knows what they will be or where they will come from? Perhaps one can only do it in a somewhat Buck Rogers' fashion. Most likely we would be in error in timing or content, but we will do some of that for a little fun as we go.

We have seen innovations in agricultural equipment, the modern sound-guard body with its noise reduction, its vibration isolation, and its fatigue-reducing aspects. We have also seen roll-over protective structure (ROPS) development and the recent development of retractable or foldable ROPS for those essential applications where you must go into a building that is shorter — not as tall as your tractor's ROPS.

I would also say to those of you who wonder about ROPS that since 1985 virtually every tractor produced has been sold with a ROPS on it or right at the fingertips. Since 1970, virtually every tractor could have a ROPS put on it, and some have since 1960.

In addition, we have open-throat designs on large round balers. We have service tether systems on cotton pickers for doing the essential maintenance and cleaning functions that are appropriate for that machine.

Improvements have been prevalent as we talk about modern implement-to-tractor driveline guarding; the controls, the steering, and the brake systems; the guarding on the exterior for thrown objects and blade contact; and improvements in the area of lighting and marking. Not revolutionary, perhaps innovative, all of these changes have made an improvement in the level of safety that is being provided, and we are, indeed, making the best better.

While some may tend to associate technology transfer only with hardware, it is also appropriate to realize that technology exists in product safety software as well. That includes the safety signs, the safety messages, the human factor. Most often there is the need to deliver a compatible blend of both hardware and software.

I do not, in any way, intend to imply that we should stop doing or not do research that discovers why things work and new information. I think that is a valuable aspect of learning that we should never lose. I also believe that there will be safety impacts of any research that is not specifically aimed at safety.

For example, reduced through-put combine harvesters may reduce the entanglement potential and keep the operator away from moving machinery parts. Improved monitoring and sensing may keep the operator in the relatively protected environs of the operator station instead of out where he or she is more vulnerable.

Essentially everyone who is on the receiving end of new information about a technology is participating in technology transfer. It is not only the "what" but the "how," the product and the process, the deliverable and how it is delivered.

The Technology Transfer Process

We need to do more to improve the technology transfer process. U.S. government, universities, non-profit research organizations, industries, and others encompass an astonishing array of research capabilities. To be of greatest value, technology must be put to use. To measure its value, we must look at how well we ultimately transfer it.

Not since the Smith-Lever Act of 1914, which established the Cooperative Extension Service, has there been such interest in increasing technology transfer. It is obviously not a one-way proposition limited to dialogue between industry and the Federal government research community.

It is more than that, and it is not a simple task. It seems to me that one of the things we ought to do is understand who is doing what in the area of safety research in various parts and regions of this country.

> Sometimes equipment is in mint condition; other times it is not, or modified, or built from scratch in a local shop.

Many companies supplement their research and development on a scale not seen in the past and establish aggressive links and liaisons with the external environment. All of this serves to unite the research community with those who really must deliver a product that is attractive to the user.

Research and development expenditures are expected to be $155 billion for 1991, according to a Battelle Report. About half of that is being spent by industry and the other half, slightly less, being spent by Federal government. Industry will focus on electronics, composite materials, communications, advanced machinery, and energy-efficient products.

Defense, Energy, and Health and Human Services will dominate Federal research and development with over 90 percent of their half of the total. The same Battelle Report suggests that all agencies will be improving and enhancing their technology transfer effort.

Interest in agriculture is building. The funding looks like it is there. We are here. Our ability to transfer the technology, to transfer the research, to transfer the information needs to be built. One part of that will be the need to deliver technology, which "understands" the needs and the application. So I direct the next portion of my remarks to the needs.

The Needs

Much has been said about the National Safety Council (NSC) injury statistics. We need representative data that can be dissected and provided in a meaningful way.

That needs to be on the national agenda. The now-outdated NSC Farm Accidents surveys, conducted overlapping both ends of the 1970's decade, encompassed 127,000 farm family members and 57,000 full- and part-time workers.

The rough conclusion from those surveys still used today is an estimate that one-third of the agricultural injuries can be associated with machinery. A parallel kind of estimate is that roughly half of the agricultural fatalities are associated with machinery.

Looking at some other data, the seven state surveys that were done with support and help of NIOSH delivered a 60 percent response rate and 5,079 returns. On aggregate, approximately 11 percent of those returns reported an accident during the past 12 months.

If one looks at the composite information from these surveys, tractors and machinery total about 30 percent or one-third. Animals are second at 16.9 percent, and following that are falls on surfaces.

A 1985 study in Arkansas showed farm machinery to be involved in about 38 percent of all injuries and about 80 percent were to farm family members. Here is something you should note: three of ten, 30 percent occurred while working off the farm.

Based on narrative descriptions for the most recent injuries, these ten narratives describe roughly 80 percent of the experience reported in those NIOSH- supported and state-run surveys. Livestock handling topped the list at 19.4 percent, machinery at 13.4 percent, and falls or slips from ladders, equipment, elevated platforms, at 12.2 percent.

This information gives you a feel for the severity and kind of injuries that are being experienced. The most frequent injuries, all of the types that we have seen in this kind of survey, have severity toward the lesser severity end of the scale. On the other end of the scale are the fatalities.

NSC estimates work deaths, and divides them among agriculture and the other seven standard industrial classifications. NIOSH, BLS, and NCHS also monitor fatal occupational injuries. There is considerable disparity in the numbers as well as in how to categorize them. The 1980 to 1985 average for non-transport fatalities on farms puts machinery at 45.6 percent of those fatalities and firearms and drownings a distant second and third at around 12 percent each.

As noted in virtually any discussion of farm fatalities, tractors are associated with about two-thirds of the machinery-related deaths or about one-third of the deaths in agriculture. The dominant tractor accident scenario is an overturn, which may contribute to over 50 percent of the tractor fatalities. Thus, tractor overturns are about one-half of two-thirds of one-half the agricultural-related deaths, approximately 15 percent of all agricultural deaths.

Another 25 percent are related to deaths when someone falls into the path of a tractor. Sometimes operators fall while the tractor is in motion, or they get off before it stops, or they start it in gear from the ground, or one of the riders falls off.

It is unacceptable to have a rider on a tractor with or without a cab. About 5 percent of tractor deaths are reported to involve the power take-off (PTO). This category is somewhat suspect since, presumably, there is a PTO-driven piece of equipment attached to it at the time.

In addition to overturns, and runovers, PTO entanglements, and the other things, the "other" category for tractors includes things like contact with overhead electrical powerlines and road transport collisions. Imagine yourself driving down the rural country roads of Iowa, perhaps just recently attending the Surgeon General's Conference in Des Moines, "tooling" down a farm-to-market road—perhaps graveled-at your regular road traffic speed then cresting a knoll behind a tractor-implement combination. The results can be startling. In some cases it does not make a difference whether there are lights on that equipment or not.

In other cases such as in turns, or when there is good visibility ahead, or at night, better lighting and marking could and should be developed.

There is a potential for research in tractors. When we talk about cresting-the-knoll, perhaps there is room for over-the-horizon detection or for moni-

toring from above that can deliver the kinds of warnings necessary to avoid collisions.

We want to make sure in all of this that we are addressing the right problem. For example, is it really the lack of lights, or the lack of good enough lights, or the lack of the right color, or the right position? Maybe more effort should be devoted to improving the connections so that they are more likely to get connected.

Consider a product which is hooked and unhooked dozens of times a day. Will it get reconnected? Will it get reconnected on products that never, or seldom, venture onto a roadway? When they do, will it still work?

Research may discover a way to multiplex information, control signals, and control power so that it is no extra effort to get the safety value at the same time that you get the desired productivity.

The lighting and marking issue is still an open one and some of you may be interested in pursuing in more detail the kind of research that is being launched at Ohio State University on lighting and marking for equipment. Research is necessary in some cases.

In other places we need to apply more of what we know. We just looked at the more frequent yet less severe farm machinery injury picture, and we looked at the most severe injury death. It is likely there are similar kinds of injuries in between—in the middle ground.

It is also likely that there are more severe, but less frequent kinds of injuries in that middle ground. We would generally call them entanglements.

Entanglements occur in the belts, chains, and gears that run auxiliary drive systems like cooling fans for engines. They occur as we transfer power from one part of the machine to another part of the machine:

1. In the crop gathering, or picking, or intake mechanisms.
2. In the parts that thresh, or transfer, or clean the material that is flowing through the machine.
3. In the discharge.
4. At the tractor PTO.
5. Along the PTO drive line.

Professionals like those in the NSC Agriculture Division and the National Institute for Farm Safety would likely divide these kinds of entanglements into three major categories of concern: those areas where we gather the crop, those where we are transferring power around the machine, and those where we are processing the crop.

A proposed revision to the ASAE standard for agricultural equipment includes a specification for an automatic means to stop the crop-gathering mechanisms and the intake mechanisms of self-propelled agricultural machines. This would be before potential entanglement of the operator, not after. Typical applications have been an operator-presence seat switch on combines and the service tether system that I showed you earlier on cotton pickers.

In responding to suggestions for those kinds of systems, the Ontario Implementation Committee rejected the usefulness of interlocking safety cut-off switches as a means for accident prevention. This com-

mittee claimed to be aware that some accidents have occurred because of the presence of those kinds of systems. When investigating emergency stop systems for that PTO drive line, they could not resolve the differences between the "invitation" for many to risk entanglement and the potential to lessen the severity of some accidents.

Research may discover the way to protect maintenance personnel and bystanders from that programmed, unmanned machine that swarms through the wheat field and vacuums up heads of wheat, flowing centimeters off the ground.

We may also find a way to detect and respond to the presence of a person who should not be in a protected zone. Perhaps the beginnings for that have already been laid at the University of Illinois with work on the capacitance of discharge systems. Maybe it starts with the radar, obstacle avoidance work in the auto industry.

Part of why we are here at this conference includes this kind of visioning. What is needed relative to nanotechnology where those micromachines with engines one-third the width of a human hair will be released to swarm across the field and devour preselected bugs from a population of pests?

Perhaps we need a more sophisticated ability to anticipate and successfully avoid tractor overturns, like the work at Penn State University, or to alter collision courses. Clearly, an early understanding of the application will lead to research that is more readily available.

Having identified some needs, it is important to also consider how those needs will be met in the real world where the operator must interface with the machine; where human factors become the field of expertise; where work, the man, the environment, and the machine come together surrounding the task.

We must be cognizant of the somewhat limited ability we have to modify the man successfully; the relative leverage of changing the machine, if that is possible and appropriate; and not forget the ability to adjust the task.

Some would say that accidents can be attributed to unsafe actions of operators. Therefore, we ought to focus our research on those behaviors and how to modify or eliminate them.

Others would say that the machine's design dictates how the operator will behave. Therefore, we ought to design the machine to not allow errors, to make it difficult to err, to not invite unsafe behaviors or to not accommodate unsafe behaviors, and to encourage safe ones.

There are, more likely, opportunities in between than at either end of these polarized points of view. I believe it is important to understand that those possibilities exist and not to forget the option of modifying the task.

Research is needed to accommodate the physical and behavioral aspects of the people in and around farm machines. I do not, however, advocate identifying any of what you might call generic or typical operator safety behaviors. Identifying new concepts in education and solidifying those guiding principles for educational training, in general, seems to be fertile ground.

It may relate to the positioning of incentives. It may also relate to cognitive risk

avoidance versus situations where the rewards are greater for risk-taking.

Perhaps it springboards from some of the work on injury control strategies and farmworker behavior which will be published by ASAE between Penn State and the University of Illinois. Where do we go when the weight of what is being published today questions the ability of safety signs to alter—to measurably alter-behavior?

I want to express a few things of importance to you, somewhat slowly and carefully, because a good friend of mine asked me to do it that way. If you will breathe deeply with me and reflect a moment—the current engineering design community, myself included, as well as students and teachers needs capabilities and tools to better incorporate human factors into what we do.

Research on how to build those capabilities and the tools themselves are needed for our organization's development and for curriculums. How does safety become the cultural value that permeates all that each of us does? After all, are we not safer than the people out there? What are the skills needed to excel in hazard recognition during the earliest stages of design? Can such skills be learned? What is a capable process for identifying and communicating safety research issues?

How do we rationally evaluate alternatives, none of which are without safety risks? What is the measure of safety improvement at a stage when we are comparing conceptual alternatives, when we have no injury experience?

We are learning more each day about the attractiveness of safety in the user's mind and in the user's perspective. How do we keep the momentum going? How do we tap that latent potential demand? How do we serve those safety needs and wants of our customers? All this could benefit from more research.

Consider, for example, how to convince the owner of a 30-year-old tractor worth, at most, $1,000, to put a $500 ROPS on it. The University of Illinois, NIOSH, and the University of Iowa are doing research to help find some of those kinds of answers. A ROPS that provides protection and still meets the needs of users under limbs, vines, and rafters holds promise.

It is likely that this kind of roll over protection will produce more acceptable designs for the user. Perhaps it may not produce as much protection as users have become accustomed to with larger or more conventional roll over protective structures. Is there an opportunity for validating acceptable ROPS for more compact tractors?

In general, research has evolved from centers isolated from commercial considerations to centers in touch with the application, in touch with the network, and with the people who must deliver. My final comment is about better technology transfer. It is for the researchers to participate in the safety network or, as Dr. Roper called it, the infrastructure.

Researchers must learn the needs, find the funding, know what is being done, share the findings, gain application insights, gather and synthesize information, learn, establish contacts, and establish conduits. All of these help promote the results of the research, to participate in sustained improvement with those engaged in agriculture.

GENERAL DIRECTIONS

I hope to have whetted your research appetite and to have given you perspectives. Now to boil my sense for direction down to three points:

1. Overturn protection, refurbished guarding, and proven effective educational training relative to products in use.

2. Integrated approaches to hazard control, primarily aimed at entanglements, which blend the latest injury prevention hardware and software, particularly software as it relates to behaviors.

3. New technologies for sensing, anticipating, and responding to the potential for an injury. This is not only in the sense of hardware. I mean it in the sense of the users and their abilities. And I mean it in the sense of those who are striving to prevent the first or the next injury from happening.□

Surgeon General's Conference on Agricultural Safety and Health
FARMSAFE 2000 • A National Coalition for Local Action
Convened by the National Institute for Occupational Safety and Health
April 30 - May 3, 1991, Des Moines, Iowa

THE MANUFACTURERS' PERSPECTIVE

By Mr. John H. Crowley, M.B.A.
Director of Safety Programs, Equipment Manufacturers Institute

The Equipment Manufacturers Institute, or "EMI," is the principal association in the USA for manufacturers of farm equipment. My remarks will be in two parts.

- First, I will give an overview of farm machinery safety research needs as identified by EMI member companies.

- Second, I will address some of the points raised yesterday in the plenary sessions, particularly the questions that Dr. Myron Johnsrud suggested for discussion in these sessions. One on these was "Where do we focus our resources to be of most success?"

Allow me to preface my remarks with a word on the role of surveillance as it relates to injuries involving farm equipment. Surveillance is said to be important to provide the foundation and direction for both research and intervention.

Manufacturers already know quite a lot about how accidents involving their products happen from information available to them. They have a good sense of the relative magnitude of product-related accidents in terms of the frequency and severity of injury that can result from them.

Nevertheless, better injury data, expressed quantitatively, which should be forthcoming from the current NIOSH-sponsored initiative, are needed to identify problems at the regional and national levels, to establish prioritized objectives, and to measure progress. Manufacturers need better data on the association, if any, between machinery and cumulative trauma disorder, noise-induced hearing loss, and illness related to the handling and application of pesticides.

RESEARCH NEEDS

The industry has identified several areas for additional safety and ergonomic research. Two years ago, EMI's Agricultural Safety Committee looked at the accident and injury data base, the product-related safety standards, and the innovative work that Murray Madsen described in his presentation that individual companies are doing. The committee developed a questionnaire to survey equipment manufacturers throughout the industry to find out where they thought additional research was needed.

The responses fell into two groupings. One was safety-related research that was thought to be appropriate for public support.

The other concerned items for which industry concluded it had the necessary expertise itself to carry out. I would like to revisit the results of this survey with you.

The survey identified eight areas that were deemed to merit public support. I will present them in no particular order.

Behavioral Research

Not surprisingly, in view of much that has already been said by others at this conference, the industry identified a need for research into behavior of equipment users. Manufacturers' experience based on in-depth evaluations of numerous accidents indicated that the manner of use of equipment was a significant factor in accidental injury. The equipment manufacturer's view is that there is a need for basic research aimed at developing a better understanding of behavior with respect to safety and risk-taking in the agricultural environment.

Behavioral research is needed to guide engineers on how equipment can be designed for safer operation and maintenance. It must also be designed for developing effective educational and training programs and other measures aimed at inducing fundamental, lasting behavioral changes.

Behavioral research is needed to guide engineers on how equipment can be designed for safer operation and maintenance.

EMI was familiar at the time of the survey with the work of Dr. Dennis Murphy of The Pennsylvania State University and Dr. Robert Aherin of the University of Illinois in examining attitudes, underlying cultural beliefs, and other factors as possible determinants of behavior.

J.I. Case, a member of EMI, has sponsored a literature review, which is being done by Drs. Murphy and Aherin. This work is nearly complete, and the results will be provided to J. I. Case in a few weeks. Case has asked the American Society of Agricultural Engineers (ASAE) to publish the results. We understand that publication may occur by the end of July, 1991. The study will look into four elements:

1. A review of the characteristics of farming and farm-accident statistics.
2. Injury- control strategies.
3. Approaches to modifying safety behaviors.
4. Effective ways of communicating the safety message.

EMI has received proposals from several organizations in response to a Request for Proposal (RFP) it issued to do additional work in the area of behavior. The proposals are being evaluated, and EMI will seek other sponsors to help fund this particular research project. Broad sponsorship by both private- and public-sector entities is being encouraged.

Injury Data Collection

The second area identified for public support was agricultural injury data collection. The industry strongly supports the work of NIOSH to develop a uniform national reporting system and database.

For our purposes, better data is needed on the relationship of machinery characteristics to such things as hearing loss, effects of whole-body vibration, and the significance of such factors as age, fatigue, and environmental variables. EMI encourages public-sector research in these areas.

Lighting and Marking of Equipment

The third area is the lighting and the marking of agricultural field equipment. Dr. Thomas Bean of Ohio State University spoke on this subject. We concur in his view that additional work of a research nature is needed. EMI has issued a RFP for research on the effectiveness of current lighting and marking systems for agricultural equipment.

Five responses were received. These have been evaluated and a study contractor selected. The study contractor will look at alternative ways of effectively identifying slow-moving vehicles, extremity lighting and marking of equipment that travels on roads and highways, and turning indications.

The system now in use in agriculture to indicate turning is somewhat different than the system for motor vehicles. The significance, if any, of the differences will be evaluated.

The study will also look at the adequacy and effectiveness of the slow-moving vehicle emblem and reflectors as specified in the standards of the ASAE. The project will include both simulation and field evaluation using subjects.

There is a need for additional funding for the lighting and marking research study. The cost of the study is about $220,000. It is 75 percent funded now and we are looking for additional sponsors for the remaining 25 percent.

Protection During Chemical Handling

The fourth area identified in the industry survey concerned protection when handling agricultural chemicals. The focus is on equipment for handling and mixing and transfer of chemicals from original containers to field application machinery.

Development of a standardized "closed" system for the mixing and transfer of pesticides would provide increased worker protection, guard against damage to the environment from accidental spills and possibly eliminate the need to dispose of excess mixture. EMI and the National Agricultural Chemical Association have undertaken a joint effort to develop such a system. We are not sure that additional research is needed at this particular point. It appears to be more a question of engineering development and standardization.

Air Filtration Systems

The fifth area is air filtration systems that can effectively reduce the hazard of exposure to pesticide vapors, dusts, and aerosols. Tractor cabs now have effective filtration systems for most particulate matter. Additional research is required to determine whether a reliable system is feasible to reduce to acceptable levels concentrations of fine pesticide dusts, aerosols, vapors, and gases.

ASAE has begun a study on this question. It is also being looked at by the International Organization for Standards (ISO). EMI is participating in both the ASAE and ISO initiatives.

Whole Body Vibration Reduction

Sixth, the industry identified improving tractor seat design to limit whole-body vibration as important. The industry has not done any work in this area through EMI. However, some individual companies are looking at it. Manufacturers look

to human factors specialists for guidance here.

Hazardous Atmospheres Detectors

Seventh, devices to detect hazardous atmospheres are needed. Reports abound concerning suffocations and toxic exposures in confined space environments such as manure reception pits and silos. There is a need for a reliable, inexpensive, and easy-to-use device for on-farm use in confined spaces where oxygen deficiency or toxic gases are present. EMI looks to the public health sector, which has the expertise and the funding, to take the lead in addressing this research need.

Broaden Research Sponsorship

Lastly, "research" could be conducted to identify effective ways to gain the interest and support of entities outside the agricultural health and safety community to help sponsor the eight kinds of research that I have just described.

INDUSTRY-BASED RESEARCH

Next, I will discuss certain safety-related areas identified in the EMI survey that the industry believes it can do either through the Institute or as individual manufacturers. These are areas for which industry believes it has sufficient expertise and resources to do the work itself, with some exceptions. There were three such areas identified by the survey:

1. Small tractor roll-over protection structures (ROPS) and seat belts.

2. Safety systems and devices.

3. Product safety signs.

ROPS for Small Tractors

The first of these was ROPS for small farm tractors. In the late 1950's and early 1960's, extensive research and development work was done by the industry to establish the efficacy of ROPS designs for the kinds of tractor overturns that can occur in normal farming and road transport.

Manufacturers began supplying ROPS commercially in the late 1960's. The experience in both the United States and Europe has proven ROPS to be an effective safety device.

There is a need for additional research on small tractors' ROPS. The standard "protective zone" around the tractor operator, which controls the size of the ROPS envelope, was defined on the basis of the ergonomic data that existed in the 1950's and 1960's. The zone remains essentially unchanged today.

EMI sponsored a literature review of the different protective zones used for the design of several kinds of vehicles, including aircraft, automobiles, racing cars, farm equipment, construction equipment, and mining equipment. This study, which was performed by Triodyne, Inc. of Skokie, Illinois, has been completed. Publication will be through both the Society of Automotive Engineers (SAE) and ASAE before the end of 1991.

The basic conclusion of the Triodyne study was that it did not appear, from the kinds of systems that are in place, that sufficient research had been done that could serve as the basis for making the protective zone of a ROPS, as specified by current standards, for smaller small tractors. Small tractors are often used in low overhead clearance

settings—in vineyards, orchards, storage buildings, and machine sheds.

The higher the profile of a ROPS relative to an overhead object such as a tree branch, the greater the likelihood that a farmer will not want to equip a tractor with ROPS or, if there is one on a tractor, to keep it in place. Clearly, there is potential safety value in making the ROPS as compact as possible without compromising protection in the event of a tip-over.

As Murray Madsen mentioned in his presentation, one approach to addressing this situation is to make ROPS that can be raised or lowered. They telescope or fold down for temporary use in the lowered position under low clearance conditions. There are some companies that have such ROPS on the market today.

Industry's research capabilities concerning ROPS are limited to mechanical and structural aspects. There is little more to be done there with the exception of the small tractor ROPS.

Accident data identify tractor roll-overs as the leading cause of machinery-related death on the farm. Therefore, perhaps the most pressing challenge for behavioral researchers and health professionals is to find an effective way to ensure, short of compulsory measures such as regulation, that ROPS are installed and kept on tractors.

EMI believes that behavioral research in this area holds promise of effecting a substantial reduction in roll-over injury and fatality rates. The starting point for such research, we submit, may be recognition that over one million of the approximately 3.6 million agricultural tractors in use today in the United States do have ROPS on them. There are over one million farmers who chose to equip their tractors with ROPS when they purchased them.

The question should be asked how these farmers arrived at their decision to equip the tractors with ROPS. Was it because of the OSHA rule? Was it because manufacturers were able to package the ROPS in a cab that was noise-insulated and isolated from vibration of the tractor? It provided air conditioning, heating, and stereo; i.e., it was made so attractive in other respects that the farmer was willing to pay for the ROPS cab.

Or were there other factors? The key to getting ROPS on the over-2.5 million tractors that do not now have them may indeed be found by examining the factors in the decisions of the approximately one million farmers who did decide to equip their tractors with ROPS.

Safety Systems and Devices

The second area identified for further industry research was safety systems and devices. There was some discussion about safety systems and devices yesterday, specifically, the concepts of interlocks for barrier-type guards and operator restraint devices.

I would like to identify the criteria that manufacturers use for evaluating concepts or proposals for safety systems and devices, or for that matter most engineering design concepts. There are five such criteria.

1. The first criterion is that a design concept must be technologically feasible. The archives of the U.S. Patent Office contain millions of concepts, inventions, and ideas.

Many have proven to be successful. Many others have not. Much more is needed than mere technological feasibility as demonstrated by the existence of a patent. This is where the other criteria come in.

2. The second criterion is effectiveness. A safety device or system must be effective. There are two necessary qualities for effectiveness.

▸ First, the system or device must substantially reduce or eliminate the hazard. The tractor ROPS is incontrovertibly effective in this respect. In contrast, there is a type of device with which most of us probably are familiar, the ubiquitous, audible back-up alarm used on heavy equipment. OSHA requires back-up alarms on construction equipment such as front-end loaders, forklifts, and dump trucks that have bi-directional movement while working.

The alarms "beep" every time the machine goes backward. There is much evidence that workers quickly become desensitized to the audible back-up alarm. They hear it going on and off all the time.

If there are several pieces of construction equipment with back-up alarms working on a site it can become difficult to distinguish the back-up alarm of one machine from that of another. The effectiveness of audible back-up alarms is generally recognized to be questionable. Alternative approaches to addressing the hazard of moving machinery in the presence of workers are being investigated.

▸ The other necessary element for effectiveness is that a device be reliable when called upon to perform its function. I will ask rhetorically, how many of us would buy an automobile if the dealer said: "The brakes will perform 999 times out of 1,000 when you apply them, but one time out of a thousand they are not going to work."

A type of device that has been proposed for use in agriculture is the electrical-proximity-warning indicator. This is an electronic device that is supposed to sense electromagnetic field or capacitance around energized overhead power lines. It either signals an alarm or deactivates a mobile machine before it gets too close to the lines.

Tests sponsored by the U.S. Mine Safety and Health Administration (MSHA) revealed that when such a device was installed on cranes it gave both false positive and false negative indications. No one has yet been able to perfect a device that will accurately and reliably detect a hazardous electrical field when one is present **and** will activate only under the hazardous condition. EMI encourages further research and would welcome the discovery of an effective electrical proximity warning device that could be used on tall farm equipment such as portable grain augers.

▸ The third essential criterion is that a safety device must not by its presence, introduce different risks that would not exist without it. Murray Madsen referred to a study that showed that some accidents occurred because of an operator presence-type device.

I am reminded of a situation that existed several years ago when OSHA, with all good intent, promulgated its ROPS rule for agriculture. As it turned out, there were some small tractors that had backhoes mounted to the three-point hitch, with a separate seat for the operator affixed to the backhoe frame behind the tractor.

Without the ROPS there was not any problem. It was discovered that when a ROPS was installed on a tractor with the threepoint-hitch-mounted backhoe, a crush point between the elevating backhoe boom and the rigid ROPS structure was created. A number of fatalities occurred because of that condition.

The solution was to do away with the three-point-hitch-mounted backhoe or redesign the ROPS or both. A combination of these measures was implemented through various field rework programs to eliminate the hazard.

▸ The fourth requirement is for a safety system or device to be economically feasible. As we have heard from others at this conference, there are strong economic disincentives to safety in American agriculture.

In the mid-1970's, when OSHA promulgated the tractor ROPS and the guarding and shielding regulations, both original equipment manufacturers and independent suppliers of these safety devices produced them in large quantities in the expectation that there would be a substantial increase in demand. Unfortunately, the demand was not there.

On the other hand, as I have mentioned, the ROPS-equipped tractor cab was attractive to the purchaser. Companies do attempt to establish the economic feasibility or salability of products and safety devices before putting them on the market; this is not always easy to do.

▸ Lastly, a purported safety system or device must be functionally practical. Even if the other requirements I have mentioned are met, the safety device cannot unduly interfere with the basic function of the machinery. This requirement is found in the ASAE Safety Standards and in the OSHA safety rule for agriculture.

Consider the intake guard of the portable grain auger. The function of a portable grain auger is to move grain from ground level to the top of a grain storage structure and dump it in. The bottom end of the auger, into which the grain flows, has a guard around the inlet opening, that is in the form of a rigid wire mesh cage or screen.

Portable grain auger manufacturers, based on the results of extensive experiments with various kinds of grain, determined the optimum size of the wire mesh openings. The size of the openings in the guard is specified in an ASAE standard.

In determining the optimum size, industry engineers were aware that if the openings were made too small the guards would plug up. The auger would no longer move grain. If that were to happen, farmers would be inclined to take off the guards, thereby totally exposing the very hazard that the guard was intended to cover.

It was known when the standard was written that the openings were not small enough to prevent passage of a small hand or foot through them and into the moving machinery. Thus, it was found to be necessary to have a portable grain auger intake guard that struck a balance between the compelling need to preserve function and safety. In doing this, the intake guard necessarily provided less-than-perfect protection.

There is evidence of a predisposition on the part of people to be unwilling to accept inconvenience in the interest of safety. Recall the 1974 automobiles with the man-

datory interlocking seat belts. The cars could be started only if the seat belts had been fastened.

A political decision was made to drop the requirement because many consumers became enraged when they found that the safety feature caused inconvenience and sometimes interfered with function. One can conjecture that, to the extent that awareness on a personal level of the importance of safety can be increased, there will be greater acceptance by the individual, in the interest of safety, of perceived impairment of function. Industry hopes that behavioral scientists can provide insights and contribute to the development of strategies to bring about changes in farmers' attitudes and beliefs, strategies that may be necessary before meaningful, lasting changes in safety behavior can be effected.

Research and development work on safety systems and devices is done by individual companies, not through EMI. Manufacturers subject the safety designs that they eventually put on the market to rigorous evaluation.

When tractor ROPS were being developed, manufacturers' test programs included actual roll overs of tractors with experimental ROPS designs at different attitudes and speeds. There is a need, in many cases, to verify that a new safety feature will be acceptable to the farmer.

Manufacturers conduct pilot studies in which designs are placed on a number of machines. They are provided to select groups of farmers to determine whether they are acceptable to the customer under a variety of usage conditions.

Product Safety Signs

The third and last area for industry research identified by the survey was product safety signs. The Institute is represented on the committee of the American National Standards Institute (ANSI) to develop a new approach to hazard pictorials and safety signs. Soon national standards reflecting that committee's work will be issued. Much of the recent innovation in safety signage is already embodied in ASAE Standard S441 - Safety Signs.

The ANSI standards will provide additional information including a methodology for measuring the effectiveness of hazard pictorials on signs. The designation of the standard covering the design and testing of hazard pictorials will be ANSI Z535.3.

The methodology contained in ANSI Z535.3 calls for an approach using subjects to evaluate the effectiveness of hazard pictorials in terms of two criteria: recognition of the hazard depicted in the pictorial and the intensity of the impression the pictorial makes on the subject. Industry successfully used the draft ANSI Z535.3 methodology to test a number of pictorials, which subsequently were put into production on new farm equipment.

CONCLUSION

I will conclude my remarks by addressing some of the points that were raised in the session yesterday. Dr. Thomas Bean discussed farm machinery and vehicle safety.

He gave an insightful review of the literature and his own interpretation of injury data that indicated that agriculture was classified as one of the most hazardous industries. Tractor overturns were the

most serious equipment-related type of accident.

Older tractors were often used for general utility work, and youth and the elderly had especially high injury and death rates. Information available to the industry lends support to the observations made by Dr. Bean.

We noted that four of Dr. Bean's six recommendations had to do with farm machinery. Among these was the recommendation that research be conducted on human sensors, automatic shutoff's, and means to effectuate the installation and use of ROPS on older tractors.

Dr. Bean also called for aggressive inclusion of safety in all ASAE standards and research on improved lighting and marking of agricultural machinery on roads. EMI concurs with these recommendations, which are consistent with current industry safety programs.

The question was raised yesterday regarding the efficacy of putting "seat bars," or restraining devices similar to those used on skid-steer loaders, on tractors. The skid-steer loader safety standard, SAE J1388, calls for a means to prevent the lift arms from lowering when the operator is entering or leaving the machine.

As a point of clarification, the kinds of devices discussed yesterday were not necessarily intended to be an operator restraint device, but a device of the kind called for by SAE Standard J1388. There are several approaches used in the industry to meet the SAE requirement. Some companies have interlocking switches in the seats. One company uses an interlocking gate at the front entry point; another uses an interlocking safety belt.

It was said yesterday that in Canada, log skidders were being equipped with seat bars. There is research and development being done in Canada on an operator restraint system for log skidders.

EMI has been following this very closely. The understanding that we have from the Canadian Research Institute is that a device may be made available for production use toward the end of 1991.

This concludes my remarks on the subject of safety-related research needs and programs for farm equipment. I wish I could tell you about the many "intervention" type programs of the Institute, such as our cooperative programs with equipment dealers to promote equipment safety at the community level. This will be a subject for another time.□

Surgeon General's Conference on Agricultural Safety and Health
FARMSAFE 2000 • A National Coalition for Local Action
Convened by the National Institute for Occupational Safety and Health
April 30 - May 3, 1991, Des Moines, Iowa

A FORESTRY PERSPECTIVE

By Penn A. Peters, P.E.
U.S. Forest Service, Morgantown, WV

My purpose in being on this panel is to present a forestry perspective on agricultural safety. The hazards to the farmer in the woodlot are similar to those of the professional logger. My remarks will consist of an introduction to logging safety, a response to the technical panel, notable quotes heard at this conference, and recommended future directions.

AN INTRODUCTION TO LOGGING SAFETY

Dr. Louis Sullivan introduced logging safety in his introductory remarks when he quoted the logging fatality rate as 200 per 100,000 workers, the highest of any occupation. The national average for all occupations is eight fatalities per 100,000 workers.

Approximately two-thirds of the logging fatalities occurred while the worker was felling trees with a chainsaw or was in the felling area (OSHA, 1988). Over 100 loggers and about 30 farmers die each year in the United States while felling trees. In addition, some farm tractor accidents undoubtedly are caused by attempting to transport logs or trees unsafely; these, though, are reported as tractor accidents. The connection with forestry does not appear in the statistics.

NIOSH lumps the principal factors contributing to a felling fatality into a single category, "struck by" accidents.[1] Based on OSHA fatality reports, in 26 percent of the deaths, a hangup fell on the victim.[2]

• A hangup occurs when a felled tree hangs in the crown of another tree. A gust of wind, vibration from mechanical equipment, or the falling of another tree can dislodge a hangup. Many fellers have been killed by a falling tree that had a hangup only minutes earlier.

• Another major factor is working too close to the feller. Often a co-worker will walk into the area as the tree falls.

• A third cause is the crown of a falling tree either breaking or pulling a tree directly behind it, which strikes the feller from behind. Poor felling technique accounted for 15 percent of fatalities.

Examples of poor techniques include felling a tree with a hangup in it, failing to put in a notch cut to control the direction of fall, or not following a notch cut immediately with a back cut to fell the tree.

Snags were involved in 25 percent of the cases and were the principal factor in 8 percent of them. Snags have no root system and easily break in pieces when struck by another tree.

Butt rebound, another cause, occurs when the bole of a falling tree strikes the top of a neighbor tree causing the butt to rebound toward the feller.

Broken limbs or tops occur when a tree with a large crown hits another tree, causing the top or limbs to be broken off and thrown back at the feller. In one fatality, the top 25 feet of a black cherry tree, weighing approximately 50 pounds, was thrown 65 feet. It struck the feller, who presumably was standing in a safe place 20 feet behind the felled stump.

The situation in logging safety has been summarized as:

- Loggers and farmers do not recognize the hazards.
- Compliance with the proposed OSHA logging rules would reduce injuries.[3] However, the rules do not effectively address the problems of butt rebound, broken limbs or tops, or being struck from behind.
- Hardwood partial cuts are dangerous; 56 percent of felling fatalities are related to a felled tree hitting another tree. Hardwoods are involved in many injuries.
- The harvesting trends of more use of hardwoods, more use of partial cuts, and more snags left standing will make logging more dangerous.
- Use of a hazard recognition procedure before felling each tree would reduce injuries.
- Research should be conducted on the dangerous reactions that occur when a felled tree strikes another tree.
- Injury investigations frequently fail to report critical research information such as tree species, heights, diameters, and separation distances.

RESPONSE TO THE TECHNICAL PANEL

The presentations of the technical panel were impressive. Most of the agriculture safety problems have a counterpart in forestry. Some of the successful intervention strategies that have been used in agriculture perhaps can be used in forestry and vice versa.

Dr. Bean stressed the need to install Rollover Protective Structures (ROPS) on farm tractors and to evaluate highway travel hazards of agricultural vehicles. The forest industry had a serious problem hauling tree-length southern pine, resulting in a 20-foot overhang on some trucks.

Dr. Cochren discussed cumulative trauma injuries. A forestry example was the disease called "white finger." This is caused by poor circulation and traced to vibration of early chainsaw designs. The problem was solved by engineering design.

Mr. McLymore discussed electrical hazards. A common electrical hazard in forestry occurs when a falling tree or piece of logging equipment contacts a high power line.

Dr. Marvel compared hearing loss of farmers with that of similar people who did not work on a farm. Similar comparisons should be done in forestry. One application could compare the accident experience of loggers who have had safety training with similar loggers who have not.

Mr. Madsen spoke on technology trends, including smarter machines, automatic control, computers in machinery and safety devices, and proximity detectors. Proximity detectors may have an application in for-

estry to indicate when someone has walked into a felling area.

NOTABLE QUOTES HEARD AT THIS CONFERENCE

- "Prevention is the key." Certainly this is true of logging injuries; some you would almost not want to recover from.

- "One logger out of five experiences a lost-time work injury in a year." An amazing statistic!

- "Logging fatality rate is 200 per 100,000 workers." Twenty-five times the national average.

- "Develop the infrastructure for prevention." Who determines the effective intervention strategy, and who implements it?

- "Build coalitions." Coalitions are needed for political and financial support of organizations and programs. Coalitions also are needed to attack safety problems effectively. Using the felling safety problem as an example, organizations that can contribute to solving the problem include the U. S. Forest Service Research, NIOSH, OSHA, insurance companies, logging companies, trade organizations, universities, and consultants. Cooperation exists among these organizations in the form of information sharing. Building of cooperative working relationships, however, to make a concerted attack on a problem is difficult.

- "Injuries are assumed to be unpredictable." Most injuries are predictable. They occur over and over again, only to different people.

- "We blame the victim." There is almost always some failure on the part of the victim. If nothing else, he or she failed to recognize the hazard. Have we given workers the information. They need to recognize the hazard?

- "ROPS is a proven intervention strategy. Why can we not implement it?" Is the problem the cost, the infrastructure, the regulation, or the legal system?

- "Do we include logging in the agricultural safety and health program?" That is a good question. Logging injury statistics are included in some farming injury statistics, making farming look more dangerous than it is. This may be an argument for including logging statistics. On the other hand, information targeted to reach farmers is unlikely to reach loggers, and vice versa.

- "We see what we look for." How often do we overemphasize a minor problem area because of personal interest or because it fits our skills and fail to see a significant problem area?

RECOMMENDED FUTURE DIRECTIONS

Detailed accident surveillance data should be used to identify problem areas and to set priorities for safety research and programs. NIOSH is progressing in this area. Expert opinion can be used to confirm the problem areas that have been identified.

For example, NIOSH has identified "struck by" injuries as a major logging injury type. Experts confirm the problem and know that it occurs most often in the act of felling trees. The experts typically are people who work with groups of loggers or farmers, or are association professionals.

Research by qualified researchers with knowledge of the industry should be conducted on the causes and potential cures. A high-priority research area is in the injuries that result from a felled tree having hit another tree, which includes hangup fell, broken limbs or tops, and butt rebound.

A high-priority research area is in the injuries that result from a felled tree having hit another tree, which includes hangup fell, broken limbs or tops, and butt rebound.

The research would identify timber stand conditions and geometry that result in felling injuries. It would develop means for loggers and farmers to recognize the hazards. Injury investigations could contribute to an excellent database.

For example, the OSHA logging fatality investigation summaries (1988) were adequate to identify causes of "struck by" accidents, but failed to report information (tree species, diameters, heights, and separation distances) in several cases that would help identify potential cures. Training of injury investigators would be useful here.

Intervention strategies should be devised based on the results of research. A number of pilot intervention programs should be funded. The programs should be tracked by research studies or surveillance data in order to identify successful pilots as models for large-scale funding and national implementation.□

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Surgeon General's Conference on Agricultural Safety and Health
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A REGULATORY PERSPECTIVE

By Thomas H. Seymour, P.E.
Fire Protection Engineer, Occupational Safety and Health Administration

I have some overheads I would like to show you so that you can see some of the things that the Occupational Safety and Health Administration (OSHA) has done. To pick up on what Mr. Peters just talked about, the OSHA has been compiling data to report the various sorts of the fatality investigations that our field staff have made over the years (e.g., logging). We have about 16 of those reports now. We are continuing to write those on various subject matters like industrial trucks.

OSHA has had its ups and downs in the agricultural arena. When we had our initial standards published, there were a number of standards that involved agriculture. The way the Occupational Safety and Health Act was written, we were to utilize national consensus standards in our initial set of standards.

In those days of President Nixon, his people wanted us to issue those standards as promptly as possible. We attempted to do just that.

Looking at the input from the agricultural community, there were only four standards that they had been actively involved in. These standards were issued in May of 1971. There were these four areas:

1. We had temporary labor camps, which is one of the 1910 standards.
2. Next was anhydrous ammonia. We used the ANSI K61 Standard for handling anhydrous ammonia on farms.
3. Pulp-wood logging is next. Farmers, especially in the northeast, would do this kind of work in the off-season winter months—to make some extra money. So pulp wood logging was also covered.
4. The slow-moving vehicle emblem from the American Society of Agricultural Engineers (ASAE) was one of the other standards that we used as part of the ANSI sign and tag standard.

OSHA was aware of the death and injury rates among farmers, at least as the National Safety Council described them in the early 1970's. We were trying to develop what we considered a balanced program for agriculture. We were looking for outreach efforts and training of agricultural workers and farmers.

AGRICULTURAL ADVISORY COMMITTEE

In order to effect this kind of effort, the agency formed an Agricultural Advisory Committee. Our Assistant Secretary was in charge of the standards office back in those days.

We formed the Agricultural Advisory Committee in 1972. You can see in Figure 1 that Rollin Schnieder was the initial Chairman of the Committee. Gary

Erisman, who was one of the speakers here this week, was also on the Committee.

The tripartite arrangement was that we had professional, state, and Federal representatives. There were employer/employee representatives, and there were representatives from the West Coast, the Midwest, and the East Coast (Figure 1). We tried to get a broad representation of agricultural interests into our committee activities.

Roll-over Protection

The committee divided itself into working groups to develop suggestions and recommendations in the areas of training, and also in the needs for standards like ROPS and machine guarding. In 1972, the full committee recommended its first standard. They recommended that we do a roll-over protective structure (ROPS) rule for farm tractors.

The first agricultural standard that OSHA issued under its normal rule-making was

		EMPLOYEE	
Rubin Contreras McMinnville, OR	Robert H. Discoe Paxton, NE	John C. Ramirez King City, CA	Peter A. Andrade Western Food Processing Division Burlingame, CA
		EMPLOYER	
Will Gill, Jr. Will Gill & Sons Madera, CA	Joseph H. Price Texas Cotton Ginners' Association Dallas, TX	Richard V. Thornton Grower, Shipper Vegetable Association Salinas, CA	J.S. (Alice) Van Mert Hampton, IA
	STATE		FEDERAL
Glenn J. Hertzler Commissioner of Agriculture Cheyenne, WY	James Wiles Administrator, Workmen's Compensation Board Salem, OR	Dr. Jon R. May National Institute for Occupational Safety and Health Rockville, MD	Robert O. Gilden Extension Service U.S. Department of Agriculture Washington, DC
		PROFESSIONAL	
Chairman: Fr. Rollin D. Schnieder University of Nebraska Lincoln, NE	Dr. John G. Erisman Illinois State University Normal, IL	Dr. Mayland Hayes, Jr. Vanderbilt University School of Medicine Nashville, TN	

Figure 1. Standards Advisory Committee on Agriculture.

the ROPS standard. We proposed that back in 1975, we finalized it in 1975, and it became effective in October 1976.

It dealt with all farm tractors made after October, 1976; they had to be equipped with the ROPS. The standard is based on the ASAE Standard, J11-94. The complete text of that Standard was put into the OSHA standard.

Even though tractors were required to have ROPS, we continue to see deaths of tractor operators from roll-overs. We have seen seat belts cut off or cut out; seat belts were not used in several roll-over deaths. Obviously, we have not seen the results that the Swedes have achieved with their standardization efforts.

OSHA wants to see its standard evaluated. We want to see this standard looked at very thoroughly to see why it is not working.

What can we do to modify it, to make it work, to become more effective? We know that seat belts are considered by many farmers and farmworkers as a hassle in hooking and unhooking, especially when you have to get off the tractor a number of times.

What other means can we use in lieu of seat belts to keep the person inside the ROPS area? How can training be made more effective? What are the weaknesses of our standard? These are some of the things that we need to look at and evaluate.

The new ASAE Standard, J21-9.4, is a revision of this effort. We have said publicly that the standard is acceptable in meeting our ROPS standard that we require here. We have done that administratively.

The International Standards Organization (ISO) is also involved in writing standards for ROPS, and the ISO Standards 5700 and 34-63 are additional new ROPS standards. Our ROPS standard is not as stringent as theirs.

In our opinion, if you have a ROPS design that meets all the tests of the ISO Standards, that will be acceptable in meeting the OSHA Standard as well. However, the seat belt requirements of the ISO Standard are not quite as stringent as our Agricultural Engineer's Standard at OSHA.

Machine Guarding

In 1973, the full committee went on to recommend that we propose a standard for machine guarding. This standard was finalized and became effective in March 1976, and became fully effective in June 1977.

This standard is also not working the way we had hoped. We need to refine ways of evaluating this Standard to see why it is not working. We have seen some power take-off (PTO) guards that are hinge-operated. Those seem to be working much better than those that you unbolt and bolt back on again.

We need to make guards—to use a term from the computer age—"user friendly," especially those on equipment that one has to get into frequently. Then, it will not be a hassle to move the guard off or move it out of position so you can make the adjustment and then put it back into place.

Augers are another area where we have serious problems. We are looking for

some practical solutions for a variety of farm machinery which people are still getting caught in and ground up by.

Publications

The full committee also looked into training and guidelines. They thought those items should be part of the overall outreach effort of the agency. The committee formed a publications group and came up with a list of things that needed to be done in the form of slides, tapes, publications, and even training films for ranchers, farmworkers, and ranch hands.

The publications were to be printed for those with low reading comprehension. Another set was printed for normal reading level for farmworkers and ranchers. Also, we had Spanish-language translation that we wanted to do for the agricultural community.

We got involved in this and entered into a contract with Purdue University's Agricultural School to help develop these publications. We were off to what I thought was a good start.

THE APPROPRIATIONS RIDER

Several U.S. Senators and others from the farm-belt states, however, began to severely criticize the agency for its standards effort and its outreach effort. We got raked over the coals.

The low-reading-comprehension booklet was a target for criticism. OSHA made a valiant effort to explain what we were trying to do. We hoped that the Advisory Committee was going to be one of our entrées to get the word out to the farm community.

We obviously did not have the kinds of coalitions and liaisons that we needed. The criticisms got to be blistering politically. As we were getting some of the booklets to press, the political pressure mounted against the effort.

Reason no longer prevailed. We came to a complete halt. OSHA withdrew their effort, and the critics continued to howl about OSHA.

The Agriculture Committee continued to work on other subjects like electrical and personal protective equipment, even field sanitation and transportation of farmworkers. No action was ever taken on any of these Agriculture Committee suggestions.

In Fiscal Year 1977, the Congress slapped a restriction or rider on the appropriations. The intent was to stop OSHA from carrying out its mandates under the Occupational Safety and Health Act. The Congress passed a law and told us to do it; they came back and told us they did not like the way we were doing it. They told us to stop doing it.

They did not want us doing more in this area, farms with 10 or fewer workers. Therefore, that rider said no enforcement, no standards-making, no investigations of fatalities or complaints would be allowed, nor would money be spent for these kinds of efforts.

The rider stopped OSHA, and that rider is still in the appropriation bill every year up to today. The Farm Bureau and other major organizations in the agricultural community are advocates for that rider.

The Congress put it on. We think that the Congress needs to be the one to take it off.

OSHA IN THE 1980'S

Let us take a look at the decade of the 1980's. Little action was taken by OSHA in the agricultural area during the 1980's. OSHA defines agriculture covered by Part 1928 to be those operations involved in planting, raising, and harvesting crops; animal husbandry including feedlots; aquaculture; cotton ginning; and others such as on-farm storage for grain handling. This is when a farmer is going to store several seasons of grain in his own storage facilities. That is considered part of our definition of farming under Part 1928.

Logging

We do not consider logging operations to be an agricultural area. We have a proposed rule to address those kinds of hazards.

Hazard Communication

OSHA issued two standards during the 1980's to add to Part 1928. Both were Federally court-mandated. OSHA was directed to issue both these standards which apply to farms with 11 or more workers.

The first one was hazard communication. This is one standard that applies to all workplaces that OSHA covers today, except for farms with 10 or fewer workers. These farms are the only ones that are not protected by the standard.

Field Sanitation

The next one was field sanitation. We went through the long, laborious steps to get the standard issued, a lot of agony. There was a lot of interaction in the Federal courts.

There was a strong desire by certain elements in the agricultural community to see this standard promulgated. They were successful, through the court system, at getting it into place.

OSHA IN THE 1990's

Where are we heading in the 1990's? OSHA continues to support NIOSH in its injury surveillance efforts, the injury prevention and control research, Fatal Accident Circumstances and Epidemiology (FACE) investigations by NIOSH, and the hazard alerts NIOSH has done like the oxygen-limiting silo problem. More needs to be done in this area on real problems on the farm and on the ranches.

OSHA wants to see its existing standards, like ROPS and farmstead machinery guarding, fully evaluated. What works? What does not work? Why does it not work? How can we make it so that it is effective?

We want to see a better injury and trauma data-gathering system. We want to analyze these data to help us better understand what are the causes of deaths and serious injuries on farms and ranches.

OSHA has about 5,000 slides that can be put into slide programs that are available to NIOSH and USDA. These are also available to our consultation program that we have in all 50 states. These were made during the 1970's, before the rider on the