFIA's positions.

Sincerely,

Brian L. Bursiek
Director, Feed Production
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August 22, 1997

Dallas Safriet
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Dear Mr. Safriet:

We appreciate the opportunity to review the draft version of AP-42, Section 9.9.1, Grain Elevators and Grain Processing Plants. It appears that the concerns we expressed in our review of the report prepared by Midwest Research Institute (MRI) for the National Grain and Feed Association entitled "Emission Factors for Grain Elevators" (reference 61 in your draft) were not considered. We have not received any response to our concerns with the protocol utilized to determine an internal emission factor. Based on reference "f" of table 9.9.1-2, it appears that this same unjustified emission factor will be applied to animal feed mills. The internal operations of a feed mill differ significantly from those of a grain elevator. Therefore, it is inappropriate to apply the grain elevator emission factors to feed mills. Furthermore, the 0.061 lb/ton PM (0.034 lb/ton PM_{10}) emission factor for internal handling is questionable for application to grain elevators as discussed in the attached comments.

Table 9.9.1-2 recommends an emission factor of 0.27 lb/ton PM for grain cleaning at feed mills. The emission factor for grain cleaning at grain elevators is 0.075 lb/ton PM (Table 9.9.1-1). It is not logical that grain cleaning at a feed mill would have an emission factor over 3.5 times higher than the same operation at a grain elevator. As discussed in the attached comments, it is likely that actual emission factors are approximately 19 times lower than in the proposed AP-42 document.

Many operations at feed mills are enclosed and utilize no dust control systems. There is a potential for misuse of AP-42 emission factors on these enclosed and uncontrolled operations. For example, a state air pollution regulatory agency may apply the 0.27 lb/ton emission factor to a feed mill because it has a scalper (grain cleaner). In reality, animal feed mills typically utilize mechanical conveyors to remove trash from scalpers. Therefore, the emission factor for grain cleaning should be zero! We recommend that a footnote be added to table 9.9.1-2 as follows:

> "Enclosed internal grain handling operations with no pneumatic dust control systems should have an emission factor of zero".

The attached report, "Determining Emission Factors for Cyclones that Separate Steam Flaked Grain," presents the results of a study we recently completed at two Texas feed mills. Please consider our recommended emission factors for cyclone separation of steam flaked corn. Our recommendations are: 0.1 lb/ton TSP, 0.015 lb/ton PM_{10}, and 0.0002 lb/ton $PM_{2.5}$.

Please let us know if you have any questions.

Sincerely,

Bryan W. Shaw

Bryan W. Shaw, Ph.D.

Calvin B. Parnell Jr

Calvin B. Parnell, Jr., Ph.D., P.E.

Enclosures

Comments and Concerns

1. *Emission factor for headhouse and internal handling at grain elevators and grain handling at animal feed mills (Tables 9.9.1-1 and 9.9.1-2, respectively).*

   One of the primary reasons the 1988 AP-42 emission factors were in error was a lack of understanding by the original contractor, Midwest Research Institute (MRI), of the purpose of dust control systems used with tunnel belts, elevator legs, headhouses and gallery floors of grain elevators and animal feed mills. Dust control systems are installed inside grain elevators and animal feed mills primarily **to prevent grain dust explosions,** and not to comply with EPA or State Air Pollution Control Agency (SAPRA) regulations.

   Dust control systems reduce the grain dust concentrations at grain transfer points to less than the minimum explosive concentration which is widely accepted as 50 grams per cubic meter (gm/m^3). In addition, grain elevators and animal feed mills are subject to OSHA standards that limit worker exposure to no more than 15 milligrams per cubic meter (mg/m^3) for grain dust, except dust from oats, wheat and barley. The OSHA standard for oats, wheat and barley is 10 mg/m^3 (OSHA 1910.1 Limits for Air Contaminants). The emission factor that would result from 100,000 cubic feet per minute (cfm) exiting the open windows of a grain elevator handling 12,000 bushels per hour of corn (bu/hr) and having an existing internal dust concentration of 15 mg/m^3 (the OSHA upper limit for worker exposure) would be 0.017 pounds per ton (lbs/ton). It is unlikely that an uncontrolled elevator will have 100,000 cfm exiting the windows of the facility at any time and is equally unlikely that the worker exposure level ever approaches 15 mg/m^3. For an internal concentration of 1.5 mg/m^3 and 10,000 cfm escaping through the windows, the emission factor would be 0.0006 lbs/ton.

   The study cited for calculating the emission factor for headhouse and internal handling at grain elevators and grain handling at animal feed mills (MRI, 1997), has several inherent errors associated with its protocol, as we have reported to you earlier.

   In trying to determine the *reasonable worst case scenario* of emissions to the ambient atmosphere from internal emissions, the researchers have developed emission factors that are not typical of grain elevators and animal feed mills. It is our view, that emission factors should be calculated to represent natural occurrences, and exhausting 15,000 cfm out a window, like the researchers did for calculating internal emissions, is not a "natural" occurrence at grain elevators nor at animal feed mills. It is inappropriate to assume natural "leaks" from the building would amount to 15,000 cfm moving from inside the facility to the outside ambient air. However, a 15,000 cfm exhaust volume of air would result in a reasonable upper limit emission factor of 0.003 lbs/ton for a grain elevator handling 190,000 bu/hr of corn based on an upper limit concentration of 15 mg/m^3, which is the OSHA standard. Furthermore, if a facility has controls that are operating, internal air will be exhausted through the dust control system outside the facility which will result in a vacuum inside the facility causing air to move into the facility from the outside.

The emission factor, of 0.061 lbs/ton, reported for internal emissions, indicated that the concentration of particulate matter inside the grain elevator would approximately be 365 mg/m^3. This is outrageously higher than the maximum worker exposure limit of 15 mg/m^3 for grain dust, set by OSHA. It is our opinion that the 0.061 lbs/ton emission factor is grossly in error.

Assuming:

Grain handling rate, R = 12,000 bu/hr = 200 bu/min;
Time grain was handled during test, t = 10 min;
Sampling time, T = 20 min;
Type of grain being handled: corn;
Density of corn, ρ = 56 lbs/bu = 0.028 tons/bu;
Sampling rate of air, Q = 15000 cfm = 425 m^3/min; and
MRI recommended emission factor, E = 0.061 lbs/ton.

Emission Rate (ER) = 200 bu/min * 0.028 tons/bu * 0.061 lbs/ton
therefore, ER = 0.3416 lbs/min

$$\text{Emission Concentration (EC)} = \frac{0.3416\ \frac{\text{lbs}}{\text{min}} * 454\ \frac{\text{gm}}{\text{lb}} * 1000\ \frac{\text{mg}}{\text{gm}}}{425\ \frac{\text{m}^3}{\text{min}}}$$

$$\text{EC} = 365\ \text{mg} / \text{m}^3$$

It is likely that most grain elevators will have dust control systems operating inside the facility to prevent grain dust explosions and not to comply with air pollution regulations. These dust controls will pick up air inside the facility and exhaust the air externally through bag filters or cyclones. Hence, the dust control systems will more likely create a vacuum such that air will move from the outside through the windows to the inside. It is our opinion that the internal emissions are negligible and there should be no emission factor for headhouse and internal handling at handling at grain elevators and grain handling at animal feed mills.

2. *Emission factor for grain cleaning at animal feed mills (Table 9.9.1-2).*

Table 9.9.1-2 recommends an emission factor of 0.27 lb/ton PM for grain cleaning at feed mills. The emission factor for grain cleaning at grain elevators is 0.075 lb/ton PM. It is not logical that grain cleaning at a feed mill would have an emission factor over 3.5 times higher than the same operation at a grain elevator. This emission factors seems large based on the capability of a properly designed cyclone to achieve emission concentrations below 0.03 grains per dry standard cubic foot. A grain cleaner with pneumatic trash removal (located at a feed mill or grain elevator) will have a volume flow rate of approximately 3300 ft^3/ton of grain cleaned. An emission concentration of 0.03 grains per dry standard cubic foot would yield an emission factor of 0.014 lb/ton PM. This is over 19 times lower than the emission factor proposed for grain cleaning at feed mills. It is likely that the data used to develop the feed mill grain cleaning emission factor are in error. Therefore, we recommend that the data source used to develop the 0.27 lb/ton emission factor (Lonnes, 1977) not be considered in AP-42.

Many operations at feed mills are enclosed and utilize no dust control systems. There is a potential for misuse of AP-42 emission factors on these enclosed and uncontrolled operations. For example, a state air pollution regulatory agency may apply the 0.27 lb/ton emission factor to a feed mill because it has a scalper (grain cleaner). In reality, animal feed mills typically utilize mechanical conveyors to remove trash from scalpers. Therefore, the emission factor for grain cleaning should be zero! We recommend that a footnote be added to table 9.9.1-2 as follows:

> "Enclosed internal grain handling operations with no pneumatic dust control systems should have an emission factor of zero".

References

Lonnes, P. 1977. Results of particulate emission compliance testing at the Peavey Company in Valley City, North Dakota, conducted March 16-18, 1977. Interpoll Inc., St. Paul, MN, April, 1977.

Midwest Research Institute. 1997. Emission Factors for Grain Elevators, Final Report to National Grain and Feed Foundation. Midwest Research Institute, Kansas City, Missouri, January, 1997.

Determining Emission Factors for Cyclones that Separate Steam Flaked Grain[1]

INTRODUCTION

Prior to this research, there existed minimal data that quantified the TSP and PM-10 emission rates from a cyclone separating steam flaked grain that is commonly used at a feed mill associated with a cattle feed yard. There is no standard design for these cyclones. They typically are designed by the millwrights and may or may not resemble the standard 1D3D or 2D2D cyclone. This type of cyclone separates the steam flakes from the airstream that conveys them from the flaking rollers to the temporary storage prior to the mixing of the finished feed. The primary difference between a steam flake separating cyclone and a cyclone that is used for dust control is the properties of the airstream. A steam flake separator handles air that is extremely high in moisture, whereas, a typical dust control cyclone will handle a much drier airstream. This study used actual source sampling data from separating cyclone exhausts to quantify the emissions from these cyclones

In the 1995 interim AP-42, the emission factor for the flaking cyclone reduced from 0.1 kilogram of TSP per tonne (0.2 lb/ton) (EPA, 1988) to 0.075 kilograms of TSP per tonne (0.15 lb/ton). Assuming 50% of the cyclone emissions is PM-10, the resulting PM-10 emission factor was 0.0375 kilograms of PM-10 per tonne (0.075 lb/ton) (EPA 1995). This interim emission factor was based on one test conducted at a feed mill that flaked corn and barley at a rate of 5,448 kg/hr (12,000 lb/hour). The outlet of the cyclone collector for the flaking machine was sampled and the resulting average particulate emission rate was determined to be 0.409 kg/hr (0.9 lb/hr). The emission factor was determined by dividing the average particulate emission rate by the processing rate of the corn or barley (EPA, 1994). If it is assumed that this cyclone has an air to feed ratio of 0.71 cubic meters of air per pound (25 ft^3/lb) of flaked corn or barley (Rodrigeuz, 1997), then this cyclone would handle 142 m^3/min (5000 cfm) of air. Dividing the emission rate of 0.409 kg/hr by the volume rate of flow (142 m^3/min) the resulting emission concentration for this test would be 48 mg/m^3 (0.021 grains/ft^3).

METHODS

This sampling was performed on-site at feed mills associated with cattle feed yards. In cooperation with the regulatory manager at Texas Cattle Feeders' Association, two feed mills were selected based on the design of the exhaust of the separating cyclone, preferably a horizontal exhaust, and the accessibility to these cyclones. Prior to the visit, a sampling probe was designed in accordance with EPA's method V, "Determination of Particulate Emissions from Stationary Sources"(40 CFR part 60, APP A). These guidelines outlined the sampling probe design that would facilitate isokinetic sampling and account for the warm and humid conditions of the exhaust. Isokinetic sampling occurs when the face velocity of the sampling probe is identical to

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[1] This information was abstracted from Demny et al. (1997).

the velocity of the sampled airstream (Boubel et al, 1994). The inlet of the sampling probe had a tapered leading edge of no more than 30 degrees and was an elbow type design (40 CFR part 60, APP A). The diameter of the tapered inlet was 3.05 centimeters (1.2 inches) which provided an inlet velocity at the inlet of the sampling probe in the range of 1067 to 2896 meters per minute (3500 to 9500 fpm). This sampling probe had a filter positioned horizontally and as close to the inlet probe a physically possible. The horizontal position eliminated the potential for losses of the collected material after it had impacted the filter media. Since the exhaust stream was high in moisture, there was concern that any condensation on and around the filter would trickle off the media carrying collected particulate matter if it was positioned in a vertical alignment. The sampling rate was dependent on the velocity of the exhaust stream from the cyclone. Prior to the source sampling, a Pitot tube was used to perform a traverse across the exhaust duct of the cyclone. The velocity pressure readings were measured with a magnahelic gauge and recorded. The average measured velocity pressure was determined from the traverse and used to calculate the average velocity of the exhaust stream. To ensure isokinetic sampling, the sampling rate was adjusted such that the inlet velocity of the sampling probe was the same as the average velocity of the exhaust stream where the sampling probe was positioned. The flow rate of the sampling probe was controlled by a portable fan unit. This fan unit had a model HP33P Cadillac blower configured with a calibrated 3.8 centimeter (1.5 inch) diameter orifice meter. The pressure drop across the orifice meter was monitored with a magnahelic gauge and adjusted with a variable speed controller.

The source sampling at feed mill A was performed on the flaked corn separating cyclone. The air lift which fed this cyclone pneumatically conveyed steam flaked corn from one flaker. This flaker processed steamed flakes at a rate of 13.6 tonnes/hour (15 tons/hour). The traverse performed on the exhaust duct of this cyclone yielded an average velocity pressure of 846 Pascals (3.4 in wg). The conditions of the exhaust air were approximately 66°C (150°F), 80% relative humidity and 90.32 kPa (13.1 psi) barometric pressure. Given these conditions the moist air density of the exhaust gas and ultimately the exit velocity could be calculated using equations 1 and 2.

$$\rho_{ma} = \frac{(P_B - \varphi\, P_S)}{0.37\ (T_{DB} + 460)} + \frac{\varphi\, P_S}{0.596\ (T_{DB} + 460)} \qquad \text{(Eq. 1)}$$

where,

ρ_{ma}	=	moist air density - (lb/ft^3)
P_B	=	barometric pressure - (psi)
φ	=	relative humidity
P_S	=	saturated water vapor pressure at T_{DB} - (psi)
T_{DB}	=	dry bulb temperature - (°F)

$$V = 1097\sqrt{\frac{VP}{\rho}} \qquad \text{(Eq.2)}$$

where,

V = velocity - (fpm)
VP = velocity pressure - (in wg)
ρ = air density - (lb/ft^3)

The resulting density of the exhaust airstream and the velocity of the exhausting air from the cyclone at feed mill A was 0.843 kg/m^3 (0.0526 lb/ft^3) and 2688 m/min (8820 fpm), respectively. Since the dimensions of the rectangular exhaust duct were 27.9x35.6 centimeters (11x14 inches), the volume rate of flow of air handled by this cyclone was determined to be 267 m^3/min (9433 cfm). This was calculated by multiplying the outlet area of the exhaust duct by the exiting velocity. Knowing the volume rate of flow and the handling rate of the cyclone, the ratio of the volume of air per kilogram of flaked corn handled was determined to be 1.19 m^3/kg (19 ft^3/lb). During each source sampling test, the pressure drop across the orifice meter was recorded. This pressure drop was used to determine the sampling volume rate of flow for that test run using equation 3.

$$Q = 5.976\ K\ d_o^2 \sqrt{\frac{\delta P}{\rho}} \qquad \text{(Eq. 3)}$$

where,

Q = volume rate of flow - (cfm)
K = calibrated K value
d_o^2 = orifice diameter - (inches)
δP = pressure drop across orifice meter - (in wg)
ρ = air density - (lb/ft^3)

Once the volume rate of flow was determined, the inlet velocity of the 3.05 centimeter (1.2 inch) diameter sampling probe could be found. The volume rate of flow and sampling probe inlet face velocity is listed in Table 1 for the source sampling at feed mill A.

Table 1: Source Sampling at Feed Mill A

Test (#)	Volume Rate of Flow m^3/min (cfm)	Probe Inlet Face Velocity m/min (fpm)
1	1.87 (66)	2563 (8408)
2	1.73 (61)	2369 (7771)
3	1.87 (66)	2563 (8408)

It was attempted to sample the cyclone exhaust isokinetically. However, due to the unexpected high velocities from the cyclone, the portable fan unit was not able to deliver the flow rate required to allow the inlet velocity of the sampling probe to equal that of the exhausting airstream (2688 m/min) for the tests using glass fiber filters. Since the pressure drop associated with a poly web filter is significantly less than that associated with a glass fiber filter, isokinetic conditions were achievable. It was determined that if the sampling probe operated with a face velocity slightly less than that of the exiting exhaust stream then the source sampling test would actually oversample the exhaust stream. The oversampling would collect more mass of particulate matter than if it were sampling isokinetically yielding a conservative measure of the cyclone emission concentration.

Source sampling at feed mill B was performed in the same manner as feed mill A. The conditions of the cyclone exhaust airstream were the same as feed mill A. However, the outlet of the exhaust was not positioned horizontally like that of feed mill A. The cyclone had a rectangular elbow that directed the exhaust vertically. It was concluded from Pitot measurements that the flow of the exhaust was not uniform. The curvature of the duct actually created a "dead space" in the duct where positive velocity pressure measurements were undetectable with the Pitot tube. It was determined based on inspection and zero velocity pressure measurements that half of the 36.83x36.83 centimeters (14.5x14.5 inch) square duct did not have an air flow associated with it. Therefore, the traverse was performed on only half of the exhaust duct area (18.42x36.83 centimeters). The average measured velocity pressure was 1368.6 Pa (5.5 in wg). This average velocity pressure resulted in a velocity of the exiting exhaust of 3419 m/min (11,217 fpm) (Eq. 3). Assuming that this velocity was associated with half of the square exhaust duct (18.42x36.83 centimeters), the resulting volume rate of flow for the cyclone at feed mill B was determined to be 224 m^3/min (7907 cfm). The air lift leading to this cyclone conveyed 9.07 tonnes/hr (10 tons/hr) of flaked corn from two flakers. These conditions produced a ratio of volume of air per pound of flaked corn handled of 1.48 m^3/kg (23.7 ft^3/lb). Again, the pressure drop across the orifice meter was recorded and used to determine the sampled volume rate of flow (Equation 6) and sampling probe inlet face velocity for that test. These results for source sampling at feed mill B are listed in Table 2.

Table 2: Source Sampling at Feed Mill B

Test (#)	Volume Rate of Flow m^3/min (cfm)	Probe Inlet Face Velocity (fpm)
1	2.04 (72)	2796 (9172)
2	1.73 (61)	2369 (7771)
3	2.01 (71)	2757 (9045)
4	1.95 (69)	2679 (8790)
5	2.01 (71)	2757 (9045)
6	1.93 (68)	2640 (8662)

RESULTS

After post-weighing the exposed filters from the source sampling tests from feed mill A, the net weight of dust captured was determined. This amount of dust captured during each test divided by the volume of air sampled during that test yielded the exiting concentration of TSP that penetrated the cyclone. Furthermore, the emission factor was determined for each source sampling test at feed mill A. The emission factor was calculated by dividing the sampled emission rate by the processing rate of that cyclone. These results are found in Table 3.

Table 3: Emission Concentrations for Source Sampling at Feed Mill A

Test Run (#)	Emission Factor kg/tonne (lb/ton)	Emission Concentration (mg/m^3)	($grains/ft^3$)
1	0.000345 (0.00069)	0.2924	0.00013
2	0.000485 (0.00097)	0.4125	0.00018
3	0.00101 (0.00202)	0.8603	0.00038
Average	0.000615 (0.00123)	0.5217	0.00023
Std. Dev.	0.00029 (0.00058)	0.244	0.000107

The emission concentrations for the source sampling test performed at feed mill B were calculated in the same manner as those for feed mill A. The resulting concentrations are listed in Table 4.

Table 4: Emission Concentration for Source Sampling at Feed Mill B

Test Run (#)	Emission Factor kg/tonne (lb/ton)	Emission Concentration (mg/m^3)	(grains/ft^3)
1	0.048 (0.09601)	32.414	0.0142
2	0.0599 (0.11980)	40.444	0.0177
3	0.04597 (0.09194)	31.039	0.0136
4	0.02775 (0.05549)	18.734	0.0082
5	0.04798 (0.09595)	32.393	0.0141
6	0.04328 (0.08656)	29.224	0.0128
Average	0.0455 (0.0910)	30.708	0.0134
Std. Dev.	0.0095 (0.019)	6.406	0.0028

The average emission factors and emission concentrations sampled at feed mill A were greater than 50 times higher than those determined for feed mill B. This was possibly the result of a few conditions observed during the sampling at this feed mill. The cyclones at feed mill A were installed approximately six months prior to the visit. Since they are of a more current design, it was assumed that they would have a greater efficiency than those cyclones used at feed mill B. Also, the exhaust from the cyclones at feed mill A were identified as having more water vapor associated with it. This could have resulted from differing amounts and properties of the steam added to the grain prior to flaking. It was hypothesized that the additional water vapor suppressed a percentage of the dust causing it to exit the cyclone with the steamed flakes. This would help explain why there was more dust captured during the sampling at feed mill B. Furthermore, visual inspection of the cyclone exhaust at feed mill B revealed that periodically whole kernels of corn would penetrate the cyclone. It was determined that this occurrence was associated with a poorly designed or improper operation of the cyclone. If the cyclone was not functioning within its design specification, then the efficiency of the cyclone deteriorates. However, there are a large number of feed mills that utilize cyclones like those at feed mill B which have been in place for many years, so this occurrence was probably not limited to feed mill B. It was a conclusion of this source sampling that the emission concentrations and resulting emission factors from feed mill B represent a worse case scenario for all feed mills based on the reasons described above. The overall average of the emission factors from the nine source sampling test are listed in Table 5.

Table 5: Average Emission Factors from Source Sampling

	TSP Emission Factor (kg/tonne)	(lb/ton)
Average	0.0305	0.061
Standard Deviation	0.0225	0.045

As a conservative measure, if one standard deviation was added to the overall average, the resulting emission factor would be 0.053 kg/tonne (0.106 lb/ton). Notably, the average emission factor from feed mill B source sampling (worst case scenario) of 0.0455 kilograms of TSP per tonne (0.0910 lb/ton) of steam flaked corn was less than the overall average plus one standard deviation. Since the worst case source sampling emission factor was below 0.05 kg/tonne (0.10 lb/ton), it is recommended that an emission factor of 0.05 kilogram of TSP per tonne (0.10 lb/ton) of flaked grain be used as an emission factor for all cyclones separating steam flaked grain. This emission factor of 0.05 kg/tonne (0.10 lb/ton) is 30% less than that reported in the 1995 interim AP-42 (0.075 kg/tonne) for these cyclones. However, this recommendation is substantiated with data obtained using scientific procedures and engineering expertise. Statistically they represent an accurate account of the emissions.

PARTICLE SIZE ANALYSES

Since TSP is no longer the regulated pollutant for particle matter, it was necessary to perform particle size analyses on the exposed filters. This analyses aided in determining what percent of TSP correlates to the current regulated pollutants for particulate matter, PM-10 and PM-2.5. This analyses yielded a particle size distribution (PSD) that has the same attributes as a PSD for corn dust and rightfully so since the collected samples were generated from the processing of corn. The results from these PSD's are listed in Table 6.

Table 6: Results From Particle Size Analyses

PSD (#)	PM-10 Content (%)	PM-2.5 Content (%)
1	14.51	0.13
2	9.56	0.06
3	10.02	0.11
4	6.93	0.07
5	9.36	0.28
6	7.14	0.10
7	15.41	0.10
8	11.53	0.06
9	12.37	0.17
Average	10.75	0.12
Std. Dev	2.8	0.067

These PSD's were performed using a 50 micron aperture tube. If it assumed that a cyclone has a 100% collection efficiency for any particles greater than 50 microns, then these ratios of PM-10 and PM-2.5 to TSP can be applied to all emission concentrations to determine the emission concentrations of PM-10 and PM-2.5 penetrating a cyclone separating steam flaked grain.

The 1995 interim AP-42 assumes that 50% of the controlled emissions from a cyclone is PM-10. Based on the particle size analysis performed on the samples taken from actual cyclone that separate steam flaked grain, 10.75% of the total emissions is PM-10 and 0.12 % is PM-2.5. As a conservative measure, if one standard deviation is added to the average PM-10 and PM-2.5 ratios, the resulting ratios are 13.6% and 0.19% for PM-10 and PM-2.5, respectively. It is a conclusion of this study that a more accurate ratio of PM-10 and PM-2.5 to TSP should be 15% and 0.2 %, respectively, for cyclones used to separate steam flaked grain.

CONCLUSIONS

The results from the source sampling performed in this study were used in determining an accurate emission factor for cyclones used to separate steam flaked grain. The recommended emission factor is 0.05 kilograms of TSP per tonne of flakes handled (0.1 lb/ton). Since TSP is not the regulated pollutant for particulate matter, the results from particle size analysis performed on the collected samples were used to determine the ratio of PM-10 and PM-2.5 to TSP. These results revealed that 15% and 0.2% of the TSP emitted from these cyclones is PM-10 and PM-2.5, respectively. The recommended emission factors are listed in Table 7.

Table 7: Recommended Emission Factors for Cyclones Separating Steam Flaked Grain

Pollutant	Ratio to TSP (%)	Emission Factor (kg/tonne)	(lb/ton)
TSP	100	0.05	0.1
PM-10	15	0.0075	0.015
PM-2.5	0.2	0.0001	0.0002

According to this data, the 1995 interim AP-42 emission factor for cyclones that separate steam flaked corn overestimates the actual emissions by 30%. In order to fairly regulate feed mills associated with cattle feed yards that utilize these types of cyclones, it is essential that accurate emission factors be used to determine their annual emissions of particulate matter. Scientifically generated data that are shown to be precise and accurate like the data in this report are imperative in this process. If it is a common goal to fairly regulate these facilities without introducing unjustified expenses resulting from annual emission fees, then the AP-42 should reflect those advancements made in determining accurate emission factors for feed mills associated with cattle feed yards.

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TEXAS A&M UNIVERSITY
Department of Agricultural Engineering

April 8, 1997

Dallas Safriet
Environmental Engineer
Emission Factor and Inventory Group
USEPA
Research Triangle Park, NC 27711

Dear Mr. Safriet:

Enclosed are our responses to the reviewer's comments on our report entitled "Emission Factors for Grain Receiving and Feed Loading". We appreciate the comments and have tried to respond to them to the best of our ability. We realize you are attempting to expedite the revisions to this section of AP-42 but it is important as you have commented in your correspondence, that the very best data be included in the revised EPA AP-42. You should notice we took considerable time and effort to respond to these comments and have included additional data in these responses (from studies and publications we referenced to facilitate your review). We have included proposed emission factors for grain elevators and feed mills associated with cattle feed yards using the TAMU model. We have included tables of emission factors that would result if EPA were to use the TAMU model that can be easily excerpted if you choose to do so. These factors were calculated with proposed "F" factors of 3% and 1.1% for grain elevators and 1.6% and 0.2% for feed mills (associated with cattle feed yards) for unloading and loading, respectively.

We are confident our recommendations for emission factors for unloading grain and loading feed at a feed yard feed mill are very conservative and we have confidence our data represent the upper limit of what will be emitted from these two operations. Even though the average emission factor we measured was 0.017 lbs/ton, we recommended 0.04 lbs/ton for unloading corn. It would be inappropriate for us to accept the EPA model that is limited to no less than 0.06 lbs/ton for unloading wheat and 0.15 lbs/ton for unloading corn. We have addressed the issue of differences in grain elevators and feed mills not to be critical of the grain elevator industry but to point out these two functions are different and to explain how we could have measured the same emission factor as Kenkel and Noyes found unloading wheat even though our measurements were made unloading corn. We believe it is a logical explanation of how these two studies could have determined the same emission factors. We support the initial EPA proposed concept

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of varying the emission factor by the type of grain handled but we think our model achieves the goal of accurate emission factors and is more flexible. We believe it can be used for many other commodities and promote the "choke flow" control measure thereby reducing the emissions of PM from truck unloading of any commodity.

Your position that grain received by a mill contains less dust than grain received at an elevator directly from the field is incorrect. Grain cleaning operations such as "scalpers" remove large trash from the grain stream. However, the grain dust content of grain increases with increased handling. Parnell (1986) presented the concept that fine dust (<100μm) in grain originates from the starch of the parent grain and exhibits a characteristic particle size distribution (PSD) as determined with a Coulter Counter (CC). We have been conducting PSDs with a CC for over 20 years and have confidence this method provides accurate results. Our data indicating less than 15% of grain dust is PM10 is accurate.

There are two positions we have taken that are controversial: (1) When trucks unload grain at a feed yard feed mill and a grain elevator, the fraction of time the unloading operation can be characterized as "choke flow" is significantly longer for feed mills than for grain elevators. This is the only plausible explanation why the "F" factor for grain elevators would be approximately twice that for feed yard feed mills. Our proposed emission factors using the TAMU model will result in emission factors for grain elevators that are ½ of those that result from the EPA model. The OSU and TAMU study results support the recommendation. (2) The emission factors for grain unloading at feed yard feed mills are approximately ½ of those associated with grain elevators. We are obligated to defend our results.

Mr. Bursiek addresses several issues in his comments that are most appropriate. Engineers with State Air Pollution Regulatory Agencies (SAPRAs) will use these emission factors in their permitting process but they will not ignore emissions from grain dryers, cyclones and bag filters emitting particulate to the ambient atmosphere. This is especially true of the Agricultural Engineers working as permit engineers with the Texas Natural Resources Conservation Commission (TNRCC) - Gary, Mark, David, Thomas, Anna, Richard, Sarah, Mike, Lois and Greg. These engineers are dedicated, motivated and competent engineers who view their obligation of being representatives of the public very seriously. It is my opinion a number of other SAPRAs and EPA have been subject to justifiable criticisms because they do not have sufficient knowledge of the industries they are studying or regulating. There are considerable differences between commercial feed mills and feed yard feed mills as Mr. Bursiek points out. Some of what we reported will apply to commercial feed mills, as well. However, the loading of low moisture feed is a situation we did not encounter in our study. There is no question the moisture content of the feed plays a large role in the quantity of particulate entrained in air during the unloading process. Commercial feed mills may function as grain elevators during the harvest season, as indicated by the NGFA reviewer. But, feed mills associated with cattle feed yards do not function as grain elevators. Commercial feed mills typically do not load feed with clam shells.

We have been working to address serious emission factor errors associated with agricultural operations that were published by EPA in AP-42 for several years. We have been responsive to requests for additional data on numerous occasions. We believe our research accurately depicts the emission factors associated with grain unloading and feed loading at a cattle feed yard. However, some of the reviewer's comments are attempts to discredit our efforts for reasons that are not technical. We realize it is difficult to locate reviewers who will provide you with comprehensive technical reviews but if EPA is to overcome the problems associated with emission factors that are in error, you should select your reviewers carefully. Let me suggest the members of ASAE SE-305 Environmental Air Quality Committee would be an excellent source.

We are continuing to perform research on topics related to this study with limited funding. Mr. Michael Demny will be completing his MS degree this fall on a related topic. Porus Buharivala will be completing his Ph.D. this summer. His dissertation is the subject of this report. We plan to publish a minimum of three refereed journal articles related to this study. We have redesigned the drop test and have conducted a number of tests on the new drop test apparatus. The results suggest this method may indeed provide data that can be used to accurately determine the FFD contents of grain or other materials.

It is our position the new emission factors published by EPA must be based upon results of studies that incorporate good science and engineering. We realize you are overwhelmed with problems associated with emission factors for other industries and this issue may seem to be less important. However, we feel strongly the new emission factors for feed mills associated with cattle feed yards are very important and the new factors should be based on the most accurate results. We believe our report provides this data. We look forward to your response. Best wishes

Sincerely,

Calvin B. Parnell Jr.

Calvin B. Parnell, Jr., Ph.D., PE

Bryan W. Shaw

Bryan W. Shaw, Ph.D.

Texas A&M Response to reviewer comments on report entitled
Emission Factors for Grain Receiving and Feed Loading at Feed Mills

by
Calvin B. Parnell Jr., Ph.D. PE
Bryan W. Shaw, Ph.D.
April 3, 1997

Response to Dallas Safriet's Comments

1. In the "over the truck" and "under the truck" protocols that used barrel cyclone preseparators, it is not clear what size particulate matter (PM) was effectively captured by the enclosure. Did you make any measurements of the cut point for the cyclone?

Our "under/over the truck" concept for determining emission factors required that **all dust** entrained in the air during the grain transfer be restrained by the plastic enclosure and subsequently captured by the sampling system. Laboratory tests performed on the barrel cyclone indicated that the cutpoint was 3.6 μm at a design inlet air velocity of 2400 fpm. We presented the enclosed paper on the barrel cyclone at the recent Beltwide Cotton Production Conferences (Tullis et al , 1997).

Our primary concern in the development of the sampling system for the "under/over the truck" sampling was an accurate measurement of the mass of dust that could potentially escape the shed during a typical unloading operation at a feed mill. Our intent was to design a system that would capture **all dust** entrained in the air as the grain moved from the truck to the pit. We used high volume (HiVol) type samplers constructed "in-house" utilizing centrifugal fans to compensate for the anticipated additional pressure drops. The sampler probe had design capture and conveying velocities in excess of 4,000 feet per minute (fpm). Our goal was to capture the dust as quickly as possible. Hence, we selected a constant sampler volume rate of flow (52 cfm). The interim AP-42 indicated that the emission factor for unloading corn would be 0.15 lbs/ton (0.06*2.5). A typical hopper bottom truck will contain 1,000 bushels or 28 tons. With an emission factor of 0.15 lb/ton, our system of four HiVol samplers would be required to capture 4.2 pounds of particulate or slightly more than one pound per sampler. We wanted to be prepared to capture one pound of dust without having to change filters or limit the unloading process during a sampling period. We performed tests in our lab and found that a maximum of two grams of corn dust could be loaded on an 8x10 inch filter. A filter loading in excess of two grams resulted in an inability to maintain 52 cfm. We realized that we would not be able to capture all the dust with just a high volume sampler filter. We chose to design a cyclone pre-separator to capture as much of the particulate as possible prior to the filter to insure that the filter loading did not exceed two grams. Performance test results, using corn dust that had been pre-filtered to eliminate all particulate larger than

100 microns, indicated that the efficiency of the preseparator was 99.6%. The sole purpose of this preseparator was to prevent overloading of the filter and avoid changing filters before completely unloading each truck. We operated four samplers simultaneously to allow for continuous sampling during the unloading period of all trucks sampled in this study. We never had a problem with overloading a HiVol filter in all of our under/over the truck sampling. As a consequence of this protocol, we were not required to limit the amount of grain unloaded to prevent overloading the filter.

2. *I believe that a discussion of the quality assurance procedures used in this study would be appropriate in an appendix. . .For some mills, the wind station was separated from the PM sampling sites by other buildings and the size and position of these buildings could affect the wind direction and velocity at the samplers compared to that at the wind station site.*

Your suggestion to include a discussion of the quality assurance procedures used in this study was appropriate. The quality assurance procedures used in this study are attached (Attachment II). From Figure 6, page 15 of our report, the weather station may appear to have been obstructed by the silage storage. However, the silage storage was an excavated pit filled with silage. The top of the silage storage was at ground level.

3. *Plastic sheeting commonly acquires a static charge that could result in the adherence of particulate to the inside of the plastic enclosure during the "under" and "over" test runs. . . If so, how was this quantity of PM quantified?*

It is indeed likely that static charge acquired by the plastic enclosure used in "under/over the truck" would have attracted grain dust. This was **not** accounted for in the results of the report we forwarded to you. We conducted some additional tests to quantify the amount of dust that may have been attracted to the inside of the plastic enclosure. We added these estimates to the appropriate measurements and recalculated the average and recommended emission factor. See the enclosed description of grain dust on plastic tests and results (Attachment I). The recommendations did not change.

The results of our tests to determine the maximum dust per unit area that would be attracted to the plastic surface if the surface had not had prior exposure to grain dust was 0.45 g/ft^2. We rounded this to 0.5 g/ft^2. We also determined that a maximum of 0.024 g/ft^2 would be attracted to the plastic surface if the surface had had prior exposure to grain dust. The maximum accumulation was measured to be 0.02 g/ft^2. We rounded this to 0.03 g/ft^2. We estimated the total surface area of one side of the plastic exposed to the grain dust to be 160 ft^2 (two 4'x8' walls and two 4'x12' walls). Once the plastic is covered with dust there is very little static charge to attract more dust particles. Hence, there was a maximum potential of 80 grams of dust adhering to a new plastic sheet (160 ft^2). After sampling the first truck with a new plastic sheet, it is estimated that approximately 5 grams could have adhered to the plastic during ensuing runs. New plastic sheeting was only used for the first truck sampled at Feed Mills B and D. The adjustments made for the dust collected on the plastic enclosure did not impact our recommendation to EPA. For example, the recommended emission factors for corn are 0.04 lbs/ton for grain unloading and 0.005 lbs/ton for feed loading. Our proposed emission factors were conservative: (1) An additional 5% and 10% adjustments were made for possible deposition inside the pre-separator for the "under/over the truck" sampling. These adjustments were significantly more than our measured deposition in the lab; (2) An additional 30% adjustment was made for the possibility of dust escaping the plastic enclosure. Although, we believe that the correction made by having the truck operator slow down the unloading rate prevented dust from escaping the enclosure after the first two runs, we made this adjustment on **all** "under the truck" sampling results; and (3) We added one standard deviation to our average emission factor for our recommended emission factor.

4. *Throughout the report, reference is made to the high moisture content of the feed (>20% moisture) in the feed loadout runs. . Also, see comment 6.*

The moisture contents of corn unloaded during tests were made using a portable moisture tester manufactured by Dickey-John Corp. For grain, this instrument worked well. However, when we attempted to use this meter to measure the moisture content of feed, we invariably observed meter error readings. We contacted Dickey-John Corporation (March 24, 1997) and discussed this problem with a Mr. Dustin Weller (217-438-3371). He indicated that the instrument will yield a reading as long as the moisture content of the grain or feed is less than 22% (wet basis). We believe that the error readings suggest that the feed moisture contents were in excess of 20% w.b. The feed moisture content data obtained from measurements made by operators at Feed Mill C for the different rations during the period we were on site are given in Table 1.

Table 1: Moisture Content of Feed at Mill C

Ration Number	Moisture Content, %
1	32.58
2	32.84
3	33.6
4	31.24
5	29.65
6	21.02

5. *On pages 43-44, emission factors for Mill B are given for grain receiving by "under truck" and "grid". . .Can you explain?*

It was our intent to sample equal number of trucks using the "under the truck" and grid sampling protocols. In order to utilize the grid sampling protocol, the wind direction must **not** be perpendicular to the shed orientation. Prior to our sampling trip, one criteria for selecting the mills was that the prevailing wind direction had to correspond to the orientation of the sheds. However, at Mill B the predominant wind direction was perpendicular to the shed orientation for much of the time allotted for sampling this mill. Grid sampling was not an option during these periods because the grain dust would not consistently leave one end of the shed for the period needed to unload a truck. However, we did manage to sample two trucks using the grid sampling protocol when the wind decided to "cooperate". The comment on page 47 of the report, "prevailing wind conditions at Mill B during the time we were sampling was such that grid sampling was not an option", was intended to justify the reason for not being able to sample equal number of trucks using both protocols at all the mills due to constant fluctuations in wind direction.

6. *For total suspended particulate TSP from feed loading on page 51, Mill B was loading dry ingredients into a truck that mixed the feed as it was distributed. . . This is contrary to your conclusions.*

   Mill B was loading partially mixed feed into mixing trucks and sufficient liquid to insure that the mixed feed delivered to the bunk was in excess of 20% moisture content (wet basis). Relative to observations of the completely mixed feed loaded into trucks at other mills, the partially mixed feed delivered to the mixer trucks was perceived to be "dry". The qualitative observation that this mill's feed was dry and that the emission factor for feed loading at this mill would be greater was not accurate. On further analysis of the feed loading operation at Mill B, the main components of the partially mixed feed being loaded into mixing trucks were steamed corn, liquids (molasses, feed fat and supplements), and dry additives. The ratio of the percentage of dry ingredients to the percentage of steamed corn was very small and had negligible effect on dust entrainment. The liquid ingredients were the last to be added to the trucks. The addition of steamed corn and liquid ingredients likely suppressed dust.

7. *On page 52, you discuss the results obtained using the "under/over truck" versus the grid method and conclude, correctly, that the enclosure method leads to more reproducible results (i.e. small relative standard deviation). . . It would seem that additional studies would be required before it can be stated that the "under/over truck" method is more accurate.*

   The results obtained using the "under/over the truck" protocols **were more reproducible** compared to the results obtained from the grid sampling method and in our opinion, were more accurate. The primary external factors affecting the grid sampling method was the wind direction and wind velocity through the shed. The "over/under truck" method was not affected by the uncontrollable wind direction and wind velocity factors. The problems that were encountered calculating accurate emission factors using the grid sampling method were primarily a consequence of wind velocity through the shed. We had anticipated using a hot wire anemometer to perform multiple readings during the sampling period. However, the hot wire anemometer velocity data suggested that the air velocity in the shed varied from less than 100 fpm to over 1000 fpm in many sampling periods. We attributed this variation in velocity in the shed to changes in ambient wind direction and velocity. We decided to use the velocity vector from the weather station which was less subjective and more conservative (yielded higher calculated emission factors). We have addressed this issue in the report. Based on our experience, there is no question that the "over/under truck" method was more accurate. However, there are conditions that do not lend themselves to using the "over/under truck" method and the only acceptable alternative method is grid sampling. These include insufficient space to place samplers for safety reasons and inability to install plastic enclosure to adequately confine the dust. We encountered both of these conditions.

The external factors associated with the grid sampling were not controllable! To obtain an emission factor from grid sampling, you must measure the concentration at the exit of the shed, multiply the measured concentration by sampling time and the volume rate of flow and divide by the mass of grain unloaded. It was our observation that the air velocity through the shed varied significantly during the sampling periods which meant that the volume rate of flow (Q) varied significantly during the sampling period. This one variable was uncontrollable but was essential. Variations of Q significantly impacted the accuracy of calculated emission factors using the grid sampling method. Variations in wind velocity in the shed had **no** effect on the "under/over the truck" method. We do not agree that additional tests should be conducted to compare the protocols. In fact, we recommend that both methods be considered in future work with goals similar to the goals of this study.

In this research, it was imperative that creative and innovative methods be used to accurately measure emission factors. We believe that the "under/over the truck" protocol could be used for other industries to more accurately measure particulate emission rates and ultimately emission factors. The problems with wind direction and wind velocity variations associated with the grid sampling method are uncontrollable and will result in larger variations in emission factor estimates.

8. *Your average emission factor for corn receiving from hopper-bottom trucks at the feed mills (0.017 lbs/ton) is stated to be eight times lower than the Interim emission factor of 0.15 (0.06 x 2.5DR for corn) for country elevators. . . The results of the forthcoming National Grain and Feed Association study may provide additional emission factor data for unloading from hopper-bottom trucks.*

The predominate method of delivering grain to a feed mill is hopper bottom trucks. The interim emission factors for grain elevators did not distinguish between hopper-bottom trucks and other types of trucks. We found it appropriate to report the emission factor for corn receiving calculated from this study (0.017 lbs/ton) to be eight times lower than the interim emission factor (0.15 lbs/ton for corn) because it is significant and we feel that the EPA interim emission factor for corn unloading would be in error if it were applied to a feed mill. Our proposed emission factor of 0.04 lbs/ton for grain receiving is similar to the emission factor measured by Kenkel and Noyes in the Oklahoma Study for end-dump trucks. We believe that we have been very careful to err on the high side in our measurements for emission factors for hopper bottom trucks.

We realize that MRI, in their report to NGFA, measured 0.3 lbs/ton for three straight trucks with a total mass of grain unloaded of 24 tons. The Oklahoma study measured the emission factor for five "end-dump" trucks which we assumed to be equivalent to MRI's "straight" trucks. Each "end-dump" truck in the OSU study unloaded 18 tons of grain for a total of 90 tons. Kenkel and Noyes did find that the "end-dump" trucks had a higher emission factor (0.04 lbs/ton) than the hopper bottom trucks (0.02 lbs/ton). The MRI study indicates that straight trucks should have an emission factor of 0.3 lbs/ton compared to 0.032 lbs/ton for hopper bottom trucks. A factor of 2 comparing emission factors of hopper bottom trucks with end dump trucks is logical; a factor of 10 **is not**. We are of the opinion that there was an error in the MRI measurements. Dr Shaw and I are reviewing the additional MRI data provided by EPA and will have a response shortly.

We do not have copies of the older studies reported in 1975 and 1976 referenced in the interim report but it is our opinion that the quality of the older data is not likely to be as good as the more recent studies.

9. *The results of your study are compared with the results of the Oklahoma study (Kenkel and Noyes) and are stated to be in very close agreement with the airborne particulate fraction (0.019 lbs/ton) of their emission factor for grain receiving from hopper-bottom trucks. . .In comparing your results with those of Oklahoma, it should be stated that the Oklahoma results were obtained using wheat and yours are for corn.*

You are correct to comment that our feed mill emission factors for hopper bottom trucks were determined from measurements of particulate emissions for unloading corn while Kenkel and Noyes obtained their emission factors for unloading wheat at country elevators. The methodology used by Oklahoma State University study (Kenkel and Noyes) incorporated a fan inside the shed with the shed doors closed to prevent settling out of grain dust. Kenkel and Noyes were attempting to accurately measure the upper limit of emission factors associated with wheat unloading at country elevators. At the time they did their study, they were being regulated by the Oklahoma DEQ with the old 1988 AP-42 emission factor of 0.6 lbs/ton. It seemed appropriate to remark that their results were similar to ours using a totally different protocol.

We think there is a logical explanation for a lower emission factor for grain unloading at feed mills when compared to grain elevators. We presented the argument in our report that feed mills are different in that they are not required to handle grain at the same rate as do grain elevators and it is likely that "choke flow" exists for longer periods while unloading grain at feed mills than at country elevators. This factor is influenced by the size of the pit and the rate at which grain is removed from the pit. Feed mills are not required to move grain into a bin as quickly as grain elevators because they have limited storage capacity and their primary objective is to provide feed to the cattle on the yard. Feed mills typically unload grain at 3,000 to 6,000 bushels/hour. Grain elevators are designed to unload grain at rates of 4,000 to 50,000 bushels per hour. It is not sufficient to argue that country elevators exist that have the same size pits and same capacity legs, therefore, country elevators have the same emission factor as feed mills associated with feed yards.

It is our experience that different grains do have different free fine dust (FFD) contents. We have measured the FFD contents of wheat and corn in previous research related to the prevention of grain dust explosions and found that wheat typically has 0.6 lbs/ton; corn has 2.0 lbs/ton using an aggressive air wash test. Logically, one could assume that the emission factor associated with unloading corn should be 2 to 2.5 times higher than that associated with unloading wheat. This logic would be correct without the confounding variables of "choke flow" and the conservative approach taken in the two studies. We believe that the fraction of time that the unloading period was influenced by "choke flow" overwhelmed the different dust contents associated with the wheat and corn. In addition, the attempts by the Oklahoma and TAMU researchers to be conservative, influenced the numbers. However, an objective comparison of the results of the two independent studies is remarkable. We believe that the emission factors presented in Table 18 (page 58) of our report accurately reflect the upper limit of emission factors that would result from unloading different grains at feed mills associated with cattle feed yards.

10. *Question the overall validity of comparing grain receiving emission factors for country elevators with the factors you developed for feed mills at cattle feedlots, considering the considerable differences in the size of the grain receiving facilities. ... these previous operations would have an impact on the PM content of the grain being unloaded.*

We do not agree with your hypothesis that the grain received at feed mills would have a lower dust content than grain delivered to country elevators directly from the harvesting point! The concept that grain is subject to PM loss with increased handling is counter to a large number of studies pertaining to grain dust explosions and grain dust contents conducted in the 1970's and 80's. There are many references on this subject which we have included with the reported data below in response to NGFA comments. Grain moved from the harvesting point to an elevator will typically have less broken kernels, less FFD, and a higher moisture content than grain moved from the elevator to a mill. The FFD content of grain will increase with increased handling. The cleaning of grain at elevators is commonly associated with the removal of foreign matter that is larger than 100 microns in size and has the potential of lowering grade. Cleaning grain at an elevator is **not** the removal of fine particles. Dust control systems removing dust from grain transfer points commonly add this back to the grain stream so as not to be penalized economically. Grains will **not** undergo PM loss at a grain elevator.

11. *At the bottom of page 55 and on page 56, the report discusses the dustiness ratio (DR). ... In your report, there may be an attempt to interpret the DR as the free fine dust content in lbs/ton. If this is interpretation, it is not correct.*

The use of DR as a measure of the FFD content of grain was **not** an interpretation. We proposed a new model for EPA to consider to replace the interim model used to calculate emission factors. The model proposed by EPA in the interim report was:

$$EF = 0.06*DR$$

where, EF = emission factor, lbs/ton;
DR = dimensionless dustiness ratio equal to 2.5 for corn; and
0.06 = emission factor for wheat, lbs/ton.

We were not comfortable with the model proposed by EPA. In effect, this model has a base emission factor of 0.06 lbs/ton for the cleanest grain (wheat) and arbitrary dustiness ratios. The Oklahoma study suggests that a more accurate emission factor for unloading wheat should be 0.03 lbs/ton. We have found that the emission factor for unloading grain at feed mills was less than the factor for unloading grain at grain elevators. The EPA model will not accurately predict emission factors for a feed mill. Hence, we proposed a new model:

TAMU MODEL FOR EMISSION FACTORS AT FEED MILLS

The assumptions we used to develop this new model were as follows:

(a) Each grain type will have a typical FFD (<100 μm) content in units of pounds of fine dust per ton of grain (lbs/ton). We proposed that the numbers published with the interim emission factors labeled DR be used as the first estimate of FFD (<100 μm) for grains.

(b) A constant fraction of the available FFD in the grain will be entrained in air at a grain transfer point. This concept is frequently used by engineers in the analysis of hazards in grain elevators when determining locations of minimum explosive concentrations (MECs) at grain transfer points. We estimated that the fraction of dust entrained in air at an unloading pit of a feed mill associated with a feed yard to be 1.6% based upon our data and a FFD content of 2.5 lbs per ton for corn.

Our model for unloading grain at a feed mill associated with a cattle feed yard is:

$$EF = 0.016*FFD$$

where, EF= emission factor, lbs/ton;
FFD = free fine dust content, lbs/ton; and
0.016 = the constant fraction entrained in the air at the transfer point.

This new model is very similar to the EPA model but it has the following advantages:

(a) The lower limit of emission factors using this model is 0.016 lbs/ton for wheat at a feed mill associated with a cattle feed yard. We believe that this will be an accurate emission factor for wheat which characteristically contains less dust than corn. The emission factor for corn unloading will be 0.04 lbs/ton (0.016*2.5).

(b) The measurement of FFD for unloading materials in a pit is a relatively simple process and there should be a characteristic FFD for any material. For example, suppose that sand is unloaded into a pit having a free fine dust (<100μm) content of 150 lbs/ton. The uncontrolled emission factor would be 2.4 lbs/ton.

(c) This new model is more general than the EPA model and is based upon measurable factors such as FFD content.

12. *Your report concludes that there is no correlation of the relative dustiness between grain types as shown by the results of the laboratory drop tests. ... This result may be indicative that the wide variety of factors that can influence particulate formation from grain surfaces is sufficiently complex and variable that there is little difference in relative dust content between grain types in the "real World" conditions.*

You have **incorrectly** interpreted our report when you state that we concluded that there was no correlation of DR for different grain types. Our intent was to use the drop test in the field to obtain a relative measure of DR of each load of grain and feed and to correlate these drop test measurements with our calculated emission factor results. There was no correlation. It was our conclusion that the design of the drop test device was flawed. Hence, it is inappropriate to conclude that "there is no correlation of the relative dustiness between grain types ..." since the drop test did not yield accurate measurements. We do **not** agree that "there is little difference in relative dust content between grain types in 'real world' conditions." Corn will typically have more FFD than wheat on the order of 2 to 2.5 times higher. We agree that a grain type can have varying FFD contents but contend that each grain type will have a typical FFD content that can be used to estimate emission factors.

13. *Minor Comments*

(a) On page 53, "Tables 9-12"should be "Tables C-2 to C-5".

(b) The references not referred to in the report should have been referenced as shown below:

- The first line on page 1 in the report, should read "The Federal Clean Air Act .... feed mills associated with cattle feed yards (Parnell 1994c)".

- The last line of page 1 in the report, should read "The emission factors for grain elevators and feed mills were not correct (MRI 1973, 1974, Parnell et al. 1994b and Wallin et al. 1992)".
- The remaining references , Federal Register 1984, Parnell 1993, U.S. EPA 1995a and 1995c, have been deleted.

(c) Your assumption, that no particulate controls were in place at the mills was correct.

Response to NGFA's General Comments

A. *Facility Equipment and Operating Characteristics*

The comments by NGFA are not clear. Our study focused on feed mills associated with cattle feed yards. It seems that NGFA is suggesting that the PM emission rate of feed mills associated with cattle feed yards should be the same as the PM emission rate of country elevators. **We do not agree.**

The profit of grain elevators is dependent upon the volume of grain handled. The profit of a feed yard is dependent upon cattle prices. The feed mill associated with the feed yard must supply sufficient feed to meet the demands of the cattle on the yard. Hence, the mill operator does not have the same incentive as the grain elevator operator to unload a grain truck as quickly as possible. More importantly, feed mills will likely be permitted on the average processing rate of the mill whereas, grain elevators will likely be permitted on leg capacity. A typical feed mill associated with a feed yard will usually process feed at rates less than 20 tons per hour. The largest feed mill associated with a feed yard in the U.S. processes feed at 100 tons/hr. A country elevator having a 10,000 bushel per hour leg will be moving 300 tons per hour. An export elevator will typically move 50,000 bu/hr or 1,500 tons/hr. To suggest that the hourly emission rate of an elevator would be equivalent to that of a feed mill associated with a feed yard is incorrect! It is our position that the relatively slow grain unloading process at feed mills is conducive to longer periods of choke flow than is typical at grain elevators. We do not dispute that "choke flow" occurs at grain elevators. However, the nature of the two operations would suggest that, on average, "choke flow" exists for a larger fraction of time during the unloading period at feed yard feed mills compared to grain elevators. This factor alone, will significantly impact emission factors.

It is our understanding that **no** feed mill associated with a feed yard functions as an elevator at any time! These feed mills typically have storage capacities of 3 to 7 days of the requirements of the yard.

B. *Choke Unloading*

The NGFA reviewer suggests that we made two mistakes when comparing grain elevators to feed mills: (1) We miss-characterized pit sizes of country grain elevators; and (2) we assumed that grain elevators handled grain with only hopper bottom trucks. To justify that we made an error in characterizing pit sizes NGFA stated "country elevators can and often do have receiving pits similar in size to those mentioned in the NCBA report.". This statement misses the point we were making entirely. **Grain elevators move grain from the truck to the bin at rates much faster than do feed mills associated with cattle feed yards! We did not assume that country elevators handle grain with only hopper bottom trucks!**

C. *Relative Dustiness: The NCBA report concludes that laboratory procedures to determine expected emissions from different grains do not provide results that are useful in predicting emissions from grain elevators.*

The NGFA reviewer misinterpreted our conclusions. We did **not** conclude that laboratory procedures "do not provide results that are useful in predicting emissions from grain elevators." We concluded that our drop test measurements that were to be used as a relative measurement of DR were in error which was a consequence of the design of the drop test apparatus. We did not attempt to make any conclusions based upon this data! We have used laboratory procedures i.e. the air wash test to determine dust content of grain. The following data (Table 2, 3 and 4) were included in the final report of the *Impact Study of Prohibiting Recombining Recirculation Dust at Export Elevators* (Parnell et al, 1992):

Table 2: Inbound and Outbound Dust Content of Corn

Corn	Dust	Inbound Dust Content	Outbound Dust Content
Elevator 3	Fine[1]	0.256% ± 0.151	0.183% ± 0.049
	Course[2]	0.323% ± 0.229	0.409% ± 0.328
	Total	0.579% ± 0.339	0.592% ± 0.367
Elevator 4	Fine	0.136% ± 0.141	0.177% ± 0.021
	Course	0.175% ± 0.160	0.160% ± 0.141
	Total	0.312% ± 0.123	0.337% ± 0.047
Elevator 7	Fine	0.103% ± 0.039	0.134% ± 0.031
	Course	0.142% ± 0.106	0.173% ± 0.098
	Total	0.245% ± 0.132	0.307% ± 0.118

1. The "fine" dust reported in this study was dust in the grain sample less than 178 μm.
2. The "course" dust in this study was dust in the grain sample that was larger than 178 μm but would pass through a 2 millimeter opening.

Table 3: Inbound and Outbound Dust Content of Soybean

Soybeans	Dust	Inbound Dust Content	Outbound Dust Content
Elevator 3	Fine	0.055% ± 0.039	0.051% ± 0.013
	Course	0.378% ± 0.264	0.523% ± 0.331
	Total	0.433% ± 0.304	0.575% ± 0.344
Elevator 4	Fine	0.033% ± 0.008	0.059% ± 0.009
	Course	0.385% ± 0.201	0.770% ± 0.234
	Total	0.418% ± 0.208	0.830% ± 0.241
Elevator 7	Fine	0.031% ± 0.008	0.033% ± 0.006
	Course	0.065% ± 0.031	0.111% ± 0.068
	Total	0.096% ± 0.037	0.144% ± 0.073

Table 4: Inbound and Outbound Dust Content of Wheat

Wheat	Dust	Inbound Dust Content	Outbound Dust Content
Elevator 2 (SRW)[1]	Fine	0.029% ± 0.005	0.029% ± 0.008
Elevator 5 (HRW)	Fine	0.028% ± 0.004	0.056% ± 0.036
Elevator 6 (HRW)	Fine	0.025% ± 0.004	0.029% ± 0.004

1. SRW refers to soft red winter wheat.
2. HRW refers to hard red winter wheat.

Using all data reported in this study, wheat sampled from an export elevator contained an average of 0.025% to 0.056% (0.5 to 1.2 lbs/ton) of particulate less than178 μm.; corn contained a range of 0.103% to 0.256% (2.1 lbs/ton to 5.1 lbs/ton) of particulate less than 178 μm; soybeans contained a range of 0.031% to 0.059% (0.6 lbs/ton to 1.2 lbs/ton) of particulate less than 178 μm. It should be noted that these samples were obtained from export elevators and that the grain had been subjected to extensive handling. Therefore, the dust contents of the grain at this point in the grain handling system should be an upper limit of typical grain dust contents.

Martin and Sauer (1976) measured the dust collected from handling operations that included wheat and corn in bin transfers and wheat car unloading (Table 5). They determined that approximately 70% of the corn collected was less than 125 μm. Hence, the range of FFD determined by Martin et al was 1.5 lbs/ton to 7.5 lbs/ton for corn and 0.14 and 0.18 lbs/ton for wheat.

Table 5: Dust Collected During Grain Handling

Lot No.	Grain	Handling Operation	Dust Collected percent (lbs/ton)
1	Corn	Bin transfer	0.129 (2.58)
2	Corn	Bin transfer	0.122 (2.44)
3	Corn	Bin transfer- first handling	0.258 (5.16)
	Corn	Bin transfer- second handling	0.534 (10.7)
	Corn	Bin transfer - third handling	0.105 (2.1)
5	Wheat	Car unloading	0.007 (0.14)
6	Wheat	Bin transfer	0.009 (0.18)

Martin and Stephens (1977) reported dust generation rates during repeated handling of corn. He stated "the amount of breakage in the corn increased from one bin to another. The level, initially 2.0 percent, increased about 0.6 percent with each handling reaching a level of 15.7 during the 21st handling." They capture dust during the transfers at rates of 1.1 to 2.13 lbs/ton.

There is sufficient scientific evidence in the literature to establish that different grains will have different FFD contents. It is a simple argument that grains with higher FFD contents will have higher emission factors. The arguments made by the NGFA reviewer that there is no difference in the FFD contents of grain is without merit.

The typing error on page ii of the Executive Summary of "Parnell (1988)" should be "Parnell et al (1992)".

D. *The NCBA report suggests that the FFD of each grain be multiplied by another factor - F - to account for the amount of FFD entrained during a specific grain handling operation...*

The comments made by the reviewer in this section are in the form of an argument opposing the new model proposed in our study report. NGFA favors a single emission factor for unloading and loading irrespective of the grain. There is merit to the simple approach of ignoring differences in FFD content of different grains and establishing a single emission factor for unloading and loading materials. **It is simple**. The effect of taking this approach would be to establish emission factors for the grain with the highest FFD content and publish emission factors for unloading and loading. It is our contention that grain elevators that would typically handle wheat rather than corn would be subject to factors 2 to 2.5 times higher than with either the EPA interim emission factor model or the TAMU model. It is unlikely that country elevators handling wheat would desire this.

We believe that the DR values published by EPA with the interim factors are in the "ballpark" of the difference in dustiness ratios between grains. If wheat has a DR value of 1, corn should be 2.5. We could have argued that wheat should be 0.6 based upon our experience with past studies Parnell et al (1992). Our concern was that the EPA model mandates a minimum emission factor of 0.06 lbs/ton for unloading wheat and 0.15 lbs/ton for corn. We have determined that the conservative emission factor for unloading corn at a feed mill associated with a cattle feed yard is 0.017 lbs/ton (including the latest adjustment for estimates of dust accumulation on the plastic sheet) which is 1/8 of 0.15 lbs/ton. We chose to add one standard deviation to this number and recommend 0.04 lbs/ton. In our view, we have recommended a very conservative number to EPA (0.04 lbs/ton). The EPA model would result in 0.15 lbs/ton for unloading corn at a feed mill associated with a cattle feed yard would be over 3 times higher than our very conservative recommendation. It is our view that EPA should use the results of the recent studies and establish an appropriate emission factor.

To address the problem of overestimating emission factors with the EPA model, we have taken the initiative of proposing the TAMU model. The reviewer is correct when he stated that we calculated the F value from our results assuming that the EPA DR values were correct approximations of the FFD contents of different grains. We believe this is a logical approach. It was the only approach that we could postulate to address the problem of overestimating emission factors with the EPA model. The two studies that provide the best scientifically defensible data for emission factors for grain elevators and feed mills are the OSU and TAMU studies.

We believe that we have justified the differences of the operations at a feed mill associated with a feed yard and a grain elevator that would impact emission factors in our report and in this response to reviewer comments. A simple approach to EPA's concern with regard to unloading wheat at a grain elevator (OSU study) and unloading corn at a feed yard feed mill (TAMU study) is to use an F value for grain elevators of 3% and 1.6% for feed mills.

The TSP emission factors for grain receiving at elevators and feed yard feed mills calculated using the EPA model and the proposed emission factors calculated by using F=3% for grain elevators (from the OSU study) and F=1.6% for feed yard feed mills in the TAMU model (EF=F*FFD) are given in Table 6.

Table 6: TSP Emission Factors for Grain Receiving

Grain (FFD)	EPA (lbs/ton)	Proposed Grain Elevator (lbs/ton)	 Feed Yard Feed Mill (lbs/ton)
Wheat (1.0 lbs/ton)	0.06	0.03	0.016
Soybeans(2.5 lbs/ton)	0.15	0.075	0.04
Corn (2.5 lbs/ton)	0.15	0.075	0.04
Milo (1.75 lbs/ton)	0.105	0.053	0.028
Mixed (1.95 lbs/ton)	0.117	0.059	0.031

Note that the values correspond well with the results of the OSU and TAMU studies and that these values are significantly different than those obtained with the EPA model. OSU determined an average emission factor for unloading wheat at an elevator of 0.029 lbs/ton averaging both "end dump" and hopper bottom trucks. This was a conservative measurement. The value from Table 6 is 0.03 lbs/ton. Our value for feed yard feed mills was 0.04 lbs/ton including one standard deviation of all the measurements. The value from Table 6 for corn unloading at a feed yard feed mill is 0.04 lbs/ton. The values in Table 6 incorporate the differences in FFD contents of grain and the differences in operations between feed mills and grain elevators.

We propose that the load-out emission factors for elevators and feed yard feed mills be calculated using the TAMU model and F=1.1% for grain elevators and 0.2% for loading feed at feed mills.

The TSP emission factors for loading grain elevators calculated using the EPA model (F = 1.1%, from the OSU study) and the proposed emission factors for unloading feed at feed mills associated with cattle feed yards calculated by using the TAMU model (F=0.2%, from the TAMU study) are given in Table 7.

Table 7: TSP Emission Factors for Grain/Feed Loading

Grain (FFD)	Grain Elevator (lbs/ton)	Feed Yard Feed Mill (lbs/ton)
Wheat (1.0 lbs/ton)	0.011	0.002
Soybeans (2.5 lbs/ton)	0.028	0.005
Corn (2.5 lbs/ton)	0.028	0.005
Milo (1.75 lbs/ton)	0.019	0.004
Mixed (1.95 lbs/ton)	0.021	0.004

The emission factors from Table 7 correspond to actual measurements of both the OSU and TAMU studies where they can be compared. OSU measured an average emission factor for unloading of 0.0109 lbs/ton for wheat which compares well with the 0.011 lbs/ton from Table 7. We measured 0.0008 lbs/ton but recommended 0.005 lbs/ton (0.0008 plus one standard deviation) for feed loading which corresponds to the value for feed derived from corn in Table 7. In reality, the primary controlling factor of the emission factor of feed is the moisture content of the feed not the FFD content of the grain. The 0.005 lb/ton emission factor is an accurate emission factor for loading feed at mills associated with cattle feed yards.

The factors suggested by NCBA - 2.5 lbs/ton for corn ... - perpetuate the myth that grain handling can be a significant source of dust. i.e., lbs/ton rather than fraction of a lb/ton as shown by the NGFA and NCBA research

The NGFA reviewer did not comprehend the TAMU model approach and has not reviewed the data included in this response. Grain will contain dust and only a fraction of the dust in grain will be entrained in air at a transfer point. **It is not a "myth" that grain contains fine dust and that the typical FFD content of grain ranges from less than 1 lb/ton to 2.5 lbs/ton.** See data provided in this response. This comment is without merit.

E. Refer to 3 (page 2).

F. We were funded to determine accurate emission factors for unloading grain and loading feed at feed mills associated with cattle feed yards. The comments made by the reviewer have no bearings on this report.

Response to NGFA's Other Comments

A. Permit fees do vary from state to state. The minimum is \$25/ton. Some states are using \$30/ton. The term "criteria pollutant" when discussing emission fees was indeed incorrect. "Regulated pollutant" is correct.

B. This comment is inappropriate. The measurement of opacity or emission concentrations at emitting points on property does not impact the definition of air pollution!

C. This comment suggests that the reviewer does not understand the engineering calculations associated with calculating emission factors from concentration measurements at the exit of a shed. See 7 (page 4).

D. The drop test was not intended to measure the total FFD for the material being handled. Hence, the drop test results should not be interpreted as the total FFD values. The statement made regarding the emission factor for corn receiving (0.017 lbs/ton) and feed shipping (0.003 lbs/ton) being ten times lower than the Interim AP-42 factors of 0.15 and 0.0275 lbs/ton, respectively, is correct based on the results of this study.

Responses to Brian Bursiek's Review

The AFIA review was excellent. Mr. Bursiek pointed out that there are significant differences between commercial feed mills and feed mills associated with cattle feed yards. However, he presents several logical alternatives for EPA to consider in revising the new section of AP-42. We support his position that the PM10/TSP ratio should be 15% for grain dust entrained in air during the unloading operation. It is logical to assume that the PM10/TSP ratio for dust entrained in air during the loading of feed should be similar to the fraction we measured at feed yard feed mills of 35%. He points out that commercial feed mills load low moisture feed and the loading of feed at these mills is through spouts. There may be higher emission factors for this operation than what we determined for high moisture feed loading with clam shells. Mr. Bursiek points out that much of the feed handled by commercial feed mills contains oil which would result in dust suppression.

We do not agree that grain delivered to feed mills will have a lower PM content than grain delivered to grain elevators. We also do not agree that there should be only one emission factor for all grains. See 12 (page 9) and C (page 11). We believe that Mr. Bursiek may have a different opinion once he reviews the discussions included in this response and has a better understanding of the TAMU model. He is correct when he mentions that SAPRA permit engineers will account for emissions from cyclones and filters emitting particulate to the ambient atmosphere. The sum of factors from controls emitting particulate matter to the air (external to the facility) may be higher than the sum of the new AP-42 factors for unloading grain and loading feed at a commercial mill.

References

Martin, C. R. and D. B. Sauer. 1976. Physical and Biological Characteristics of grain Dust. Transactions of the American Society of Agricultural Engineers, Vol. 19(4)720-723.

Martin, C. R. and L. E. Stephens. 1977. Broken Corn and Dust generation During Repeated Handling. Transactions of the American Society of Agricultural Engineers, Vol.20(1)168-171.

Attachment I

Dust Loading Tests on Plastic

Observations made during sampling at feed mills indicated that the plastic sheeting (4 Mil) used to build the enclosure for the "under/over the truck" sampling protocols did attract dust particles. Due to the static charge developed by the plastic sheeting dust particles adhered to it. It was not feasible to physically weigh the dust loaded on the plastic in the field. Hence, field sampling conditions were simulated in the laboratory to quantify the amount of dust that adhered to the plastic.

The objectives were:

(1) to determine the amount of dust loaded on the plastic during the first truck sampled (first exposure) with the brand-new plastic sheeting;
(2) to determine the maximum amount of dust that can be loaded on the plastic; and
(3) to determine the amount of dust loaded on the plastic during subsequent exposures.

Two test protocols were utilized to meet the above mentioned objectives. The first, Maximum Loading Test, was to determine the amount of dust loaded on the plastic during its first exposure and the maximum amount of dust that can be loaded on the plastic. The second, Subsequent Loading Test, was performed to determine the amount of dust loaded on the plastic during subsequent exposures.

Protocol for Maximum Loading Test (Under the Truck)

It was anticipated that a brand-new piece of plastic sheet would attract a notable amount of dust during its first exposure. Once the plastic was completely covered by a thin layer of dust, the plastic would not have sufficient static charge to attract any significant amount of dust particles. During subsequent exposures there would be very little dust added to the plastic surface.

To test this hypothesis, a sample piece of the plastic sheet was exposed to the level of dust concentrations measured in the field. The first truck sampled using the "under the truck" sampling protocol was Truck# B-03 at Feed Mill B. The dust concentration measured for Truck# B-03 was calculated as shown below:

Total mass of dust entrained while unloading Truck# B-03, m = 211 gm
Volume of the plastic enclosure, Vp = 384 ft^3
Rate of sampling through each sampler, Qs = 52 cfm
Number of samplers used, N = 4
Sampling time, T = 8 min

Total volume of air with dust entrained, V = Vp + {Qs * N * T}

$$= 384 + \{52 * 4 * 8\}$$
$$= 2048 \text{ ft}^3$$

Measured dust concentration for Truck# B-03, C $= m/V$
$= 211/2048$
$= 0.103 \text{ gm/ ft}^3$

To conduct the test, 6x6 inch pieces of brand-new 4 Mil plastic, the kind used to build the plastic enclosure under/over the truck, was cut, numbered and weighed. The sample piece of plastic was hung on a wooden frame and placed inside the chamber (38 cubic feet) shown in Figure 1. A 2 inch inlet pipe was introduced horizontally into the chamber at a height of 28 inches from the bottom. The pipe extended to the center of the chamber and was connected to an 8x10 inch transition, via a right angle joint. The transition was positioned such that it was 20 inches from the bottom and faced downwards to the center of the chamber floor. The external end of the pipe was connected to a centrifugal blower. The 1x1 foot opening at the top of the chamber was covered with a filter media to prevent dust from escaping the chamber during tests. The plastic was positioned along one side of the chamber at a height of 2 feet from the bottom. Due to the configuration of the chamber and the type of blower used for the test, dust inside the chamber could be kept in suspension for approximately one minute. After the first minute the dust would either settle out or get deposited on the walls of the chamber. This limited the run time for each test to one minute. The amount of dust to be entrained inside the chamber, corresponding to the measured dust concentration for Truck# B-03, was calculated as shown below:

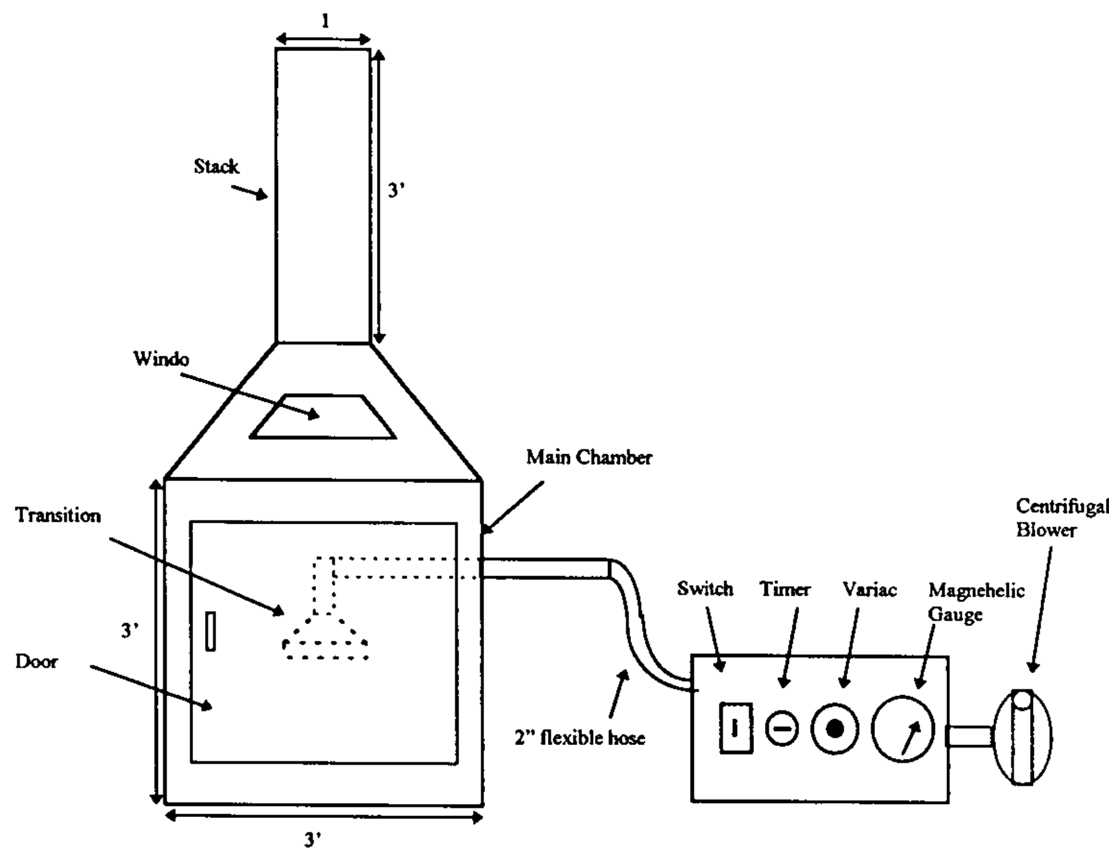
Volume of chamber, $V_c = 38 \text{ ft}^3$
Air flow rate, $Q_c = 110$ cfm

Mass of dust to be entrained in the chamber, Mc $= C * \{V_c + Q_c\}$
$= 0.103 * \{38 + 110\}$
$= 15$ gm/min

To simulate the sampling of Truck# B-03, the plastic was exposed for eight, one minute runs, with 15 gm entrained inside the chamber for each run.

Corn dust obtained from a local mill was sieved to separate out particles less than 100 μm in diameter. 15 grams of corn dust (< 100 μm) was spread on the floor of the chamber just below the transition. The door of the chamber was closed and air (approximately 110 cfm) was blown directly at the corn dust. This caused the corn dust to become entrained in the air inside the chamber. The centrifugal fan was operated for a minute and then switched off. The piece of plastic was removed from the chamber and weighed to measure the amount of dust that had been loaded onto it. After spreading an additional 15 gm of corn dust in the chamber, the same piece of plastic was exposed for another minute and reweighed. This process of exposing the same piece of plastic was duplicated for a total of eight runs to simulate the eight minutes sampled while unloading corn from Truck# B-03. The dust inside the chamber was swept clean after every three runs to avoid the risk of a dust explosion.

Figure 1: Test Equipment



To measure the maximum amount of dust that can be loaded on the plastic, the test runs were continued until there was no significant amount of additional dust being added to the surface of the plastic. Tests were conducted on three 6x6 inch pieces of plastic, with only one piece exposed during each run. The results of the test are given in Table 1. The relative humidity measured during tests was 50%, which was comparable to the relative humidity measured in the field.

Table 1: Maximum Loading Test

Run	Time	Weight of dust on both sides of the plastic, gm		
#	min	Plastic # 15	Plastic # 16	Plastic # 17
1	1	0.0734	0.0467	0.0570
2	1	0.0962	0.0726	0.0820
3	1	0.1324	0.0942	0.1078
4	1	0.1569	0.1165	0.1351
5	1	0.1838	0.1396	0.1522
6	1	0.2064	0.1595	0.1702
7	1	0.2203	0.1806	0.1951
8	1	0.2229	0.1959	0.2123
9	1	0.2246	0.2219	0.2173
10	1	0.2248	0.2200	0.2150

Table 1 indicates that:

(1) there was no significant amount of dust added to the plastic after run # 8.

(2) the maximum amount of dust loaded on both sides of the 6x6 inch piece of plastic was 0.2248 gm.

These results justify the assumption that the plastic is completely and uniformly covered with dust to its maximum limit after its first exposure.

Protocol for Subsequent Loading Test (Under the Truck)

Based on the results of the maximum loading test it was assumed that the plastic was loaded to the maximum limit during its first exposure. The next step was to determine if there was any significant amount of dust added to the plastic during subsequent exposures. To conduct this test a 6x6 inch piece of 4 Mil plastic was cut, numbered and weighed. This 6x6 inch piece of plastic was introduced into a cylindrical container (6" in diameter and 6" in height) along with approximately one pound of corn dust less than 100 µm. The container was closed with an air tight lid and tumbled for approximately five seconds. The container was maintained in an upright position for approximately five seconds to allow the dust in the container to settle. The container was opened and the piece of plastic removed with a pair of tweezers. The plastic, now covered with a layer of corn dust on both sides, was shaken with the tweezers to allow the clumps of corn dust to fall back into the container. The plastic was then weighed to determine the amount of dust that had adhered to it. This dust was assumed to be the maximum loading that could occur on the brand-new plastic during the first exposure.

The piece of plastic, already loaded to the maximum limit with corn dust, was placed inside the test chamber. 3 grams of corn dust less than 100 µm in diameter was spread in the center of the bottom of the chamber and the chamber was closed. Air, at approximately 110 cubic feet per minute, was blown directly at the corn dust to entrain it inside the chamber. The centrifugal fan was operated for one minute and then switched off. The piece of plastic was removed from the chamber and weighed to determine the additional amount of dust adhered to it. The dust inside the chamber was swept back to the center of the chamber and the test repeated with the same piece of plastic. After weighing the plastic again, it was exposed for another run, but this time an additional 3 gm of corn dust was added to the chamber floor. The plastic was exposed for a total of 4 runs with 3 gm of dust added to the chamber before every other run. The plastic was weighed after each run. The results of these tests are given in Table 2.

Table 2 indicates that:

(1) The maximum amount of dust loaded on both sides of a 6x6 inch piece of plastic was 0.2269 gm.

(2) The average additional amount of dust loaded on the plastic after the each run in the chamber was:

0.0113 gm after run # 1;
-0.0026 gm after run # 2;
-0.0016 gm after run # 3; and
-0.0060 gm after run # 4.

Table 2: Dust Loading Test Results

No. & Type of Exposure		Plastic #					
		3	4	5	6	7	8
	% Relative Humidity	52	52	52	50	50	50
Dust Container	Wt. of plastic. gm	1.8911	2.0384	1.9485	2.1787	1.9203	2.0271
	Wt. of dust on plastic, gm	0.17064	0.1974	0.2107	0.2077	0.2129	0.1623
Chamber: Run # 1	Wt. of dust added to chamber, gm	3	3	3	3	3	3
	Wt. of total dust on plastic, gm	0.2174	0.2113	0.2241	0.2044	0.2123	0.1598
	Wt. of additional dust on plastic, gm	0.0468	0.0139	0.0134	-0.0033	-0.0006	-0.0025
Chamber: Run # 2	Wt. of dust added to chamber, gm	0	0	0	0	0	0
	Wt. of total dust on plastic, gm	0.2146	0.2123	0.2269	0.1943	0.2069	0.1585
	Wt. of additional dust on plastic, gm	-0.0028	0.0010	0.0028	-0.0101	-0.0054	-0.0013
Chamber: Run # 3	Wt. of dust added to chamber, gm	3	3	3	3	3	3
	Wt. of total dust on plastic, gm	0.2076	0.2146	0.2230	0.1921	0.2063	0.1603
	Wt. of additional dust on plastic, gm	-0.0070	0.0023	-0.0039	-0.0022	-0.0006	0.0018
Chamber: Run # 4	Wt. of dust added to chamber, gm	0	0	0	0	0	0
	Wt. of total dust on plastic, gm	0.2053	0.2051	0.2265	0.1872	0.2038	0.1353
	Wt. of additional dust on plastic, gm	-0.0023	-0.0095	0.0035	-0.0049	-0.0025	-0.0250

The results of the Subsequent Loading Test shows that there is very little dust added to the plastic after it has been completely covered with dust. The negative weights of dust added to the plastic are due to the handling of the plastic between runs and the possible reentrainment of dust particles that adhered to the plastic during previous runs.

Calculations to quantify the dust loaded on the plastic during sampling are as follows:

Exposed surface area of plastic enclosure (two 4' x 8' walls and two 4' x 12' walls),
$A = 160\ ft^2$

Concentration of dust loaded on the plastic during first exposure,
$C_{p1} = 0.2269/(36 \times 2)\ gm/in^2$
$= 0.4538\ gm/\ ft^2$

To be conservative, we rounded off the 0.4538 to 0.5 gm/ ft^2.

Mass of dust loaded on the plastic enclosure during the first exposure, $M_{p1} = A * C_{p1}$
$= 160 * 0.5$
$= 80\ gm$

Conc. of dust adhered to the plastic during subsequent exposures,
$C_{pn} = 0.0113/(36 \times 2)\ gm/in^2$
$= 0.0226\ gm/\ ft^2$

To be conservative, we rounded off the 0.0226 to 0.03 gm/ ft^2.

Mass of dust loaded on the plastic enclosure during subsequent exposures, $M_{pn} = A * C_{pn}$
$= 160 * 0.03$
$= 5\ gm$

The only trucks sampled with a brand-new plastic enclosure were Truck# B-03 and D-01. Since Truck# D-01 was unloading milo, the change in its emission factor due to dust loading on plastic will not affect the final emission factor. Sample calculations for correcting emission factors for trucks sampled with a brand-new plastic enclosure is given below:

Total mass of dust entrained for Truck# B-03 (page B-6 of the Final Report), m = 210.9063 gm
Mass of dust loaded on the plastic enclosure during the first exposure, $M_{p1} = 80$ gm
Mass of grain handled, M = 56960 lbs

Adjusted emission factor for Truck# B-03 $= (m + M_{p1})/M$
$= (210.9063 + 80)/\ 56960$
$= 0.0051\ gm/lb$
$= 0.0225\ lbs/ton$

Sample calculations for correcting emission factors for trucks sampled with an already exposed plastic enclosure is given below:

Total mass of dust entrained for Truck# B-04 (page B-7 of the Final Report), m = 77.0849 gm
Mass of dust loaded on the plastic enclosure during subsequent exposures, M_{pn} = 5 gm
Mass of grain handled, M = 56960 lbs

Adjusted emission factor for Truck# B-03 $= (m + M_{pn})/M$
$= (77.0849 + 5)/ 56980$
$= 0.0014$ gm/lb
$= 0.0063$ lbs/ton

The old and adjusted emission factors for grain unloading are given in Table 3.

Table 3: Emission Factors for Grain Unloading

Truck #	Sampling Technique	TSP (lbs/ton) Old	TSP (lbs/ton) Adjusted	PM-10 (lbs/ton) Old	PM-10 (lbs/ton) Adjusted
B-01	Grid	0.0027	0.0027	0.0004	0.0004
B-03	Under	0.0163	0.0225	0.0024	0.0034
B-04	Under	0.0060	0.0063	0.0009	0.0009
B-05	Under	0.0120	0.0124	0.0018	0.0019
B-06	Under	0.0049	0.0053	0.0007	0.0008
B-07	Under	0.0129	0.0133	0.0019	0.0020
B-30	Grid	0.0235	0.0235	0.0035	0.0035
C-01	Under	0.0054	0.0058	0.0008	0.0009
C-03	Under	0.0149	0.0153	0.0022	0.0023
C-04	Under	0.0053	0.0057	0.0008	0.0009
C-05	Under	0.0033	0.0037	0.0005	0.0006
C-06	Grid	0.0711	0.0711	0.0107	0.0107
C-07	Grid	0.0144	0.0144	0.0022	0.0022
C-08	Grid	0.0081	0.0081	0.0012	0.0012
C-09	Grid	0.0104	0.0104	0.0016	0.0016
C-10	Grid	0.0590	0.0590	0.0089	0.0089
C-11	Under	0.0058	0.0062	0.0009	0.0009
D-03	Under	0.0196	0.0200	0.0029	0.0030
D-06	Under	0.0186	0.0190	0.0028	0.0029
D-07	Under	0.0185	0.0188	0.0028	0.0028
Average		0.0166	0.0172	0.0025	0.0026
Std Dev		0.0177	0.0177	0.0027	0.0027
Avg.+Std. Dev.		0.0344	0.0349	0.0052	0.0053
Proposed		0.04	0.04	0.005	0.005

Protocol for Feed Loading Test (Over the Truck)

Over the truck sampling was performed for feed loading only at Feed Mill B. The plastic enclosure for above the truck sampling was only used for 6 samples. Though the total surface area of the plastic used to build the enclosure was considerable (810 ft^2) the actual surface area of the plastic exposed to the dust was relatively small (72 ft^2). The clearance between the feed truck and the clam shell was only 12 inches. The process of loading feed onto the truck required approximately 30 seconds. As soon as the clam shell opened, the moist feed fell into the truck and there was very little dust entrained in the air. For all the 22 trucks sampled (156,400 lbs of feed unloaded) with the "over the truck" sampling protocol the total amount of dust entrained (after adding 40% of the dust captured to account for the deposition of dust in the pipe and the dust that escaped from the enclosure) was 117 gm. Due to the very low numbers involved, it was assumed that there was negligible loading of dust to the plastic enclosure during over the truck sampling. However, to be conservative, 5 gms of dust was added to the total dust captured to account for the dust that adhered to the plastic. The old and adjusted emission factors for feed loading are given in Table 4.

Table 4: Emission Factors for Feed Loading

Truck	Sampling	TSP (lbs/ton)		PM-10 (lbs/ton)	
#	Technique	Old	Adjusted	Old	Adjusted
B-08 to 11	Over	0.0042	0.0050	0.0004	0.0005
B-12 to 14	Over	0.0036	0.0048	0.0004	0.0005
B-15 to 17	Over	0.0035	0.0044	0.0004	0.0004
B-18 to 21	Over	0.0028	0.0035	0.0003	0.0004
B-22 to 25	Over	0.0031	0.0040	0.0003	0.0004
B-26 to 29	Over	0.0024	0.0032	0.0002	0.0003
C-12 to 15	Grid	0.0003	0.0003	0.0001	0.0001
C-16 to 20	Grid	0.0015	0.0015	0.0005	0.0005
C-21 to 24	Grid	0.0043	0.0043	0.0015	0.0015
C-25 to 27	Grid	0.0040	0.0040	0.0014	0.0014
C-28 to 30	Grid	0.0038	0.0038	0.0013	0.0013
D-08 to 11	Grid	0.0020	0.0020	0.0007	0.0007
D-12 to 16	Grid	0.0035	0.0035	0.0012	0.0012
D-17 to 19	Grid	0.0075	0.0075	0.0026	0.0026
Average		0.0033	0.0037	0.0008	0.0008
Std Dev		0.0016	0.0017	0.0007	0.0007
Avg. + Std. Dev.		0.0050	0.0054	0.0015	0.0015
Proposed		0.005	0.005	0.002	0.002

From Tables 3 and 4 it can be noted that the proposed emission factors for feed mills remain the same even after making conservative estimates for the amount of dust that adhered to the plastic. The adjustment made for the amount of dust that adhered to the plastic did not affect the final numbers because the magnitude of the numbers involved was very small. The addition of one standard deviation to the average value allows for a conservative but accurate emission factor that is applicable to a wider range of feed mills. EPA should consider this concept for calculating emission factors for other types of industry, too.

Attachment II

Quality Assurance Procedures

Strict procedures were followed during field tests to ensure precision and accuracy of the data collected. Quality control procedures described by Texas Natural Resource Conservation Commission (TNRCC) were followed wherever applicable. Quality assurance procedures pertaining to specific equipment used while sampling will be discussed in the following section.

Filter Media

Dust particles captured during sampling were collected on a Polyweb filter. The filters were dried for 24 hours in a constant temperature chamber at 120 degrees Fahrenheit. The filters were then conditioned for 24 hours in a chamber maintained at 40% relative humidity and 70 degrees Fahrenheit. The conditioned filters were individually numbered and each filter was weighed three times for precision. The balance was re-calibrated before weighing the first filter during that particular shift or session. Approximately 1200 filters were carried along to the field out of which approximately 500 were actually used on samplers. Fifty of the unused filters served as blanks to assist in determining potential error due to handling.

Care was taken to ensure that the loaded filter cassettes were kept covered until the samplers were turned on. The filters brought back from the field were dried and reconditioned using the same procedures explained above. The filters were reweighed three times to calculate the amount of dust collected on them.

Samplers

The Hi-Vol and PM-10 samplers used for this study were cleaned and calibrated before using them in the field. The sampling system used for the "under/over the truck" and grid sampling was specifically designed for this study. The system was tested at Feed Mill A and appropriate adjustments were made before sampling at Mills B, C and D. Orifice meters were calibrated before sampling at Feed Mill A. A maintenance check was performed on the generators, motors, timers and flow measuring devices prior to field sampling.

Cyclone Preseparator

Care was taken to dislodge as much dust as possible that had deposited in the extension pipe and cyclone preseparator between samples. To be conservative, 5% and 10 % of the total dust captured, was added before calculating the emission factor to account for deposition in the extension pipe and cyclone preseparator, for under and over the truck sampling, respectively.

Under/Over the Truck Plastic Enclosure

Care was taken to ensure that the plastic enclosure used for sampling was as snug to the truck and the dump pit as possible. Although, negligible amounts of dust escaped the plastic enclosure, the total dust mass captured using the "under/over the truck" sampling protocol was increased by 30% to account for the possible loss of particulate escaping the plastic enclosure.

It was originally assumed that the dust collected on the plastic enclosure during sampling would be negligible. However, laboratory tests on the plastic indicated that a maximum of 0.4583 gm/ft^2 could adhere to a brand new sheet of plastic. To be conservative, 80 gms of dust was added before calculating the emission factor for all the trucks sampled while unloading grain with a brand new plastic enclosure. For all the other subsequent trucks sampled while unloading grain and all trucks sampled with the "over the truck" sampling protocol, 5 gms were added before calculating the emission factor.

Coulter Counter

The Coulter Multisizer II was calibrated and operated based on the instructions described in the Operator's Manual before use. Apparatus cleaning and sample preparations followed are as described in Appendix C of the report.

Weather Station

The CM10 weather station manufactured by Campbell Scientific was installed and operated based on the procedures described in the Installation Manual before use. The locations of the weather stations were carefully selected to ensure that there were no obstructions that could affect the accuracy of the weather data. The wind velocities measured inside the grain unloading and feed loading sheds were always lower than those recorded by the weather station during respective sampling periods.

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March 4, 1997

Dallas Safriet
Environmental Engineer
Emission Factor and Inventory Group
U.S. EPA
Research Triangle Park, NC 27711

Dear Mr. Safriet:

We appreciate the opportunity to review the report prepared by Midwest Research Institute (MRI) for the National Grain and Feed Association entitled "Emission Factors for Grain Elevators". We have a unique perspective in that we have performed a similar study for feed mills associated with cattle feed yards. We have an appreciation for the difficulties associated with accurately measuring particulate emissions and subsequently calculating emission factors. It is our assumption that EPA desires a comprehensive technical review and that this review will be considered in the evaluation of this report and ultimately in the formation of the new AP-42 emission factors. It is our desire that the new AP-42 emission factors for grain elevators, feed mills associated with feed yards and fugitive emissions from cattle feed yards accurately reflect the emission rate from these facilities. This can only be accomplished if the studies that serve as the basis for these emission factors are properly and comprehensively reviewed by reviewers with the capability of evaluating the science and engineering used in the studies. As you are aware, we have been critical of EPA AP-42 emission factors in the past. It is not our desire to be critical of EPA or MRI for any reason but to improve the quality of the data used to generate AP-42 emission factors. As per your request, we have attempted to perform a comprehensive, technical review of the report.

It should be noted that we performed our study completely independent of the MRI study. **We were not provided any details of sampling protocols or results of the MRI study prior to planning and conducting our study.** In fact, we had not been given a copy of the NGFA/MRI report until you forwarded it to us for review.

We have performed a partial review and included comments and concerns. Specifically, we found that the sampling protocols were not explained clearly and the sampling data were not included in the report. This lack of information made it impossible to reproduce engineering calculations necessary to verify the emissions factors reported by MRI. We have attached our concerns and attempted to document the necessary additional data that would be needed to appropriately review this report. We have also, wherever possible, provided a critique of the portions of the study that were explained in sufficient detail to allow for analyses. **<u>There was not sufficient data included in the MRI report to perform a comprehensive technical review</u>**.

It is our desire to work with EPA to obtain appropriate emission factors for agricultural operations based on quality science and engineering. We have cooperated with you by responding to requests from your contractor (MRI) to supply additional data on numerous occasions. More recently, we forwarded nine disks with data from a study that was completed several years ago to facilitate your contractor's ability to perform a comprehensive technical review of our work. We find ourselves in a unique position in that we are reviewing work performed by your contractor that will eventually be utilized by your contractor to revise AP-42. We have remained objective and reviewed this report as if the contractor had the same burden of performance that is placed on any other source. In this context, we do not feel that statements such as a sampling procedure was an "EPA-endorsed testing technique" should be used as a justification for not including the details of the procedure in the report. It is our view that a proper technical review must include a detailed analysis of potential errors associated with the sampling procedures. The sampling procedures used to determine emission factors for feed mills, grain elevators, and cattle feed yards are significantly different than the more common source sampling methods used to measure emission rates from stacks (EPA Method 5 or 201A). The researchers were required to be creative and innovative in an effort to obtain accurate measurements. MRI demonstrated this creativity as we did in our study. For studies that require this kind of innovation and creativity, it is essential that the reviews be comprehensive and thorough. We anticipated this when we submitted our report and included all sampling data, sample calculations, sampling procedures and a thorough analysis of the strengths and weaknesses of the sampling procedures. This was not included in the report you asked us to review.

As you have mentioned in your letter, dated January. 29, 1997, it is important that information published in AP-42 have a sound technical basis. **We totally agree**. We would like to suggest that NGFA or MRI expand the report to include the additional necessary information and data and that we be allowed to more thoroughly review this work. If EPA intends to incorporate the emission factors reported by MRI into the elevator portion of the revised AP-42, it is essential that results of studies be based upon good science and engineering.

If you have any questions, please feel free to reach us at (409) 845-3985 or (409) 845 -9793.

Sincerely,

Calvin B. Parnell Jr.　　　　Bryan W. Shaw

Calvin B. Parnell, Jr. Ph.D., P.E.　　　　Bryan W. Shaw Ph.D.

Enclosure

REVIEW OF THE MRI REPORT ENTITLED "EMISSION FACTORS FOR GRAIN ELEVATORS"
By

Calvin B. Parnell, Jr. Ph.D., P.E.
and
Bryan W. Shaw, Ph.D.

Comments and Concerns

1. The following statement was made in Section 1 - Introduction: "It is widely accepted that the inlet side of a dust control device cannot be used as an accurate estimate of uncontrolled emissions (the basis for the emission factors in AP-42)." The authors explain this by suggesting this method will measure the "amount of dust that is stripped from a grain stream rather than the dust that occurs from an uncontrolled operation." The implication that the 1988 emission factors were in error because of this one factor is misleading. One of the primary reasons the AP-42 emission factors were in error was a lack of understanding of why dust control systems were, and continue to be, used with tunnel belts, elevator legs, headhouses and gallery floors of grain elevators. This "why" is critical to correction of AP-42 emission factors and should have been considered in the planning and conduction of this study. Dust control systems inside grain elevators are installed primarily **to prevent grain dust explosions** not to comply with EPA or State Air Pollution Control Agency (SAPRA) rules and regulations. Dust control systems reduce the grain dust concentrations at grain transfer points to less than the minimum explosive concentration, which is widely accepted as 50 g/m^3. In addition, grain elevators and feed mills are subject to OSHA standards that limit worker exposure to no more than 15 mg/m^3 for grain dust other than dust from oats, wheat, and barley. The OSHA standard for oats, wheat and barley is 10 mg/m^3 (OSHA 1910.1 Limits for Air Contaminants). The emission factor that would result from 100,000 cubic feet per minute (cfm) of air exiting the open windows of a grain elevator handling 12,000 bushels per hour of corn (bu/hr) and having an existing internal dust concentration of 15 mg/m^3 (the OSHA upper limit for worker exposure) would be 0.017 lbs/ton. It is unlikely that an uncontrolled elevator will have 100,000 cfm exiting the windows of the facility at any time and is equally unlikely that the worker exposure level ever approaches 15 mg/m^3. For example, an internal concentration of 1.5 mg/m^3 and 10,000 cfm escaping through the windows, would yield an emission factor of 0.0006 lbs/ton. It is more likely that grain elevators will have dust control systems operating inside the facility (to prevent grain dust explosions, not to comply with air pollution regulations). These dust controls will pick up air inside the facility and exhaust the air externally through bag filters or cyclones. Hence, the dust control systems will more likely create a vacuum such that air will move from the outside through the windows to the inside. It is our opinion that the emission factor for internal emissions will be negligible.

2. On page 6, the authors state: "One of the primary goals of the testing program was to determine the *reasonable worst case scenario* of emissions to the ambient atmosphere from internal operations." Interpretation of "reasonable" is very subjective. No scientific data were

given to justify the level of "reasonable worst case scenario" used in this study. On page 6, the authors state: "Most importantly ... sample emissions as they occur naturally." It is our view that pulling 15,000 cfm out a window is not a "natural" occurrence at grain elevators. Sampling "natural" emissions and using a statistical approach to recommend emission factors would have eliminated the bias of interpreting the "reasonable worst case scenario" and minimized the risk of producing emission factors that are not typical of grain elevators.

3. In order for any of the dust captured by this protocol to leave the building in the form of emissions, some external force would be required to cause 15,000 cfm of air to flow out of the building. No explanation was provided to justify exhausting 15,000 cfm through windows of an operating grain elevator. Furthermore, if the facility has controls that are operating, internal air will be exhausted through the dust control system outside the facility which will result in a vacuum inside the facility causing air to move into the facility from the outside.

4. The protocol used for sampling internal emissions is not clearly explained and has potential sources of error.

   - Operating a 48 inch fan to pull air from inside the head house of an elevator is not a typical activity. It was not explained what "natural" phenomenon was intended to be simulated by exhausting 15,000 cfm. We contend that it is inappropriate to assume natural "leaks" from the building would amount to 15,000 cfm moving from inside the facility to the outside ambient air. However, a 15,000 cfm emission volume would result in a reasonable upper limit emission factor of 0.003 lbs/ton for a grain elevator handling 10,000 bu/hr of corn if the elevator enclosure had an upper limit concentration of 15 mg/m^3, which is the OSHA standard.

   - Figures 5 and 10 fail to explain the placement of samplers. It is assumed, based on Figure 6, that a single sampler was placed along the centerline of the "enclosure". It is not clear where along the centerline the sampler was placed.

   - The description provided for the fan and sampling enclosure was too brief. It is assumed that a probe was connected to a high volume sampler with the inside diameter of the probe configured so that the sampling velocity corresponded to the exit velocity of the air leaving the elevator caused by the induced draft fan (isokinetic sampling). This kind of assumption should not be required. What were the materials and what were the dimensions of the sampling enclosure? Where was the fan placed with respect to the sampler? What purposes other than ducting air out of the facility did the enclosure serve? What were the specifications of the sampler/probe/enclosure?

   - Figures 6 and 11 fail to give pertinent information regarding the deployment of samplers? Do the squares represent the windows of the head house? Where are the samplers located relative to the floor/ceiling of the room?

- How was the mass of dust collected converted into the reported emission factor? Due to the lack of data provided, it was not possible to verify the emission factor calculations.

- The authors indicated that they sampled with and without controls operating. What controls were being used and what were their volumetric flow rates?

- Table 1 states that background tests were performed at the country elevator and terminal 2. These data were not included in the report. Were they used in the final emission factor calculations for internal emissions?

- The explanation on page 13 suggests that the sampling time was 20 minutes and the volumetric flow rate of air was 15,000 cfm. We have attempted to reproduce calculations of particulate concentrations inside the facility. Since no data were provided, the following assumptions were made to facilitate calculations:

Grain handling rate, R = 10,000 bushels/hour = 167 bushels/min;
Time grain was handled during test, t = 10 min;
Sampling time, T = 20 min;
Type of grain being handled: corn;
Density of corn, ρ = 56 lbs/bushel = 0.028 tons/bushel;
Flow rate of air leaving the building, Q = 15000 cfm = 425 m^3/min; and
MRI recommended emission factor, E = 0.06 lbs/ton.

ER = 167 bu/min*0.028 tons/bu*0.06 lbs/ton = 0.281 lbs/min

where ER = emission rate, lbs/min.

EC = (0.281 lbs/min*10 min*454 g/lb*1000 mg/g)/(425 m^3/min*20 min) = 150 mg/m^3

where EC = emission concentration, mg/m^3.

The data on measured concentrations were not provided. The above is our best estimate of the average concentration inside the facility, during internal emission sampling. That could be interpreted as worker exposure of 150 mg/m^3. It is our opinion that the 0.06 lb/ton emission factor is grossly in error. Without data on the measured concentrations and a better description of the sampling method used, it is not possible to determine the source of the error.

The internal emission protocol called for exhausting air from the headhouse for 20 minutes and moving grain for only 10 minutes. Under steady state conditions the dust would be exhausted at 0.28 lb/min in the 15,000 cfm draft. That would require a 300 mg/m^3 internal concentration. This indicates that the concentration levels inside a head house at an elevator would be at least 20 to 30 times higher than the OSHA limit. This is unlikely.

5. In the report it is indicated that the filter began overloading after "several hundred milligrams" were deposited. It is assumed that "several hundred milligrams" is less than one gram. This seems logical for use of the axial flow high volume sampler fans. With centrifugal fans we were able to increase the maximum loading to slightly less than 2 grams, while maintaining a constant flow rate. Our interpretation of the sampling procedures used for internal emissions is that the preseparator cyclone was used for these measurements. Assuming that the leg capacity was 10,000 bu/hr the estimated PM10 concentration sampled was 85 mg/m^3 based on the 0.034 lb/ton internal emission factor recommended. In a 20 minute sampling period, the sampler would capture 1.9 grams for a concentration of 85 mg/m^3. This exceeds the reported capacity of the filters. Were the filters changed during the test period? If so, how was this accounted for in the analysis?

6. The implication of the statement on page 3 that "36 tests were directed to emissions from operations with deactivated control measures (i.e., dust pickup points or oil suppression)" is that the authors were under the impression that the controls and oil suppression were utilized to comply with air pollution regulations. **This is not the case.** These measures are utilized to prevent dust explosions! This is not to say that the grain elevator operators will not appreciate any benefits that might assist them in complying with air pollution regulations.

7. On page 7, it is stated that the cutpoint of the cyclone preseparator used for this study was 10 µm. How was this determined? There is an implication that the vender claimed that the cyclone had a 10 µm cut point or that the 10 µm cut point was "by design". If the cut point was verified with performance tests, these data should be included in the report. Based on our experience with designing cyclones, the cut points of cyclones determined by performance tests are frequently different than the design cutpoint. If performance tests were conducted, the data should be included in the report. It has also been our experience that it is difficult to design a pre-separator cyclone that will have a 10 micron cut point. Our cyclones typically have 3.5 to 4 micron cut points. If the authors collected performance data on the preseparator cyclone, the following items should be addressed in the report: How well did the design and actual cutpoints of the cyclone preseparator compare? Were there any deviations from the design cut point that would have a direct impact on the PM10 values reported and the quality of the data? If no performance data are available, the authors should address the concern that they must have faced in developing the protocol: How can we be assured that our results represent accurate measurements of PM10?

8. The explanation of the "exposure profiling" concept used for this study was not clear.

   - Figure 1, suggests that the measurement plane was not placed at the exit of the shed/baffle as there is no shed or baffle shown in the diagram. On the other hand, Figures 7 - 9 suggest that the measurement plane was placed at the exit of the shed or baffle. The placement of the measurement plane is an important factor in determining the accuracy of the measured dust concentrations. The narrative suggests that the measurement plane was placed at the exit with baffles used to direct the particulate toward the sampling points.

- On page 3, the statement is made that "exposure profiling" relies on a mass balance method scheme similar to "EPA standard test methods". The authors go on to say that "exposure profiling" induces a strong draft to capture particulate. It is not clear what is meant by the term "mass balance method" and induced strong drafts. (Did the authors use a fan to induce a draft in the shed?) Our assumptions were as follows: (1) The authors measured the concentrations of particulate at multiple points in the plane at the downwind exit of the shed. (2) The particulate matter entrained in air at the grain transfer points was carried by the prevailing wind in the shed to the sampling points and (3) These measured concentrations were used to determine the mass of particulate.

- In order to determine the mass of particulate leaving the shed using exposure profiling, the authors had to determine the volume rate of flow through the shed. They say that they used a Biram vane anemometer. We have attempted to use a hot-wire anemometer to measure the wind speeds through a shed, but the wind speeds were so variable during the sampling period and at different elevations that we opted to use wind speed data from a weather station. Wind speed is a critical variable in the calculation of the volume rate of flow and ultimately the mass emission rate of particulate. No data was included in the report on the number of wind velocity measurements, location of the measurements, variation and the magnitude of the velocities during the sampling periods. This data is critical to the evaluation of the "exposure profiling method" for determining emission factors. By not including discussions of wind velocity variations during the sampling periods, the authors are implying that the wind velocities were uniform and constant. This is not consistent with our observations. On page 17, the authors state: "A brief wind reversal occurred during BE-2 ..." This suggests that MRI personnel observed variations in wind velocity during their tests.

9. The placement of individual samplers for exposure profiling was unclear.

    - Were the samplers placed on the ground? If so, was there an extension pipe used between the cyclone preseparator placed at ground level and the corresponding sampling probe? How was the deposition inside the extension pipe accounted for?

    - Were the samplers themselves mounted on a frame?

10. The elaborate explanation regarding quality assurance procedures followed for this study indicated that data were documented well and that good care was taken to prevent any samples from getting contaminated.

11. The authors, on numerous occasions, state that the exposure profiling technique is based upon a " mass balance scheme similar to EPA standard methods". It would be helpful if the authors would explain what they mean. Detailed descriptions and critical evaluations of the

exposure profiling technique should be included in the report. It is not justifiable to exclude these discussions because exposure profiling is a sampling method that is "similar" to EPA standard methods.

12. On page 16, it is stated that due to the concern of overloading the filters subsequent sampling runs were limited to handling 7 to 9 tons of grain. The trucks for which the limitations were put into place were all straight trucks sampled while unloading at the country elevator. The final emission factors for the straight truck receiving operations were calculated based only on three straight trucks sampled at the country elevator. The fact that the recommended emission factor for straight trucks is higher than hopper bottom trucks by a factor of 10 could be associated with the grain handling limitations imposed while sampling. The quality of the emission data for three partial loads (approximately 24 tons total grain) from straight trucks is questionable. The results of the Oklahoma State University (OSU) Grain Elevator Dust Emission Study indicate that for the five end-dump trucks (approximately 90 tons total grain) the emission factor was 0.0388 lb/ton. Unless there were special circumstances for the specific trucks sampled by MRI, it seems unlikely that the emission rate was ten times higher than hopper bottom trucks and the end-dump trucks sampled by OSU.

13. On page 17, the authors state that because of an observation that dust escaped out the upwind end of the shed, "the grating was covered during the remaining tests to block displaced air and thus direct emissions through the downwind doorway to ensure that the test captured all dust emitted." It would be helpful if the authors would included a more detailed description of the method and materials used to cover the grating and how this covering directed emissions through the downwind doorway. The authors did not capture "all dust emitted". They measured concentrations and estimated mass emission rates by multiplying concentrations by the estimate of the volume rate of flow.

14. The authors state on page 31 that there was no significant difference in the amount of dust emitted from a specific operation handling different grains. It is our opinion that the number of tests conducted for each type of grain and type of operation are not sufficient to suggest that there is "no significant difference" between grains in field tests. The cause of no significance detected by the paired t-test is the large standard deviation and the limited data. Comparing results based the limited data (3 wheat tests and 3 soybean tests), in Table 5, is misleading. Different types of grain do have different dust contents. It is logical that grains with very high free dust contents will have higher emission factors. We recommend the authors reconsider this conclusion.

    It is stated by the author that when evaluating the emission factors for receiving from hopper trucks "one finds that the results for both soybeans and sorghum lie within the range for wheat". This conclusion is based on 4 wheat tests, 1 soybean test, 1 milo test, and 1 corn test. The reason the other grains fell within the range of wheat is that there was a broad range of values measured for wheat (maximum = 0.0103 lbs/ton, minimum = 0.00286). It was not discussed that the corn test did <u>not</u> fall within the range for wheat. It is misleading to draw the conclusion that there is no difference between grains with such limited data.

SERVING CLARK, COWLITZ, LEWIS, SKAMANIA AND WAHKIAKUM COUNTIES

SOUTHWEST AIR POLLUTION CONTROL AUTHORITY

FACSIMILE TRANSMISSION

TO: Dallas Safriet FAX NUMBER: (919) 541-0684

U.S. EPA Emission Factor Division

FROM: Tim Gould ext. 31

DATE: May 7, 1997 TIME:

MESSAGE:

I contacted you about a year ago and again 8 to 9 months ago regarding emission factors for ship loading at marine grain terminals.

A grain terminal in SWAPCA's jurisdiction is planning to conduct a source test to justify a revised visible emission limit and obtain emission factors that it hopes to use to opt out of Title V. Attached is a copy of the test plan provided by the source test company the grain terminal has hired to conduct this work. I would appreciate your comments on the procedures described in this test plan. The results of the test may be valuable to your group in updating the ship loading emission factors published in Interim §9.9.1 of AP-42.

If there are serious flaws or omissions in the test procedure, I would appreciate learning of your concerns before the test plan is finalized so it can be revised. The grain terminal source, test company, and this agency all want to avoid rejection of the test results by EPA because no opportunity for review occurred prior to the emissions testing.

Thank you for your input.

THIS MESSAGE CONSISTS OF 5 PAGES INCLUDING THIS COVER SHEET

If you do not receive a complete and legible message, or if you have questions about this message, please call the voice number provided below.

OUR TELEPHONE NUMBERS ARE ▸ FAX: (360) 576-0925
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May 1, 1997

Mr. Tim Gould
SWAPCA
1308 N.E. 134th St., Suite D
Vancouver, Washington 98685

Re: Source Testing, United Grain Corporation
1927 Elevator Way
Vancouver, Washington 98660-1025

This correspondence is notice that Horizon Engineering is to do source testing for the above-referenced facility, currently scheduled for May 28-30, 1997, although the days do not need to be consecutive. This will serve as the source test plan unless changes are requested prior to the start of testing.

1. **Source(s) to be Tested:** Loading of grain into a ship's hold

2. **Purpose of the Testing:** Evaluation of emission factors for Title V Permitting and BACT analysis. Also, determine if a new "warhead" is effective in reducing fugitive emissions from the operation.

3. **Source Description:** Grain loading into the holds of ships is through a movable boom and spout system. Grain is conveyed along the dock on a covered conveyor. A movable gantry pulls grain off the first conveyor to another conveyor on a boom that swings out over the open holds of the ships. At the end of the boom, the grain drops through a "warhead" spout that can be raised and lowered to stay just above the rising pile in the hold. The warhead has a dust collection system attached that evacuates to a Carter-Day baghouse back near the pivot on the boom. The operator sits in a cab out near the end of the boom.

   The open top of the hold observed during our site inspection was about 45 feet by 60 feet.

4. **Pollutants to be Tested:** Particulate and opacity.

5. **Test Methods to be Used:**
   Visible Emissions: EPA Method 9 (observations)
   PM10: EPA Method 201A

also include PM-2.5

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6. **Schedule:**

Day 1: Existing Warhead Opacity
- -Certified Opacity Observer to record opacity at hold exit
- -Baghouse solids rate measurement and three samples for PM10 fraction
- -Wind speed and direction (on grain loading boom) — calibrated ?

To determine the baghouse solids rate, Dick Grimes has indicated that a diverter could be installed to divert the solids collected by the baghouse to a container or bag that could be timed and weighed. They expect about 600 lb/hr of solids, so five tests of about five minutes each should give a good idea of the rate. ?

is this repeated 3 times? or are 3 separate PM10 fractions determined from these ~25 min of collected solids.

I don't think 5 five minute samples are sufficient to quantify emissions collected by the FF. The duration of the entire test should be at least one if not three complete cleaning cycles of the entire FF.

We expect to do these observations during the three "stages" of loading; 1) when the hold is nearly empty and the spout cannot be extended to the pile, 2) later, when the spout can be controlled close to the pile, and 3) during topping operations.

Day 2: New Warhead Opacity
- -Certified Opacity Observer to record opacity at hold exit
- -Baghouse solids rate measurement and three samples for PM10 fraction
- -Wind speed and direction (on grain loading boom)
- -Start setup for Day 3

Day 3: New Warhead Fugitive Emissions. Ship's hold is to be covered with a "temporary total enclosure" with a fan and exhaust duct for testing. ?
- -Flow rate: EPA Methods 1 and 2 (possibly done in shop prior to tests)
- -Moisture: EPA Method 4 (approximate, wet and dry bulb temperatures)
- -PM10: EPA Method 201A (modified, no "back half"
- -Total Particulate: Approximate (from PM10 train)
- -Opacity: EPA Method 9 (at temporary stack exit) this reading is not indicative of standard operating conditions? Is it really needed?
- -Baghouse solids rate measurement and three samples for PM10 fraction
- -Wind speed and direction (on grain loading boom)

No

I would suggest that a PM-2.5 cyclone be included in the sample as well. I would analyze the back half as a QA check of the filter. Flow measurement of the natural draft of openings should be made to document TTO guidelines

Put a temporary cover over the top of the hold area (probably tarps) to contain dust and add a temporary fan and exhaust stack so that almost all dust not trapped by the warhead exits the hold through the exhaust stack. Controlled gaps may be left intentionally on the side of the hold opposite the fan to allow sweep air collection of all dust in the hold. The controlled exhaust will permit emission testing with more conventional emission testing methods and equipment.

two collection points? 1) Warhead & 2) temp exh stack

We expect to have a fan moving about 10,000 cfm with a short stack section (probably with flow straighteners) for sampling. It is our understanding that the warhead vacuum system exhausts about 10,000 cfm. The grain, entering at 2,400 TPH and occupying 48 lb/ft^3, displaces about 1,700 cfm in the hold. Although, theoretically, the hold could be sealed, with no fugitive emissions, we know that normal winds across the hold drag out dust. A 10,000 cfm axial fan is a weight that can be manually installed and can be powered by an available generator. Assuming a 10 foot depth to the grain and a 45 foot wide hold, we will be creating a wind of only about 22 fpm (about 1/4 mph) in the hold. Although large particulate could settle out in the relatively stagnant enclosed hold, suspended PM10 is not likely to drop out.

height of gap in side of hold?

I think a higher velocity should be used. Terminal settling velocity for PM-10 is 10 cm/sec and typical wind velocity is 447 cm/sec. The velocity of 1/4 mph is 11 cm/sec and would not create turbulence like wind would. I would suggest a blower to create some turbulence in the hold being tested even if two additional fans are required to insure that TTO conditions are being met.

I agree but some method of generating turbulence in the hold should simulate the air. Also 1/4 mph is too far away from ambient windspeeds

Ideally, it seems a typical 5 to 10 mph velocity would be best for the testing, but artificially creating this in a sealed hold would take more fan and electricity than can be done reasonably.

PM10 will be done using a modified EPA Method 201A. We would like to omit the normal impingers in the train. Total particulate can be determined by recovering the PM10 cyclone catch.

The baghouse solids catch rate will be determined concurrently with the PM10 tests (as on Days 1 and 2).

Three tests of at least one hour each to be made with the enclosure. Results will be expressed as a concentration (gr/scfd), a rate (lb/hr), a fraction of PM10, and on a production basis if that information is provided.

Definitely need loading rate info for resolution equivalent to that of the sampling test.

7. **Horizon Engrg. Contacts:**		David Rossman or Kurt Torgerson (503) 255-5050
	Fax	(503) 255-0505
8. **Source Site Personnel:**		Dick Grimes (360) 693-1521
	Fax	(360) 694-1986
9. **Consultant:**		Marie Piper (425) 334-7627
	Fax	(425) 334-5819
10. **Regulatory Contacts:**		Tim Gould (360) 574-3058
	Fax	(360) 576-0925

and opening size

11. **Applicable Process/Production Information:** Process operating data and production information that characterizes the source operation is considered to be: Grain loading rate, types of grain, ships hold size, and warhead distance above grain pile. Process information is normally gathered by the Source Site Personnel and provided to Horizon for inclusion in the report.

    The source must operate at a normal maximum rate during testing. Rates not in agreement with those stipulated in the Order of Approval can result in test rejection for application to determine compliance. Imposed process limitations could also result from atypical rates.

12. **Control Device Operating Parameters:** Baghouse pressure drop (if measurable) and baghouse material collection rate (as described above).

13. **Opacity readings to be taken by:** Horizon Engineering

14. **Certified plume evaluator: Yes (x) No ( ) N/A ( )**

15. **Other process considerations,** including intermittent production, special feed or product, etc.: None known

16. **Administrative:** Unless notified prior to the start of testing, this test plan is considered to be approved for compliance testing of this source. A letter acknowledging receipt of this plan and agreement on the content (or changes as necessary) would be appreciated.

The Authority will be notified of any changes in source test plans prior to testing. It is recognized that significant changes not acknowledged could affect accuracy and reliability of the results.

Method-specific quality assurance/quality control (QA/QC) procedures will be performed to ensure that the data is valid. Documentation of the procedures and results will be presented in a source test report.

Any questions or comments relating to this test plan should be directed to me.

Sincerely,

HORIZON ENGINEERING

Kurt Torgerson

Kurt Torgerson
Test Team Leader

cc: Dick Grimes, United Grain
Marie Piper, Cascade Environmental Management

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Cowlitz
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Southwest Air Pollution Control Authority

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TDD Accessible

May 13, 1997

Dallas Safriet
Emission Factor Branch
U.S. EPA, MD-14
Research Triangle Park, NC 27711

Subject: Background Information for Vancouver, Washington Grain Export Terminal

Dear Mr. Safriet:

Enclosed please find drawings of the ship loading system at United Grain Corporation (UGC) in Vancouver, Washington. As we have discussed, source testing is scheduled for May 28-30 to evaluate the performance of two different deadbox "warheads". Improved dust capture and reduced opacity of visible emissions is expected to occur with replacement of the "warhead".

Uncaptured emissions from ship loading are to be quantified by the source test procedures and related to the ship loading rate. The importance of quantifying emissions is indicated by the enclosed spreadsheet which summarizes 1996 emissions from UGC. Based on loading of 4.12 million tons of wheat, none of which is treated with oil, and use of the AP-42 Interim §9.9.1 emission factors, the calculated annual emissions of PM_{10} are 108 tons, of which 103 tons originate from ship loading. This calculation assumes a capture ratio of 50% by the loading spout pneumatic system and baghouse, i.e. half of the uncontrolled emissions as determined by AP-42 are captured and half escape as uncollected emissions to the ambient air. Our observations of grain loading operations suggest that 50% capture may be a generous assumption.

I have also included a description of some of the equipment design and operational factors that influence dust emissions from ship loading of grain. "Table 1" describes some of the approaches we have considered to reduce visible emissions from grain loading terminals.

The state of Washington limits visible emissions to 20% opacity for all sources without uncombined water and does not provide a specific exemption for grain export terminals. We have routinely issued violations to all three grain terminals along the Columbia River in SWAPCA jurisdiction, but Title V has caused these facilities to reconsider their dust control systems and operating techniques.

We welcome any comments you and your colleagues have regarding the proposed source test.

Sincerely,

Tim Gould

Timothy R. Gould, P.E.
Air Quality Engineer

1996 UGC Emission Inventory based on AP-42 Emission Factors

United Grain Corporation change from 1995

Vancouver, WA total grain shipped, 96 4,124,278 tons/yr -11.4%

		grain type:	wheat	barley	soybeans	corn	
		metric weight:	3,741,545	0	0	0	M tons/yr
	1.1023	weight:	4,124,278	0	0	0	tons/yr
PM-10		weight percentage	100.0%	0.0%	0.0%	0.0%	137.5E+6 bu/yr
		AP-42 grain DR	1.0	1.0	2.5	2.5	

January - December 1996

Terminal Operation & Emission source	Dusty Ratio	Process/ Thru-put	Grain processed (tons/yr)	PM-10 Emsn factor (lb/ton)	uncontrol PM-10 (tons/yr)	Oil sys. control efficiency	Pneum. Control Efficiency	PM-10 emissions (ton/yr)	Captured dust (tons/yr)
Railcar Unloading, filters #11 & 18									
Wheat	1.0	0.50	2,062,139	0.015	15.5	0.0%	99.9%	0.015	15.5
Barley	1.0	0.0	0	0.015	0.0	0.0%	99.9%	0.000	0.0
Other	2.5	0.0	0	0.0375	0.0	0.0%	99.9%	0.000	0.0
Barge Unloading, filter #3 {1}									
Wheat	1.0	0.50	2,062,139	0.15	154.7	0.0%	99.0%	1.547	153.1
Barley	1.0	0.0	0	0.15	0.0	0.0%	99.0%	0.000	0.0
Other	2.5	0.0	0	0.375	0.0	0.0%	99.0%	0.000	0.0
Internal Handling									
Wheat	1.0	2.0	8,248,556	0.08	329.9	0.0%	99.9%	0.330	329.6
Barley	1.0	2.0	0	0.08	0.0	0.0%	99.9%	0.000	0.0
Other	2.5	2.0	0	0.2	0.0	0.0%	99.9%	0.000	0.0
Bin loading vents {2}		Assumes one-time in & out of bin							
Wheat	1.0	1.0	4,124,278	0.005	10.3	0.0%	72.3%	2.852	7.5
Barley	1.0	1.0	0	0.005	0.0	0.0%	72.3%	0.000	0.0
Other	2.5	1.0	0	0.0125	0.0	0.0%	72.3%	0.000	0.0
Ship Loading, filter #17			{3} fraction of dust captured by pneu. system =				0.50		
Wheat	1.0	1.0	4,124,278	0.1	206.2	0.0%	50.0%	103.21	103.0
Barley	1.0	1.0	0	0.1	0.0	0.0%	50.0%	0.00	0.0
Other	2.5	1.0	0	0.25	0.0	0.0%	50.0%	0.00	0.0
						ship loading sub-total =		103.21	
Dust load-out		0.18%	7,510	0.03	0.11	0.0%	30.0%	0.08	0.0
						Total PM-10 (tons/yr) =		**108.03**	609
	Dust / grain shipped =		0.18%			TSP emissions =		432.1	2,435
									0.324

{1} Barge unloading control efficiency is 99.0% based on less effective capture compared to rail car unloading.
{2} Bin vents connected to pneumatic system (126) credited with 99.9% control efficiency, while uncontrolled vents (remaining 48) are assumed to emit all PM-10 generated, i.e. 0% control efficiency; avg. = 72.3%.
{3} 50% capture fraction is a guesstimate based on observed loading operations.

Table 1. Fugitive Grain Dust Emissions from Ship Loading at Grain Terminals

Operational Parameters Causing Emissions	Potential Remedies	Compliance Evaluation
Height of spout above grain pile	Reduce distance between spout and grain pile by keeping head of spout on grain pile surface	Maximum height of spout above grain pile specified; visual observation of loading to confirm operation (exception at initial loading for existing short spout)
Velocity of falling grain at spout exit	Stop or slow the falling grain with baffles, diverters, etc. (choke feed) in the head of the spout	Review of equipment before installation; visual observation of grain velocity at spout exit and detailed inspection of equipment when out of service
Cascading of grain kernels down sides of steep pile	Move spout horizontally within ship's hold to prevent build up of tall grain pile with long, steep slope	Maximum height of pile in hold specified; visual observation of loading technique to confirm operating practice
Design Parameters Causing Emissions	Potential Remedies	Compliance Evaluation
Extension of spout into the bottom of hold at initial loading	Temporary attachable spout extension for use during initial loading; design modification to spout that extends the grain exit close to bottom of ship's hold	Review of equipment before installation/ modification; maximum height of spout above grain pile at initial loading specified; visual observation of loading technique
Opening of ship's hold during loading	Temporary cover over hold opening to inhibit escape of fugitive dust; conduct loading with ship hatch cover only partially open (depends on ship design)	Use of portable cover during loading specified; visual observation of loading with covers in place