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***National Safety Council***

## Food & Beverage Sessions

### WHAT WE HAVE SEEN AND LEARNED FROM RECENT DUST EXPLOSIONS

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(This is a summary of the illustrated talk presented by Dr. Schoeff.)

A tragic series of dust explosions in December 1977 focused national and world attention on the U.S. grain industry. Fifty-seven persons lost their lives, including 13 federal grain inspection personnel, and 47 were injured, some so severely they may never be able to work again. Property damage will fall between 50 million and 100 million dollars. Personal lawsuits will add millions more to the final costs. Two major export terminals will be out of business for 12-24 months.

A similar situation occurred in the early 1900's, with one difference. The explosions were occurring at interior grain processing facilities, with the worst being at a cornstarch plant in Cedar Rapids, Iowa in 1919 where 43 persons were killed.

History has a way of repeating itself, and this has occurred in the grain storage and processing industry in the form of dust explosions. There has been more than the usual number of dust explosions in the past five years based on very inadequate statistics.

We are tending to forget that many more grain facilities are being damaged or lost to fire each year than through dust explosions. Physical damage and losses have been very heavy and beyond description. Many unusual situations have occurred that cannot be explained.

Personnel losses have been light, with two exceptions, because of the

time of the explosions. Families of injured and dead employees have been neglected.

Because of the severe damage and destruction, it has been very difficult to determine what caused the primary explosions. There has been too much speculation as to causes by uninformed persons outside of the industry and also on ways to stop dust explosions.

It appears that very few firms had an emergency or disaster plan for dealing with such a catastrophe. As a result, management was not able to deal with problems of personnel rescue, product salvage, and the news media effectively.

Government regulatory agencies were equally unprepared and found it difficult to provide assistance.

#### What We Have Learned

There has been a great lack of understanding by employees and management as to how dangerous grain dust can be under the right conditions. Grain dust must be treated with respect as a major explosive force. Employee safety education must be given top priority.

Grain dust explosions can be prevented by applying common sense knowledge already available. Good housekeeping does pay!

Disaster planning is a must. Some firms are doing an outstanding job, and others should take action immediately.

Industry safety codes are unknown to most of the grain industry and ig-

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nored by others.

Industry safety codes and government regulatory agencies can assist, but not guarantee accidents will not occur. Safety is still a people problem!

Inaccurate news stories are the rule. A good disaster plan can alleviate the problem somewhat, but there will continue to be conflicts due to the emotional situations that occur.

The Federal Grain Inspection Service has greater impact on terminal grain elevator safety today than OSHA.

Many reinsurance firms have withdrawn from the grain industry market, and rates have increased several hundred per cent, which will have an impact on the entire industry for many years. There appears to be no good actuarial data on losses on which to establish rates.

Professional rescue and salvage experts can minimize the shock on employees and loss of inventory and facilities.

Safety specialists must be given recognition and top management support to carry out this very important function within their firms.

The entire grain storage and processing industry has a big stake in improving its safety record: (1) to reduce loss of lives and injuries; (2) to hold and attract good employees; (3) to hold down and/or reduce insurance costs; and (4) to keep government regulatory agencies from further involvement.

The grain industry is concerned and taking positive steps to prevent fires and dust explosions through employee training, installation of safety equipment, improve plant design, better maintenance and housekeeping and research.

Industry trade associations are the most effective way to deal with government regulatory agencies and to provide leadership in conducting research. They deserve whole-hearted support in their efforts.

## CONTROL OF NOISE IN THE FOOD INDUSTRY USING MATERIALS THAT ARE FDA AND USDA APPROVED

By RICHARD K. MILLER

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As if the control of industrial noise were not difficult enough, food plants have the added constraint that their acoustical installations must also be sanitary.

Operating under the Federal Food, Drug and Cosmetic Act, the Food and Drug Administration (FDA) is responsible for regulating all foods except red meats, poultry and eggs, which are the responsibility of the Department of Agriculture (USDA).

Information was recently obtained from the FDA and USDA regarding requirements for noise control materials.

### FDA

The Division of Regulatory Guidance, Bureau of Foods, Food and Drug Administration provided the following information:

"The Federal Food, Drug, and Cosmetic Act contains no specific requirements concerning building construction or building equipment used in food processing plants. However, the various adulteration provisions of the Act must be taken into account in considering the construction and types of building fixtures and equipment used in a plant intended for processing.

"The Act provides, among other things, that food is adulterated if it has been prepared, packed, or held under insanitary conditions whereby it may have become contaminated with filth, or whereby it may have been rendered injurious to health. We

would expect that materials used in building construction to be of a nature so that the food processed in its vicinity would be adequately protected from contamination with filth or other substances deleterious to health. The construction employing the material should be of a design to facilitate inspection and cleaning and should be rodent proof and should not provide harborage for insects or other vermin."

### USDA

The Facilities Group, Technical Services, Meat and Poultry Inspection Program, United States Department of Agriculture provided the following information:

"We require materials which represent a surface in any room where meat or poultry products are prepared, handled, or stored to be chemically acceptable and possess the physical characteristics associated with cleanability. Basically, that implies smoothness, firmness, and imperviousness. The material should not have cracks or crevices which make cleaning very difficult, and should be firm enough to resist the normal abuse that will occur whether it occurs from operation activity or cleanup. Obviously, the use technique of the material can affect the acceptability. In other words, a material may be acceptable both from a chemical and physical standpoint; but, the construction design used in effecting noise control may re-

sult in the finish item not being acceptable. Any noise control design cannot cause unsanitary conditions to occur."

The USDA utilizes FDA approval lists and procedures for approval of non-toxic materials. A list of approved materials is provided in the Food Additive Regulation, *Code of Federal Regulations*, Section 121.25. Approval may be obtained for other materials by providing (1) trade or brand name, (2) use, and (3) chemical compliance to: Scientific Services, Animal & Plant Health Inspection Service, U.S. Department of Agriculture, Washington, D.C. 20250.

Our investigation has indicated that the most compatible materials for noise control would be stainless steel and certain plastics such as Teflon, PVC, etc. It may be noted that USDA approval has been granted to PVC curtain impregnated with a metallic lead; however, lead salts are not allowable.

Regarding materials not in food contact, the primary requirement is the prevention of porous or irregular surfaces which permit dirt or bacterial build-up. The material must be cleanable. MPI Bulletin 350 directs enforcement against open polystyrene foams for walls and ceilings. Foams with an impervious facing, however, have received USDA approval.

Present FDA regulations dealing with good manufacturing practices (GMP's) are contained in Title 21, *Code of Federal Regulations*, Part 128. Part 128 is generally recognized as an "umbrella" GMP regulation ap-

plying to all facilities engaged in the manufacture or processing of foods for human consumption and sets forth requirements for sanitation and cleanliness that must be complied with to assure that such food is safe and has been prepared, packed, and held under sanitary conditions.

The following sections may be applicable to noise control installations: Section 128.3 (b) (1)—Plant Construction and Design—specifically relates to conditions within the actual facility and, in part, requires that "... floors, walls, and ceilings in the plant shall be of such construction as to be adequately cleanable and shall be kept clean and in good repair."

Section 128.3 (b) (1) "... fixtures, ducts, and pipes shall not be so suspended over working areas that drip or condensate may contaminate foods, raw materials, or food contact surfaces."

Section 128.4 (a) "... all equipment should be so installed and maintained as to facilitate the cleaning of the equipment and of all adjacent spaces."

Section 128.6 (c) "... all utensils and product-contact surfaces of equipment shall be cleaned as frequently as necessary to prevent contamination of food and food products. Nonproduct-contact surfaces of equipment used in the operation of food plants should be cleaned as frequently as necessary to minimize accumulation of dust, dirt, food particles, and other debris."

## CONTROL OF NOISE FROM DAIRY PACKAGING AND PROCESSING EQUIPMENT

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The acoustical environment of dairies consists of the noise of numerous items of mechanical equipment which is amplified by the reverberation of the work space due to hard wall, ceiling, and floor surfaces. In some cases, reverberant noise levels may be reduced by sound absorptive treatment. Generally, however, noise reduction must be achieved by means of equipment modifications. Approaches to equipment noise control are presented in the following sections.

**Sanitary Requirements.** Precaution must be paid to maintaining sanitary conditions within the dairy while solving noise problems. A good discussion of the problem faced by the dairy industry in complying with the USPHS Grade A Pasteurized Milk Ordinance and OSHA standards has been prepared by Greiner.\*

**Fillers.** Gas fired burners used on some fillers generate sound levels in excess of 90 dBA. Ex-Cell-O Corporation has developed two quiet burner models which reduce the burner noise to 76 dBA at three feet. The cost of replacement burners is approximately \$700. It should be pointed out that some fillers use electric heaters rather than burners, eliminating this noise source.

Another source of noise is the 92 to 94 dBA generated by using compressed air to discharge the cartons from the bottom forming section through a chute to the rear conveyor chains. A prototype machine developed by Ex-Cell-O is presently running in the field, which uses a mechanical

stripper device, eliminating the air in this location. As a result, a reduction of noise was accomplished as a reading of 82 dBA was recorded at a distance of three feet while the machine was running. The cost of the modification is approximately \$1,000.

**Homogenizers.** The noise level of homogenizers is typically 97 dBA at five feet. The following approaches may be considered for reducing the noise of homogenizers.

1. The best approach for noise abatement of homogenizers already installed is the use of acoustical enclosures or to isolate the equipment in acoustical rooms.

2. A thru-wall installation may be considered where the liquid end would be on the production floor and the drive end may pass through a wall into an area where employees are not located.

3. One dairy has reported a noise reduction from 107 to 97 dBA by boring the head and replacing the motor.

4. Installing an acoustical insulation inside the housing.

5. Apply a vibration damping treatment to the stainless steel skin.

6. Silencing the louvers which are necessary for heat transfer but also serve as a noise path.

7. Using a quiet-line motor.

8. Using quiet gears, such as ones with shaved teeth which reduce contact noise.

**Separators and Clarifiers.** The method of standardization and clarification of milk presents the problem of the separator/clarifier location. In many new installations the separator/clarifier is an integral part of a high-capacity HTST system. Unfor-

\*Greiner, F. J.: Dairy Industry Committee, Testimony before OSHA, U.S. Department of Labor, re: Proposed Revision Occupational Noise Exposure Regulations, June 23, 1978.

tunately, the noise level of most separator/clarifiers does not meet the minimum allowable noise standards. To circumvent this problem, the new plant layout should isolate the separator/clarifier in a separate room that is near the short-time equipment, near the main control panel, and adjacent to the processing room. Control of the machine is by the main panel operator on the processing room floor.

**Ice Cream and Popsicle Machines.** Sound levels ranging from 87-92 dBA were measured for two machines. The major noise sources were identified to be metal-to-metal impacts, exhaust from air cylinders, and a vibratory bowl feeder.

**Material Handling — Automatic Casers and Stackers.** The primary noise sources of these items of equipment are air exhaust and metal-to-metal impacts.

**Air Exhaust Noise.** Air discharges are observed throughout many plants and are considered a primary source of excessive sound levels in most areas. Most air discharges result from pneumatic exhaust of control systems, and these air exhausts are either continuous or cyclic in nature.

Sound levels generated by air exhaust, where concentrated air flow is not required, may be silenced by the installation of pneumatic mufflers which diffuse the air stream. The specification of an optimum pneumatic silencer for any application should be based upon sound level reduction, low pressure drop, durability, non-clogging features for the air contaminants present, and economy. Mufflers should be periodically inspected for wear and effectiveness. If necessary, an in-line filter system may be installed to prevent muffler clogging.

**Metal-to-Metal Impact Noise.** Where structures or parts are impacted with metal-to-metal surface contact, a large portion of the impact energy is converted to vibrational energy, and in turn sound. The acoustical energy generated by part impacts is directly proportional to the kinetic energy at the impact point.

**Motors.** The two primary types of

motors are the drip-proof (DRPR) and the totally enclosed, fan cooled (TEFC) motors. The DRPR cools itself by pulling in outside air and circulating it around the electrical conductors, while the TEFC motor uses a fan to accomplish cooling. It is evident that high speed (3500 rpm and above) and TEFC motors are noisier than their slower speed and DRPR counterparts.

Solutions to motor noise problems include muffing or muffling the inlet and outlet air and isolating or damping the vibrations. Motors with horsepower ratings of 75 or more often require abatement. Motors below this rating do not normally generate noise levels that are above 90 dBA; however, these smaller motors may contribute to other equipment noise, and additive levels may exceed 90 dBA.

Several motor manufacturers have developed new lines of quiet motors with higher horsepower ratings. This has been accomplished through quiet fan designs and minor internal modifications. To insure minimum motor noise levels, specifications that sound pressure levels are not to exceed 85 dBA at three feet and that sound power levels are not to exceed 95 dBA should be made to manufacturers for any new motors purchased.

**Vibratory Bowl Feeders.** Vibratory bowl feeders are designed for a certain maximum capacity and are generally quiet within their design range. When the bowl speed is exceeded, excessive noise is generated due to system non-linearities. It is often observed that bowls are set to feed parts faster than required by the line flow. Maximum operating bowl speed should be determined for satisfactory operation, and a limiter should be put on the potentiometer dial to prevent operation above this setting. The maximum operating point may be determined quite easily by ear. If a limit is not considered practical, the normal operational range should be marked on the potentiometer. In addition to noise level reduction, potentiometer control will result in both energy and machine wear savings.

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The sound levels of vibratory bowl feeders may easily be reduced to below 85 dBA by the installation of an acoustical enclosure. Noise control enclosures for vibratory bowl feeders are available from several manufacturers (cost generally ranges from \$300-\$800).

**Reverberation.** Whenever machinery is operated within enclosed spaces, sound levels will be increased to some extent due to reverberation. When this reverberant sound level increase becomes significant, it is appropriate to install sound absorptive materials on the ceiling above offending machinery. A simplified procedure can be used to estimate the increase in noise due to the reflected component.

Any sound absorptive treatment used on ceilings of food process areas must be cleanable and meet other good manufacturing practice guidelines.

Attention should also be given to machine location within a room.

**Truck Refrigeration Units.** The nighttime operation of truck refrigeration units can create a community noise problem for dairies and other food plants. Two approaches to noise abatement may be considered:

1. Acoustical barriers may be constructed to isolate the refrigeration unit noise from adjacent residences. The barriers may be constructed to be portable on wheels, lift-on, or as a permanent structure similar to a car port.

2. Mechanical modifications may be made to the refrigeration units. In response to one community noise problem, Thermo-King NWD units were modified by replacement of the fan and maintenance. The noise reduction achieved was seven dBA.

## OSHA COMPLIANCE STRATEGIES, RECENT COURT DECISIONS ON COST BENEFIT ANALYSIS

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The Williams-Steiger Occupational Safety and Health Act of 1970 (Public Law 91-596) was established "to assure safe and healthful working conditions for working men and women." The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor was delegated the responsibility of implementing and enforcing the law. Title 29 CFR, Section 1910.95 of this original law pertains to the protection of workers from potentially hazardous occupational noise.

While the OSHA regulations establish a maximum noise level of 90 dBA for a continuous eight-hour exposure during a working day, higher sound levels are allowed for shorter exposure times. A noise dose, D, is defined as the actual exposure time divided by the allowable exposure time. The allowable exposure time is given in Table G-16 of the OSHA regulation. The employee noise exposure exceeds the OSHA limits if the noise dose exceeds unity (1), or 100 percent.

$$D = \frac{C}{T}$$

where: D = noise dose  
C = actual duration of exposure in hours  
T = noise exposure limit in hours

### Feasibility

The Occupational Safety and Health Act requires that engineering or administrative noise control measures be implemented where feasible, if noise levels exceed 90 dBA for eight hours, or a noise dose of unity. There does not, however, exist a special descrip-

tion or definition of "feasible" beyond the Webster dictionary definition, "capable of being done." OSHA enforcement personnel and industry often differ in their opinion of what noise control measures are "capable of being done," and the final determination rests on the legal opinion of an OSHA judge in many cases.

The difficulty in defining feasibility status of many problems lies in the misconception that all problems fall into two categories: feasible and non-feasible. In truth, the noise abatement feasibility of many projects cannot be determined in advance. Unforeseen problems or engineering variables may be encountered in the implementation of any design. Feasibility, therefore, cannot be definitely established until a proposed design is implemented and assessed. Only designs implemented and found to be satisfactory within the industrial environment can be considered to have established their feasibility.

The legal burden of proof in determining a violation of the OSHA standards, and, therefore, of establishing noise abatement feasibility, rests with the U.S. Department of Labor (Title 29, Part 2200, Rules of Procedure, Paragraph 2200.73). In some OSHA offices, it is the policy that a compliance officer should have a potential noise control solution in mind prior to issuing a citation for an operation.

### Determination of Feasibility

To establish that solution of a noise control problem is feasible, one must consider three areas: acoustical feasibility, production feasibility, and economic feasibility.

To establish acoustical feasibility, it must be shown that designs exist which would provide adequate noise reduction.

Assessment of each of these feasibility categories must be made in order to determine the total feasibility of a proposed noise abatement solution. In cases where doubt arises as to acoustical or production feasibility, a design prototype may be required.

### OSAHRC

The Occupational Safety and Health Review Commission (OSAHRC) is an independent governmental administrative agency consisting of three commissioners in Washington, D.C. and assisted by approximately 60 federal law judges throughout the country.

Decisions handed down by the Occupational Safety and Health Review Commission regarding contested OSHA citations serve to define and clarify the legal responsibilities with which an employer is required to comply. The complete decision and judicial comment is available as a matter of public record. All OSAHRC decisions relating to noise are summarized in detail in the *Noise Regulation Reporter*, published by The Bureau of National Affairs, Inc., Washington, D.C. 20037.

### Economic Feasibility

Until 24 August 1976 the Occupational Safety and Health Administration did not formally recognize economic factors as related to the feasibility of a noise control program. On that date, the Occupational Safety and Health Review Commission ruled that the Labor Department must consider economic as well as technical aspects of feasibility.

The following summarizes major OSAHRC decisions regarding economic feasibility:

1. *Continental Can Company*. The Commission decided that the engineering controls proposed by the Labor Department at eight plants are not economically feasible and need not be installed. The chairman, in his lead opinion, stated that the standard only

required the implementation of those engineering controls which are economically as well as technically feasible. Controls may be economically feasible even though they are expensive and increase production costs, but they will not be required without regard to the costs which must be incurred and the benefits they will achieve. In determining whether controls are economically feasible, all the relevant cost and benefit factors must be weighed.

The decision upheld the October 31, 1974 decision to vacate citations for violations of 29 CFR 1910.95(b)(1) which resulted from inspections made in 1978 at eight plants.

Experts for the Continental Can Company stated at the hearing that the cost to develop and install enclosures for the body-makers and die presses in question at the eight plants is \$494,000 and the exposure of approximately 125 employees would be reduced to within G-16 limits, and some lesser reduction would be experienced by an unspecified number of other employees. In addition, to reduce noise within G-16 limits at all 79 plants in its Metal Division would require the expenditure of approximately \$83 million, plus annual maintenance costs of \$175,000 as opposed to an annual cost of \$100,000 for the company's current hearing conservation program utilizing personal protective equipment. (Docket 3973, 24 August 1976). The decision has been appealed by the U.S. Department of Labor.

2. *Turner Company*. The Commission affirmed a finding that the citation and \$75 penalty assessed was in order and rejected the Turner Company's contention that the noise standard was invalid. The Commission ruled that engineering controls were technically and economically feasible and Turner agreed. Enclosures for three metalworking presses at the cost of \$25,000 were found to be within the resources of the company. (Docket 3635, 24 August 1976).

The case was appealed by Turner Company to the U.S. Court of Appeals. The U.S. Court of Appeals for the Seventh Circuit refused to

accept the Labor Department's argument that economic feasibility of engineering controls should be based on the firm's ability to pay for such controls. The court found that OSAHRC incorrectly failed to consider the relative cost of adopting engineering controls at Turner versus the effectiveness of an existing personal protective equipment program using individually-molded earplugs. It accepted the company's argument that the Turner decision is inconsistent with other commission rulings on economic feasibility of controls, directing that the commission reconsider Turner under a procedure outlined in the case of Continental Can Company, issued the same day as Turner.

3. *Great Falls Tribune Co.* The economic feasibility of engineering noise controls depends upon whether or not the benefits they will achieve can sufficiently justify their cost, the Commission ruled. The Commission concluded that, at a cost of \$12,500 per employee, the installation of controls in the Tribune's press room at Great Falls, Montana was not economically feasible in "view of the relatively slight benefits which controls will achieve in this case." Personal protective ear muffs are used and reduce noise to safe levels while engi-

neering controls would not achieve compliance, the cost of which the Commission held is clearly excessive and thus not economically feasible. (Docket No. 6632, May 19, 1977).

4. *Castle & Cooke Foods.* Economic feasibility is evaluated on the basis of relevant costs and benefits, the Commission ruled, not an employer's financial condition. The Commission vacated an OSHA citation for non-serious violation of permissible noise exposure limits at Castle & Cooke's Hawaiian can plant and cannery. Considering the estimated implementation and annual cost impact of engineering controls to be \$3,100 and \$1,100 per employee at the can plant and \$3,400 and \$111 at the cannery, the Commission concluded that the benefits gained would not justify the cost of the controls. While engineering controls would significantly reduce noise exposure, the noise hazard would not be eliminated and the hazard was not critical at any rate. Further, for a relatively insignificant cost, the firm provided personal protective equipment that reduced noise levels to within the requirements of standard 1910.95(b)(1). The engineering controls were, therefore, not economically feasible and the citation was vacated. (Docket No. 10926, 19 May 1977.)

## TWO TOPICS IN HEALTH HAZARD LOSS CONTROL IN THE FOOD AND BEVERAGE INDUSTRY

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I would like to discuss two rather specialized topics in the health area. They are tank entry procedures, and the subject of medical monitoring for purposes of health standard compliance.

Large scale food production operations often utilize chemical industry techniques. These generally include the use of isolated or closed systems for as much of the food processing as possible. This may even occur on smaller scale operations in plants with only a few employees. Weighing and blending hoppers, reaction vessels, roasters, and similar equipment used in large scale manufacturing all contain food products at one time or another, and as everyone knows, food products are non-toxic. If they can be eaten, how can they possibly represent a health hazard?

The obvious response is that there are health hazards involved in tank entry operations. The interior of many of these vessels or enclosed spaces may have toxic gases, vapors of liquids, and dusts, all of which may present a health hazard. The rusting of the interiors of tanks or work such as welding, chipping, and grinding may produce air contaminants that may pose a health problem. The accumulation of sludge and food products in the bottoms of vessels may result in decomposition releasing carbon dioxide or other toxic gases or vapors, and leaks of processing chemicals into the tank through feed lines may introduce hazardous materials. Carbon dioxide is not particularly toxic in itself, but it does displace oxygen, which results in a hazard which may be undetectable by normal sensory evaluations. Release of carbon dioxide or other toxic gases

may result in a stratified condition inside the tank, so that the upper levels of the tank may contain what appears to be pure air, with a serious oxygen deficiency in the lower levels.

Serious incidents do not often happen during enclosed space entry operations, but when they do happen they are frequently very severe. They arise not only from the types of health hazards that I've talked about but from common safety hazards such as electric shock, falling, start-up of equipment such as agitators while a person is in the vessel, and other incidents. Frequently, the "chain reaction" type of incident occurs where a worker will be overcome by toxic atmospheric contaminants, and when a second and third worker attempts to enter the vessel to perform a rescue, the rescuers become victims themselves.

In a fairly recent incident in a candy manufacturing plant, the death of a worker in a sugar storage hopper was only discovered when the worker's leg appeared in the dispensing chute. The protective measure for prevention of incidents like these is fairly simple and straightforward but is not frequently carried out in a formal, organized fashion. To be effective, particularly in small plants where enclosed-space entry may be infrequent or may be done only on night shifts or week-ends, the program must be formal and must be rigidly enforced, for example, a tank entry program utilizing permits and checklists.

The permit should include a checklist requiring the foreman's initials from the processing department in which the tank is located and from the maintenance foreman who is responsible for carrying out the task. It in-

cludes checklists for oxygen content of the tank, cleaning and purging, opening of access ports, installation of ventilation equipment, combustible gas indicator readings, recheck of oxygen content, availability of breathing air equipment, lockout of electrical switches, availability of low voltage lights and blowers, blanking off of lines into the tank, closing and tagging of valves, equipment and electrical supply cords grounded, harness and rope for lifeline use, and safety and security of ladders.

The program requires not only the checklist but the conscientious use of the checklist by responsible plant management. It must be filled out, and filled out completely, or its usefulness will be diminished.

Let me review in detail the safety steps which should be on the tank entry checklist:

1. Cleaning, purging, and ventilation of the tank. The cleaning steps will depend on the initial contents of the tank; these have to be worked out on an individual basis. It may consist of nothing more than flushing out the tank with water, or it may involve use of detergents, high pressure steam, or other more vigorous cleaning methods to remove as much foreign material from the tank as possible without actually entering the tank. The tank must then be purged with clean air to insure the steam or nitrogen inerting blankets have been removed and a normal oxygen atmosphere established. Ventilation may be used at that point to maintain that atmosphere in a fresh condition.

The question of whether to blow fresh air into the tank or suck it out is one that creates some confusion. There is no definite choice one way or the other, but a decision must be made on the basis of the operation to be carried out inside the tank. If there will be no air contaminants generated during the work operation, blowing the air in or sucking it out will probably not make much difference, provided that adequate mixing of the air in the tank occurs and that there is no short circuiting (a condition where fresh air enters the tank and leaves immediately without mixing into some portion of

the enclosed space being worked on). If work such as welding is being carried out, it is usually best to use exhaust ventilation which is kept near the point of welding or contaminant generation, so that the contaminants may be exhausted to the outside of the tank. Makeup air must then enter access ports elsewhere in the enclosed space to create a sweeping action of fresh air entering the work space. If air is blown into the tank under these types of operations, it acts as dilution ventilation, which may not be sufficient to dilute air contaminants such as ozone as oxides of nitrogen from building up to potentially hazardous levels.

2. Testing of the tank must occur before entry and periodically during operations inside the tank if there is any possibility at all of contaminants being generated or entering the tank during the operation. The specific type of testing may consist of use of detectors for specific contaminants, such as carbon monoxide, oxygen testing to ensure adequate levels of oxygen in the tank, combustible gas indicators to measure potential explosive vapors in the tank. In any case, the testing must be carried out by personnel who have used the equipment before and are thoroughly trained in its proper usage, and the equipment must be properly calibrated on a periodic basis to ensure that it is indeed working. Since vessel entry procedures are usually infrequent, it is not asking too much to carry out a calibration of the equipment before every enclosed vessel entry operation.

Another equally important factor in testing is that the measurements must be taken at several levels in an enclosed space. Because of the stratified condition mentioned earlier, toxic gases or oxygen deficiency may exist at the bottom or in an isolated corner of an enclosed space, while at the top or near the entry port of the vessel or space there may be a normal atmosphere.

3. Isolation of the tank must be thorough to prevent the entry of hazardous materials of any kind during the operation. It would even be a disaster if an innocuous material such as water were to enter the tank during an

operation using electrical equipment, or one in which workers could be trapped by rising water levels and unable to leave the tank. The isolation occurs by closing, tagging, and locking shut all valves leading to the tank, by blanking off feed lines where possible and necessary.

4. Electrical power to the space must not only be shut off but locked out so that there is no possibility of accidental engagement of machinery. Locks should be placed on the electrical switch for the equipment. Many programs provide for each person entering the tank to place their own lock on the main power switch, the workers retaining the only keys. This prevents any misunderstandings about whether or not there is still anybody in the tank.

5. Low voltage lighting systems are available for use in tank entry operations and help to reduce the possibility of electrical shock and/or ignition of combustible vapors in the tank if a bulb should be broken.

6. Electrical equipment certainly should be grounded adequately before use in enclosed spaces.

7. Rescue breathing air equipment should not be utilized as a main protection against possible air contaminants or lack of oxygen in the tank, but it should be available during the operation for emergency and rescue purposes. All of the elements of a respiratory protection program must be adhered to, emphasizing the training of employees who are to use the equipment. It is absolutely essential that the equipment be well-maintained in good order, that the air tanks be full, and that the workers know exactly how to use the equipment and what its limitations are.

8. There must be a worker on standby by acting as an observer of the worker or workers in the enclosed space. The standby worker should have no other duties which may take him away from the enclosed space, and he should be able to see what is going on at all times. As part of the training, the worker should know what to do in the event of an emergency, whether it is simply to ring an alarm bell to summon extra help or to actually perform

a rescue operation himself.

9. Lifelines are necessary for tank entry to be able to remove workers in a manner which will not expose the observer or other rescuers to the hazard that rendering the worker incapable of leaving the tank himself. The particular configuration of the tank must be taken into account as to what type of a harness is best for this operation. One kind of harness would raise an unconscious worker in a slumped over position, so that it is possible he would not be able to fit through the opening of the tank. There are lifelines which attach to the wrists of the worker which would solve this problem, but also raise the possibility of breaking the worker's arms if they are in an awkward position when the lift begins. No matter what kind of lifeline is used, a mock rescue drill must be performed to assure that the observer or rescuers are capable of lifting an unconscious person and removing them from the tank using that particular setup. A winch may be necessary.

All of the foregoing has been a very fast review of the subject of enclosed space entry. The major point I have attempted to make is that this is an infrequently performed and often neglected area of work which results in severe injuries and fatalities more often than it should. The safety precautions are not complicated or mysterious, in fact they are obvious, but they must be carried out in a formal, organized fashion or serious injury or death may result in your operations.

I am now going to shift gears and direction completely and talk about another subject, which is again related to health problems in not only the food and beverage industry but in all industries where industrial hygiene exposures may occur. The topic is medical monitoring programs, which are relatively new and somewhat controversial. I would like to discuss what these monitoring programs are, when they should be considered, the situations in which you will want to consider instituting a program, and I will give you a couple of examples of typical monitoring programs for specific exposures.

A medical program may be defined as a preplacement and/or periodic

medical evaluation of health status in workers exposed to toxic substances or physical agents in the environment.

The objective of the monitoring program should be to assess the effects of the toxic substances on the health status of the worker to insure that there will be no adverse health effects and to assess the ability of the worker to perform safely and efficiently in the environment. The medical monitoring program serves as a check on other environmental monitoring programs, such as air sampling, as a preventive device.

The need for these monitoring programs arises from at least four causes. First, is the presence of toxic materials or environmental stresses, such as noise or heat or radiation in the environment. Second, is an evaluation of the exposure to these stresses or toxic substances, indicating that they are at or near some level where some health effect may be expected. The third condition that may require them would be governmental regulations, such as that for asbestos, requiring the medical monitoring program regardless of the degree of exposure. The fourth reason may be employee complaint requests or demands, which may then be integrated into a worker health insurance program.

Development of the monitoring system starts with an industrial hygiene survey, which is usually a two-phase program: First, a walk-through to identify potential problems and exposures and, second, a detailed study involving air sampling or other measurements of exposures. These exposures may be measured and compared to standards which may be as rigorous as the OSHA minutes and action levels, or they may consist of arbitrary standards established by management at a level higher or lower than the OSHA standards. If the exposures are judged to be high by whatever standards are decided upon, further action is necessary. If they are not high, then the information is filed and perhaps followed up on a routine basis.

In the case of exposures which are in excess of the limits decided upon, our industrial hygienists take two actions: they recommend engineering or

other controls to reduce the exposures to individual workers and to the general environment, and they refer the case to our occupational health consultants who will then conduct an evaluation of the medical program established in the facility.

While this evaluation or occupational health study includes many factors regarding the staffing, objectives, and actual performance of all aspects of the medical program, the one we are considering here is the status and existence of a surveillance program. If no surveillance program exists in view of excessive exposure to toxic materials, one will undoubtedly be recommended. The contents of that medical program will vary, depending upon the objective of the program (whether it is intended to screen employees before entry into certain positions or whether it is intended to elicit signs or symptoms of adverse health effects), and considerations such as economic feasibility.

If there is a surveillance program, a review of the results of that program will indicate whether or not there are abnormal health findings in the worker population being exposed. If there are no abnormal findings, this information likewise is filed, or perhaps sent on to the industrial hygienist who has measured the environmental exposures to indicate that some controls are effective at least.

If there are abnormal findings, action should be taken with the employees, either removing them from exposure, giving them appropriate treatment, or whatever the particular situation calls for. The other action that occurs with this information is to refer it back to the industrial hygienist who is responsible for the environment which presumably caused the abnormal findings. This will cause reevaluation of the environment and start the chain over again. Perhaps it will result in more stringent engineering controls.

What do these programs consist of? This is an item that is somewhat controversial and can be argued. However, it will consist of two parts: (1) a general medical surveillance program, which would apply to nearly any environmental exposure, and then (2) spe-

cific medical evaluations, which would be specially required for specific toxic materials.

The content of the general medical surveillance program again can be argued, but would probably involve the following steps:

1. Determination of exposure levels to toxic materials or agents in the environment.
2. The determination of decision guidelines, as mentioned before, establishing criteria for various actions. As an example of this, one might decide that any exposures measured to be below the OSHA "action level" would not require any specific medical testing. Any exposures over the OSHA permissible exposure limit, or perhaps twice the exposure limit, would require mandatory and extensive medical testing. Those exposures between the action level and the permissible exposure limit might indicate that a quick screening surveillance program might be appropriate and that further testing would be desirable, if feasible. In any case, the decision guidelines must be established by management.

3. The third phase is the conduct of the actual physical examinations. This would include blood tests, such as an SMA 16, a complete blood count, which are both standard tests. A urinalysis for very specific compounds would be recommended, and perhaps most importantly, a "hands-on" examination by a physician. Other aspects of the exam would include collection of a history, both personal, family, and occupational.

I have included examples of medical evaluation programs for two specific toxic materials, carbon monoxide and asbestos. As I indicated, these can be argued with, and undoubtedly will vary depending on the specific conditions of the plant and the exposures and the objectives of management's program. However, I offer these to illustrate the general concept of what may be included in the specific test.

For carbon monoxide, please note that all of the tests listed—the x-ray,

EKG, hemoglobin, and carboxy hemoglobin tests—all refer to the heart and lungs. This is logical, since carbon monoxide affects the ability of the body to transport oxygen to the muscles, and excessive carbon monoxide exposure will produce added stress on the heart. Thus, the specific physical examination requirements would measure the body's current capacity to acquire and transport oxygen to tissues. In addition, the history collected with the physical examination would stress factors such as smoking or tendency towards respiratory infections.

The purpose behind the questions, then, is to ascertain whether or not there has been some adverse effect from carbon monoxide exposures, as well as to make an evaluation of that worker's ability to function in an environment which contains exposure to carbon monoxide.

The other example is that of asbestos. Once again, the specific tests we have included here all refer to the effect of asbestos exposure: the respiratory disease known as asbestosis and the development of the cancer known as mesothelioma. In this case, however, the reason for implementing the medical monitoring program may be different from that for carbon monoxide. The government requires the medical program for workers exposed to asbestos.

Other programs that may be required for industry operations might be evaluations of exposure to pesticides, noise, and heat stress.

These medical programs, as I have indicated, are not new. However, it is only within the last few years that they are being recognized as an integral part of a safety and industrial hygiene program, and they are becoming more widely required under occupational health regulations. I would expect to see each new standard that is developed by OSHA include specifications for medical testing. Industry should be aware this is coming and get their act together in advance.

## EMPLOYEE PROTECTION CHALLENGES OF THE 80'S

By BOB VANDENBERG  
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We no longer can lounge leisurely in the solitude of our office with a feeling of smugness, security, and comfort because we work in the slow-changing occupational safety field. Things today in the safety field are anything but slow. They are changing at a rate that most of us cannot keep in stride with—and these rapid changes will continue to accelerate for many years to come, far into the 80's and beyond. I find myself running harder and harder, but I still cannot keep up, and it's not just because I am getting older. Things are happening—changing, if you will—faster and faster.

Unfortunately, these changes are not always for the better. They don't always actually impact on the health and safety of employees. They aren't always realistic. Some circles seem to think that if change is good, then many changes are wonderful, wonderful! Some government agencies seem to be using many changes as a way to keep critics off their back and a way to shadow box sufficiently confusingly to impress everyone with their busy-ness and activity. Little thought seems to be given to the literally millions and millions of dollars we in business and industry are forced to spend needlessly because of useless and unrealistic standards and totally unnecessary changes—and the economy of the consumer is the ultimate loser.

We in the safety business have two major problems today. One is that government and the unions expect management to do the impossible, which is to eliminate all chance of accident or injury regardless of the cost or the effect on productivity. This is not realistic, because the prime reason for any business to exist is to make

a reasonable profit, and there is no such thing as a "zero risk" probability. The other major problem is that there are still too many managements that are reluctant to assign a high enough priority and make a sincere enough commitment to employee protection.

Another major problem today is that many managements are too concerned about compliance to OSHA standards. They are spending their time, money, and energy to comply with specification standards and they are becoming negligent in doing some of the things that truly relate to employee protection, notably, training, motivating and communicating.

I recognize the problem on both sides—and unfortunately today we do have sides. There is a definite adversary relationship existing. Instead of government and industry working together to protect the health and safety of our citizenry, we spend far too much time, money, and effort trying to "score" on each other. That's really too bad. We are both to blame, and it really hinders the effectiveness of the safety effort.

I think this working relationship will improve in the 80's; probably the economic problems of the nation will be mainly responsible for bringing it about.

When all managers are willing to make a suitable commitment toward employee protection, and government, unions, and the public are willing to accept a reasonable risk and settle for a feasible and workable standard with realistic special interpretation, we will be able to move forward in protecting the health and safety of the employees working for a profit-motivated organization. We live in what is still the most wonderful country in this entire world.

Our very successful capitalistic system, based on the potential of the profit motive and innumerable freedoms and choices, has led to almost unbelievable progress and advancement in the quality of human life. Heaven help us if these basics are eroded further.

It is imperative that we develop a less adversarial climate between industry, labor, and the government. Quit trying to out maneuver each other and instead join hands and realistically, feasibly, and economically work together in harmony to develop a safe and healthful working environment for all employees.

OSHA was labor legislation and it was needed. Now that everyone is awake, let's cooperate and work together to accomplish our common employee protection objective.

Now that you have heard my philosophy, let's take a quick look at a list of things that I think are going to happen or are already starting to happen in the safety and health arena. There is definitely going to be more and more governmental intervention in our business. This is highly unfortunate and will adversely affect the economy. But it's coming, so let's face it.

It's no secret that major emphasis is changing to the health area.

Accident-related costs will dramatically increase. The only way to cut these costs down will be to prevent accidents from happening. Be sure to use this argument on your managers. Make it clear to them that you are talking money. Some profit eroders associated with accident costs will be: wage maintenance for injured; job protection for injured and disabled; larger compensation settlements; direct employer liability; settlements over and above worker's compensation where recognized hazard was not corrected and caused serious injury.

National worker's compensation standards are on the way. They will establish minimum standards for state-run compensation programs and will mandate a minimum compensation schedule for occupational diseases. Some states will be greatly affected, and overall compensation costs will increase.

Executive liability will be established as a point of law. Basically, it will establish that an employer is responsible for knowing the hazards of the workplace and he is also responsible for communicating this information to the employee (this in addition to providing necessary training and protective equipment to avoid becoming the victim of the hazard). This will require better documentation of the training effort.

We will have new consensus groups writing standards (combination of groups), e.g., ASTM-ANSI-NFPA.

Many, many more OSHA regulations are coming and the following changes will be a part of them:

We will have self-inspection and certification to government.

We will have concurrent agency inspections, either by one inspector inspecting for OSHA, EPA, FDA, CPSC, etc., or several inspectors entering your plant at the same time representing two or more agencies. This is currently being set up. Some cross-agency training is being done and a crossover inspection form is already in existence.

Much higher penalties for repeat violations.

Shift to more performance oriented standards.

Plants with higher than industry incidence rate will become "target plants"—will get immediate attention.

There will be requirements for documentation of training in more areas. Better training will be necessary. More part-time workers in the future will require better training programs and more emphasis on training.

It will become an absolute requirement that each location must have a complete, well rounded, effective, documented safety effort requiring a written program, safety meetings, inspections, accident investigation, employee participation, etc.

In the health area, we will see an emphasis on generic standards for hazardous materials, chemicals, carcinogenic items, health exposures, fumes, dusts, etc. OSHA will place an ever increasing emphasis on developing health standards as compared to

safety standards. Unions will become much more active in workplace monitoring of health standards.

As a result of the Toxic Substances Control Act, any chemical that is examined by one regulatory agency will be simultaneously scrutinized by OSHA, FDA, EPA, and CPSC. Standard toxicological testing protocols will be developed under TSCA. Emergency temporary standards will be used repeatedly in the future for compounds suspected of being carcinogens, mutagens, or teratogens. Generic standards will be issued for groups of compounds suspected of causing dermatitis, fibrosis, etc.

A new noise standard will be issued which will maintain the eight-hour 90 dBA TWA but incorporate a three dB doubling rule and require annual audiometric examinations.

Biological TLVs will become equivalent to or replace environmental air TLVs for certain compounds. For example, concentrations of a compound in the blood, urine, or expired breath will replace ambient air standards.

OSHA standards will also require more medical monitoring. The monitoring will be very similar to biological TLVs and will include enzyme levels, pulmonary function exams, audiograms, blood chemistry tests, etc.

OSHA will insist that companies periodically report their epidemiological records, both morbidity and mortality. Industry norms will then be established, and if a particular plant reports higher morbidity or mortality than would be expected, an OSHA inspection would probably occur.

At some point we will finally realize that animals are not people, or at least, more realization that animal studies do not necessarily accurately depict the effect on humans and that they do have limitations in their translations and interpretations. This will result in more accurate and meaningful studies.

There will be a rejection of the "zero risk" concept. In most cases, it isn't realistic or practical.

OSHA will accept the philosophy that there is a reasonable and feasible combination of engineering controls, personal protective equipment, and ad-

ministrative programs that will effectively protect the employee (such as from noise, etc.).

We will have much better and much more good, solid, rational research in many health areas and on many specific substances.

Safety and health knowledge is lacking in so many areas because we have had a definite shortage of good safety and health research. Great strides will be seen in this area. Certainly, we need a much more judicious use of the money earmarked for research than is currently being exercised with some of the NIOSH and other grants made for such studies. Many, many dollars have been spent on absolutely worthless subjects and other projects have been so ineptly handled that the so called "results" were, in my opinion, meaningless and worthless. If we can learn to spend our research money wisely and effectively, I am sure we can gain much valuable information.

Additionally, there will be much more emphasis placed on the use of ergonomics in design and engineering. The legislation to hire more handicapped will create new challenges for the safety department, (probably also for labor relations, engineering, personnel, and training departments—and the unions). Demands from unions, employees, and government will force employers to allow more employee involvement in all phases of the employee protection effort.

The intensified labor involvement will find more and more unions hiring safety directors. They will be more actively involved in safety conferences and seminars, and with more technical competent persons, the unions will be getting more involved in standard-making bodies. They will be demanding more involvement in plant safety matters such as inspecting, monitoring health hazards, medical records, etc., and serving on safety committees. We have often said that safety is a management responsibility, but labor is effectively muscling into the arena, and this could lead to more effective safety efforts if the true concerns can focus on employee health and safety and union and management can really

work together to accomplish their safety objective.

There will be considerably more pressures to give extra pay for jobs with recognized hazards.

Of course, there will be an enormous demand for better trained and better qualified safety and health personnel. It behooves all of us to continue our education and to keep current on employee protection innovations by attending seminars and other continuing education courses as well as being active in the National Safety Council and other safety and trade associations.

The safety director's job should be a better job, moving into a true middle management position, many at the V.P. level. But this will happen only for those who perform as true professionals. The safety person must realize that times are changing and he must keep up. He must prepare himself to be a new type of hybrid professional: part humanitarian, part economist, part lawyer, part psychologist, part accountant, and at the same time he must learn to be an effective communicator, a good salesman, and have a command of the technical aspects of safety management and administration. He also must be a part time first sergeant. Now, that doesn't sound like a very tough assignment, does it?

While we are at it, let's also suggest that we need to develop some public relations abilities. For far too long, the crusaders—and I won't mention any names—without too much regard for the truth or without documented evidence of their charges and claims have been painting industry as the bad guys with no concern for the welfare of employees. Well, we know that is a tremendously unfair rap, but because of a desire to keep out of controversy and maintain a low profile (or else we weren't competent to counteract the unfair charges), we just have not made much of an effort to set the record straight. I for one think it is about time that we started to set the record straight.

We should be telling it like it is, shouting from the house-tops about our efforts and our successes and about the

tremendous effort that industry is putting forth to provide a safe working environment for its employees. I realize there are some laggards out there, but that doesn't mean that you and I and our companies should be branded as bad guys. Think about this a little bit, and maybe we can come up with some community effort right here in the food and beverage section that could get something rolling.

Considering all these challenges facing us, we should be setting the stage back at the ranch. We should be lobbying for closer interdepartmental working relationships in our own operations. We in occupational safety must have good rapport with engineering, labor relations, legal, personnel, training, medical, maintenance, production, and all levels of line management. In short, we must be the diplomatic catalyst that brings this whole thing together. Knowing how to smell out a hazard and make a guard just won't do it for us anymore.

In my opinion, most major companies have done a reasonable and effective job of protecting the health and safety of their employees, but naturally they haven't thrown caution and fiscal responsibility to the winds. The reason for being in business is to earn a profit, and regardless of what government or the employees think, there must be a profit or we will have no business and no employees. What is the advantage of putting so much time, money, and effort into employee protection that the doors are locked for lack of profit and the employee has no job?

You say I am sounding very radical, I think I am being realistic. There is nothing in the industrial world, or anywhere else, for that matter, that can offer a "zero risk" factor, but that is what the government, the unions, and some segments of the public are demanding.

We have come a long way since that first accident study made in 1906 in Pennsylvania, but we still have a long way to go, because people are still having accidents and getting hurt. In our business we are dealing with human lives and the quality of life for

our employees. That's important business! We have some difficult challenges ahead of us in the 80's, but with conscientious safety professionals like you

involved, I know that our employee protection efforts will result in the best health and safety record this nation has ever seen.

## SEVEN YEARS OF HEARING CONSERVATION

By MARK WRIGHT

Manager of Safety Services, Adolph Coors Co., Golden, CO

Many years before the Occupational Safety and Health Act was adopted or the State of Colorado had a Workmen's Compensation Hearing Loss Statute, the management of Coors Industries became actively engaged in a formal program of hearing conservation for all employees. The thrust for this program grew from top management's concern for the protection of every employee's hearing ability and a commitment to the philosophy that employees are the most important factor in the success of any company. This philosophy was demonstrated by top management's conviction that hearing loss can be prevented through a professional and well-implemented hearing conservation program that is designed to recognize the problems, evaluate how they can be corrected, and control the factors which can lead to hearing loss. Such a philosophy results in a benefit to all employees in that they retain the full use of their hearing abilities and gain an understanding of what they must do to protect these abilities both on and off the job.

Because of the commitment and concern demonstrated by Coors top management, a tone and common purpose has been established for the entire company regarding the importance of hearing conservation. This common purpose—to prevent hearing loss—has led to a close coordination between individuals in the safety services department and the noise engineering control program. Individual talents and expertise can be blended in the close coordination of both functions with a feeling of mutual respect for the problems and ideas of both disciplines. Mutual cooperation between these two departments is essential for total and smooth implementation of any hearing conservation program.

One of the basic concepts that has

continually been a part of the Coors hearing conservation program is that mere compliance with a standard is not synonymous with doing everything that can be done to correct a problem. Coors has always aimed at ultra-compliance rather than just meeting the minimum requirements of the law. The company voluntarily adopted 85 dBA (which is lower than the 90 dBA level established by Federal regulations) and is constantly working toward a goal of no higher than a 78 dBA exposure for any employee. Every new employee is required to take a preemployment audio screening and a yearly recheck and evaluation of his/her hearing ability.

A second concept which is an integral part of the hearing conservation program at Coors is that informed and educated employees will be much more likely to be self-motivated to conserve their hearing than individuals who have never received any information on the mechanics of the human ear and how this mechanism can be damaged. Working in conjunction with the Colorado Hearing and Speech Center, Coors has developed hearing conservation educational programs which are relevant and meaningful to all employees.

For example, supervisors, managers, and directors receive mandatory training in the anatomy and physiology of the human ear and what factors in the environment can cause damage or impairment to this sense organ. They are introduced to and familiarized with a variety of demonstrative training aids (such as tapes of electronically-simulated hearing loss) that they can implement in training sessions with the employees under their supervision. The supervisors are familiarized with various personal protective equipment that can be used

to reduce noise exposure and are accountable for requiring its use by any employee who is exposed to a noise level that is considered potentially harmful. Each individual in a supervisory capacity is then required to conduct training programs on hearing conservation with the employees under his/her supervision.

In order to graphically demonstrate the importance of the ability to hear, Coors worked in conjunction with ten other companies to develop a motivational film to be used in supervisor and employee training. The film is a 12-minute color presentation entitled "Stick It In Your Ear" that is aimed at convincing each individual to do whatever he/she can to protect his/her hearing or the hearing of his/her family and friends. (This film is available for sale/rental from Colorado Hearing and Speech Center, 4280 Hale Parkway, Denver, Colorado 80220.) Through the use of this film and other training aids, the employee can be made to realize that his/her hearing abilities can be maintained and protected throughout a lifetime.

A concerned and committed management group working in conjunction with informed employees plays a major role in the success of the Coors hearing conservation program. But, the factor of competent technical surveillance and controls must be included if the hearing conservation program is to accomplish its purpose. The surveillance methods developed for use at Coors are not haphazard or sporadic. Specific steps within a well-defined time frame have been developed to insure that no potential hazard will go undetected.

The first step in analyzing the noise level in the environment is to subject a particular work area to an octave band or frequency analysis to identify the prevalent noise patterns. This information is essential for making the correct choice of noise protectors to insure that they attenuate or block out the particular noise that prevails in the environment. At the time of selection, the noise protectors can also be checked for such characteristics as comfort, sanitation, recyclability, and cost.

available to supervisors no later than three weeks prior to the testing date.

At the time that the published schedule is distributed to management, a pervasive educational campaign about hearing conservation is launched. Information about the testing program, its purpose, its timing and its benefits should be addressed to the employees. This information is posted wherever it can be easily seen and read by employees. Special efforts are taken to insure that supervisors are kept fully informed about each step of the program.

On the day of the actual testing, the final preparations need to be made. These preparations include setting up the audiometric equipment, making certain that enough chairs and tables are available, putting up directional arrows to guide employees to the testing area, and making certain that access to the testing area is unencumbered. One individual is assigned the task of tracing the whereabouts of employees who fail to report for testing. If a scheduled employee does not report for testing, the supervisor of the employee's area can be contacted and reminded of the scheduled appointment. This tracing procedure greatly reduces the number of individuals who will have to be tested in the follow-up program.

Ten days to two weeks after the first testing, the follow-up tests are conducted. These tests are set up for employees who were on vacation, ill, had days off, or simply failed to report for the first testing session. Each employee scheduled for follow-up testing should be listed on a schedule notice which is distributed to all supervisors one week prior to the retest date.

Once an employee has been tested, the audiologist will record all pertinent examination data to use in comparison with the individual's baseline audiometric reading. This comparison will make it possible to quickly detect any changes in the individual's hearing abilities. Three classifications of results are used at Coors:

1. A Significant Shift: 20 dB shift in the 4,000 and 6,000 frequency range or at the 4,000 frequency alone. If any problem in this range is detected and

corrected, it will not interfere with the "classic" speech frequencies.

2. Medical Problems: Wax buildup, home condition abnormalities, etc., are referred to the Coors Medical Center. If the company physician cannot correct the problem, the employee is referred to a specialist.

3. No Significant Shift: No changes. After the employee's audiometric analysis has been compared with the baseline reading and the results analyzed, the employee is notified of the audiologist's conclusions. This notification takes place via a preprinted, color-coded postcard that states, in understandable terms, the present condition of the employee's hearing ability. If an employee demonstrates a significant shift in hearing ability, the audiologist will schedule that individual for an interview to try to determine what factors have contributed to the shift.

After the results of the audiometric testing have been used to compare individual hearing abilities, the data is compiled to obtain an overall analysis of hearing patterns for all employees. Careful attention is given to this data so that any unusual patterns or features can be detected. For example, engineers in one Coors plant were beginning to show a pattern of hearing loss. This pattern was investigated and it was discovered that they were frequently in and out of noisy areas all day long and were neglecting to wear any kind of hearing protection. Because of this discovery, engineers are now required to wear hearing protection in all noise-intensive plant areas. This requirement has caused the hearing loss pattern to subside.

Improvements are constantly being made in the hearing conservation program at Coors. Gunned, computerized labels containing the employee's name, Social Security number, and address are used on recheck audiograms to improve the efficiency of the audio-recheck. The color-coded postcards for employee notification are used exclusively as they were found to be more effective than letters. Once the initial testing program is completed, it has been discovered that each annual hearing test becomes easier to carry out and the impact of the program be-

comes more significant. This is due to the elimination of earlier inefficiencies, greater familiarity with the procedures and increases in employee participation. Indoctrination on the importance of hearing conservation is a year-round process at Coors. Various media and audio-visual reminders, such as articles in the company newspaper, murals, posters, table tents, etc., are

constantly being utilized to remind employees to protect their hearing at all times. As a result, employees take an active part in reducing their hearing loss. The joint commitment on the part of management and employees to protect the hearing abilities of each individual is proof that at Coors hearing conservation is definitely an important and ongoing program.

## STROH'S PERSONAL PROTECTION PROGRAM

By EDWARD G. RATZENBERGER  
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The Stroh Brewery Company adheres to the philosophy that the safety of its employees is a paramount responsibility. The company also believes that top management's attitude toward safety determines employees' safety attitude, and that safety is not a separate function but an integral part of daily operations. Starting with the chairman of the board, safety has high priority in all brewery operations. Along with product quality and company image, it is one of his top concerns. This concern is shared by the president and other top officials. The chairman has a reputation as a strong advocate of safety, and the knowledge of this fact affects everyone's attitude.

The Stroh Brewery Company Safety Credo, which is wholeheartedly supported by the chairman, the president, and the operating management, emphasizes why The Stroh Brewery Company has experienced such good safety record over the years. The Credo states:

A primary concern of the Stroh Brewery Company is for the safety of all employees.

The company recognizes and accepts its responsibility to its employees to maintain safe working conditions and safe work practices.

It is the firm and continuing policy that all department heads and supervisors make accident prevention a part of their daily concern.

No task, large or small, shall be performed unless all reasonable and required safety measures have been taken.

Each department head and supervisor will be held accountable for safe working conditions and safe work practices in his area of responsibility.

Each employee is expected to follow the rules and procedures provided for

his or her safety and to report unsafe conditions or practices to his or her supervisor as soon as possible.

Employees shall not be directed or permitted to perform unsafe practices. One important part of the total safety effort is the company's responsibility of providing personal protective equipment to employees to protect them from various potential and existing hazards. Enforcement of rules pertaining to personal protective equipment is a priority at Stroh's. Whenever necessary and practical, wearing personal protective equipment is required. By establishing a mandate requiring personal protective equipment, we aid supervisors in their enforcement efforts.

It has been our experience that some supervisors consider the enforcement duty unpleasant and difficult. Some say it often interferes with production considerations, so brewery management makes every effort to assist supervisors in this quest for safety.

In this presentation, which focuses on certain articles of protective equipment, I plan to describe some of the items we use in our safety program at the Stroh Brewery.

In the operation of the brewery, we use ammonia for coolant and carbon dioxide in the brewing process. During equipment maintenance and repairs, it is necessary for engineers, maintenance machinists, electricians, or stock cellar employees to wear self-contained breathing apparatus when entering hazardous atmospheres. Engineers required to enter atmospheres containing unknown gas concentrations to make repairs, shut down equipment, or perform other functions are trained in the use of self-contained breathing apparatus with positive-pressure face masks and oxygen tanks.

Other employees who are occasionally called on to enter less hazardous atmospheres or to exit an area when a problem develops are also provided with and trained in the use of self-contained breathing apparatus. These are the demand-type face masks which utilize chemical cartridges designed for rebreathing processes.

The engineers are given monthly training and machinists, electricians, stock cellar employees, and supervisors are given quarterly training. We have developed a booklet pertaining to the respirator protection program which is issued to all departments affected.

Hearing protection has been in use at Stroh's for a number of years. We have a formal audiometric testing program established for all employees. The registered nurses on each shift administer hearing tests that are in turn evaluated by the company doctor. Use of hearing protection is mandatory in parts of the buildings which contain high dBA machinery like can and bottle fillers, soakers, pasteurizers, and centrifuges. When the program was established, employees were educated in advance in the importance of wearing hearing protection.

Employees are given the opportunity to utilize the equipment which is most comfortable to them. The fact that the employees have a choice aids enforcement. They have available to them several makes of approved ear muffs and ear plugs. The brewery discontinued the use of cotton type protection some time ago because we found the employees were not using enough cotton to attenuate the noise, and quite often cotton fibers would be lodged in ear canals, creating the risk of ear infections. The cotton was replaced with a compressible sponge-like ear plug which has proven very acceptable.

Posted rules and the possibility of disciplinary action aid our enforcement of hearing protection requirements. The rules are as follows: "Hearing protection must be worn by all packaging production personnel, without exception, as well as warehouse employees working on palletizers. In the event that hearing protection is not worn, disciplinary action

will be taken as follows: (a) the first time any individual does not use hearing protection, he will receive a verbal warning; (b) the second time any individual does not use hearing protection, he will receive a written warning and a day off without pay; (c) the third time any individual does not use hearing protection, he will get a written warning and additional time off without pay." Wherever hearing protection devices are required, signs are posted to make everyone aware.

Certain employees and supervisors are required to wear head protection as well as hearing protection, so we found it necessary to shop around to find an acceptable combination.

Head protection is another difficult program to enforce. Head protection must be worn by machinists, electricians, engineers, supervisors, Hi-lo operators, and warehouse employees. Bump caps are worn by employees who work in the brewhouse, stock cellars, racking, and packaging laboratory. Skilled trade employees are somewhat reluctant about wearing protection and it has been necessary to resort to discipline. Electricians are provided with dielectric helmets (ANSI 289.2 Class B-1971). We use color coding for the various departments: light blue for engineers and machinists, orange for electricians, and white for warehouse and supervisory employees.

Foot protection is important in the brewery because of the broken glass, wet floors, and material handling. A shoemobile visits the plant, on our request, semi-annually. Employees are able to purchase steel-toed shoes and boots through payroll deduction. The company pays a fee to the shoe company for their visit, which allows them to sell the shoes at a reduced rate; subsequently, the employees are able to buy quality work (and dress) shoes at prices lower than they can buy them in the community. This results in good participation. Except for hard-toed shoes, all other protective footwear and protective equipment is provided by the brewery.

About two years ago we began supplying steel shank boots for those who work around broken glass. We also began providing sponge-covered metal

sole inserts for boots and shoes to prevent penetration of broken glass through the footwear. Frequent inspections of boots and shoes are conducted to assure that the soles of the foot protectors are not worn out.

The combination of these programs has nearly eliminated foot lacerations at Stroh's. We have installed a display board with samples of acceptable and non-acceptable shoe soles to help employees understand their responsibilities.

The Eye and Face Protection Program has also been in existence for many years. However, there have been periodic improvements in the program, such as the addition of the prescription safety glasses and the acquisition of new models of eye protection. There has been a need in recent years to implement enforcement and disciplinary procedures.

In certain operations of the brewery we have found it necessary to require eye or face protection. These areas include the bottleshop, where bottling processes sometimes result in glass breakage. The brewhouse and stock cellars are other areas where mandatory use of chemical splash goggles is enforced because of the various chemicals used for cleaning. Plano glasses of several manufacturers are available to promote the voluntary use of eye protection in all areas. For recalcitrant employees, the policy of enforcement with progressive discipline has been established and posted on the bulletin boards. The disciplinary action includes: (a) the first time any individual is caught without safety glasses, he will get a verbal warning; (b) the second time any individual is caught without safety glasses, he will get a written warning and a day off without pay; (c) the third time any individual is caught without safety glasses, he will get a written warning and additional time off without pay.

Other types of eye and face protection included in our program are: goggles for employees working at grinders, and chemical goggles for use in handling of corrosive chemicals. Goggles are to be used under face shields when working with alkali solution under pressure. A chemical goggle with a

respirator attachment is used by laboratory personnel when handling strong acid.

With the exception of one style, the face shields used at the Stroh Brewery are the standard plastic type. The one exception is a face shield with a clear plastic window and a screen surrounding the window. This was ordered for use at the discharge end of a pasteurizer. Flying glass from bursting bottles required full face protection, but the plastic face shields would steam up, so we opted for one with a screen.

All the mandatory eye protection areas are clearly marked with signs.

As is the case with foot protection, we also have displays showing the various types of personal protective equipment available for hearing and eye protection.

One third of injuries that occur at the brewery each year are lacerations, mostly to the hands. To combat this, we utilize many types of gloves for various operations and duties. Plastic-coated gloves for handling chemicals, leather and cloth for rough work, light gloves for material handling of paper, etc.

On jobs with revolving machinery which may snag a glove, we do not allow gloves. In their place we provide tools or procedures to protect hands, such as shutting off a conveyor or labeler to clear broken glass. As a result of our new emphasis on hand protection and tools, the percentage of lacerations to the hands, compared with other parts of the body, has decreased during the past two years.

Contractor employees are required to adhere to all Stroh Brewery safety rules. When they do not comply, after ample warning, individual contractor employees are not permitted to enter the premises. There are about 100-150 contractor employees on the premises year-round, so enforcement is indeed no simple task.

New employees are given a personal safety orientation during which I show them the types of protective clothing they will wear. During that orientation, they are given an explanation about why they must wear it, and why they should not wear certain items of clothing, such as sandals, cut offs,

necklaces, etc. Case histories are cited to emphasize the need for the protective equipment being discussed.

The Stroh Brewery Company has periods of high injury rates, as other companies do, but because of the company's basic safety philosophy and willingness to spend money and time to

protect and train its employees, the lower injury rates predominate.

We find that the company's strong commitment to safety serves to promote a more safety-conscious attitude among the workforce and holds our annual injuries far below the norm.

## Meat & Leather Industries Sessions

### POTENTIAL HAZARDS IN LEATHER PRODUCTS INDUSTRY

By BETSY EGAN

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Over the last few decades we have made tremendous strides in reducing or eliminating many of the safety hazards in the workplace that can result in immediate injury or death. Many of the remaining workplace hazards associated with chemical exposures are often more subtle in their cause/effect relationships and therefore are probably more widespread in industry than early studies have suggested.

For those chronic diseases such as angiosarcoma of the liver, bladder cancer, or lung cancer that have been associated with certain chemical exposures, a long time period (latency) usually elapses between first exposure and the subsequent development of disease. Because of this long latent period, workers who may be potentially at risk of developing a certain chronic disease may no longer be employed at the plant when the disease becomes manifest. It is therefore difficult to determine if any excess disease risks are associated with employment in certain occupations or job areas, and if so identified, to determine the cause.

The purpose of the material presented here is to review some of the more recent epidemiologic studies in which an attempt was made to evaluate whether any chronic health problems exist in the leather and leather products industry. This review will be followed by a description of some of the additional epidemiologic study designs that can be used to further evaluate whether any chronic health risks exist in the leather and leather products industry.

Several studies have indicated that

there is an increased cancer risk associated with employment in the leather and leather products industry. One of the chronic diseases that has been associated most often with employment in the leather industry is bladder cancer. Three major case control studies that compared the work experience of a group of bladder cases with appropriate control groups found that more leather workers were represented among the bladder cancer cases.<sup>1,2,3</sup>

Cole et al<sup>1</sup> compared the occupational histories of 356 Eastern Massachusetts males newly diagnosed with carcinoma of the lower urinary tract to a random sample of the adult population in the same study area. The control population was stratified by age and sex to be comparable with the study population. The expected numbers of individuals employed in each occupational category for the study group were generated by assuming that the bladder cancer cases would be distributed the same as the controls with respect to occupation. Sixty-five members of the study group reported having been employed in the leather or leather products industry at some time in their career, whereas, based on the employment histories of the controls, only 32.7 would have been expected to report employment in the industry. This increased relative risk held even when the data were adjusted for cigarette smoking. In order to further delineate if there were any specific areas in the leather and leather products industry where the excess risk seemed to concentrate, the 65 bladder cancer cases were classified into three broad subdivisions of the industry:

preliminary processes and tanning; finishing and associated processes; and jobs involving contact with the finished product. Forty-four of the 65 cases worked in leather finishing and associated processes, yielding a relative risk for this category of 2.65. This job area involves the cutting and assembling of leather pieces and related activities (e.g., buffing).

In 1963, Wynder et al.<sup>2</sup> reported the results of a study of 300 male bladder cancer patients and 300 age-matched controls. Twelve members of the bladder cancer study group reported employment in the leather and leather products industry at least five years, whereas only three control cases reported similar employment. A more detailed examination of occupational histories revealed that six of the 12 bladder cancer cases who had been employed in the leather industry were listed as shoe repairers, compared with one shoe repairer among the controls. There were three leather workers, two shoe factory workers, and one shoe store owner in the leather group, but none in the controls.

Through a unique set of data maintained at Roswell Memorial Park Research Institute (RMPI), a major cancer research and treatment center in Buffalo, New York, Decoufle et al.<sup>3</sup> retrospectively examined the lifetime occupational histories of patients developing cancer between 1956 and 1965. The risk of developing cancer at a specific site among persons employed in a given occupation was calculated relative to the age-specific risk for persons whose lifetime occupational history consisted almost entirely of clerical jobs. The highest relative risk for bladder cancer among all occupational groups studied was demonstrated in the category "operatives in the leather industry." Out of the total set of bladder cancer cases diagnosed among males at RMPI between 1956-1965, 11 had been employed in the leather industry at some time during their working lifetime. The risk of developing bladder cancer for males employed in the leather industry compared to clerical workers was estimated to be almost sevenfold. To further evaluate this risk, only the work

experience of individuals with five or more years employment in the leather industry was analyzed. One would expect the risk in this group to be greater than the "ever-employed" group, since a longer length of employment would increase the potential for exposure to any toxic agents. Eight of the original 11 bladder cancer cases in male leather workers were employed in that industry for at least five years. As was expected, the relative bladder cancer risk for these leather workers, compared to clerical workers employed for at least five years, increased to 12.9.

A more detailed examination of the employment histories of all leather workers diagnosed with bladder cancer indicated that the majority of these individuals had been employed in shoe manufacturing. In addition to bladder cancer, male leather workers in this study seemed to exhibit an excess relative risk for cancer of the buccal cavity and pharynx (relative risk 3.4) and cancer of the larynx (relative risk 3.6). The relative risk for both cancer sites was higher in those individuals employed in the leather industry for at least five years.

While conducting a survey of the incidence of nasal cancer in Northamptonshire, England, for the period 1963-1967, Acheson et al.<sup>4</sup> noted an excess incidence of nasal cancer among individuals employed in the boot and shoe industry. Twenty males diagnosed with nasal cancer were identified through the Oxford Cancer Registry during the years 1963 to 1967. A review of the occupational histories of these individuals indicated that 17 of these 29 males (59 per cent) had been employed in the boot and shoe trade. In contrast, it was estimated that only 17 per cent of the male population aged 15 or over in Northamptonshire are active or retired boot and shoe workers. The expected number of cases of nasal cancer that should have occurred in boot and shoe workers in Northamptonshire during the years 1953 to 1967 was estimated using the average rates for nasal cancer from the Southern Cancer Registry in England. These average rates for nasal cancers were applied to the estimated age-spe-

cific population of leather workers employed in Northamptonshire from 1953 to 1967 in order to generate the number of nasal cancers that would have been expected to occur if this occupational group had experienced a nasal cancer rate similar to that found in the Southern Cancer Registry. According to these calculations, there was an eightfold excess of cases of nasal carcinoma (all histologic types considered together) in boot and shoe workers during the period studied. The excess is more striking among those diagnosed with adenocarcinomas than among those diagnosed with squamous carcinomas.

A more detailed review of work history information on the identified nasal cancer cases revealed that almost 85 per cent of those individuals initially listed as boot and shoe workers had worked in either the finishing room or the areas concerned with the cutting and sorting out of leather for soles and heels. It was estimated that the operatives working in these two departments comprised only about 20 per cent of the skilled labor force. The author noted that in these two work areas there is the greatest worker exposure to dusts.

The Registrar General's Office in Great Britain compiles periodic reports comparing cause-specific mortality for the various occupational groups in England and Wales. The most recent British Registrar General's report of occupational mortality for England and Wales during the period 1970-1972<sup>5</sup> reported that leather workers as a group had a standard mortality ratio (SMR) of 107 for all malignant neoplasms. The cancer sites that had the most elevated SMR's were prostate cancer (SMR=166), bladder cancer (SMR=151), and lymphosarcoma (SMR=184). The most unusual disease occurrence seen among the leather workers in England and Wales, however, was an excess rate of influenza (SMR=252). The only cancer site that was still in excess when specific groups of leather workers were examined was lung cancer (SMR=143); however, the number of deaths in each of the subgroups of

leather workers was rather small.

The fact that several independent studies have indicated that leather workers are repeatedly over-represented among cancer patients or deaths suggests that some factor (or factors) associated with employment in the leather industry may also be associated with the development of cancer. The results of the Roswell Park Study and the studies conducted by Cole and Acheson suggest that the excess cancer risk is seen among workers involved in the manufacture of leather and leather products rather than the shoe repairers trade as indicated in Wynder's study and the most recent British Registrar General's Study. However, because the job classifications are very broad and little exposure data are available in these studies it is very difficult to derive any conclusions in terms of etiology. In Cole's study it is possible to determine that the bladder cancer risk is higher in the leather finishing than in either the leather tanning or finished products area. However, in the Roswell Park and Acheson study it is not possible to determine if the manufacture of leather products includes the entire leather manufacture process, from the dehairing and tanning of leather to the assembly of leather goods, or if only one or two work areas in leather production are involved. Although all of these studies are very useful as initial health screens across numerous occupational groups, their most valuable function is that of promoting and directing future research. More definitive investigations are needed to evaluate whether employment in certain job areas is associated with a greater disease risk and to thoroughly characterize the employee exposures associated with these job areas.

Characterizing the industrial hygiene exposures associated with the different job categories in the leather industry will be a complex task, especially when consideration is given not only to the numerous steps involved in the manufacture of leather, but also to the multiplicity of chemicals used or formed in each step. For example, although nitrosamines are not intentionally used in any single process, these

compounds have recently been identified in the environment of several leather tanneries.<sup>6</sup> Although there has been much speculation, the exact mechanism for formation of these compounds in leather tanneries has not been identified. Nitrosamines are a very potent class of carcinogens that have induced cancer in a variety of organs in virtually every species in which it has been tested.

Some of the earliest concerns with potentially toxic chemical exposures in the leather industry have been with worker exposure to chromates in the leather tanning process and the dyes used in the finishing areas.<sup>7</sup> Some of the dyes such as Direct Blue 14 and Basic Orange 2 have been directly demonstrated to be carcinogenic in rodents. The benzidine-based azo dyes are another class of dyes that have been associated with an excess bladder cancer risk.<sup>8</sup> These dyes are metabolized *in vivo* back to free benzidine—the parent compound. Benzidine has been repeatedly demonstrated to be a potent bladder carcinogen in both human and animal studies.

When characterizing the employees' work environment for a chronic health study, consideration needs to be given not only to the numerous chemicals currently being used or formed in the various stages of the leather making process, but also to how the use of certain chemicals has changed over time. Changes in worker exposure due to high job mobility also need to be considered.

One of the more common epidemiologic study designs used to evaluate the health experience of industrial populations and to develop evidence on cause/effect relationships is the retrospective cohort study. In this type of study, a complete population of workers is identified who were first employed in the specific occupation or industry of interest many years in the past, and the health experience of this population is followed through time. A control group is selected and an evaluation is made as to whether there is any differential risk of disease or mortality between the two groups.

I would like to briefly review the major steps followed in conducting a

retrospective cohort study of an industrial population. First of all, it is important to clarify that the retrospective approach puts restrictions on the measurements used for disease response. Morbidity information for many industrial populations is, at most, available only for those currently employed. Unfortunately, active employees are not an adequate study population for evaluating chronic disease risks. Consequently, studies of long-term disease are usually restricted to an analysis of mortality patterns, since information on cause of death among all those at risk is more readily obtained than retrospective morbidity information.

The first step in a retrospective mortality study is to evaluate recordkeeping systems on employees for certain key information. The quality of any retrospective mortality study is dependent on the quality of this recordkeeping system. This is the major link to reconstructing historical employment information on the defined study population.

A recordkeeping system is evaluated in three major areas before it can be determined if adequate information for conducting a retrospective cohort mortality study is available. These three areas are the history of the recordkeeping system, which includes the age and completeness of the system, the extent of demographic information in the system, and the extent of work history information contained in the system.

In retrospective studies for chronic health problems, it is important that a recordkeeping system can be used to identify a study population that was first employed many years in the past (i.e., 30 years or more). Adequate time must have elapsed since individuals in the study population were first employed to allow for the development of any chronic occupational disease.

Completeness of the recordkeeping system means that all persons who were employed at the plant or process being studied during the defined time period can be identified and included in the study population. Failure to include terminated employees can often lead to biased results, since some indi-

viduals may have terminated for health reasons. This could lead to erroneous conclusions about the health status of the population, since only the more healthy survivors may be included in the study.<sup>9</sup>

It is essential that certain key demographic information such as sex, race, and date of birth are important variables associated with the occurrence of disease. The variables, therefore, must be known not only for the cases of disease identified, but also for the population at risk. Appropriate adjustments should be made for these key variables when defining any comparison population. Other important demographic information includes social security number and last known address. This information is often of invaluable assistance for locating individual members of the study population to determine their current vital status (i.e., alive or dead).

Finally, detailed work history information must be included in a recordkeeping system if any cause/effect relationships are to be elucidated. Work history information needs to be available on each member of the selected study cohort that defines the time period spent in the various work areas of a plant and, if possible, the specific job performed in each area. For example, in a leather tannery it would be important to be able to identify if an employee switched from the coloring and fat liquoring area to the tanning area of the plant and the time period spent in each of these areas.

Once a study population is defined, the next important step is selecting an appropriate comparison group. It is usually difficult to define the ideal control population with which to compare our industrial populations. Selection of other industrial populations could present a problem if the employees in the selected comparison group are also exposed to potentially toxic chemicals. In many studies, the most reliable data available for contrast are the general United States population. This comparison population can also lead to some bias if the mortality rates for certain diseases in the geographic area where the study is being conducted differ greatly from the general United

States rates. Other biases may result from the so-called "healthy worker effect." In many industrial populations a certain level of good health is required for employment, and continued good health is required for continued employment. In contrast, the general United States population includes all the sick and disabled persons.

Following the selection of an appropriate study and comparison group, all information that is relevant to the study is microfilmed. Demographic and work history data are then abstracted from the microfilmed records for computer study. The vital status of all members of the cohort is ascertained through agencies such as the Social Security Administration, the Post Office, Bureau of Motor Vehicles, or credit bureaus. Death certificates are obtained on all members of the study population identified as deceased. The specific cause of death is coded according to the International Classification of Disease and entered into the computer.

Once all follow-up and coding of the data have been completed, a life table analysis will be conducted. In this analysis, the mortality experience of the study population is compared with that expected based on the general United States mortality rates to determine if there is any excess in cause-specific mortality among the study population. Adjustments are made for age, race, sex, and calendar time period. The results of this analysis are calculated in the form of a standard mortality ratio (SMR), which is simply the ratio of the observed number of deaths in the study population over the expected number of deaths. This expected number of deaths is calculated based on the assumption that the distribution of deaths in the study population will be similar to the comparison population. If the observed number of deaths is the same as the expected number of deaths, then the SMR will be equal to 100.

In the attempt to define the cause of any excess disease risks identified in the industrial study population, the data are analyzed by various subgroups. If an *a priori* hypothesis exists that exposure to a certain agent or

employment in a certain job area is associated with the subsequent development of a particular disease, then an attempt is made to rank certain population subgroups in terms of their exposure in order to determine if any type of dose-response relationship exists. Since we rarely have access to quantitative data which depict the extent of exposure to specific toxic agents in the work place, the degree of exposure to certain agents can usually only be quantified indirectly in terms of the length of employment within specific work areas.

An excellent example of a dose-response relationship in an occupational study using work assignments and years of employment as an estimate of exposure was demonstrated in a study of steelworkers conducted by Lloyd et al.<sup>10</sup> The hypothesis that prompted the analysis was that the slight lung cancer risk identified in the study population of steelworkers was caused by the effluents from the coke ovens, which had been found to contain carcinogenic polynuclear aromatic hydrocarbons (PNA's). If this hypothesis is valid, one would logically expect to see the greatest lung cancer excess among those employees who worked the longest at those jobs where there is the greatest exposure to coke oven effluents.

In the study, this hypothesis is confirmed. The excess of lung cancer is associated with five or more years of employment at the coke ovens, and the level of risk seems to increase with the amount of exposure, the greatest exposure to the effluent being at the top side of the ovens. These findings also illustrate how occupationally-related diseases might be masked by limiting the study to broad occupational groups and thus diluting the study population. For example, the SMR for total malignant neoplasms for the entire steelworkers population was 92, which actually indicated there was a deficit of total cancer.

Finally, it should be pointed out that once a study is completed, it is important to consider the results of that study in the context of other available information. For example, were the findings biologically plausible? Is there

any evidence from animal studies that the suspect agent or agents are carcinogenic? Are there any other independent epidemiologic studies that indicate there is an excess risk of disease among workers in the particular occupation or industry being studied? A thorough examination of all these questions can sometimes reinforce the study results.

Other types of studies sometimes used to evaluate the incidence of chronic disease in industrial populations include case control studies and proportional mortality studies. Both of these study designs are also dependent on the data systems available.

The best type of study design for clearly developing evidence on cause-specific relationships between industrial exposures and chronic disease is the prospective cohort study. With a prospective study design, one can be certain that a record system is set up to contain basic demographic and health information on each employee which can readily be associated with his work location and chemicals or materials therein. The health experience of this defined population can then be followed prospectively through time.

In many plants, the setting up of prospective surveillance systems may be accomplished at minimal costs if full use is made of the recordkeeping system already in existence at the plant. Information on employee health is recorded in the plant medical records, absentee reports, workmen's compensation reports, and plant-sponsored health and life insurance plans. Work history information on employees is often retained in the personnel records, payroll records, or plant seniority rosters. Industrial hygiene information is often retained on plant purchasing sheets or reports from routine sampling surveys.

Once provisions are made for the uniform collection, classification, and measurement of medical, work history, and industrial hygiene information, the final step will be to provide a cross-link between these systems. Cross-linking these various data systems would allow information to be obtained not only in terms of the number of employees having a given medical condi-

tion, but also in terms of their work location and the chemicals used there-in.

Our ability to recognize and control chronic occupational diseases is really only in its beginning stages. Over the last several years the health hazards associated with work place exposures such as asbestos, vinyl chloride, benzidine, and  $\beta$ -naphthylamine have become more recognized, and many plants have initiated appropriate control measures. We are more aware of the importance of pre-testing of chemicals to evaluate their health effects before their introduction into the work environment. Many companies are now setting up prospective surveillance systems for the earliest identification of new problem areas.

The pre-testing of chemicals and prospective surveillance systems are valuable additions to many occupational health programs; however, these do not preclude the importance of conducting in-depth epidemiologic studies for those occupations where suspected problems have already been suggested. If an appropriate study population can be defined retrospectively, possibly a cause/effect relation-

ship for an excess disease risk can be identified now rather than allowing hazardous exposures to continue for many more years.

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## Trades & Services Sessions

### IMPACT OF W. C. REHAB LEGISLATION ON LOSS CONTROL PROGRAMS

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The title of this presentation is actually a misnomer insofar as it implies that rehab legislation is something recent. All states have had some sort of rehabilitation law for a good number of years. They simply have lacked either the mechanisms or the motivation to apply them. California has corrected this via a rigidly enforced mandatory vocational rehabilitation procedure. Georgia appears to be following. However, employers and insurers in many states are beginning to consider vocational rehabilitation independent of legal requirements. Evidence of this is the number of rehabilitation services now expanding into national services.

Why this sudden burst of altruism? Primarily it is from recent workmen's compensation legislation which has provided the necessary economic incentives to return injured employees to some type of employment. This began following the recommendations of the National Commission on State Workmen's Compensation Laws to bring benefit levels in line with today's cost of living, as well as today's social expectations. Thus, since 1972, there have been approximately 1,000 amendments to state workmen's compensation laws. This process is still very active. Three hundred of those amendments were passed just last year. Indemnity or benefit provisions were increased in 51 jurisdictions!

What does this mean to employers? Well, it means footing the bill for overall workmen's compensation benefit increases of 125 per cent between 1972 and 1976. In 1976, workmen's compensation payments totalled nearly

\$8 billion. Estimates of workmen's compensation costs for 1978 have been noted in excess of \$10 billion.

Let's bring this down from the national level to the individual employer for better understanding. Between 1972 and 1977, workmen's compensation premiums for the average employer more than doubled. Companies accustomed to paying \$250,000 are now paying over a half million dollars per year for the same coverage. Even worse, insurance carriers are demanding higher and higher deductibles, so that it is not uncommon today for large employers to pay the first \$100,000 of each claim plus an expense factor for the insurance company's handling. Thus, many large companies are in effect on a cost plus basis. It is apparent why workmen's compensation costs have captured the attention of top management.

To better understand why workmen's compensation rates are so high, let's examine what individual workmen's compensation injuries are worth today. I'm sure you've all heard the horror story of the 26-year-old widow in the District of Columbia whose husband was earning \$15,000 per year at the time of his death. With the escalating benefit provision, computed at six per cent annual inflation, she would receive nearly \$2.5 million in benefits should she live her full life expectancy of 77 years. At that time she would be receiving annual benefit income of \$156,220! Underwriters used to reduce the reserves for such cases based on a "remarriage factor." With that type of security, and today's relaxed moral standards, our widow could have the

combined physical attributes of Helen of Troy, Liz Taylor, and Raquel Welch and still not remarry!

Since such horror stories are infrequent, let's look at a typical injury for a typical worker, say age 35 with earnings of \$14,000 per year. He twists his knee and sustains a torn meniscus. After 60 days of conservative care, they operate. He has a normal recovery and returns to his usual job 90 days later. Figuring the medical, temporary total disability, and usual percentage of permanent partial disability, you can expect that claim to cost you approximately \$17,000 in Illinois, \$14,000 in California, or \$20,000 in D. C.

The true problem cases usually involve back injuries, which, incidentally, account for about one out of three lost time claims. While most return to their former job, some either honestly cannot go back to lifting or allege they can't. If you do not re-employ that person within your operation or find them work elsewhere, you may end up paying benefits for the rest of their life. Using our typical worker again, this translates into an exposure of approximately \$300,000 in nearly every major state. That figure, incidentally, does not include cost of living escalator benefits now payable in several jurisdictions.

Benefits for a 40-year-old female making \$8,500 per year will exceed \$200,000 if she is judged to be unemployable and lives her normal life expectancy. This is why shivers go up and down a claims person's back when employees sustain even a moderate back injury, have children living at home, pay a babysitter, and have a spouse with a good income.

Perhaps you're thinking, "More horror stories," or that "Permanent total disabilities are only granted for major injuries following some sort of catastrophe, chances of which are remote." Not so. This is where so-called "social inflation" begins to impact. Today, many workmen's compensation administrators and judges place responsibility for an employee's continued welfare squarely on the employer. If the injured employee cannot find a job they are physically capable of performing, then we will be called upon to

support them until they do. Viewed in the light of today's social expectations, one can see the rationale behind it. Unfortunately, it does not take into account the varying motivations of injured employees.

The Illinois Supreme Court recently supported an award of permanent total disability to a woman with contact dermatitis. She broke out in a rash whenever exposed to a common cleaning compound. The court held that once a claimant establishes the fact of a permanent injury and limited ability to work, the burden of proof then shifts to the employer to establish not only that the claimant can work, but that such work is available. In effect, we must prove not only that they can work, but we must also find them a job. This is really the basic principle behind California's mandatory rehabilitation law. Other states have reached the identical position, holding that a person does not have to be reduced to a state of physical incapacity to be awarded permanent total disability. Thus, an employer has a choice of (1) training and employing the individual in another capacity, (2) having an outside vocational rehabilitation firm retrain them, or (3) accepting the tremendous cost of lifetime workmen's compensation benefits.

This social inflation of workmen's compensation laws, coupled with the tremendous escalation in claims values, has had substantial impact on claims loss control programs. Workmen's compensation laws used to contain fairly restrictive definitions of "accidental" injury, "arising out of" and "in the course of employment," "going and coming," etc. which had to be met before a claim was compensable. As a result, loss control was equated with investigation. While investigation is still important in selected cases, the number of such cases has sharply diminished. Many of the old defenses have been removed through legislation or judicial interpretation.

Today, effective loss control programs must include the limiting of financial losses after the claim has been accepted. This should focus on affirmative employer-employee relationships,

litigation avoidance, and prompt return to work.

*Affirmative Employer-Employee Relationships.* In 1976, the California Workers' Compensation Institute commissioned a study of workmen's compensation claimants. They found that three out of four injured employees received no information about workmen's compensation from their employers. For 92 per cent of the employees, it was their first work injury and 85 per cent felt their injuries to be "serious" or "very serious." Even when contacted by insurers, 40 per cent perceived an unwillingness by the adjuster to answer questions and explain procedures.

The injured employee is lying in a hospital bed or at home with a multitude of questions and concerns: What's going to happen to me? What's my employer's attitude now? Will I have my job back? What will I live on? Who's going to pay the medical bills? What do I have to do to get benefits? What are the benefits? etc.

At Marriott, we have a formal program designed to answer these questions and provide reassurance to the employee. It is called CARE (an acronym for Concern and Response to Employees). Under this program, the employee's immediate manager must visit the disabled employee as soon as possible at either hospital or home. The purpose is to assure the employee of our concern and that his job is secure. Our manager provides the employee with a pamphlet explaining in simple language when and what benefits are provided. The employee is informed of the exact amount of his temporary total benefit and the date the first check will be mailed. The manager then remains in periodic contact with the employee throughout the disability period. Direct communications of any questions or problems are encouraged. Frank, complete answers are provided. The manager's job is to maintain our credibility as well as the employee's motivation to return to work.

*Litigation Avoidance.* This, of course, flows from the preceding. Workmen's compensation was initially intended as a no-fault concept to eliminate litigation. Unfortunately, the

tremendous increase in benefit levels, perhaps coupled with the effects of automobile no-fault, seem to have caused more lawyers to become involved in workers' compensation claims. Generally, when a lawyer enters the picture, the probability of an adversary relationship between employer and employee increases. Some lawyers have brought the same techniques used in automobile claims to workmen's compensation. Treatment is abruptly switched to physicians selected by the attorney. In some areas of California, for example, an expensive, orchestrated merry-go-round of referrals is begun. The employee is often unnecessarily paraded in and out of the plush offices of high cost specialists, in and out of x-ray laboratories, into and out of hospitals for long series of tests, and given unending daily palliative treatments of physical therapy and massage. They are told little and understand less. After a couple of months of this, they become totally convinced that they are seriously injured, otherwise why would they be the center of such incredible attention?

In one case, an employee with a low back strain had been under the care of an orthoped who was treating him conservatively. After retaining an attorney, he was seen in short order by a neurosurgeon, another orthoped, a chiropractor, a physical therapy specialist, hospitalized for a myelogram and tumogram, put in traction, etc., to the tune of over \$3,500. And what was the result of this rapid application of all this medical science? Whereas before his complaints centered in the low back, he now complains of inability to walk, stand, or sit and has continuous pain throughout every part of his body!

His original physician, in one of the strongest medical reports ever written, condemned this approach as having "taken an individual with a back condition which would ordinarily be handled on a strong supportive basis and converting it into a condition which might warrant a consideration for surgical intervention!" He also speaks of "... the unwarranted and injudicious performance of a cervical and lumbar myelogram on this patient."

I do not mean to imply that all attorneys handle workmen's compensation cases in this way. Many are concerned with their client's welfare as well as their fee. However, I have noted a deterioration of motivation to return to work and the development of an adversary attitude in more cases than not after an attorney enters the picture. While the claim becomes more expensive for the employer, I question whether, in the final analysis, the employee nets any substantial financial gain in many cases.

*Prompt Return to Work.* A long recognized rule in disability claims is "the faster we can get an employee back to work, the better." Experience has demonstrated that the longer a person receives benefits, the harder it is for them to return to work. The increased maximums on temporary total payments means that the majority of workers receive the full two-thirds of their gross wage. While seemingly a drastic cut from their wage, the injured employee gradually begins to realize he can live on it without a great reduction in his standard of living. There are no deductions for federal, state, or local taxes, no FICA, no deductions for welfare or retirement funds. In addition, other savings begin to accrue. There are no expenses for lunches or transportation to and from work. Clothing or uniform expense is also eliminated. For parents with children, there are no babysitter or day care fees. Unfortunately, today the work ethic for some people flows not so much from pride as from necessity. Remove the necessity and motivation to work decreases. It is these type claims that become so expensive.

One way to minimize this risk is to take the employee back on modified duty as soon as medically possible. Note we talk of modified duty or work rather than "light work." The term "light work" not only carries an adverse connotation but is not necessarily accurate. An individual with a weak left arm may still be capable of lifting substantial weights with his right. The point is that the employee's prior job, or even another job, might be tailored to fit the particular disability involved. An employee with a strained back, al-

ready on the way to recovery, may temporarily be able to perform a job that requires no lifting or repeated bending or stooping.

Modified duty offers advantages to the employee as well as the employer. It is concrete assurance of the employer's commitment for a job. It allows the employee to regain confidence in his ability to work while permitting gradual resumption of full activity. Finally, it provides the employee with full wages once more.

We have had some excellent results with this approach. Employees with back injuries whom we feared would not resume any employment have come back in limited capacities and over a period of two to three months have resumed most or all of their prior activities.

Two pieces of advice, however:

1. This program needs commitment from top management. Many managers, faced with tight budgets and high production quotas, are reluctant to put someone to work who is not capable of maximum production. The costs of the alternatives have to be emphasized. A claims charge-back system helps.

2. Medical clearance must be obtained. To do this, we must anticipate the probable work limitations for the type of injury and design a job to fit them before going to the doctor for clearance. Doctors have little idea of what jobs are available and are usually extremely reluctant to authorize any work without a detailed job description.

Now, let's look at the employee who physically cannot return to his former job. Prior to seeking outside rehabilitation, a concentrated effort should be made to locate a suitable position within the company. This takes patience, persistence, salesmanship, and support of top management. While the potential cost savings described previously make it worthwhile, I would be remiss not to point out that the greatest benefit is often the human being involved.

We have had many excellent success stories within Marriott. One employee had injured both wrists and insisted she could not lift anything or even use

her hands extensively. After several unsuccessful placement attempts, we finally located a job as a purchasing agent. It's a better job, pays more, and offers a good future. The employee is enthusiastic and once again a productive member of society. We also gained a substantial loss savings.

If there is no chance of placing the injured individual within the organization, then the sooner we obtain a rehabilitation evaluation the better. Not everyone is a good candidate for vocational rehabilitation. It will be costly. We estimate the cost of vocationally rehabilitating an individual in California to be between \$10,000 and \$12,000. Even then there is no guarantee of a successful placement, in which case you will be no better off than before. However, if there is a chance and the injured employee's motivation

is good, you are far better off supporting the attempt even in those states where it is not mandatory.

In summary, today's workmen's compensation system is causing redirection of claims control programs. Employers can no longer say, "We're sorry you're hurt. Come back when you're fully recovered." Claims loss control now includes taking the initiative in maintaining a positive relationship and returning the employee to work as soon as possible. If the employee is not capable of resuming his former duties, many states consider it the employer's responsibility to obtain alternative suitable employment, either in-house or through vocational rehabilitation. It may not yet be legally mandatory in all states, but it has become financially mandatory.

## DEVELOPING EFFECTIVE JOB CONTROL PROCEDURES

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The subject of job control procedure is not new. What is new is the recognition that many of the safety management or loss control approaches being taken are not working. They are not reducing the dollar losses. They are not improving the accident experience in many companies.

OSHA was created as the answer to reducing the number of accidents and injuries. We are beginning to recognize that the millions of dollars spent by OSHA and the many more millions of dollars spent by industry to get into compliance with standards on physical conditions in the work place have not produced the results intended.

The need now is to have an approach to control or guide the way our employees do their job. We need some guidelines on the procedures we allow or require our employees to follow.

### *Creating the Climate*

The job control procedure approach is in the basic concepts and programs which were developed years ago. Numerous major companies with excellent safety programs and corresponding results have been using a job control procedure program for many years. Only the terminology has changed: from job safety analysis to job control procedures.

Experience with these programs has taught us that if the program is to be successful and effective, it must be accepted by top management, supervision and the workers. In order to obtain acceptance and a commitment, the safety professional must obtain and communicate an understanding on some very basic elements that are involved.

Safety must be put in perspective. A good argument could be made that

many of our present problems in accident costs were caused by industry concentrating for the past six years on the OSHA standards and ignoring the real problems. Keep in mind that the OSHA standards are primarily on physical conditions, such as guarding etc. Accident causation studies, depending upon which one you read, indicate that somewhere between 50 to 90 per cent of the accidents are caused by procedures. One study that has been used for over 40 years indicates that only 10 per cent of the accidents were caused by physical conditions.

When OSHA started, many companies concentrated on getting into compliance with physical conditions and ignored 50-90 per cent of the real problems—procedures, the way we do our job, the way we allow people to work. The human element.

A case could probably be made that much of the legislation passed on health and safety, environmental controls which required capital expenditures is not contributing to productivity. In fact it may be counter-productive. No one can question the intent of the new laws; however, cost-benefit apparently was not considered.

Attitude understanding can be a problem. One of the reasons is that there is a tendency to make attitude understanding into an unworkable program based on abstract theories. We simplify this into terms that can be understood and handled in plant operations in the "real world."

We can define the word "attitude" as a "belief." What the individual, the employee, believes to be true about a given situation, the company, his supervisor. What he believes to be true about his supervisor is his attitude, his belief, and it reflects, controls, or influ-

ences his on-the-job behavior. Attitudes are beliefs, correct or incorrect, positive or negative beliefs. If we can determine his beliefs by simply asking, then we can do something to develop the proper attitude you want, either through training of the employee or the supervisor.

In many attitude development programs an important factor is often ignored: the learning process—how people learn. A sound understanding of the learning process is essential in the development of people to be effective. The first step in the process is the acquiring of knowledge. The second step is taking the knowledge, applying it to the job, and developing the necessary skills.

Once the knowledge is acquired and the skills are developed, the individual's attitude and behavior should change. This behavior change, the way he acts and does his job, now reflects his attitude. This determines his effectiveness in performing his job.

Since the learning process is important in the training and development of people, we need to recognize that the class room type training, or so called book learning, is inadequate by itself. There needs to be a follow-up to ensure that employees and supervisors are actually developing the necessary skills on the job. Learning is not accomplished until the skills are developed and a change of behavior takes place.

Motivation must be put in perspective. Motivation is another subject often blown all out of proportion. Some of the experts lead us to believe that we can motivate people by appealing to their needs and drives or by the use of gimmicks. Our studies indicate that the best motivator or demotivator is the employee's immediate supervisor.

For a supervisor to be properly motivated, to be able to motivate, he must be prepared and qualified. This means that a supervisor can motivate by possessing a reasonable balance of knowledge, skill, and a positive attitude to enable him to conduct himself in a manner that will command respect and will create in subordinates and superiors the desire and the need to actively respond.

There are no gimmicks in that thought, only sound management principles. People will respond to the supervisor who is qualified to lead.

The final element in establishing a successful job control procedure is in the supervisor's skill development areas. What skills must a supervisor have to be effective? This will vary from company to company. Generally included in this area would be communication skills, coaching skills, job construction skills, disciplinary action skills, and many more.

When we talk about developing supervisory skills, we often hear that employees have changed. We have a new type of employee, a new breed. I believe this is true. The employee of today is more independent, wants more out of life, possibly better educated, certainly more informed and aware of his rights. The employee is also more independent because there are more families with two wage earners. In many cases he comes to industry with limited skills.

The problem is that management has not responded and changed accordingly. In many cases we conduct ourselves the same as we did ten years ago. And yet we are the very ones saying that the only sure thing is change.

#### Implementing the Program

Once you have obtained an understanding of these elements then there are certain steps that are necessary in developing the job control procedures.

Many programs or attempts at developing and implementing programs have failed because the line supervisor and workers were not committed to the program. In order to obtain this commitment, the program must be in the line supervisor's program with the workers participating.

There are essentially five steps in developing job control procedures.

1. Obtain top management's approval and support of the program. This will be easy when the word "safety" is deleted and the analysis covers production problems in addition to safety hazards.

2. Identify those jobs which lend themselves to procedure control. Most

jobs can be included, with the exception of maintenance-type work.

3. Present the need and the approach to be taken to the supervisors as a group. Ensure them that top management is involved and wants the program to be a success. Present the list of jobs to be analyzed (or have them develop the list) and then have each supervisor decide which job he wants to analyze. (You may have to help the supervisor "volunteer.") The supervisor with the workers' assistance and participation, can develop in writing the hazards or the production problems and then the suggested control procedure.

4. The supervisor then presents the job analysis to the supervisors as a group. Each has an opportunity to participate and agree on the steps. The desired result is that with the hazards or production problems being identified in writing they can then be eliminated. Where this is not possible, the supervisors must agree on the control procedures.

5. The next step is for the supervisor to meet again with the worker or the operator involved and obtain agreement of the steps, the hazards, and the control procedures.

With the agreement and the commitment of supervision and the work-

ers, the job analysis then becomes a job control procedure. It can now be used for training employees.

#### Benefits of the Program

The program establishes the procedure to be followed, identifies the hazards and or production problems, and permits elimination of hazards or production problems. Where hazards or production problems cannot be eliminated, then control procedures can be established. It provides a training guide for new and old employees, provides a check for supervision, and improves employee participation and communication. It assists in accident investigation. It recognizes the importance of the human element and assists an employee in planning his job. When a new supervisor is assigned to a department, he has available, in the job control procedure, ready reference material to assist in his new responsibilities.

The expected results will be significant if the program is monitored and maintained. The job control procedures, when used properly will reduce the number of accidents, reduce the costs involved, and will improve productivity. All of these can be objectively measured.

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