AP42 Section: **9.10.2.1 Almond Processing**

Title: **Correspondence and notes to January 1995 edition**

April 28, 1994

NOTE TO: Dallas Safriet, Tom Lapp
RE: SCC codes for section 9.10.2, Almond Processing
From Ron Ryan

I have reviewed the AP-42 section and the descriptions given me for the emitting processes, and suggest the following SCCs. There are some questions to be resolved which require more knowledge of the processes than I have. Therefore, please review the following as my draft best guess only, and provide comment on how to best convey the factor information in an electonic table format such as AIRS or FIRE. The goal is to have the description (up to 70 characters) unambiguously tie to an emitting process, so that someone only slightly familiar with the industry will be able to accurately select the factors which are applicable. The SCC number and description should also allow a user to find more detail about the process in the AP-42 section. I suggest MRI use consistent nomenclature in the section and also add the SCC codes to the process diagrams to reduce ambiguity.

PROPOSED SCCs/DESCRIPTIONS

3-02-017-11 Unloading of Almonds to Receiving Pit
3-02-017-12 Precleaning of Orchard Debris from Almonds
3-02-017-13 Hull Removal & Separation of In-shell Almonds from Hull Pieces
3-02-017-14 Hulling & Shelling of Almonds
3-02-017-15 Classifier Screen Deck (removal of shells & pieces from almond meats)
3-02-017-16 Air Leg (removal of shells & pieces from almond meats)
3-02-017-17 Almond Roaster - direct-fired rotating drum

Please note and confirm or clarify the following (refer to table 9.10.2.1-1):

I have dropped the word "loading" from the description for 3-02-017-11.

The combined vent from unloading and precleaning has not been given an SCC, because both processes have already been defined separately. SCCs identify the process creating emissions, not the particular exhaust point or combinations of ducted sources at a particular site. The associated emission factor cannot go into AIRS or FIRE without an SCC. One solution is to review the data to create factors for the individual processes rather than the combined vent.

I have suggested separate SCCs for Hulling/shelling versus Hulling/separating. These are different processes, actually occurring at two different type plants. This should be made apparent in the section. Labeling the SCCs on the process diagrams would help.

I have created separate SCCs for Classifier and Air Legs, but these processes are not apparent on the process diagrams, and no distinction between them is apparent from the descriptions. Is there a distinction to be made here between hullers versus huller/sheller operations?

The throughput units will be set up as tons field weight (except for the roaster) unless I hear otherwise. (I suggest making this fact more evident in the factor column headings, rather than via the footnote.) Finish weight would be the preferred basis, and lbs/1000 lbs could be used since these SCCs are new to AIRS.

I will wait for your comments/approval before requesting any codes be established in AIRS.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ► 1

To Brian Shrager	From Ron Ryan
Dept./Agency MRI	Phone # 541-4330
Fax # 677-0065	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

April 28,

NOTE TO: Dallas Safriet, ~~Tom Lapp~~ Brian Shrager
RE: SCC codes for section 9.10.2, Almond Processing

I have reviewed the AP-42 section and the descriptions given me for the emitting processes, and suggest the following SCCs. There are some questions to be resolved which require more knowledge of the processes than I have. Therefore, please review the following as my draft best guess only, and provide comment on how to best convey the factor information in an electonic table format such as AIRS or FIRE. The goal is to have the description (up to 70 characters) unambiguously tie to an emitting process, so that someone only slightly familiar with the industry will be able to accurately select the factors which are applicable. The SCC number and description should also allow a user to find more detail about the process in the AP-42 section. I suggest MRI use consistent nomenclature in the section and also add the SCC codes to the process diagrams to reduce ambiguity.

PROPOSED SCCs/DESCRIPTIONS

3-02-017-11 Unloading of Almonds to Receiving Pit
3-02-017-12 Precleaning of Orchard Debris from Almonds
3-02-017-13 Hull Removal & Separation ~~of In-shell Almonds from Hull Pieces~~ Huller from in-shell almonds (Huller only)
3-02-017-14 Hulling & Shelling of Almonds (Huller/Sheller ~~plant~~)
3-02-017-15 Classifier Screen Deck (removal of shells ~~& pieces~~ from ~~almond~~ meats) (Huller/Sheller ~~plant~~)
3-02-017-16 Air Leg (~~removal of shells & pieces~~ to separate from ~~almond~~ meats) (Huller/Sheller ~~Plant~~)
3-02-017-17 Almond Roaster - direct-fired rotating drum

Please note and confirm or clarify the following (refer to table 9.10.2.1-1):

I have dropped the word "loading" from the description for 3-02-017-11.

The combined vent from unloading and precleaning has not been given an SCC, because both processes have already been defined separately. SCCs identify the process creating emissions, not the particular exhaust point or combinations of ducted sources at a particular site. The associated emission factor cannot go into AIRS or FIRE without an SCC. One solution is to review the data to create factors for the individual processes rather than the combined vent. Data cannot be separated.

I have suggested separate SCCs for Hulling/shelling versus Hulling/separating. These are different processes, actually occurring at two different type plants. This should be made apparent in the section. Labeling the SCCs on the process diagrams would help.

I have created separate SCCs for Classifier and Air Legs, but these processes are not apparent on the process diagrams, and no distinction between them is apparent from the descriptions. Is there a distinction to be made here between hullers versus huller/sheller operations?

The throughput units will be set up as tons field weight (except for the roaster) unless I hear otherwise. (I suggest making this fact more evident in the factor column headings, rather than via the footnote.) Finish weight would be the preferred basis, and lbs/1000 lbs could be used since these SCCs are new to AIRS.

I will wait for your comments/approval before requesting any codes be established in AIRS.

Mail message jkleeman scc request-almonds

Items in Current Envelope (Tab next item)

MESSAGE

Please modify the 6-digit description for 3-02-017 from "Food and Agriculture - Peanut Processing" to "Food and Agriculture - Nut Processing", and add the following new 8-digit SCCs:

3-02-017-11 Unloading of Almonds to Receiving Pit
3-02-017-12 Precleaning of Orchard Debris from Almonds
3-02-017-13 Hull Removal & Separation from In-shell Almonds (Huller Only)
3-02-017-14 Hulling & Shelling of Almonds (Huller/Sheller)
3-02-017-15 Classifier Screen Deck to remove shells from meats
3-02-017-16 Air Leg to separate shells from meats
3-02-017-17 Almond Roaster - direct-fired rotating drum

The throughput units will be "tons field weight" for the first six SCCs. The last SCC (3-02-017-17) will have units of "tons final product".

Brian- SCC's will be set up as shown above.

Ron

5-6-94

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ► 1

To Brian Shrager From Ron Ryan

Dept./Agency MRI Phone # 541-4330

Fax # 677-0065 Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

TOTAL P.01

CONTACT REPORT--MRI Project No. 4601-08

From: Tom Lapp, Environmental Engineering Department

Date of Contact: April 15, 1994

Contacted by: Telephone

Company/Agency: Alabama Dept. of Environ. Management

Telephone Number: (205) 271-7861

Person(s) Contacted/Title(s)

Kathy Mitchell

CONTACT SUMMARY:

Ms. Mitchell was contacted to determine if any emission test data for particulate emissions from peanut processing were available from the State of Alabama. She checked the available test reports and stated that no test reports or data were available for emissions from peanut processing.

I contacted NRC. - inc.

493-4591
205- ~~792-6482~~ Joe

3-30-94

Joel Smith -- Anderson Permits Div

Alabama has been
— Air Division - have NOT
TESTED.

→ ~~EPA~~ Region

Alabama Agency → Kathy D. Mitchell
Non Hazardous Waste
Emergency Service Br.
(205) 271-7861

CH2M Hill --
~ James W. Grassiano
~ Montgomery
~ 205 279-1444

Have worked for
— American Petroleum Chemists Association —

National Report Group, Inc

Mr. Keith Adams

(703) 838-9500

Recd from Dallas
2/8/94 TC

NATIONAL PEANUT COUNCIL, INC.

1500 King Street • Suite 301 • Alexandria, VA 22314-2737
(703) 838-9500 • FAX: (703) 838-9089 • Telex: 440497 NPC DC

Quality USA

January 13, 1994

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

Dear Mr. Safriet,

Enclosed you will find letters of comment on the MRI Report "Emission Factor Documentation for AP-42, Section 6.10.2".

These are in response to a call for volunteers at a recent meeting of the National Peanut Council's Peanut Handling Committee.

As you will see, there are some concerns and corrections made by these committee members.

If we can be of any further assistance, please don't hesitate to call.

Sincerely,

H. Keith Adams
Director of Industry Services

ANDERSON'S PEANUTS
A Division Of Ala. Farmers Coop., Inc.
DIVISION OFFICE
P.O. DRAWER 420, OPP, ALABAMA 36467

12-17-93

Mr. H. Keith Adams
Director of Industry Services
National Peanut Council
1500 King Street
Suite 301
Alexandria, Va. 22314-2737

Dear Keith,

This letter is a follow-up to phone conversation we had on Tuesday, December 14th regarding the MRI report Emission Factor Documentation for AP-42, Section 6.10.2, Salted and Roasted Nuts and Seeds, Draft Report (Revision 3).

In reviewing this report especially the section dealing with the description of the peanut shelling industry there are no major points of disagreement. I do feel the writer could have used terminology that better describes our industry today.

The flow diagram (Figure 6.10.2.2-2) although simple in illustration does do an adequate job of identifying our industry PM emission points.

The statement on page 12 under Section 6.10.2.2.3 Emissions and Controls that says No information is currently available on emissions or emission control devices for the peanut processing industry is hard to believe since we have air permits for our plants today.

If you have questions or need additional assistance regarding this matter please let me or John Reed know.

Sincerely,
Anderson's Peanuts, A Div. of AFC

L. Joel Smith

c: John Reed- Anderson's Peanuts

Planters LifeSavers Company
Winston-Salem NC 27102
(919) 741-2000

Fax Cover Page

TO: Keith Adams

LOCATION: NPC

FAX NO.: 703-838-9089

FROM: Ed Holloway

DATE: 12/20/93

PAGES TO FOLLOW: 2

SENT FROM: 910-741-5706

SUBJECT/COMMENTS:

MRI Report Review

Planters LifeSavers Company

1100 Reynolds Blvd.
Winston-Salem, NC 27102

December 20, 1993

MRI Report Review

AP-42 is an industry guide to pollution emission factors for specific processes or operations. PLS uses AP-42 information when preparing permit applications for air pollution sources and emission control equipment.

Technical Merit

The report is intended to address air emissions from all operations associated with nut meat production. However, the document is based solely on limited and questionable quality air emission data from almond processing.

The general process descriptions presented in Section 2 are only partially representative of our plant operations. To provide our process descriptions would likely not gain us a competitive advantage, in fact, we might be giving away proprietary information.

Section 2.3 concerning emissions presents a hypothesis that roasting of almonds is a potential source of volatile organic compound (VOC) emissions. This assumption is carried over to peanut processing based on process similarities. The point to emphasize is that no chemical characterization data is available to identify what compounds could be emitted nor is there emission source test data available to quantify these potential emissions.

Section 3 presents data review procedures and EPA quality rating systems applied to the data and emission factors developed from the reviewed data. Based on the data quality rating system discussed in Section 3.2, data with a rating of less than A or B should not be utilized for determining emission factors. Ratings less than A or B represent tests based on untested or new methods and unacceptable methods. Emission factor quality ratings discussed in Section 3.3 specify the quality of the emission factors developed from analysis of test data. Ratings less than C appear to be of questionable value based on the quality of the test data, representativeness of the test sample pollution or variability within the emission sources.

Pollution emission factor development (Section 4) is based on only three (3) reports containing information suitable for development of particulate matter (PM) emission factors. These reports apparently identified the complex and variable air stream handling practices. The four cited references (from the three reports) contained data with a quality rating of C to D, with data from two references being cited as be not suitable for emission factor development. These ratings mean that the test data is based on either untested or unacceptable methods.

Emission factors developed for total PM were rated E (poor) by the EPA quality rating system. PM-10 emission factors were developed based on particle size distribution data rating of C to D since no reliable direct measured PM-10 data was found for review. The resulting PM-10 emission factor was rated E (poor).

MRI has recommended adopting PM and PM-10 emission factors based on the reviewed test data. The data quality is questionable as evaluated by EPA quality rating system. I disagree that the recommendation to adopt the proposed emission factors based on the poor quality ratings derived from the use of EPA's own rating system.

Policy Implications

The potential implications of this draft report being adopted as actual emission factors could include concerns such as the following:

- Potential need to conduct emission testing for PM and VOC's for peanut roasting operations to characterize and quantify actual emissions.
- Increased cost of nuts from suppliers based on tighter regulatory control of their operations.
- Potential need to permit emissions currently grandfathered (i.e. emission parts not currently required to have emission permits).
- Potential impact on peanut industry's public image as people learn that peanut processing potentially produces air pollution.
- High potential capital costs to install control equipment on roasting emission points if VOC emission testing indicates the need for such.

Based on our review of the draft report by MRI, PLS will work with the National Peanut Council and others in providing public comment on the proposed emission factors.

EH-1/asp

WILCO PEANUT CO.

P.O. DRAWER B • PLEASANTON, TEXAS 78064 ★ (210) 569-3808 • FAX (210) 569-2743

December 14, 1993

Mr. John Reed
Chairman, Peanut Handling Committee of
The National Peanut Council

FAX 205-493-7767

Dear John,

I have read the section of the MRI report Emission Factor Documentation for AP-42, Section 6.10.2, Salted and Roasted Nuts and Seeds, Draft Report (Revision 3) dealing with shelling of peanuts. This description of shelling is found on page 9, paragraph 2.2.1.3 Shelling -.

The flow diagram (Figure 2-2.) is on page 10. In order to more accurately reflect the terminology used in the industry today, I would suggest that the center block [Roll Crushing] be titled [Shelling]. I don't believe any of the rest of the flow diagram needs to be changed.

The second paragraph could more accurately describe normal processing practice if the first two sentences were deleted. The third sentence could be modified to read "A horizontal drum with a perforated and ridged bottom and rotating beater is used to shell peanuts."

The third paragraph, last two sentences, could be modified to read "The sized and graded peanuts are bagged or boxed for shipment or shipped in bulk hopper cars or trailers to end users, such as peanut butter plants and nut roasters."

If you would like me to work further on this or visit with other members of the committee, please let me know.

Sincerely,
WILCO PEANUT CO.

Byron Warnken

peanuts for reuse. The nuts are then dried and powdered with talc or kaolin to whiten the shells. Excess talc/kaolin is shaken from the peanut shells.

2.2.1.3 Shelling—

A typical shelled peanut processing flow diagram is shown in Figure 2-2. Shelling begins (1) with separating the foreign material using a series of screens, blowers, and magnets. The cleaned peanuts are then sized using screens (size graders) to separate desired sizes. Sizing is required so that peanut pods can be crushed without also crushing the peanut kernels.

Next, the shells of the sized peanuts are typically crushed by passing the peanuts between rollers that have been adjusted for peanut size. The gap between rollers must be narrow enough to (2) crack the peanut hulls, but wide enough to prevent damage to the kernels. A horizontal drum with a perforated and ridged bottom and rotating beater is also used to hull peanuts. The rotating beater crushes the peanuts against the bottom ridges pushing both the shells and peanuts through the perforations. The beater is adjusted for different sizes of peanuts to avoid damaging the peanut kernels. Shells are aspirated from the peanut kernels as they fall from the drum. The crushed shells and peanut kernels are then separated using oscillating shaker screens and air separators. The separation process also removes undersized kernels and split kernels.

Following crushing and hull/kernel separation, peanut kernels are sized and graded. Sizing and grading can be done by hand, but most mills use screens to size kernels and electric eye sorters (3) for grading. Electric eye sorters detect discoloration and separate peanuts by color grades. The sized and graded peanuts are bagged in 45.4-kg (100-lb) bags for shipment to end users, such as peanut butter plants and nut roasters. Some peanuts are shipped in bulk in rail hopper cars.

2.2.1.4 Roasting—

Roasting imparts the typical "peanut" flavor many people associate with peanuts. During roasting, amino acids and carbohydrates react to produce tetrahydrofuran derivatives. Roasting also further dries the peanuts and causes them to turn brown as a result of peanut oil staining the peanut cell walls. Following roasting, peanuts are prepared for packaging or for further processing into candies or peanut butter.

There are two primary methods for roasting peanuts: dry roasting and oil roasting.

Dry roasting—Dry roasting is done on either a batch or continuous basis. Batch roasters offer the advantage of adjusting for differences in moisture content of different peanut lots from storage. Batch roasters are typically natural gas-fired, revolving ovens (drum-shaped). The rotation of the oven continuously stirs the peanuts to produce an even roast. Oven temperatures are approximately

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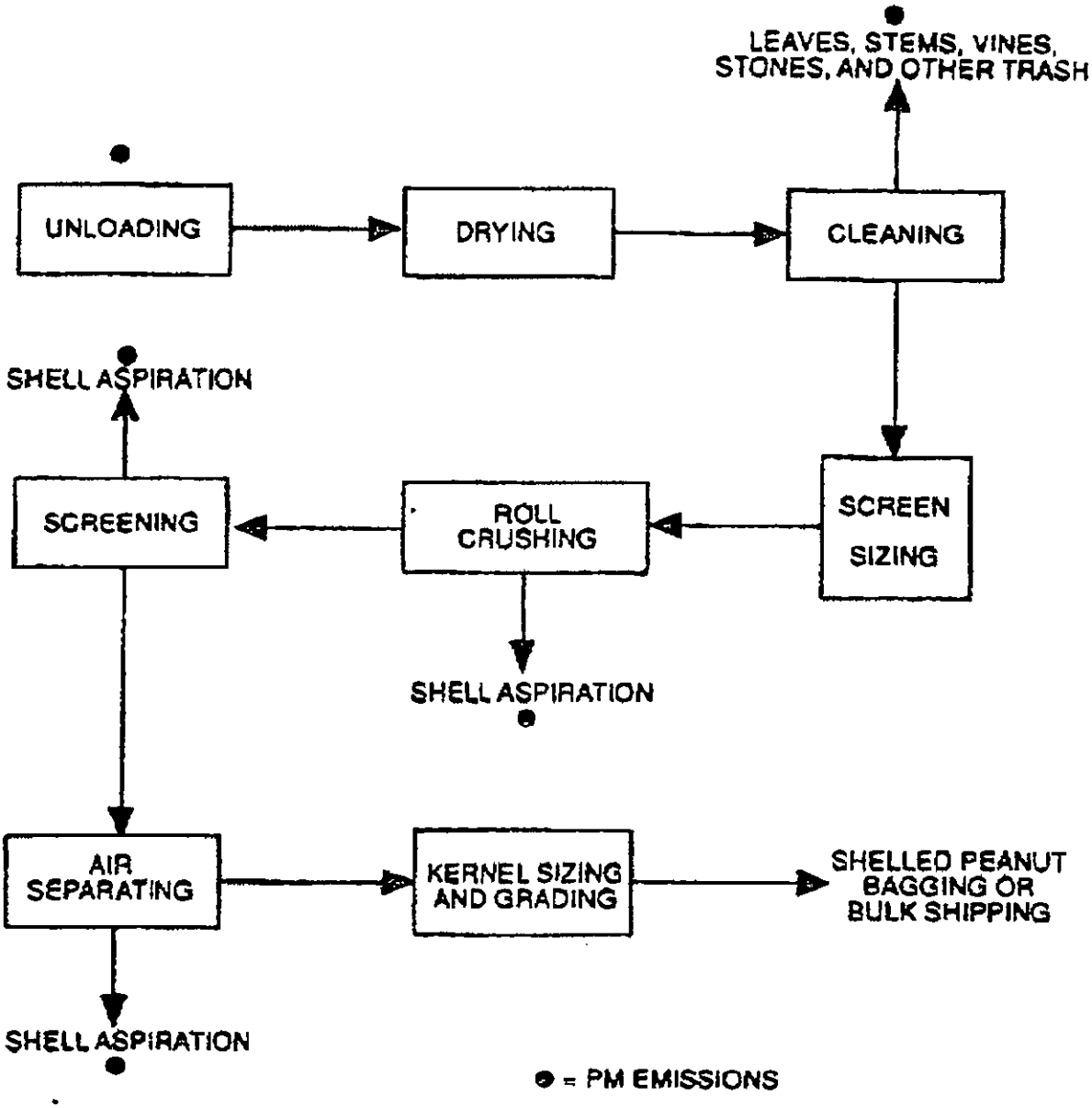

Figure 2-2. Typical shelled peanut processing flow diagram.

Recd from Dallas 2/8/94 tr

PEANUT BUTTER AND NUT PROCESSORS ASSOCIATION

9005 Congressional Court
Potomac, MD 20854
Fax: (301) 365-7705

RUSSELL E. BARKER
Managing Director
(301) 365-2521

JAMES E. MACK, CAE
General Counsel
(301) 365-4080

January 24, 1994

Mr. Dallas W. Safriet
Environmental Engineer
Emission Inventory Branch (MD-14)
Office of Air Quality Planning
and Standards
United States Environmental
Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Safriet:

Thank you for the fine cooperation you have provided regarding the reports you have developed in draft form, "Section 6.10.2, Salted and Roasted Nuts and Seeds" which will be published as a supplement to *Compilation of Air Pollutant Emission Factors*. Especially we appreciate your making available a sufficient number of the documents so that each Active member company might have the opportunity to review it. Interestingly and somewhat surprisingly, to date we have received only minimal reaction which suggests that the members are not disturbed by it. At the business meeting of Active member company Official Representatives at the annual convention last week, the subject was discussed. Again, the reaction was most restrained. Some of the members of this Association are very small companies and do not have technical personnel to make an evaluation. Quoted below is the text of one of the responses received.

> "In reference to the Air Pollutant Emission Factor report issued to Dallas W. Safriet, we cannot confirm or dispute the data as presented. We do not totally understand why this study was conducted. We assume it will simply be used as a data base to evaluate total environmental loads. We do not have any comments on this particular report at this time."

It is believed that the foregoing is generally representative of the thinking in the industry at this time. As of now we have not received any adverse comment. During the next few weeks I will be traveling, however my associate, Russell Barker who is Managing Director of the Association, will write you in further regard to the matter, although I suspect it is likely that it will be a reaffirmation of the content of this letter.

Sincerely,

James E. Mack

JEM:rma

Recd 3/4/94 TC

PEANUT BUTTER AND NUT PROCESSORS ASSOCIATION

9005 Congressional Court
Potomac, MD 20854
Fax: (301) 365-7705

RUSSELL E. BARKER
Managing Director
(301) 365-2521

JAMES E. MACK, CAE
General Counsel
(301) 365-4080

February 17, 1994

Mr. Dallas W. Safriet
Environmental Engineer
Emission Inventory Branch (MD-14)
Office of Air Quality Planning
and Standards
United States Environmental
Protection Agency
Research Triangle Park, NC 27711

Dear Mr. Safriet:

This letter is in further reference to the report you have developed in draft form, "Section 6.10.2, Salted and Roasted Nuts and Seeds" which will be published as a supplement to *Compilation of Air Pollutant Emission Factors*, and the correspondence of James Mack, most recently, his letter of January 24, 1994. Mr. Mack is, as noted in his letter, traveling at this time, and I am writing to advise you of comments we have received since January 24.

Quoted below are portions of additional responses:

> "...Interestingly, in reviewing the peanut portion of the write-up, it came to mind that both weather conditions, planting, and harvesting under certain moisture conditions may create as much particulate matter in the air as the direct processing. Regardless, what is put back into the air is predominantly the product from the ground and soil. Can't imagine it to be a major problem."

> "The Emission Factor Documentation ... basically states that practices of combining and controlling specific exhaust stream from various operations within the hullers and shellers vary considerably among facilities. They also state that out of approximately 350 almond huller/shellers, no two are alike.

...A poor emission factor means that the test data is average or below average with reason to suspect that facilities tested did not represent a random sample of the industry. There also may be evidence of variability within the source category population.

Another important point is the variation in reporting the processing rate. Early emission factors were based on pounds particulate per field weight ton. Field weight includes nuts plus orchard debris, including leaves, twigs, soil and stones, which varies among facilities. Later results were obtained by using tons of finished almonds. Plus, no reliable direct PM-10 measured data (Method 201 or 201A) were found for the almond processing industry. They actually calculated PM-10 emission based on particle size distribution data."

We appreciate the opportunity to respond to this report and want to thank you for your cooperation. Please contact me directly if you have any questions, or if I can be of further assistance.

Sincerely,

Russell E. Barker

REB:rma

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

Ms. Wendy Eckley
Eckley Engineering
Suite 105
255 North Fulton Street
Fresno, California 93701

Dear Ms. Eckley:

Enclosed for your review is the second draft version of Section 6.10.2, Salted and Roasted Nuts and Seeds, that we proposed to publish in a supplement to AP-42, *Compilation of Air Pollutant Emission Factors*, by early 1994.

As you probably know, AP-42 is widely used by the United States Environmental Protection Agency, State and local air pollutant agencies, and industry to develop emission estimates for particular sources when source specific data are not available. It is increasingly used in a variety of air quality management applications, including inventories, modeling, new source review, and operating permits. However, it is important that information published in AP-42 have as sound a technical basis as possible.

In order to meet our deadlines, we would appreciate receiving any comments you may have no later than December 20, 1993, which allows approximately one months for your review. If you have more recent data or information which can be included in this section, please submit it on the same schedule, and we will make every effort to review and include it in the section.

Please direct reviews, comments, and questions you may have to me. My address is United States Environmental Protection Agency, Emission Inventory Branch (MD-14), Research Triangle Park, North Carolina 27711. My telephone number is (919) 541-5371.

To: Dallas Safriet
EPA
919.541.0684

ECKLEY ENGINEERING
205 North Fulton Street
Fresno, California 93701
Phone (209) 233-1217 FAX 209.233.5756

July 7, 1993

MEMO

After talking with you this morning, I called Jim Ryals.

He informed me that you had told him that EPA had no interest in almond hulling and had no intention of using the AP-42 revision at all; therefore, you didn't care whether the information was accurate or not.

His explanation (attributed to you) was that since virtually all almonds were grown in one state, the federal regulators weren't interested in getting involved, but would rely on California to police itself.

He also told me the people he had appointed to study the draft. After hearing the names, I wish to repeat that our office has no interest in being part of careless or fraudulent work.

I am sending part of the critique I wrote two weeks ago. It is only a small fraction of what I had hoped EPA would want. We have developed emissions factors for varying types of shellers and hullers that have been used in California for permitting modifications and new construction, and for ERC applications.

The only way meaningful numbers can be provided is by producing pounds emissions per tons processed. There is too much to explain on how to develop these factors for this industry to try forcing the information on anyone who is not interested.

If you are not just "checking off an assignment" (as Jim Ryals said), I will be happy to share the test data, calculations, and other pertinent information.

wke

2.2.2
It does not appear to me that any distinction between hulling and shelling is made. Some facilities remove just the hull and sell in-shell almonds; other facilities remove the hull and shell and sell meats. In turn, the hulls are sold, often for the manufacture of cattle and horse food; the shells may be sold to co-generation plants for fuel.

In 2.2.2.2 [After the almonds are hulled, they are ready for further processing (roasting and salting) or raw consumption] the implication is clear that roasting and salting are performed in the shell or that we all consume the shells, roasted or raw. Pistachio's are, in fact, roasted and salted without shelling, but NOT almonds.

In Figure 2.1 I do not see anywhere the shell is discussed. I am inclined to think that the authors do not realize that the meat is covered by a shell, and the shell is covered by a hull.

Let's skip to Reference 9 under 4.1. I provided the flow diagram of the Kerman facility (*EE Drawing D475A*) and discussed it with MRI people. They quoted from it in this draft (2-10), proving that they have it.

Under 2.4, the cyclone emission of 0.1 gr/dscf is true of some of the cyclone collector data we sent MRI. The range from 18 cyclones in four counties and seven facilities was from 0.0019 to 0.6729 gr/dscf. The pounds/field-weight ton processed PER SYSTEM (which is NOT the same as an emission factor per ton processed) was, in pre-cleaner cyclones from 0.152 to 1.388. In huller/sheller cyclone systems the range was from 4.120 to 0.085 pounds per meat ton processed. But I don't think any of the MRI people understand that those figures alone do NOT tell anything about the total emissions per ton.

To develop that emission factor, a flow diagram of each facility is needed. The airflows through EACH emission point have to be calculated along with the process rate and the grain loading. A facility may have multiple cyclones, a baghouse, and a multitude of airlegs venting to atmosphere. I provided MRI with the spreadsheet of testing we performed on seven airlegs at a Butte County facility. The range in pounds/hour emitted was from 0.0396 to 0.2859; in gr/dscf the range was 0.00079 to 0.2442.

I have calculated complete facilities' emissions and emission factors, but recall sending only one to MRI.

The sentence that starts "For high flow rates..." is misleading and wrong. It is excerpted from the 1974 CARB report and is totally non-sensical in terms of engineering. It is based on a "theory" that has

long since been discredited. Don't lend credence to a myth by perpetuating it, please. A properly designed, fabricated, and operated control device can be extremely efficient. High flow rates are not a factor.

Under 2.3, I have no idea why the statements are made as they are. We tested for metals and both total and crystalline silica. I have the certified lab reports for thirteen samples and the emissions factors as submitted to CARB and to all concerned APCD's for AB-2588 reporting. I don't recognize "small" as a scientific term, but the substances and their values follow:

Air Toxic	Pounds of toxic/pound of emissions
Arsenic	$2x10^{-6}$
Beryllium	$2x10^{-7}$
Cadmium	$3x10^{-6}$
Copper	$1x10^{-4}$
Lead	$4x10^{-5}$
Manganese	$5x10^{-4}$
Mercury	$5x10^{-11}$
Nickel	$3x10^{-5}$
Crystalline Silica	$7x10^{-3}$

Of the metals, only Cu, Pb, Mn, and Ni were found in all samples.

"The source of these metals....." is an irresponsible sentence. There are many sources besides the soil - fertilizers, sprays, elements picked up through the tree roots from both soil and water. Botanists realize that each plant has a propensity for certain substances. That is why planting oleanders around selenium-laden ponding basins has been considered. Cotton plants "attract" (to be facetious in word choice) arsenic, and so on.

The second sentence in 2.3 isn't true either. There are uncontrolled emission points in some almond facilties, just as there are in some cotton gins.

The last sentence in 2.4 is the type of irresponsible writing that makes me wonder why I care about helping. In the CCAGA test cited, the three runs showed PM_{10} to be 47%, 100%, and 21%. In the Particle Measurement Technology data in which a microprocessor controlled sonic siever was used to separate and collect the sample fractions from one of our airleg tests, only 0.4% of the sample was less than 10 microns and 3.1% fell into the range between 10 and 20 microns. It has been known (and published) for years that even baghouse emissions are NOT all PM_{10}, but one still finds statements like the "it might be expected" one in 2.4. I am always tempted to ask: "By whom?"

If the MRI people can't grasp the concepts involved, how can you possibly publish meaningful numbers? If nobody in MRI or EPA realizes that the nutmeat is surrounded by a shell and the shell is encased in a hull, how can they even begin to write about almond hulling/shelling? If there is no understanding that there must be a units emissions/units processed (e.g. pounds/meats-ton, pounds/bale) to discuss the subject sanely, how can you even generate meaningful AP-42's?

Somebody has to understand the process - no matter whether that process in in hullers or gins or anything else. The two most blatant flaws in the cotton gin AP-42 are so obvious that fifth-graders could spot them with only a few sentences explanation - one is a misprint and one is just utter nonsense. And yet, the gin numbers have been used for years with all of the conflicting data being almost universally ignored.

GIGO may be used for computers, but it applies equally to human minds. Can't we at least correct the most obvious errors? We've spent several years digging out material; analyzing source tests and publications; and performing research, testing, and modifications. We have documented information galore, especially on gins and hullers.

Even if Jim Ryals quoted you correctly, and EPA has no interest in a process that is limited to California, that is not justification for knowingly publishing an inaccurate document that will be used to determine whether facilities survive. Under current legislation, a facility must provide offsets in order to perform modifications that increase emissions. The cheapest way is to clean-up existing emissions enough to allow the increase. But because of the demand for meats (rather than in-shell product), many hullers are having to add shelling lines or to go out of business. AP-42's have enough influence that a carelessly written one could, in fact, cause decisions to be made that cause companies to fold.

After talking at length with involved people today and learning that they are planning to invite you to California to observe hulling, shelling, and processing operations, I would like to offer to make our records available to you. We have collected data from many sources, established the pooled source test and reporting figures for AB-2588, performed two major surveys and extensive testing, reduced the data, and worked with the regulatory agencies in permitting and air toxics recording. We also have designed equipment for a number of ag related fields. Our drawing and disk package of plans and specifications for 1D-3D cyclone collectors with low turbulence inlet transitions we make available to anyone throughout the country at no charge (although, since requests are becoming more frequent, I plan to ask a small fee to cover postage and printing). Since we don't sell any equipment, nor do we accept any percentage from manufacturers (as most engineers and architects do), we are not reimbursed for any of this educational work with regulatory agencies.

Let me make one more effort to communicate with you. If it is true, as Jim Ryals insists you told him, that you really don't care what you publish because almond hulling is limited to one state, then admit it. If his statement is not true, then try to understand the process.

You must be made aware that the process rate is normally an estimate given to the source testing technicians, whether or not it is published in the lab report. The source testing company takes no responsibility for its accuracy. On our CCAGA test we recorded the actual weights at unloading; therefore, the field weight processed is accurate. One of the most common ways to change the emission factors is to use inaccurate process rates/weights.

Without a flow diagram of a facility, there is no way to develop an emissions factor. All emissions points must be accounted for. On the 1974 CARB tests we have no way of knowing how many cyclones were in each pre-cleaner system, for example. The information is only given per cyclone. We also have no knowledge of other emissions points, such as airlegs. Look at the Butte Co. flow chart: it has one cyclone for the pre-cleaner, one from the huller, and one serving both. It also has seven airlegs from the huller, six of which vent directly to atmosphere.

Now look at items 1023, 1028, 1031, 3014, and 3022 on the two cyclone print-out sheets from the testing we did last fall. Those systems have from three to ten cyclones each. If a source test by the CARB approved testing lab had been performed, the data would have been printed as gr/dscf, pounds/hour, and, IF the management gave the lab process numbers (right or wrong), as pounds/ton processed.

BUT THE POUNDS/TON PROCESSED WOULD APPLY TO ONLY ONE CYCLONE! If the only emissions point in that pre-cleaner were one cyclone, the number could reflect emissions. If there were multiple cyclones on a splitter serving that pre-cleaner, the number would be wrong. By the same token, the labs are printing "pound/bale" figures for cotton gins BUT WITH RESPECT TO ONLY ONE OF MULTIPLE CYCLONES ON A SPLITTER. The unsophisticated engineer writing permits for an air district, assumes "pounds/bale" means pounds/bale. The practice is misleading at best.

With respect to flow rate, there is even more confusion. Roughly five tons must run through a pre-cleaner to produce one ton of meats. That means that to generate a pounds/meat-ton emissions factor, five times the pre-cleaner factor must be added to the huller-sheller factor. But only about 70% of the material coming into a plant enters the huller and only about 30% enters the sheller. Because there is no way to weigh the intermediate process, it is necessary to calculate from both ends towards the middle to develop an emissions factor. We can determine field-weight; we can determine end-product weight (whether it is in-shell or meats). I have developed a series of equations to make these calculations easier and given them to interested air quality engineers.

Example of illustrated problem w/ interpreting source tests. The unsophisticated air quality engineer would assume a meaning not justified.

	Run #1	Run #2	Run #3	Average
Total Particulate				
gr/DSCF	0.0130	0.0124	0.0113	*0.0122*
lb/hr	0.45	0.43	0.39	*0.42*
lb/Bale	0.04	0.04	0.04	*0.04*
Particule Size Distribution				
+10µ (%)	57.08	62.74	73.10	*64.31*
+10µ (lb/hr)	0.26	0.27	0.29	*0.27*
+10µ (lb/Bale)	0.02	0.03	0.03	*0.03*
-10µ (%)	42.92	37.26	26.90	*35.69*
-10µ (lb/hr)	0.19	0.16	0.10	*0.15*
-10µ (lb/Bale)	0.02	0.01	0.01	*0.01*

Final facility (FF)
See bottom line

Calc sheet FF
Flow chart, raw data, etc. available

Est. airleg emissions

3 ea 48"

$$\frac{(3)(48)(12)(1200)}{144} = 14,400 \text{ cfm}$$

average gr/ft³ (from chart)

.00079
.00088
.00269
.00624
.00187
.00291

$\bar{x} = 0.00256$

$$\frac{(14,400)(0.003)(60)}{7000} = 0.37 \text{ lb TSP/hr}$$

$$\overset{50\%}{\underset{\text{conversion}}{=}} 0.18 \text{ lb } PM_{10}/\text{hr}$$

ave. process wt = 0.852 tons/hr

airleg emissions/ton = 0.21 lb/ton PM_{10}

Est cyclone emissions (50% conversion)

if 5 Tons held wt → 1 ton meats

cyc # 3038	5(0.143) =	0.715	lb/ton meats PM_{10}
# 1051		0.278	
# 1058		0.203	

Total PM_{10} emissions/ton meats

0.21 + 0.715 + 0.278 + 0.208 = 1.4 lb.

Pre-Cleaner Cyclones

	SYSTEM		Gr/ DSCF	DSCFM	Cyl - Cone - ϕ Inches	Field tons/hr	TSP lb/hr	TSP lb/ton
# 3008	Leaf & Dust		0.6046	4436	80 - 80 - 40	18.44	25.59	1.388
			0.7147					
			0.6994					
		$\bar{X}$=	0.6729					
# 3014	Destoner		0.0146	4752	80 - 80 - 40	18.41	1.29	0.559
			0.0485				Note: 8 Cyclones	
		$\bar{X}$=	0.0316				10.30	
# 3022	Off-Pit		0.0374	2377	80 - 80 - 40	18.34	0.70	0.152
			0.0310				Note: 4 Cyclones	
		$\bar{X}$=	0.0342				2.79	
# 3028	Leaf Aspirator		0.0450	6229	59 - 50 - 39	11.67	2.61	0.224
			0.0461					
			0.0557					
		$\bar{X}$=	0.0489					
# 3032	Sand Screen		0.1269	4289	78 - 78 - 54	21.36	5.20	0.243
			0.2284					
			0.0690					
		$\bar{X}$=	0.1414					
# 3037	Destoner		0.0472	7355	48 - 117 - 88	13.20	2.41	0.183
			0.0323					
			0.0351					
		$\bar{X}$=	0.0382					
# 3038	Pit, Deleafer, & Destoner		0.0382	7186	120 - 130 - 60	7.16	2.05	0.286
			0.0282					
			0.0333					
		$\bar{X}$=	0.0332					

Data sheets supplied to MRI previously

All documentation, raw data, etc. in our office

HULLER CYCLONES

	SYSTEM		Gr/DSCF	DSCFM	Cyl - Cone- ϕ	Meats tons/hr	TSP lb/hr	TSP lb/ton
# 1016	Gravity Table		0.0042	7079	60 - 60 - 44	2.89	0.1638	0.057
			0.0012					
		$\bar{X}$=	0.0027					
# 1017	Shell Aspirator		0.0212	2388	72 - 72 - 34	1.96	0.4514	0.230
			0.0230					
		$\bar{X}$=	0.0221					
# 1019	Huller Aspirator		0.0264	1626	72 - 72 - 34	2.89	0.3512	0.122
			0.0239					
		$\bar{X}$=	0.0252					
# 1023	2 ~ 48" Airlegs		0.0030	5027	88 - 88 - 44	2.52	0.1293	0.154
			0.0031				Note: 3 Cyclones	
		$\bar{X}$=	0.0030				0.3878	
# 1028	1 ~ 60" Meat Airleg		0.0055	2707	66 - 84 - 42	2.52	0.1114	0.133
			0.0042				Note: 3 Cyclones	
		$\bar{X}$=	0.0048				0.3341	
# 1031	8 ~ Sheller Decks		0.0645	1767	68 - 69 - 26	2.52	1.0375	4.120
			0.0725				Note: 10 Cyclones	
		$\bar{X}$=	0.0685				10.37	
# 1046	Decks		0.0016	6175	61 - 104 - 46	1.18	0.1006	0.085
			0.0018					
			0.0023					
		$\bar{X}$=	0.0019					
# 1048	Shell		0.1320	3450	78 - 78 - 56	2.09	4.1016	1.960
			0.1430					
			0.1411					
		$\bar{X}$=	0.1387					
# 1055	Huller		0.3641	2545	43 - 77 - 42	6.78	7.58	1.120
			0.3264			Note: In-shell tons		
			0.3517					
		$\bar{X}$=	0.3474					
# 1057	Shear Rolls		0.0146	3328	68 - 80 - 72	0.852	0.4735	0.556
			0.0175					
			0.0178					
		$\bar{X}$=	0.0166					
# 1058	Huller		0.0170	2842	68 - 80 - 64	0.852	0.3459	0.406
			0.0141					
			0.0114					
		$\bar{X}$=	0.0142					

Sample number	Emission point	Run number	Filter wt start (gm) (after drying)	Filter wt stop (gm) (after drying)	Filter gain (gm)	Run time (min)	Sample flow acfm	Sample grams/min collected	Sample grains/min collected	Grains/dcf	X̄ GSCF	System ACFM	System grains/hr	System pounds/hr	Destination	Assumed % emitted	Pounds/hr emitted
7	(Regenerator) 12 Airleg N	1	20.763	21.069	0.306	48	102.5	0.0064	0.09875	0.00096	0.00079	5852	277	0.0396	atmosphere	100	0.0396
11		2	21.207	21.405	0.198	48	102.5	0.0041	0.06326	0.00062							
4	12 Airleg S	1	20.622	21.019	0.397	48	106.8	0.0083	0.1276	0.00119	0.00088	6290	332	0.0474	atmosphere	100	0.0474
8		2	20.877	21.067	0.190	48	106.8	0.0040	0.0611	0.00057							
6	(Final Finish) E Airleg S	1	20.951	21.838	0.887	48	120.4	0.01848	0.2851	0.00237	0.00269	6212	1003	0.1432	atmosphere	100	0.1432
4		2	21.101	22.227	1.126	48	120.4	0.02346	0.3620	0.00301							
1	E Airleg N	1	21.278	23.730	2.452	60	89.4	0.0409	0.6306	0.00706	0.00624	5945	2001	0.2859	atmosphere	100	0.2859
2		2	20.914	22.421	1.507	48	89.4	0.0314	0.4844	0.00542							
9	Wash Airleg S	1	21.233	21.984	0.751	60	116.8	0.0126	0.1931	0.00165	0.00187	4286	481	0.0687	hull house	100	0.0687
12		2	20.951	21.862	0.911	60	111.9	0.0152	0.2343	0.00209							
10	Wash Airleg N	1	21.133	21.673	0.540	30	96.5	0.0180	0.2777	0.00288	0.00291	3700	646	0.0923	hull house	100	0.0923
13		2	21.068	21.620	0.552	30	96.5	0.0184	0.2839	0.00294							
5	Dryer	1	23.571	23.581	0.010	60	45.5	0.00017	0.00257	0.000056	0.000066	41,493	164	0.02346	atmosphere	100	0.02346
3		2	23.693	23.706	0.012	60	40.4	0.00020	0.00302	0.000076							
15	(Carrier) Sea Airleg	1	23.269	66.276	43.007	18	196.6	2.389	36.862	0.1875	0.2442	2928	42,901	6.129	hull house	3.5 (< 20 µ)	0.2145
16		2	21.420	42.524	21.104	6	196.6	3.517	54.267	0.2908							
														Σ 7 airlegs			0.8936

1992 Cyclone Collector Testing Program by County

STANISLAUS

Fraser Almond Farms
3530 Geer Road, Hughson 95326

Waterford Almond Huller & Sheller
12013 El Pomar Avenue, Waterford 95386

MERCED

Monte Cristo Packing Company
11173 W. Mercedes Ave., Livingston 95334

Swanson Hulling
19835 Fowler Road, Turlock 95380

MADERA

Minturn Huller Cooperative, Inc.
9080 S. Minturn Rd., Chowchilla 93610

BUTTE

Almont Orchards, Inc.
3108 Burdick Road, Chico 95928

Shasta Vista Almond Huller
4471 Nord Highway, Chico 95926

Central California Almond Growers Association
10910 East McKinley
Sanger, California 93657
Phone (209) 251-1050 FAX 209.251.8642
July 9, 1993

Mr. Dallas V. Safriet, Environmental Engineer
USEPA
Emission Inventory Branch (MD-14)
Research Triangle Park, North Carolina 27711

Dear Mr. Safriet:

As you requested in our telephone conversation today, I have enclosed copies of the AP-42 draft we discussed. I have made some notes and a few comments which I feel are important if reporting is to be accurate. There are great variations in the type and arrangement of almond huller/shellers, from very small family operations that service only one orchard and operate less than two weeks a year to large operations which serve several counties and operate several months a year.

I feel communication between people in our industry and government regulators is the only way to achieve fair and accurate guidelines under which to work.

With reference to our source test information used in your AP-42 draft, we did, in fact, document production rates during the times of testing. Certified weigh tickets with printed times and weights are available; the registered professional engineer who wrote the test protocol and supervised testing can stamp the tickets, if you require further verification.

Enclosed also is a stamped and signed copy of the flow diagram of our tested facility.

I would be pleased to show you a variety of facilities in our San Joaquin Valley that demonstrate the range of activity in the hulling/shelling industry with respect both to processing methods and air pollution control methods if you could arrange to visit during our season which we anticipate will begin in mid-August this year.

I look forward to meeting with you in person.

Sincerely,

Darin Lundquist
Manager

prevent charring of the peanuts on the bottom. Oil is constantly monitored for quality and frequent filtration, neutralization, and replacement is necessary to maintain quality. Coconut oil is preferred, but other oils such as peanut and cottonseed are frequently used.

Cooling also follows oil roasting so that a uniform roast can be achieved. Cooling is achieved by blowing large quantities of air over the peanuts on either conveyors or in cooling boxes.

2.2.2 Almond Harvesting and Processing

Almond processing facilities consist of ~~three~~ FIVE basic operations: harvesting, hulling Shelling ~~hulling~~ and processing, and roasting. Each is described below. Major steps are included in the process flow diagram, Figure 2-1, although differences exist between operators in nut processing and in air pollution control practices and equipment.

2.2.2.1 Almond Harvesting—

The almond harvest and process season runs from 2 to 4 months and usually starts in August. The beginning and the length of the season varies with the weather and the size of the crop.

Almonds are harvested either by knocking the nuts from each limb with a long pole or by mechanically shaking them from the tree. The almonds are swept into rows. Mechanical pickers gather the contents of the rows and load them into special trailers for transport to the almond huller. Approximately 25% of the material in the rows may be orchard debris, such as leaves, grass, twigs, pebbles, and soil.

2.2.2.2 Almond Hulling and ~~Processing~~ Shelling—

Almond processing is part of the Salted and Roasted Nuts and Seeds industry (SIC 2068). Almond hulling is the part of almond processing in which almonds are cleaned and the ~~almond nut meat is separated from the hull~~. After the almonds are ~~hulled~~, they are ready for further processing (roasting and salting) or raw consumption. Waste almond hulls are used in a variety of products as an abrasive. almond shell is used for co-generation fuel.

hulled/shelled

Inshell almonds are removed from the hull. Almond meats are then removed from the shell. (over) →

Some facilities produce In-shell almonds only.
Some facilities produce In-shell almonds first, then from the inshell produce meats.
Some facilities produce almond meats in one process removing & separating hull & shell simultaneously and separating all products.

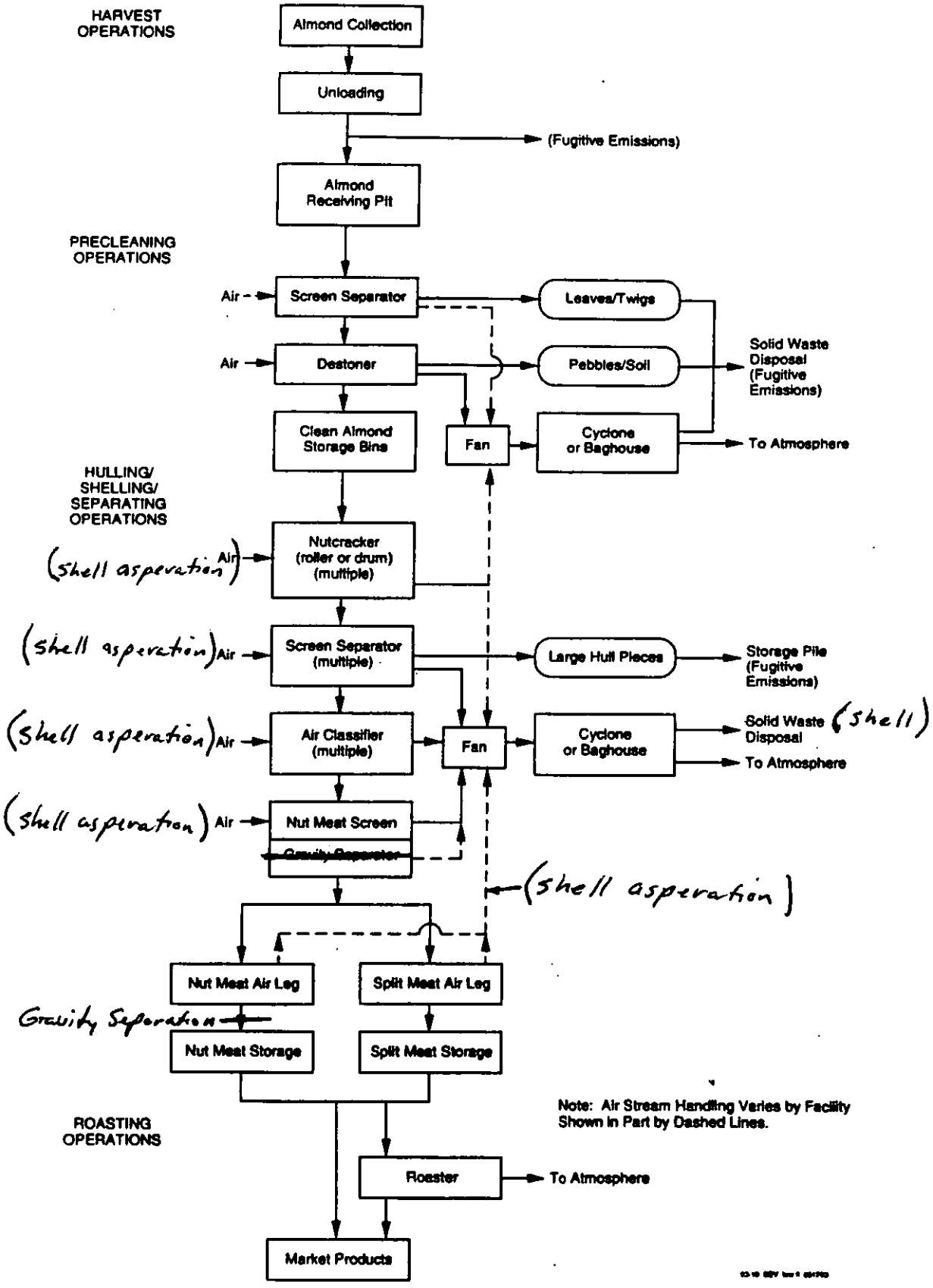

Figure 2-1. Representative almond processing flow diagram.

Precleaning—Almonds arrive at the almond hulling facility via trailers from the orchards. The almonds are loaded into a receiving hopper or trench, and transferred to a set of vibrating screens. The screens remove the orchard debris (leaves, soil, pebbles, etc.). The unhulled almonds then are conveyed to destoning units which remove stones and other larger debris. Particulate matter in the air stream from the destoning units is removed by a cyclone or a baghouse for disposal. The precleaned almonds are then stored in storage bins for further processing.

Hulling—Almonds are conveyed from the in-process storage bins on belt and bucket conveyors to sheer rollers or tined drums which crack the almond hulls. The cracked almonds are then discharged to the separating section.

Separating or Shelling—Cracked almonds are passed through a series of vibrating screens which loosen and separate hulls from the almond meat. The separating section may consist of one or more screens. The number of passes and the combinations of equipment vary from facility to facility. The screen shakes the unshelled almonds loose from their hulls and the nut meats fall to a vibrating conveyor. The remaining unhulled almonds pass through additional sheer rolls or tined drums and screen separators.

The hulled/shelled almonds (meats) and small hull pieces are conveyed on vibrating conveyor belts and bucket elevators to an air classifier that separates hull pieces from the meat. The almond meats then typically move through a series of gravity separators which sort meats by lights, middlings, goods, and heavies. Dust emitted from the sheer rollers, separating screens, and air classifier is transferred to a cyclone or baghouse for collection and disposal.

Final Processing—Almond meats are now ready either for market or for further processing, such as slicing, roasting and salting, or smoking. Small pieces may be made into meal or pastes for bakery products, etc. Roasting is done by gradually heating the almonds in a rotating drum. This process must be done slowly to prevent the skins and outer layers from burning. The flavor which develops corresponds to the color of the roast. To obtain a light brown color and a medium roast to the almonds, a 500-lb roaster fueled with natural gas would take about 1¼ h at 245°F.

Reference 9

This 1991 test focused on determination of PM-10 emissions and volumetric flow rates for two baghouses at a central California almond growers association, Kerman, California. The devices were designated as the precleaner baghouse (24-in and 60-in outlets) and the huller baghouse (22-in, 36-in, and 70-in outlets), but a process flow diagram was not provided. Sampling was performed using EPA Method 201A: PM-10 and CARB Method 1-4: Volumetric Flow Rates.

The report provided the following testing data.

	Precleaner baghouse		Huller baghouse		
	24-in duct	60-in duct	22-in duct	36-in duct	70-in duct
Airflow, dscfm	16,300	57,900	7,900	16,000	101,200
Total PM, gr/dscf	0.031		0.001		

Process rate information was not provided in the report, but a private communication from Eckley Engineering[11] revealed that field weights (uncleaned, unhulled) and 24-h almond meat production were recorded. Huller/sheller input weight of precleaned almonds was not available. This communication also indicated the precleaner baghouse test results were declared invalid because of a split in one bag. For the huller/sheller, from the sum of mean airflows, an average particulate loading of 0.0012 gr/dscf, and an almond meat production rate of 6.18 tons/h, Eckley estimated an emission factor of 0.21 lb TSP/meat ton. The factor on a field weight basis would be about one-fifth of this value, or 0.04 lb/FWT.

This reference is assigned a rating of B since it is based on a limited number of baghouses and lack of verifiable process information.

4.2 EMISSION FACTOR DEVELOPMENT

Emission factors for total particulate emissions were developed for the almond precleaning and hulling processes. Because of the substantial differences in process air stream handling between facilities, the uncertainties in much of the available data

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April 9, 1993

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

Subject: Draft Background Document for Section 6.10.2, Salted and Roasted Nuts and Seeds, EPA Contract No. 68-D2-0159, MRI Project No. 3605-M

Dear Dallas:

Enclosed for review and approval are ten (10) copies of the subject report.

The reviewers we have identified for this document are listed below. We have included form letters to request their comments.

Ms. Susan McCloud Research Director Almond Board of California P.O. Box 15920 Sacramento, CA 95852 916-338-2225	Dr. Sam Cunningham Research Director Blue Diamond Growers 1802 C Street Sacramento, CA 95814 916-446-8388
Mr. Jim Ryales, President Almond Hullers and Processors Association 3900 Braeburn Drive Bakersfield, CA 93306 805-871-2515 Fax 805-872-3830	Ms. Wendy Eckley Eckley Engineering Suite 105 255 North Fulton Street Fresno, CA 93701 209-233-1217

If you have any questions, please do not hesitate to give me a call at 816-753-7600, Ext. 449.

Sincerely,

MIDWEST RESEARCH INSTITUTE

Margaret G. Thomas

Margaret G. Thomas
Senior Resource Planner

MGT/arc

Enclosures