



NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2004-0014-2929
Navajo Agricultural Products Industry
Farmington, New Mexico

February 2004



**DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health**



PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Chandran Achutan, Ph.D., Randy L. Tubbs, Ph.D., and Daniel J. Habes, MSE, CPE, of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing was performed by Shawna Watts. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Characterization of noise exposures during agricultural operations at the Navajo Agricultural Products Industry

NIOSH received a management request from the Navajo Agricultural Products Industry (NAPI) to monitor employee noise during processing and packaging of potatoes (Fresh Pack area), making of alfalfa pellets, and working at the mechanic shop.

What NIOSH Did

- We took noise measurements on employees in Fresh Pack, alfalfa pellet operation, and mechanic shop.
- We observed work practices in Fresh Pack and the alfalfa pellet operation.

What NIOSH Found

- Employees in Fresh Pack are exposed to loud noise.
- Noise is well managed in Fresh Pack. Employees are wearing ear protection properly and at all times.
- Employees who stack boxes and sacks of potatoes have potential for low back injury.
- The alfalfa pellet mill operator and mechanics are exposed to loud noise.
- The alfalfa pellet mill operator and front loader are exposed to organic dust that may contain mold.

What NAPI Managers Can Do

- Develop a hearing conservation program for the alfalfa pellet mill operator and mechanics.
- Start a respiratory protection program at the pellet mill operation.
- Reduce the time spent continuously stacking boxes and sacks to two hours.
- Reduce the weight of potatoes in boxes and sacks in Fresh Pack.

What the NAPI Employees Can Do

- Continue to wear ear plugs in noisy environments.



What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2004-0014-2929



**Health Hazard Evaluation Report 2004-0014-2929
Navajo Agricultural Products Industry
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February 2004**

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SUMMARY

On October 1, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a management request to conduct a health hazard evaluation (HHE) at Navajo Agricultural Products Industry (NAPI), in Farmington, New Mexico. The request was to evaluate noise exposures during potato processing and packaging (Fresh Pack area), corn storage and dispensing (Granary), and equipment maintenance and other mechanical tasks at the Mechanic Shop. During the course of the investigation, NIOSH was also requested to measure noise exposure during the manufacture of alfalfa pellets. During the NIOSH visit, the granary was not operating and was not monitored. Potential ergonomic hazards were identified during the packaging of potatoes in the Fresh Pack area.

Between October 27 and 30, 2003, NIOSH investigators conducted a site visit at NAPI. Following a meeting on October 27, 2003, with NAPI's safety officers, NIOSH investigators toured the facility. On October 28 and 29, 2003, NIOSH measured noise exposure to 18 employees in the Fresh Pack area, where potatoes are unloaded from a truck, washed, sorted, and packaged for shipment. On October 30, 2003, NIOSH investigators measured noise exposure on two employees during the manufacture of alfalfa pellets, and on two mechanics from the mechanic shop.

The noise exposure assessment revealed that, of the 22 employees monitored, 6 attained or exceeded the NIOSH Recommended Exposure Limit (REL). Four of these employees were from the Fresh Pack area, and one each from the alfalfa pellet-mill operation, and the mechanic shop. Two of the six (bagger and pellet mill operator) also exceeded the Occupational Safety and Health Administration (OSHA) Action Limit (AL). NAPI has a well-managed hearing conservation program for employees in the Fresh pack area. Employees were observed wearing foam ear plugs correctly and consistently. We observed ergonomic-related issues during the packaging of potatoes and potential exposure to mold during the manufacture of alfalfa pellets.

There is a potential for excessive noise exposure in the Fresh Pack area, the alfalfa-pellet manufacturing area, and the mechanic shop. Twenty-seven percent of the employees who were monitored for noise attained or exceeded the NIOSH REL. In addition, there is an ergonomic hazard during the packaging of potatoes in the Fresh Pack area and a potential for respiratory hazards during the manufacture of alfalfa pellets. Recommendations on these issues are included in this report.

Keywords: SIC: 0723 (Crop Preparation Services for Market), 2048 (Prepared Feeds for Animals and Fowls) and 7538 (Automotive Repair/Mechanic), noise, potato packaging and processing, alfalfa pellets, mechanics, agriculture, ergonomics, mold

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INTRODUCTION

On October 1, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a management request to conduct a health hazard evaluation (HHE) at Navajo Agricultural Products Industry (NAPI), in Farmington, New Mexico. The request was to evaluate noise exposures during potato processing and packaging (Fresh Pack area), corn storage and dispensing (Granary), and equipment maintenance and other mechanical tasks at the Mechanic Shop. During the course of the investigation, NIOSH was also requested to measure noise exposure during the manufacture of alfalfa pellets. During the NIOSH visit there was no work at the granary, and this operation was not monitored. Potential ergonomic hazards were identified during the packaging of potatoes in the Fresh Pack area.

Between October 27 and 30, 2003, NIOSH investigators conducted a site visit at NAPI. Following a meeting on October 27, 2003, with NAPI's safety officers, NIOSH investigators toured the facility. On October 28 and 29, 2003, NIOSH measured noise exposure to 18 employees in the Fresh Pack area, where potatoes are unloaded from a truck, washed, sorted, and packaged for shipment. On October 30, 2003, NIOSH investigators measured noise exposure on two employees during the manufacture of alfalfa pellets, and on two mechanics from the mechanic shop.

BACKGROUND

NAPI was established in 1970 as the Navajo Nation's farming and agri-business enterprise. Approximately 60,000 of the 110,000 acres of Navajo land are cultivated. Crops grown by NAPI include potatoes, onions, pumpkins, and corn. NAPI is a main processor of potatoes for the potato chip industry.

Fresh Pack

The potato processing plant is located in a rectangular "high-bay" area measuring

approximately 200 feet by 60 feet. There are 28 salaried employees in this area. Normal working hours are between 8:00 a.m. and 4:30 p.m., Monday through Friday, with a lunch break between noon and 12:30 p.m. The major processes involved with potato processing and packaging are as follows:

Unloading

Potatoes are brought into the unloading area in trucks. They are then transferred into a storage bin, via a conveyor. Employees are positioned between the end of the truck and the beginning of the conveyor and along the conveyor to separate good potatoes from rotten potatoes, mud clods, and other debris. Unloading a truck takes approximately 30 minutes, and usually, four or five employees are involved with the process. During this survey, between four and eight truck loads of potatoes were unloaded each day. The potatoes are stored in a bin, from which they are sent to the washer. The washer is an automated process. When not unloading, employees assist with other tasks in the plant.

Sorting

Three sorting lines at this facility separate the potatoes by size and quality. The washed potatoes come off a conveyor to Sorting Line I. This sorting line is split into two lanes. Five metal bins are located between both lanes. Rotten potatoes are discarded in one of the bins, which are then transported outside the facility via a conveyor. In the remaining four bins, oversized or fused potatoes are placed for further processing. The rest of the potatoes are passed over a set of rollers that separates them by size. From there, the potatoes are sent to Sorting Line II. Potatoes are further sorted for size and quality, and sent for packaging. Potatoes discarded at Sorting Line II and the oversized and fused potatoes from Sorting Line I are further processed at Sorting Line III. At Sorting Line III, potatoes are discarded or sent for packaging. Two employees work in Sorting Line I, one on each lane. About four employees work in each of Sorting Lines II and III.

Packaging

The packaging operation includes one or two employees who assemble cardboard boxes, one who weighs boxes, two to three employees who feed boxes to the boxing line, three who stack the 50 pound filled boxes on pallets, four who fill and weigh 100-pound bags, two to three who stack the 100-pound bags on pallets, and a forklift driver who removes the stacked pallets for storage and shipment.

Manufacture of Alfalfa Pellets

The first step in the manufacture of alfalfa pellets is the grinding of raw alfalfa. The alfalfa used to manufacture pellets is sometimes moldy, and/or mixed with moldy hay. The grinder is about 20 feet high and 10 feet wide. The grinder stands vertically, part of it is on the main floor, but most of it is in a basement. Raw alfalfa is loaded a little at a time onto the grinder by a front loader, to prevent the grinder from clogging. The ground alfalfa is transported via a vacuum system to the pellet-mill, where under heat and pressure, it is compressed into pellets. The pellets are cylindrical in shape, and are cut into lengths of six to eight inches. The pellets are cooled, sieved, and transferred to storage bins via a vacuum system. The pellet-mill operation is carried out by two employees: a front-loader driver who loads the alfalfa onto the grinder and an operator who runs the pellet-mill machine.

Mechanic Shop

At the time of the survey, at least two mechanics were working in the mechanic shop. One person remained in the shop, while the other was in the field, on service calls. Tasks performed by both individuals included changing oil in trucks, repairing tires and wheelbarrows, and miscellaneous small projects.

METHODS

Noise Sampling Strategy

NIOSH investigators selected employees working in all parts of the Fresh Pack area, employees working in the alfalfa pellet-mill operation, and two employees from the mechanic shop. Eighteen employees were monitored in the Fresh Pack area over a two-day period: three unloaders, eight sorters, and seven in the packaging area. The front loader and the pellet-mill operator from the alfalfa pellet-mill operation and two mechanics from the mechanic shop were each sampled for one day. In addition, real-time, instantaneous noise monitoring was also conducted in various parts of the Fresh Pack area and the alfalfa pellet-making operation.

Noise Sampling Instrumentation

Quest[®] Electronics Model Q-300 Noise Dosimeters were worn by the employees while they performed their daily activities. The noise dosimeters were attached to the wearer's belt and a small remote microphone was fastened to the wearer's shirt at a point midway between the ear and the outside of the employee's shoulder. A windscreen provided by the manufacturer of the dosimeter was placed over the microphone during recordings. At the end of an inspection, the dosimeter was removed and paused to stop data collection. The information stored in the dosimeters was downloaded to a personal computer for interpretation with QuestSuite Professional computer software. The dosimeters were calibrated before and after the measurement periods according to the manufacturer's instructions. Real time, instantaneous noise monitoring was done by a Quest Electronics Model 2400 Sound Level Meter (SLM). The instrument was set to measure noise levels between 70 and 140 decibels, on an A-weighted slow-response scale [dB(A)]. The SLM was calibrated before and after the measurement periods according to the manufacturer's instructions.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),¹ (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),² and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).³ Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91-596, sec. 5(a)(1)]. Thus,

employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

Noise-induced loss of hearing is an irreversible, sensorineural condition that progresses with exposure. Although hearing ability declines with age (presbycusis) in all populations, exposure to noise produces hearing loss greater than that resulting from the natural aging process. This noise-induced loss is caused by damage to nerve cells of the inner ear (cochlea) and, unlike some conductive hearing disorders, cannot be treated medically.⁴ While loss of hearing may result from a single exposure to a very brief impulse noise or explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 Hertz(Hz) (the hearing range is 20 Hz to 20000 Hz) and spreads to lower and higher frequencies. Often, material impairment has occurred before the condition is clearly recognized. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Although the primary frequencies of human speech range from 200 Hz to 2000 Hz, research has shown that the consonant sounds, which enable people to distinguish words such as "fish" from "fist," have still higher frequency components.⁵

The A-weighted decibel [dB(A)] is the preferred unit for measuring sound levels to assess worker noise exposures. The dB(A) scale is weighted to approximate the sensory response of the human ear to sound frequencies near the threshold of hearing. The decibel unit is dimensionless, and represents the logarithmic relationship of the measured sound pressure level to an arbitrary reference sound pressure (20 micropascals, the normal threshold of human hearing at a frequency of 1000 Hz). Decibel units are used because of the very large range of sound pressure levels which are audible to the human ear. Because the dB(A) scale is logarithmic, increases of 3 dB(A), 10 dB(A), and 20 dB(A)

represent a doubling, tenfold increase, and 100-fold increase of sound energy, respectively. It should be noted that noise exposures expressed in decibels cannot be averaged by taking the simple arithmetic mean.

The OSHA standard for occupational exposure to noise (29 CFR 1910.95)⁶ specifies a maximum PEL of 90 dB(A) for a duration of 8 hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship, or exchange rate. This means that a person may be exposed to noise levels of 95 dB(A) for no more than 4 hours, to 100 dB(A) for 2 hours, etc. Conversely, up to 16 hours exposure to 85 dB(A) is allowed by this exchange rate. The duration and sound level intensities can be combined in order to calculate a worker's daily noise dose according to the formula:

$$\text{Dose} = 100 \times (C_1/T_1 + C_2/T_2 + \dots + C_n/T_n),$$

where C_n indicates the total time of exposure at a specific noise level and T_n indicates the reference duration for that level as given in Table G-16a of the OSHA noise regulation.⁶ During any 24-hour period, a worker is allowed up to 100% of his daily noise dose. Doses greater than 100% are in excess of the OSHA PEL.

The OSHA regulation has an additional action level (AL) of 85 dB(A); an employer shall administer a continuing, effective hearing conservation program when the 8-hour time-weighted average (TWA) value exceeds the AL. The program must include monitoring, employee notification, observation, audiometric testing, hearing protectors, training, and record keeping. All of these requirements are included in 29 CFR 1910.95, paragraphs (c) through (o). Finally, the OSHA noise standard states that when workers are exposed to noise levels in excess of the OSHA PEL of 90 dB(A), feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels.

NIOSH, in its Criteria for a Recommended Standard,⁷ and the ACGIH,² propose exposure

criteria of 85 dB(A) as a TWA for 8 hours, 5 dB less than the OSHA standard. The criteria also use a more conservative 3 dB time/intensity trading relationship in calculating exposure limits. Thus, a worker can be exposed to 85 dB(A) for 8 hours, but to no more than 88 dB(A) for 4 hours or 91 dB(A) for 2 hours. Twelve hours exposures have to be 83 dB(A) or less according to the NIOSH REL.

RESULTS

A total of 22 full-shift dosimeter samples were collected during the evaluation. The Quest dosimeters collect data so that one can directly compare the information with the three different noise criteria used in this survey, the OSHA PEL and AL, and the NIOSH REL. The OSHA criteria use a 90 dBA criterion and 5-dB exchange rate. The difference between the two is the threshold level employed, with a 90 dBA threshold for the PEL and an 80 dBA threshold for the AL. The threshold level is the lower limit of noise values included in the calculation of the criteria; values less than the threshold are ignored by the dosimeter. The NIOSH criterion differs from OSHA in that the criterion is 85 dBA, the threshold is 80 dBA, and it uses a 3-dB exchange rate. Because of the different 8-hour criteria and exchange rates, the dose equations used to calculate the equivalent TWA values are different for the NIOSH and OSHA criteria. The OSHA dose equation is $TWA = 16.61 \times \log_{10} [\text{Dose}/100] + 90$, and the NIOSH equation is $TWA = 10.00 \times \log_{10} [\text{Dose}/100] + 85$.

A summary of the personal dosimeter results is presented in Table 1. In addition, real-time, area measurements taken at various locations in the Fresh Pack and pellet-mill areas are provided in Table 2. The dosimeter also provides real-time exposure monitoring over the sampling period. Each data point represents the integrated average noise for a 1-minute period, using the NIOSH 3-dB exchange rate. Typical graphs from the survey are shown in Figures 1-4. The graphs have a lower limit of 70 dBA which is the lowest noise value the dosimeters captured.

Fresh Pack

In Fresh Pack, noise levels were below the OSHA PEL. The OSHA AL was exceeded once, and one reading (84 dBA) was close to the OSHA AL of 85 dBA. In four instances, the NIOSH REL was either attained or exceeded. In two instances, the percentage of daily dose exceeded 100%, as computed by the NIOSH formula, and in two additional instances, exceeded 90%. The percent dose was not exceeded by the OSHA computation based on the PEL criterion. Noise exposures in the packaging area were higher than those in the unloading and sorting areas. Among the packagers, the highest exposure (90 dBA) was during the packaging of potatoes in 100-pound sacks.

As shown in Figure 1, exposures among the unloaders followed a “box-plot” pattern, whereby exposures increased sharply, stayed constant during the unloading process, and then dropped sharply at the conclusion of the tasks. Smaller peaks with a rapid response time may be attributable to other tasks performed by the unloader, such as making boxes, feeding boxes to the line, etc. Noise exposures to the sorters were uniform throughout the day. A typical noise profile is shown in Figure 2.

Manufacture of Alfalfa Pellets

During the manufacture of alfalfa pellets, the noise exposure to the pellet mill operator exceeded the OSHA AL and the NIOSH REL, but was below the OSHA PEL of 90 dBA. The front loader’s exposure was below all exposure criteria, probably because he was up high in the vehicle and spent time away from the grinder. The front loader had a cab, but it was open at least part of the day. Figure 3 compares the noise exposures to both the pellet mill operator and the front loader. The pellet mill operator’s exposure was higher than that of the front loader, probably because he was right next to the mill most of the day. The noise levels by the grinder ranged from 86-105 dBA, as shown in Table 2.

Mechanic Shop

One of the mechanics in the mechanic shop (mechanic-1) exceeded the NIOSH REL, but was well below the OSHA PEL and REL. The second mechanic (mechanic-2) was below all recommended and regulatory values. Figure 4 shows the profile of the mechanic who exceeded the NIOSH REL. The profile is useful to identify tasks that result in high noise exposure.

DISCUSSION

Fresh Pack

Employee noise exposures measured during this survey were below the OSHA PEL, but above the NIOSH REL. The hearing protection provided for exposed workers (formable earplugs) was adequate to reduce exposures measured during this survey to below the NIOSH REL, provided that it is used properly and consistently. We observed good compliance with the wearing of the earplugs during the two-day survey.

Sound level measurements in various parts of the Fresh Pack area showed that noise levels were between 85 and 93 dBA. The highest noise level was recorded next to a machine guard in the sorting area. The machine guard was worn out, thus exposing the belts that are contained within the guard.

The results obtained on this survey are comparable to a similar, smaller survey NIOSH conducted at this facility in August 1998.⁸ During the 1998 survey, production was not to capacity, and there were many equipment failures, which led to a less-than-typical work environment. Nevertheless, personal dosimeter samples collected on four individuals during the 1998 survey exceeded the NIOSH REL and, in two instances, exceeded the OSHA AL. Sometime after the 1998 survey, NAPI instituted engineering modifications to the equipment to further reduce noise exposure. These modifications included rollers with ball bearings and the incorporation of elastic materials between roll structure and metal braces.

During the survey, we observed that some employees in the packaging area were involved in tasks that required heavy and repetitive lifting of boxes and sacks filled with potatoes. Repeated awkward and heavy lifting can lead to back injuries and other musculoskeletal problems. Though a comprehensive ergonomic evaluation was not done in this survey, we noted work practices and collected measurements that enabled us to conduct a limited ergonomic evaluation of the workplace.

We observed employees in the packaging area lifting 50-pound boxes of potatoes and stacking them on pallets. The pallets were usually seven boxes (70 inches) tall. Each box had cut-out handles and measured 18 inches by 11.5 inches, with a height of 10 inches. In most cases, employees were lifting the boxes using the cut-out handles. In some instances, especially when stacking the boxes high, the employees were holding the boxes vertically between the palms of their hands. We observed an employee stacking a maximum of nine boxes every 5 minutes or 90 pounds per minute. The total number of 50-pound boxes stacked by four employees during a 5-minute time span was 30.

Some employees were lifting 100-pound sacks and stacking them on pallets. Three employees stacked 31 bags, each weighing 100 pounds, during a 20-minute period. One of the three employees stacked 19 bags in 20 minutes. When broken down into 5-minute time periods, this employee stacked eight bags in one 5-minute time period, or 160 pounds per minute. To assess the health impact from heavy and repetitious lifting, we used the NIOSH Lifting Equation (NLE). The NLE is a tool for assessing the physical demands of two-handed lifting tasks. The equation provides a Recommended Weight Limit (RWL) and a Lifting Index (LI) for a lifting task, given certain lifting conditions. The RWL is the maximum weight that can be handled safely by almost all healthy workers in similar circumstances. The LI is the ratio of the actual load lifted to the RWL. Lifting tasks with an $LI \leq 1.0$ pose little risk of low back injury for the majority of workers. Tasks with an $LI > 1.0$ may place an increasing number of individuals at risk of low

back pain or injury. Many researchers believe that tasks with an $LI > 3.0$ pose a risk of back injury for most workers.⁹ NIOSH recommends that the LI not exceed 2.0 for any given task. Based on the assumptions that there is no twisting of the body during the lifts, the boxes and bags are held close to the body, and that the boxing and bagging of potatoes lasts more than 2 hours a day, we calculated an LI of 2.9 for the boxing operation, and an LI of 4.7 for the bagging operation. Both of these operations, therefore, place the workers at an increased risk for low back pain or injury.

Assuming that the boxes are stacked seven-boxes high, the LI during the stacking of 50-pound boxes on pallets can be reduced by (1) limiting the number of continuous hours that a person stacks the boxes to less than 2 hours at a time and (2) reducing the weight of potatoes in each box. By simply limiting the continuous number of hours that a person stacks boxes to less than 2 hours per lifting session, the LI can be reduced to 2.2. (The positive effect of this control measure would be maintained provided the worker is allowed to recover by resting or performing some non-lifting task for about 45 or more minutes before lifting boxes again.) By reducing the weight of the potatoes in each box from 50 to 40 pounds, the LI can be reduced to 2.3. By reducing the number of hours, and the weight of potatoes in each box, the LI can be further reduced to 1.8. Similarly, if the weight of the 100-pound potato sacks is reduced to 50 pounds, and the continuous work hours is limited to less than 2 hours at a time, the LI can be reduced to 1.8. It is assumed that the average height of the stacked sacks is 42 inches.

The unloading process can be dusty, though the dust levels are not likely to exceed any exposure criteria. Nevertheless, respirators are provided to employees who may wish to wear them. We noticed that employees wearing respirators were not doing so correctly. In one instance, an employee stuffed the top set of the respirator's bands inside the respirator. The same employee was also noticed beating a respirator on a pole to remove dust.

The forklift in the Fresh Pack area that is used to lift pallets stacked with boxes and sacks is not equipped with a back-up alarm. Backing up a forklift when the rear view is obstructed may result in injuries or fatalities. Back-up alarms are specified in the OSHA Construction Safety and Health requirements, which is covered by 29 CFR Part 1926.601(b)(4). OSHA has no requirements for back-up alarms in the general industry standards, 29 CFR Part 1910, which covers operations similar to NAPI, but injuries and fatalities that may occur as a result of operating forklifts without back-up alarms can be cited under the general duty clause [Occupational Safety and Health Act of 1970, Public Law 91-596, sec. 5(a) (1)].

Manufacture of Alfalfa Pellets

Of the two employees sampled during the manufacture of alfalfa pellets, the noise exposure to the front loader was below all exposure criteria. Thus, this employee is not required to be part of a hearing conservation program. The noise exposure to the pellet mill operator exceeded the OSHA AL and the NIOSH REL, and was close (88 dBA) to the OSHA PEL. Any employee who runs the pellet mill should be included in a hearing conservation program. The operator controls the machine operation from a control booth, which can afford adequate noise protection. The noise level on a platform outside the booth was 100 dBA, but it dropped to 80 dBA with the door partially closed. The door could not be completely closed because there was an electric cord that was blocking the opening. It would be prudent to run the wire through the wall, via a conduit, thus shutting the door completely. We also observed that the pellet mill operator spends a great deal of time outside the control booth. The process by which raw alfalfa is loaded onto the grinder generates a thick cloud of dust. Since some of the alfalfa is moldy, the dust may contain microorganisms, which if inhaled, could be detrimental to the health of the employees in the area.^{10,11}

Mechanic Shop

Of the two mechanics who were monitored, the one who stayed in the shop exceeded the NIOSH REL. His major activity during the day of monitoring was repairing a large tire from a tractor. The noise exposure occurred during the pounding of the metal rim of the tire. This repair job took approximately two hours. The second mechanic was in the field on service calls. His largest exposure to noise occurred when intermittently stepping on the gas pedal of a stationary tractor. Other tasks done by this mechanic included servicing a truck (changing oil and air filters) and changing a door handle on a tractor. The sampling duration on this mechanic was only 5-1/2 hours, because he had to leave work early on the day of sampling. The mechanics informed us that their busiest times were in spring and in summer, just prior to and during the planting and harvesting season.

CONCLUSIONS

The noise exposure assessment revealed that of the 22 employees who were monitored, 6 attained or exceeded the NIOSH REL. Four of these employees were from the Fresh Pack area, and one each from the alfalfa pellet mill operation and the mechanic shop. Two of the six (bagger and pellet mill operator) also exceeded the OSHA AL. None of the employees exceeded the OSHA PEL.

Overall, the noise exposures at NAPI are well managed. Employees who work in areas with exposure to loud noise are provided foam earplugs that reduce their noise exposure to an acceptable level. We observed that employees were wearing their earplugs properly. NAPI has a hearing conservation program for employees in the Fresh Pack area; employees are sent to occupational medicine physicians for annual hearing examinations. Also, NAPI has made engineering changes in the potato processing equipment.

We identified a hazard from lifting and stacking heavy boxes and sacks of potatoes that puts employees at risk of musculoskeletal injuries.

We also identified the potential for exposure to microorganisms from inhaling dust during the alfalfa manufacturing process.

RECOMMENDATIONS

We are making the following recommendations to make the workplace safer for all employees:

Fresh Pack

Both human speech and machine sounds contain high and low frequencies that can be distorted by conventional Hearing Protection Devices (HPD). To minimize this distortion, and to improve communication, we recommend the use of HPD that are linear and more moderate in attenuation. Examples of this include Natural Sound Technology™ or NST™, developed by Bilsom (www.bacou-dalloz.com), and the Ultra-Tech or Musician series HPD, by AEARO (www.aearo.com). These devices are available from most vendors who sell safety supplies. Grainger [(505) 327-9953], and Strategic Supply [(505) 326-3333], located in Farmington, New Mexico, are two distributors for AEARO products. Additionally, a maintenance program for noise controls need to be implemented, to assure that they continue to function as designed.

To prevent musculoskeletal injuries, we recommend reducing the weight of potatoes in the sacks and boxes to a weight not exceeding 40 pounds for the boxes and 50 pounds for the sacks. We also recommend reducing to 2 hours the maximum amount of time that an employee is continuously stacking boxes and sacks on pallets.

We recommend installing a back-up alarm on the forklift that is approximately 10 dB above the ambient noise, and fixing the machine guard.

Manufacture of Alfalfa Pellets

Enroll pellet mill operators in a hearing conservation program. We also recommend that the operator limits the amount of time spent

outside the control booth and continues to wear ear protection when outside the control booth.

The door on the control booth should be closed tightly when the operator is inside the booth. The electric cord that is currently blocking the door needs to be routed outside the booth through a conduit in the wall.

A written respiratory program based on OSHA's Respiratory Protection Standard (29 CFR 1910.134) that outlines the appropriate respirator based on the hazard, and employee training on how to wear a respirator and store it safely, should be developed and managed by a qualified program administrator.

Mechanic Shop

Employees involved with service call activities and employees in the mechanic shop who are potentially subjected to high noise levels must be included in a hearing conservation program. Alternatively, a task analysis can be carried out to determine which activities require HPD.¹²

REFERENCES

1. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.
2. ACGIH [2003]. 2003 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. CFR [1997]. 29 CFR 1910.1000. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
4. Ward WD, Royster LH, Royster JD [2000]. Anatomy & physiology of the ear:

normal and damaged hearing. Chapter 4. In: Berger EH, Royster LH, Royster JD, Driscoll DP, & Layne M, eds. The noise manual. 5th ed. Fairfax, VA: American Industrial Hygiene Association, pp 101–122.

5 Suter AH [1978]. The ability of mildly hearing-impaired individuals to discriminate speech in noise. Washington, DC: U.S. Environmental Protection Agency, Joint EPA/USAF study, EPA 550/9–78–100, AMRL–TR–78–4.

6 Code of Federal Regulations [1992]. OSHA. 29 CFR 1910.95. Washington, DC: U.S. Government Printing Office, Federal Register.

7 NIOSH [1998]. Criteria for a recommended standard: occupational noise exposure (revised criteria 1998). Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98-126.

8 McCammon J [1998]. Health hazard evaluation report: Navajo Agricultural Products Industry, Farmington, N.M. Denver, CO: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, HETA 98-0315.

9 Waters TR, Putz–Anderson V, Garg A [1994]. Applications manual for the revised NIOSH lifting equation. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Publication 94–110.

10 Merchant JA [1987]. Agricultural exposures to organic dusts. *Occupational Medicine*. 2(2): 409-425.

11 Kirkhorn SR, Garry VF [2000]. Agricultural lung diseases. *Environmental*

Health Perspectives. 108 Supplement 4: 705-712.

12 Tubbs RL [2002]. Health hazard evaluation report: Marion County Board of Education, Fairmont, West Virginia. US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, HETA 2002-0222.

Table 1
Personal Noise Dosimeter Results
Navajo Agricultural Products Industry
Farmington, New Mexico
October 27-30, 2003

Date	Department	Duration (hh:mm)	Job location	Dose (Percent)			L _{avg} (dBA)		
				OSHA AL	OSHA PEL	NIOSH/ACGIH	OSHA AL	OSHA PEL	NIOSH/ACGIH
10/28/03	Fresh Pack	07:03	Unloader-1	16.8	0.7	40.1	77.1	53.9	81.0
		06:52	Unloader-2	18.5	0.5	36.6	77.8	52.4	80.6
		07:19	Sorter-1	38.8	0.1	80.4	83.2	41.0	84.1
		07:15	Sorter-2	36.7	0.6	76.5	82.8	53.1	83.8
		07:10	Sorter-3	43.3	0.1	94.6	84.0	42.5	84.8
		07:21	Box maker	29.5	0.8	57.6	81.2	54.8	82.6
		07:01	Bagger-1	76.5	43.2	281.4	88.1	83.9	89.5
		07:02	Bagger-2	39.4	2.6	93.3	83.3	63.7	84.7
		07:01	Pallet stacking	34.6	2.2	88.2	82.3	62.5	84.5
		07:04	Plastic bag packing	30.3	0.6	61.8	81.4	52.9	82.9
10/29/03	Fresh Pack	08:06	Sorter-4	29.8	0.2	60.4	81.3	45.3	82.8
		08:05	Sorter-5	34.9	0.2	70.9	82.4	45.0	83.5
		08:13	Sorter-6	37.3	0.2	80.7	82.9	43.9	84.1
		08:12	Boxer	25.1	6.9	358.9	80.0	70.7	90.5
		08:23	Box loader-1	28.9	0.6	55.0	81.0	53.4	82.4
		08:08	Box loader-2	32.3	3.9	74.1	81.9	66.6	83.7
		07:55	Box loader-3	23.7	1.6	64.9	79.6	60.3	83.1
		08:02	Forklift driver	15.4	2.8	47.9	76.5	64.2	81.8
10/30/03	Pellet Shop	06:07	Operator	100.8	73.9	458.6	90.1	87.8	91.6
		06:12	Front loader	20.4	2.3	47.2	78.5	62.8	81.8
10/30/03	Mechanic Shop	07:06	Mechanic-1	18.2	15.1	253.1	77.7	76.4	89.0
		05:26	Mechanic-2	2.4	0.7	12.2	63.1	53.7	75.9

The various dose percentages are the amounts of noise accumulated during a work day, with 100% representing the maximum allowable daily dose. L_{avg} refers to the average noise levels measured.

OSHA: Occupational Safety and Health Administration
 NIOSH: National Institute for Occupational Safety and Health
 ACGIH: American Conference of Governmental Industrial Hygienists
 AL: Action Limit
 PEL: Permissible Exposure Limit
 dBA: Decibels on an A-weighted scale

Table 2
Area Noise Levels in Fresh Pack and Alfalfa Pellet-Making Operation
Navajo Agricultural Products Industry
Farmington, New Mexico
October 27-30, 2003

Department	Location	Noise Level [dB(A)]
Fresh Pack	Sorting Line-I	91
	Sorting Line-II	86
	Sorting Line-III	87
Alfalfa Pellets	Edge of grinder turret opening	86
	Stairway to grinder	91
	Downstairs	105
	Output end	94
	Platform next to control booth	100
	Control booth door open	87
	Control booth door closed with electric cord blocking seal	80

dB(A): Decibels on an A-weighted scale

Figure 1
Typical noise exposures for unloaders, and baggers in the Fresh Pack area

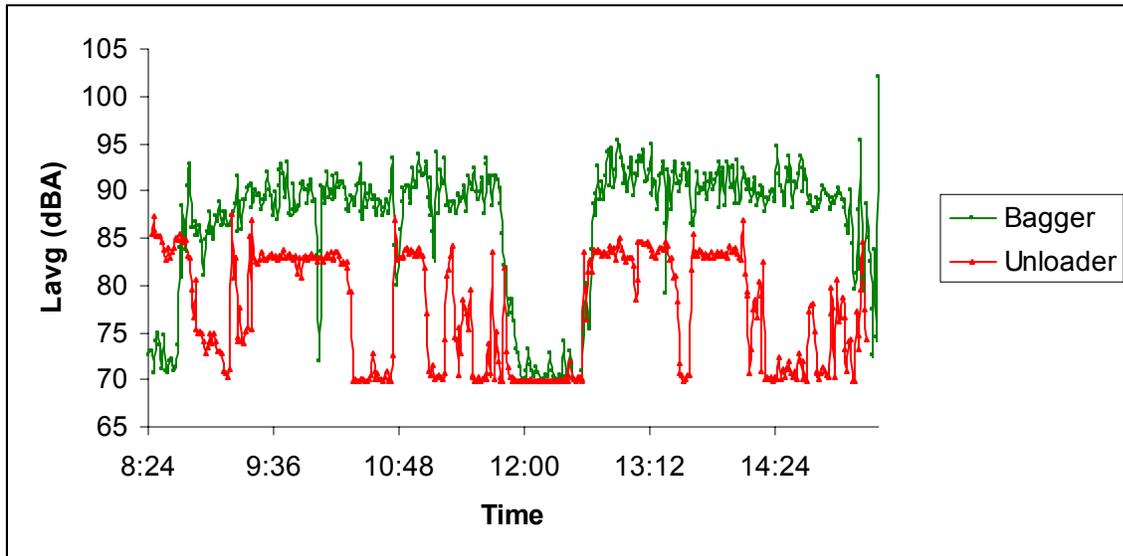


Figure 2
Typical noise exposures for sorters in the Fresh Pack area

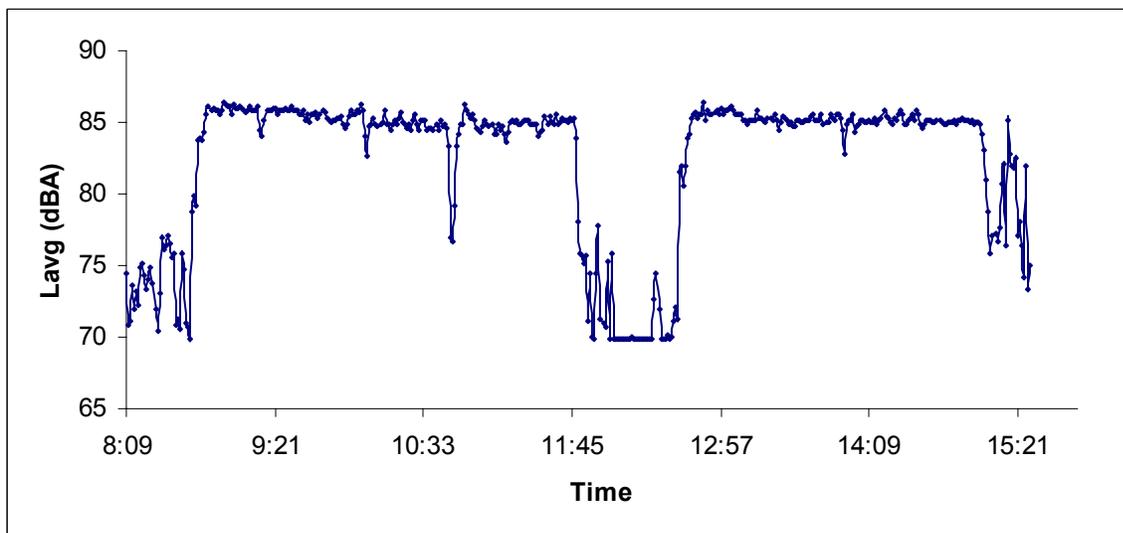


Figure 3
Profile of noise exposure to the front loader and pellet-mill operator
during the manufacture of alfalfa pellets

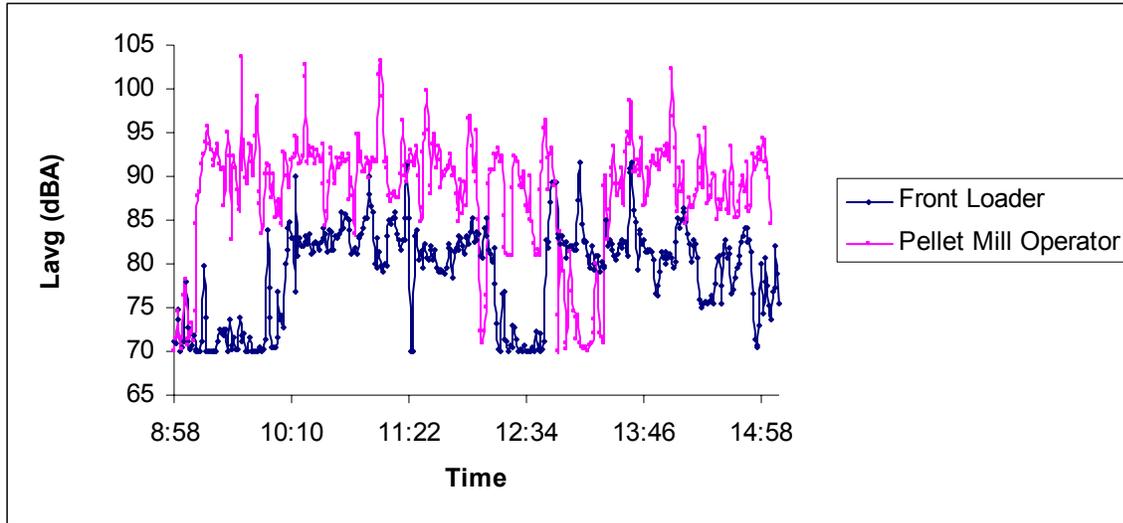
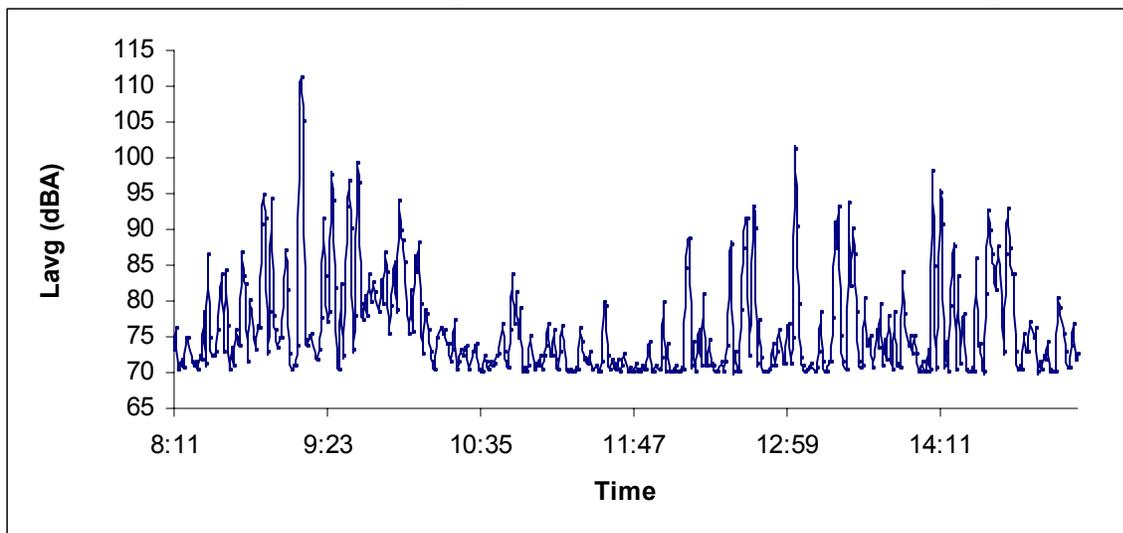
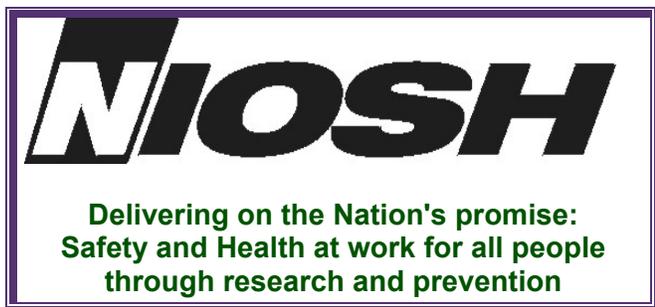


Figure 4
Profile of noise exposures to a mechanic at the Mechanic Shop



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