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Public Utilities Sessions

BASIC ELEMENTS OF INDUSTRIAL HYGIENE PRACTICE IN UTILITIES

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I speak to you as Chairman of the Industrial Hygiene Committee of the Public Utilities Section of the National Safety Council. The Industrial Hygiene Committee is the youngest of the Section's committees, having been formed about three years ago. The committee has set as goals the solution to three basic problems:

1. What occupational health hazards are inherent to the public utilities industries? This is the recognition phase of industrial hygiene practice.

2. How serious are those hazards? This is the evaluation phase of practice. Decisions are made here concerning the need for control. Priorities are established.

3. How can control be implemented? This is the ultimate step in industrial hygiene practice, that of control. This is the area where the industrial hygienist needs to be of greater assistance to plant managers and workers.

The Industrial Hygiene Committee is addressing itself to the first question by developing a health hazard identification matrix for each of the public utilities industries. The health hazard identification matrix displays the potential health hazards associated with specific operations or locations within a particular industry. The data for the matrixes are obtained from industrial hygiene survey information. Matrixes are being prepared for the electric generating industry (both nuclear and coal-fired thermal plants), the gas industry, the telephone industry, and the water industry. When these are completed they will be made available to all sectors of the public utilities industries.

Based on what has been observed to date, it appears that most of the occupational health hazards associated with the public utilities industry are similar to those generally found in industry. If this proves to be factual, most of the problems will lend themselves to control by conventional technology.

Classification of Occupational Health Hazards

The occupational health hazards commonly found today may be classified into three basic categories: (1) chemical agents—toxic gases, dusts, fumes, mists, vapors, poisonous plants and insects, etc.; (2) physical agents—noise, heat, vibration, nonionizing radiation, electric fields, abnormal pressure, etc.; (3) biological agents — viruses, rickettsia, bacteria, fungus, parasites. The first two categories, chemical and physical agents, are probably the most important in the public utilities industries. For this reason, the Taylor and Thornton presentations will treat those two categories in more detail.

Steps in Industrial Hygiene Practice

The three basic steps in the practice of industrial hygiene are (1) hazard recognition; (2) hazard evaluation; and (3) hazard control.

Recognition may be achieved by several means, including direct inspection of working environments, review of medical findings on plant workers, careful consideration of suggestions and complaints from workers and their spokesmen, review of plant records for abnormalities, e.g., decreases in production or increases in absenteeism, and review of plans and operating procedures for facilities in the design and preoperational phases.

In identifying health hazards in the workplace, and as a first step in evalua-

tion, a preliminary survey or what is sometimes called a "walk-through" survey is often performed. The following checklist may be of assistance in conducting such surveys: Acquaint management with your survey plans. Obtain plant and process descriptions, flow sheets, operating instructions, etc., and become acquainted with them. Consult with the medical officer prior to and after the survey. Inquire of potential trouble spots. Note approximate number of workers at risk. Note types of crafts and operations associated with potential hazards. Note raw materials and products which may present health hazards. Note by-products and wastes. Note supportive operations and substances, e.g., welding, painting, abrasive blasting, insulation operations, solvent cleaning, etc. Note sources or presence of contaminants, using your sensory indicators (smell, sight, etc.) or by use of on-the-spot detectors. Note physical agents (noise, heat, ultraviolet, radioactive sources, etc.) List control measures—systems (ventilation, shielding, etc.), personal protective devices in use, administrative and medical controls, etc. Visit warehouse and note possibly hazardous materials, storage techniques, etc.

The preliminary survey often reveals the need for a more in-depth evaluation of certain potential hazards. The objective of the in-depth (or comprehensive) survey is to determine if employee exposure is sufficient to be hazardous. Thorough sampling for atmospheric contaminant concentrations may be performed by use of samplers or analyzers placed in the workroom atmospheres. Using these sampling results and the work schedules of the workers, computations of their time-weighted-average exposure may be performed. More often the evaluation is performed by placing samplers or detectors close to the worker's breathing zone (for example, these may be clipped to the worker's lapel or attached to the hat brim). In the latter case, samples are drawn continuously by miniature precision sampling pumps fastened to the worker's belt. In this manner, a more representative sample of the character and amount of exposure is obtained, since the sampler is carried with the worker as he or she moves about. If physical agents are identified in the preliminary survey, corresponding in-depth evaluation may be necessary. For example, it may be that sound surveys and analyses or noise dosimetry measurements on workers should be performed. Sampling and analysis of process materials, wastes, or supportive substances may be indicated.

The most accurate index of exposure for evaluation purposes is the state of health and well-being of the exposed worker. Thus biological sampling of blood, urine, breath, or other specimens may be taken and analyzed for contaminants or related metabolic substances. Physical measurements such as audiometric testing and pulmonary function testing may be performed. However, since medical testing is often complex and expensive, the first estimate of exposure is usually obtained by survey measurements in the working environment itself.

Upon completion of the field surveys, data are reduced, analyzed, and tabulated. Comparisons are often made between survey results and permissible exposure limits. The most commonly used permissible exposure limits are those published and updated annually by the American Conference of Governmental Industrial Hygienists (ACGIH). To quote from the ACGIH document *Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment*, the threshold limit values "should be used as guides in the control of health hazards and should not be used as fine lines between safe and dangerous" conditions. Any extension in the use of the threshold limit values beyond that of guides indicates a misunderstanding of their intended use.

The ultimate test of the health consequences of environmental conditions is the extent to which exposed individuals are harmed. If medical data are available for exposed workers, correlations between survey results and worker health should be sought. Thus, conclusions drawn from survey results are carried one step beyond the reliability provided by comparison with threshold limit values alone.

Upon completion of this phase the industrial hygienist should be able to answer the questions: Is this particular hazard posing a threat to workers? If so, what type of control is indicated, and to what extent should it be applied? Which control alternative appears to be most promising?

Control

Too often in the past, industrial hygienists, after taking strong steps in the identification and evaluation of workplace hazards have too timidly approached the matter of control. Usually, several alternatives are available for control of a particular hazard. However, the selection of control techniques is often left to the plant manager who may not have staff expertise to assist him in making the proper selection. Moreover, he may have little idea of control costs and may lack staff expertise to design and implement control.

To be of real value, the industrial hygienist should be capable of assisting the manager by outlining which of the control alternatives would be the one of choice from the viewpoint of both cost and effectiveness. He should be able to relate to the manager the gains and the penalties which will accompany implementation of each alternative. Thus, the manager is put in a much stronger position to make a sound management decision concerning control.

Control alternatives will usually fall within one or more of the following categories: design and preoperational review of potential hazards in planned future facilities; provision of design criteria and safe work practice procedures; medical control programs; training—workers, supervisors, and management; process or procedural changes; substitution of less harmful substances or equipment; containment of the hazard; isolation of the hazard, the worker, or both; automation; ventilation for air contaminant control—local exhaust and general dilution types; wet methods of dust control; shielding for radiation control; good housekeeping; labeling and signposting; hazardous substances control for very dangerous agents; monitoring and alarms; and personal protection.

Once the control decision is made, the industrial hygienist should be capable of offering more detailed assistance in planning, designing, implementing, and evaluating the control program.

In all instances where control measures are implemented (short of closing down the operation), it is important that the industrial hygienist evaluate and document the effectiveness of these controls. Too often, this step is not taken. It is important to determine if control was sufficient or, as sometimes happens, if it was excessive. Follow-up of this kind provides a valuable reservoir of information upon which to base future control decisions.

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PHYSICAL HEALTH HAZARDS IN UTILITIES

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Industrial hygiene concerns recognition, evaluation, and control of physical, chemical, biological, and ergonomic stress hazards within a work environment. It concerns the effect of these stresses upon employees' health. At times, employees may be exposed to pressure, electrical fields, illumination, microwaves, lasers, infra-red, ultra-violet, cold, radiation, noise, vibration, and heat, which are the physical health hazards.

This paper first presents a brief overview of these hazards. The remaining two sections discuss recognition, evaluation and control of heat and, finally, noise stresses within the work place.

Physical Hazard Overview

Air bubbles on the surface of a deep lake suggest a diver may be hidden below the water surface. The diver, if brought up too fast from too great a depth, will experience the pressure decompression sickness commonly known as the "bends." Although it has been observed that static electricity can almost drip from personnel when exposed to certain electrical fields, the real health significance of this condition is under investigation. We recognize hazards to personnel and a tendency for poor quality workmanship which can result from poor illumination. We also recognize improved workmanship, productivity, and attitude are benefits to be expected after shop lighting is upgraded. Once upgraded, routine periodic cleaning of the fixtures and lamps is important to help maintain adequate illumination levels. Fluorescent lamps begin to fatigue soon after first use. When a lamp fails, it is advisable to cycle older and therefore less efficient fluorescent lamps into warehouse areas which do not require quality illumination. The new lamps should be installed within areas where better visibility is needed to do the job.

Safety and health personnel strive to keep welding screens in position to shield workers from eye-flash exposure to ultraviolet energy. More and more, applications for laser energy are developing, not only within laboratories, but also for construction purposes, as well as communications. Misdirected laser energy can produce an optical blind spot, and the person involved may not be aware of his injury. Therefore, when a laser produces more energy than the job requires, filters can be installed to reduce the laser energy output to a more safe, yet functional, level. Of course, when not in use, the laser energy should itself be blinded. A wooden screen can serve as a shutter to close the laser energy window.

Micro-wave type of electrical energy may harm health consequent to excessive personnel exposure to energy leaked from a micro-wave oven or inadvertent exposure to micro-wave antenna energy. Occupational safety and industrial hygiene personnel also evaluate the potential for misadventure from x-rays and other ionizing electro-magnetic energies. Hot environments are potential physical stress problems. When should workers be removed from an obviously hot workplace?

The final physical health stress included within this overview is noise. Noise is measured in units called decibels. It's an ever increasing problem to decide whether a particular hearing loss is mostly work related or due to something else like hard-rock band noise. Safety and health professionals deal with physical health hazards frequently.

We work within a world of recognition, evaluation, and control. The word "recognize" implies to perceive whether or not a potential hazard is present within a work environment. When it isn't entirely obvious that a potential problem is a hazard, the concentration of the contaminant is measured to fix its value to determine whether other action is needed or not. Once it's shown a health problem exists, safety and health professionals influence others with expert advice to regulate the problem.

Heat Stress

The top housing of most operating electro-static precipitators is hot enough to burn shoe leather. Obviously, this can be a hot spot in which to work. We also recognize a potential for hurt from heat stress when working inside a furnace which has just been taken off line. Heat stress is defined as that environmental condition which contributes to a breakdown in man's thermal regulatory system. Most of the time, our bodies function like industrial plants and everything goes along smoothly, with output balancing input. However, when things get out of balance, flare-ups occur and production is thrown out of kilter. Heat stress is that environmental condition which contributes to a flare-up in man's temperature regulating process. The result can lead to heat collapse.

Insight into the fundamentals of heat stress can be gained through a review of a blacksmith's forging operation. Before the forge coal is fired, air circulation is controlled by room conditions. However, once lit, hot air rises up the stack and near work air is drawn toward the fire to be warmed in its turn. This is the convective heating process. A metal anvil nearby will be more hot than the surrounding air. The anvil has been warmed by a different type of heat energy called radiative heat.

A third concept about heat transfer may be illustrated with a pan of water. When moisture evaporates from the surface of the water, it takes a bit of heat energy from the water which remains within the pan. Just as the surface of the water remaining within the pan is cooled somewhat by moisture evaporation, so is the human body cooled by the evaporation of sweat. Sweat evaporation is probably the most important temperature control mechanism. A living body, like an industrial plant, attempts to maintain a balance between input and output. The word for this living attempt for sameness is homeostasis. The life process produces internal heat continuously. A hot, stressful work place dams up the normal drain away of this internal heat. When they are stressed by heat, the body defense systems such as sweat rate and heart rate increase their activity. When the body can no longer cope with heat, the sweat rate may exceed one kilogram per hour, the heart rate may exceed 110 beats per minute, and stored heat energy may accumulate so rectal temperature might exceed 38°C. These higher readings indicate inability to handle a hot environment. Regretfully, it is not convenient to measure workers sweat or heart rates or core temperature while they are on the job.

We do measure those environmental conditions which interfere with body heat loss to index hot working conditions. We determine the radiative, convective, and evaporative capacity of a work area to take up heat. These are the environmental indicators of heat stress, and in health they are interrelated within a balanced equation. Hence, a hollow black globe indexes radiative energy. A wet bulb thermometer measures humidity, which indexes the evaporative sweat potential within a work place. Convective heat load is related to the dry bulb temperature. These environmental temperatures can be combined into one number. However, the single number does not relate to what is ordinarily known and felt from a dry bulb temperature of the same number. An 81° wet bulb globe temperature is more stressful than an 81° dry bulb temperature. Inconveniences encountered with most wet bulb globe temperature equipment are its bulk and also the glass thermometers are somewhat fragile. Through experimentation the author found the wet globe instrument called a Botts-ball provides a reasonable estimate of a hot stressful environment. It is a cloth-covered hollow sphere which, when wetted and placed within a work area, indicates a single number for the heat stress load within that environment. This number can also index how long a worker should stay within a hot spot and when it's time to leave.

Sometimes protective equipment may increase heat stress. It can be ten degrees cooler under a vest than within a slicker jacket. Jacket type garments often interfere with sweat evaporation and in so doing can contribute to heat stress conditions within the slicker.

A device called a vortex tube divides a single air stream into two parts. One is more hot while the other is more cool. The

airline-fed vortex is worn by workers while within a hot, stressful area. The cooler air stream is directed inside the worker's vest and helmet to provide a more safe, yet portable, workplace.

Another method for heat stress control may be helpful when sufficient cooling water is available. To be effective, a coiled metal tube should be included within the hose system to duct air to the worker at a hot job. When the metal coil is immersed below the water, some of the heat is removed from the air fed inside a sandblaster's suit, for example.

Acclimatization is the most important body control mechanism for heat stress exposures. Acclimatization is a gradual physiologic adjustment to what previously had seemed excessively hot and stressful. Within limits, workers not accustomed to excessive heat can work safely after the duration of their exposure time to heat has been gradually increased over several weeks.

Sometimes air can be directed upon a group of men to provide convective cooling. However, paddle wheel type air movers are noisy and may be turned off because of the nuisance noise. The same quantity of air can be moved with a furnace type air mover. A furnace fan is more quiet and no more expensive. Convective type heat problems can be relieved by moving a large quantity of air through a hot area. Sometimes large volumes of air can be blasted upward through openings within a work room floor. However, increasing air movement will not relieve heat stress which is caused by a radiant heat source.

A more effective and less expensive control than air movers is to reflect the radiant heat load away from a work area. For example, aluminized material will reflect radiant heat back to a hot stack which passes through a workplace. Sometimes initial fuel dollars can be conserved by reflecting radiant heat energy back into a process. A special type glass window can be placed to reflect radiant heat before it reaches an operator. Of course, if an operator can perform a task from a remote location, the control station can sometimes be air conditioned. This may be feasible with an enclosed vehicle or within an enclosed overhead crane cab. An effective control device for the hot precipitator job, which was recognized at the beginning of this section, is wooden shoes. They serve to insulate a worker from the hot surfaces.

There are a number of good resources for heat stress information. The NIOSH document about heat stress presents a lot of information, while the new publication from the American Industrial Hygiene Association, *Heating and Cooling for Man in Industry*, is most comprehensive.

Noise Stress

Vibrating equipment and turbulent gases produce compressions and rarefactions within the surrounding air. These compressions and rarefactions produce a mechanical reaction within the ear. This movement is transduced into electrical impulses which, when received within the brain, are interpreted as sound. Noise is unwanted sound.

When a pneumatic tool is operated within a metal vessel, the noise is tremendous. Increasing the number of drills within an enclosed space, as with a tunnel drill rig, increases sound pressure and reverberation even more. An air chisel chipping at a metal frame may cause those exposed to hear a delayed ringing sound. It is not difficult to recognize obvious noise stress. However, other noises may not be so obvious. For example, the piercing blast of a steam release line is loud but intermittent. Is this type of intermittent noise a potential threat to produce a gradual decrease in hearing perception? Other questionable exposures include those to continuous noise at lesser levels. For example, how detrimental is steam line or gas turbine noise to hearing?

To answer these questions effectively, a program should be instituted to define the health implications of noise within the particular work environment of concern. The effect of noise upon workers is assessed best by measuring the noise exposure and also by testing workers' hearing perception. Hence, a complete noise control program not only considers the environmental noise exposure dose, but it also seeks to determine what has happened to workers' hearing perception. Sound level meters document the noise levels within various plant areas. These meters provide sound information in

units called decibels. The human hearing system does not perceive all vibratory energy, because the hearing mechanism blanks out significant amounts of the low frequency vibrations. Information from the A scale electrical network on sound meters is most like the ear hears.

The A scale decibels or dBA's found within a work area can be written upon a plant layout plan to make a noise grid or map. To determine personnel noise exposure dose, another type of grid to locate people must also be developed. The way the people location grid overlaps the noise levels grid is most important. Individual noise doses are developed from this information. All of this would be more simple if it were possible to attach an instrument to a man which would predict oncoming hearing loss.

Noise dosimeters are useful to help perform a preliminary noise evaluation within a noisy area. However, to be accurate, final conclusions about borderline type noise exposures should include information developed by integrating worker location into a noise contour grid.

Noise is a series of airborne compressions and rarefactions which are a complex combination of various vibratory pitches. An instrument called an octave band analyzer can provide a fingerprint of a particular noise. This energy fingerprint can identify the distribution and strength of the various component pitches of noise. A noise exposure dose is modified by the vibratory agent and is also weighted by the duration of the noise exposure. Perhaps equipment manufacturers should equip their sound meters with stop watches.

A sound measuring instrument can be coupled with an audiometer to check the accuracy of the audiometer. Audiometers help establish the level of hearing perception. This hearing level information should be recorded upon a document called an audiogram. If and when the new OSHA hearing conservation program becomes effective, it is likely the person operating the audiometric instrument must be certified to do so.

Noise control can be achieved by a number of methods. For example, temporary wooden structures can be designed to enclose a temporary compressor noise source at construction sites. To be most effective, its walls and roof should have a mass of at least five pounds per square foot. The lower the frequency of the offending noise, the more barrier mass is necessary to contain the noise. The octave band analysis or fingerprint of a noise helps define the most feasible or least expensive way to control a particular noise. Enclosures around steam turbines can reduce noise about six dBA's. Likewise, pipe noise can also be reduced six dBA's by wrapping the pipe with acoustical material covered with a more heavy outer sheath. Air blast circuit breaker noise can be muffled by a spherical housing to reduce impact noise 20 to 30 decibels. Duct type material movers can be enclosed by fiber lined wooden boxes to reduce noise also by six dBA's. Noise enclosures fabricated from a lined vinyl material can be hung to enclose machinery. Noise from a wood planer, for example, would be expected to be reduced about six dBA's by this control technique.

Sometimes it's possible to intercept the direct line of noise, particularly at frequencies over 2,000 Hertz, with a partition or even an acoustical blanket. However, be careful about potential fire hazard and also noise reflection around the screen. This method may provide two to three dBA's of line of sight noise reduction. At times, a work station can be set up to isolate an operator from a noisy environment. A well installed commercial booth can reduce noise exposure levels for those inside by 20 dBA's. However, it may be more feasible for the operator to retreat periodically into an open sided booth, which, if designed properly, will reduce many noise exposure levels about five dBA's. Such a five dBA reduction may be all that is needed to make the operator's total noise dose acceptable.

When noise cannot be controlled at its source, when it cannot be intercepted or the worker isolated, and when administratively the worker cannot be removed before excessive exposure, it is necessary to provide effective personal hearing protection. That means ear inserts or ear muffs. A finger in each ear is not effective. It's also best to have someone check the condition of an ear before inserting plugs into the ear canal. Ear plugs may aggravate existing ear canal problems. Before they are worn, ear plugs should be

fitted to match the size of the wearer's ear canal. Muffs have an advantage over ear plugs since it's relatively easy to determine that people are wearing muffs without performing a close-up inspection. Again, the nature of the noise fingerprint defines whether muffs or plugs will provide adequate control. In many situations there may not be an advantage one way or the other. However, for noise like that from steam locomotives inside plants, both plugs and muffs may be required to reduce perceived noise to within acceptable levels.

In summary, a noise program consists of elements to monitor both the working environment as well as employee hearing, to institute design for noise control for new installations, to attempt feasible engineering controls of existing noise, to put up warning signs, to require personal protection where noise cannot be reduced, to have those exposed wear appropriate protective devices when within high noise areas, and to periodically update and substantiate the program.

In addition, if there is not expertise to repair and truly check the calibration of noise instruments, someone else must substantiate data findings. The environmental data cannot be more true than the measuring instrumentation is accurate. Although there are a number of sources for good information about noise, it's presented fairly well within the NIOSH noise criteria document.

The Industrial hygienist attempts to prevent financial loss from unexpected, often chronic, and insidious events which injure health, through a process which recognizes, evaluates, and makes expert recommendations for control of hazards within the workplace.

Professional expert advice should be like a Watts' governor. The faster the governor responds to system speed-up, the higher its spheres are thrown. This action in turn produces an automatic breaking reaction upon the system.

The purpose of this paper has been to describe a system to help keep employees on the job healthy, thereby encouraging productivity. When this is so, employees, in turn, receive maximum benefits to carry to their families and loved ones. This seems consistent with the convention theme . . . "With Safety for All."

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FLAME RETARDANT CLOTHING FOR EMPLOYEE SAFETY

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We have a tendency to talk about protective clothing as if it were a new concept, but since the beginning of the human race clothing has been worn for protection. Our ancestors clothed themselves in everything from animal skins to armor to gain protection from their environment and their enemies. While clothing today still has a functional purpose, it has also become a way for us to project personal tastes and individual lifestyles.

A definition of protective clothing today should include those garments that offer an extra measure of safety against certain types of exposures, including excessive heat or cold, chemicals, impact, and machinery. Too often, however, the tendency has been to equate protective clothing with flame resistance. All protective clothing is not flame resistant, just as all flame resistant garments are not necessarily considered protective clothing. To explain this, I'd like to discuss the reasons for wearing flame resistant protective clothing, who should wear it, and what it really is.

The foremost reason for wearing flame resistant protective clothing is safety in areas where thermal hazards exist. In the Institute of Industrial Launderers booklet "Fabric Flammability of Work Clothing" it is reported that an estimated two million persons in the United States annually suffer burns requiring medical attention or restricting normal activity for at least one day. Approximately 75,000 to 100,000 of these people require hospitalization, and about 1.5 million work days are lost each year due to burn injuries. The IIL report further states that of 1.3 million persons injured each year from contact with hot objects, corrosive chemicals, steam, and open flames, more than 11 per cent are injured when clothing ignites. From fires and explosions, about 260,000 people are burned each year, with about 35 per cent occurring in the home, 43 per cent at work, and the remainder in public places and vehicles. About 8,000 of these cases result in death, and approximately 3,000 of these are related to clothing ignition.

The IIL's technical committee reports that victims suffering from clothing ignition are four times more likely to die than those whose clothing did not ignite. On an average, the clothing ignition patient has burns covering almost twice as much body area, has six times as much body area burned full skin thickness, spends 21 more days in the hospital, and has medical costs $5,000 higher than the patient whose burns are not attributed to clothing ignition.

The costs of burn injuries are high both in human suffering and in dollars. Some of you may have had first hand experience with serious burns or burn injury victims. Physicians generally agree that a serious burn is one of the most traumatic of all injuries. Cost figures from three actual burn cases in 1967 illustrate the direct expenses.

Case 1: Moderate—20% body area burned to 2nd and 3rd degree
Hospital—$24,647
Workmen's Comp.— 10,200
Total—$34,847

Case 2: Moderate to serious—about 40% body area burned to 2nd and 3rd degree
Hospital—$30,000
Workmen's Comp.— 8,250
Pro Rate Life— 32,000
Total—$70,250

Case 3: Serious—80% body area burned to 2nd and 3rd degree
Hospital—$ 75,000
Workmens' Comp.— 42,800
Pro Rate Life— 33,000
Total—$150,800

Since these are 1967 costs, we can be relatively certain that at least the hospital portion would be significantly higher today. The indirect costs, involving lost production, retraining, employee morale, and effect on company benefits are even greater and far more difficult to attach a

dollars and cents figure on in the total picture.

Our rapid growth as an industrialized nation has been a contributing factor in the number of fires experienced annually. New science and technology has given us a host of new materials and processes to work with, along with more complex distribution systems in the utilities. In short, there are many new areas of exposure and more unknowns today than in the past.

The enactment of the Occupational Safety and Health Act has focused more attention on many of the problems with which safety engineers have long contended. OSHA and the National Institute of Occupational Safety and Health are aware of the need for protective clothing in certain areas and are gathering statistics necessary to develop programs for industry's use. Our cooperation will play an important role in all of this. The hazards unique to each industry are perhaps best understood by the safety engineer, and the input of that individual can help in the development and implementation of practical, effective standards.

The decision as to where flame resistant protective clothing should be worn should be based upon the past experiences of that company, along with the total industry evaluation of burn injury records and costs. Many jobs are easy to classify, such as those in the fire services, petroleum, munitions, and utilities industries, but many jobs fall into a gray area where the safety engineer or the safety department is in the best position to establish individual standards.

I would like to concentrate now on what protective clothing is and what it should do in terms of offering protection to the wearer. First of all, it is important to make a distinction between flame resistant clothing and garments that offer substantial thermal protection. (Slide presentation given to support text.)

We have elected to break thermal hazards into two categories: (1) small ignition source hazards; and (2) large ignition sources or catastrophic explosions. Category 1 includes items such as matches, cigarettes, fireplaces, heaters, gas stoves in kitchens, and even, to some extent, welding sparks. The federal standards for children's sleepwear were designed to protect against such small ignition sources. Flame resistant garments offer protection against these sources which most often result in only a minor burn injury. There are many flame resistant fabrics for this market today and many others being developed as the industry voluntarily expands the use of such fabrics to provide a consumer choice in the market place.

Category 2—large ignition sources or catastrophic explosions—presents an entirely different problem requiring the need for thermal protective garments that will isolate and insulate the wearer from the hazard for as long as possible. An example of a large ignition source would be a building fire which could trap firemen in areas where adequate thermal protective garments are essential. Race drivers face the prospect of collision and fire as a part of the job. Jackie Ickx was involved in a fiery collision in the 1970 Spanish Grand Prix where he and his car were both completely engulfed in a fuel fire. As the car came to a halt, Ickx jumped out and fell into the burning fuel. He escaped—protected by a thermal protective garment system of double layered fabric made of Nomex aramid fiber—and went on to race again the following day.

Gas utilities workers face the possibility of exposure to large, catastrophic fires and, therefore, have a need for thermal protective clothing.

In slides showing a simulated natural gas ignition, we see Ira Simpson of Southern Union Gas Company walking through a flame thrower wearing a thermal protective gas suit made of Nomex. Tests performed by the Arizona Public Service Company were run to determine just how well this same gas suit worked in an actual exposure situation. In the test, a mannequin was dressed in regular work clothing and lowered into a hole which had a gas line running into it. The hole was filled with gas and ignited for several seconds. The gas was turned off and the mannequin removed from the hole. From the extent of damage to the clothing, which had ignited, and to the mannequin, it was determined that a human would have suffered serious burn injuries. The test was repeated with the mannequin dressed in a gas suit of Nomex aramid. The results showed that a person would have suffered minor or no burns under the same exposure. A final test involved dressing the mannequin in regular work clothing with the gas suit made of Nomex worn over the regular clothing. This was done to determine whether the regular work clothes would ignite under the suit of Nomex. No ignition of the regular work clothing occurred, nor did it appear that the temperature became high enough to burn a person or melt any of the man-made fiber in the regular work clothing.

As you can see, there is a major difference between small ignition source hazards and large ignition source hazards, thus a different level of protection is required. Flame resistant fabrics are usually adequate for small ignition sources, but if contending with large ignition source hazards such as catastrophic explosion, then thermal protective clothing is a must in order to give the wearer as much time as possible to escape.

One thing important to remember is that all thermal protective clothing can and will fail with a great enough exposure. The goal is to design thermal protective clothing systems that move the failure point out as far as possible in light of the anticipated maximum exposure.

Properly constructed thermal protective clothing designed to isolate and insulate a human from a large ignition source thermal exposure consists of several things. First, the material should be flame resistant and maintain its integrity. In other words, it should not break open to expose the skin when exposed to a high heat load. The material should have low thermal shrinkage to insure against shrinking against the skin, destroying the insulating air space, and thus burning the skin through conductivity. A medieval suit of armor meets our standards so far, but it has its problems on the next requirement—that of good insulation against the heat. Metal is not a good insulator. So the material in a good thermal protective system should have low heat transfer. Finally, all these protective features should be an inherent part of the fabric or fiber in order to eliminate any human error in the application or reapplication of any flame retardant treatment, or during wear and maintenance of the garment.

Proper design of a thermal protective garment is also very important. A garment that is either too tight or does not provide adequate coverage, or one that is not sewn with flame resistant thread can result in injury even though it may be fabricated from the best fabrics available.

We feel properly designed protective clothing made of Nomex aramid fiber will best meet these requirements for thermal protective clothing. Nomex is inherently flame resistant. It has very good thermal stability with excellent insulating properties, and it does not melt.

That's a strong sales pitch, but I'd like to demonstrate how we at Du Pont reached this conclusion. It has been neither a short nor an easy program to develop and establish Nomex fiber for the thermal protective clothing market. Nomex was developed by Du Pont in the mid-1950s to meet a market need for an inherently flame resistant, non-melting textile fiber with a high degree of durability. Successful early development work led to its commercialization in 1967. Since its introduction, Nomex aramid has been exposed to a tremendous amount of testing. In fact, we would venture to say that Nomex is probably the most thoroughly tested man-made fiber ever produced.

Most notable of the early testing programs was the military test for pilot flight suits. The military found that much of the previous testing had been somewhat shallow and in many cases subjective. There was a need for a new approach in determining just what was needed to offer a pilot maximum protection and, at the same time, minimum interference with his ability to perform his assignment. The approach taken was to first define what heat exposure would result in first, second, and third degree burn damage to human skin. The noted Stoll research at the U.S. Naval Air Development Center was of major importance in providing concrete numbers on human skin burn tolerance. With this information, the next step was to determine the heat load produced by the various hazards expected to be encountered. Once these two variables were established, it was relatively easy to establish the thermal protection required to prevent human

skin from being burned when exposed to these various thermal hazards.

One of the most noted test methods used to determine the thermal exposure level of a hazard was the military "pit test." This test was used to simulate the thermal exposure from a plane crash. Instrumented mannequins were hung from an overhead trolley-like arrangement so that they could be drawn across a pit which contained burning jet fuel. The mannequins were instrumented to simulate human skin in order to give a readout of the per cent of body area burned, burn depth, and location of burn injuries. While these were drastic test conditions, they were instrumental in the development of optimum thermal protective clothing systems.

Du Pont believed that a more convenient, controlled evaluation method was needed to reproduce thermal exposures encountered in the various hazardous environments. This has been accomplished with an apparatus called the Behnke Test Stand. The exposure levels possible with this test stand have allowed us to closely duplicate actual exposure conditions, including radiant and convective heat, and determine the effectiveness of various fabrics and fabric systems in providing adequate protection against thermal hazards.

From research conducted by Du Pont, we have learned that all thermal protective fabrics and systems will fail in one or more of four ways. The first mode of failure is burning. The material does not have adequate flame resistance, as is the case with cotton, which readily burns in air. The second type of failue is a chemical/thermal burn. This results from a flame retardant treatment on a fabric decomposing under thermal exposure and giving off hot tars which can transfer onto the wearer of the garment. The third form of failure is when the fabric or system breaks open under thermal exposure, leaving the skin unprotected. Finally, a fabric can fail through heat transfer. This can occur by a fabric shrinking against and coming into direct contact with the skin, or it will occur from just too great a heat load. All systems will, at some point, fail through heat transfer if the heat load is great enough for a long enough period of time.

We are satisfied that the results of these tests are realistic, since they relate to actual exposures and human tissue tolerance to heat. The following examples will help to illustrate the effectiveness of thermal protective systems of Nomex aramid.

Race driver Mario Andretti was involved in a spectacular crash during the time trials held for the Indianapolis 500 several years ago, yet went on to win the race that year. He was protected by a double layered system of Nomex.

A zinc worker who was splashed with molten zinc escaped with only minor burns as a result of being protected by a coverall of Nomex.

Two Minneapolis fire fighters—one wearing a turnout coat of Nomex and the other a rubber coat—were trapped in the same fire. From every indication, both saw equal thermal exposure, yet the one in the rubber coat was severely burned and spent 43 days in the hospital, while the fire fighter wearing the coat of Nomex suffered only minor burns to areas of his body not covered by the coat. Additionally, the coat of Nomex remained intact, while the rubber coat was completely destroyed.

And there is Jim Welch of the Minnesota Gas Company. He was out making repairs on a gas line when a leak ignited and exploded. Jim spent several days in the hospital for observation, but suffered burns only on his face where his air mask and hood did not provide a complete closure. He was wearing a gas suit of Nomex. Jim Welch, George Kohan, and George Jones of Minnesota Gas all credit the gas suit of Nomex aramid with saving Jim from serious burns, and very probably with saving his life.

In addition to the protection garments of Nomex provide, they can also represent a cost savings in the long run. While the initial cost of protective clothing of Nomex is higher, Nomex has proven itself to be a very durable fiber which gives exceptionally long wear life in properly constructed fabrics and garments. Experience has shown that garments of Nomex will outlast flame-retardant-treated cotton garments of equal weight and similar fabric construction by up to six times. So, in the long run, garments of Nomex can be a money saver in more ways than one—long wear life and outstanding protective performance. Nomex will pay for itself the first time you need it. If you don't believe me, ask Jim Welch.

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OVER THE HILL TO THE . . . IMAGINATION IN WORK AREA PROTECTION

By JERRY S. TAYLOR
Dir. of Safety, Continental Telephone Service Corp.,
Bakersfield, CA

It seems that every year someone talks about work area protection and tells us where to put signs, flags, and cones. Even with that, many of our companies are still having problems. So here we are going to take a different tact and talk about "imagination in work area protection." Our theme will be "over the hill to the . . . and we'll see if any of you have found yourself in a similar situation. Put yourself behind the wheel and let's go on up this hill—to what?

Imagine that you are with a group of ladies going home from Wednesday's bridge party. The lady driving the car has just come over the top of the hill. When she sees the situation she starts to slow down. When she gets closer, she suddenly realizes that the man crossing the roadway is pulling something behind him. It looks like a rope or a wire. Not being too sure what will happen if she runs over the wire, she decides to stop. Another car coming over the hill from the same direction has no warning that a car has stopped ahead. When this driver first sees the stopped car, it's too late to avoid it. Results: four people seriously injured.

A few days later, the attorney for one of the injured stopped by the telephone office to interview the telephone man who had been listed as a witness to the auto accident. The telephone man stated that he was installing a telephone for a customer which required that a new drop be strung across this lonely country road. He didn't think it would be necessary to put up warning signs, because it would just take a few minutes to complete the job. Besides, what are the odds of one car being on this lonely road, let alone two at the same time and same place?

The telephone company became a defendant in a law suit and was found to be negligent. The court awarded the injured $26,000. Not only were there needless injuries, but there was needless loss of company revenue because a telephone man didn't use his imagination.

Let's go back to our country road. Slide behind the wheel, fasten your seat belt and drive on up the hill. Go on over the hill and let's see what other situation a telephone man could find himself in.

This is a typical telephone central office where we can find several different kinds of work areas. But before we go inside, let's take a look at the parked vehicles. Someone in charge of this area has certainly used some imagination and recognized the need for control of the parked vehicles. Backing the vehicles into a parked position has eliminated the need for backing when leaving an area that may have changed since the vehicle was first parked. Yes, I would say that parking a vehicle safely is a form of work area protection. Now let's go inside the central office and see what kind of work area protection is needed there.

Here is a common area seen in many telephone exchanges. Notice that someone has stacked some boxes in a careless manner to the right of the vault and a reel of wire to the left. The vault door was left open, which makes the fire extinguisher difficult to get to.

Imagination after the fact changed the area. The housekeeping has been cleaned up, guard rails were installed, and the fire extinguisher was moved to a more accessible spot to eliminate the possibility of someone stepping into the open vault. Too bad someone hadn't used imagination and installed work area protection before a worker fell into the opening and sustained a compound fracture of the leg, severe bruises, and a concussion.

Slide back under the wheel and fasten your seat belt. Let's go back to our hill and over the top and see what other situation is waiting for us.

This is a typical neighborhood that all telephone men find themselves in. Each time our workers enter this type of work area, there are problems that must be considered before any kind of work can start. Let's consider the fact that much like the fire truck or a Sherman tank, the telephone vehicle is something different than the normal neighborhood vehicle. These vehicles are enough different that they tend to attract the curious, and especially the curious young. So, it becomes essential that work area protection be considered before we leave a vehicle standing in any area. The protection I'm really interested in is the protection of others from the work area. Earlier we talked about parking a vehicle so it will not have to be backed when it is time to move. This is especially true in the neighborhood. Keeping this in mind, we should never allow our vehicles to be parked in a customer's driveway. Let's not give that five-year-old telephone man the opportunity to park his three-wheel telephone truck behind our curiously painted panel. Let's require that our driver set cones out, not to protect our vehicle from getting hit by another, but to make it necessary for our worker to walk around the curious vehicle and retrieve them before leaving.

If, while doing that, he uses a little imagination and observes what is around, some small child may not be run over by the work area that we want to protect. This reminds me of the telephone man that used his imagination one day and did something a little extra while picking up his cones. When picking up the cone in front of his vehicle, he stooped down just enough to see the tiny feet of the four-year-old mechanic who was working under his curiously painted truck.

Work area protection—for whom? I believe for us and them.

Fasten your seat belt again, and let's go back to our lonely country road. Let's go on over the hill and see what is in store for us next. As we are driving along I wonder how many of us would have seen the man standing at the left side of the roadway. Even when we are working off the roadway it is sometimes difficult for an unaware driver to understand what is happening. Some drivers may not even see the man standing in the bushes near the telephone pole. He would just continue on over the hill to this scene:

Notice that the truck on down the way has its protective cones out, but the men walking back up the hill toward the oncoming vehicle have no protection. Without warning signs before the hill, an oncoming driver would have no idea what is over the hill. This is a fairly narrow road and doesn't have many places to go should the driver panic and lose control of the vehicle when he suddenly comes unexpectedly on this scene at 55 m.p.h.

Enough said about that—let's go on to the next hill and over the top and see what other situation we might get into. Suddenly you find yourself in another situation of the unknown. What in the world is going on up there? Doesn't look like it is moving. It is probably safe to pass to the left of the truck. But beware, a few minutes ago a telephone man disappeared into the bushes to the left of the roadway. He was pulling the winch line from the front of the truck, and probably has it attached already to the front of another vehicle stuck in the mud. As soon as he gets it hooked up he is going to run down the roadway and stop the oncoming traffic. This actually happened when a small sports car came along and tried to pass the truck. Fortunately, the sports car wasn't a convertible, but it did receive severe windshield damage and a badly scraped top. All of this because the telephone workers didn't think it was necessary to take the time to put up warning signs to protect the work area. After all, it's a lonely country road with practically no traffic.

I hope my message has been clear as we've traveled my lonely country road. The examples I've used are simple, and I'm sure none of us would ever get caught in the same situations.

I hope that these examples will serve as a good reminder that, without proper warning, none of us can be absolutely sure what is over the next hill. Common sense tells us to always expect the unexpected and remember—if it is possible to happen, it probably will.

ONE, TWO, THREE–INTEGRATED SAFETY TRAINING

By GEORGE W. BARNARD, JR.
Staff Mgr., Safety, American Telephone & Telegraph—Long Lines, Somerset, NJ

When I gave this presentation a title it was not intended to be a take off of that James Cagney movie of the 1960's, entitled "1, 2, 3," where a Coca Cola executive running the West Berlin operation gave staccato commands to an assistant—a former Nazi—who continually clicked his heels upon receipt of each command, which he dutifully executed. I can assure you that AT&T Long Lines executives, middle management and non-management, do not operate or respond in this fashion.

It was intended to identify the three needs to which the Long Lines Accident Prevention Plan is responsive:

1. To inform employees uniformly and accurately of safe work procedures.
2. To measure employees knowledge, understanding, and ability to perform safely.
3. Provide a follow-up to assure continuing performance by employees and administration by management.

And, of course, it must be integrated into the existing Long Lines Safety Program.

But before we get into the Plan, I think we should orient you to Long Lines—the organization and its function. The Long Lines Department is the only operating department of AT&T. Our function is to provide the major interstate toll facilities and switching machines that tie the local telephone companies together into a single integrated network. This applies whether the local telephone company is a Bell System Company or an independent. We also are responsible for the portion of the overseas service in which the Bell System has an interest.

We provide no service directly to customers, only to other telephone companies. So you might say we are a telephone companies telephone company. Long Lines has about 36,000 employees, located in almost all the 48 continental states plus most U.S. possessions.

We are quite different from the local telephone companies in the type facilities we have, their location, employee body which operates and maintains those facilities and, consequently, their exposure.

Let's take a look at a cross section of the Long Lines work force and compare this with a typical operating or local telephone company; you'd find a different distribution and obviously a different occupational exposure:

	LL %	Telco %
Staff and Support	35	32
Traffic Operations	14	27
Central Office Operations	46	17
Outside Plant Operations	5	24
Total	100	100

For the purpose of this comparison, "Staff and Support" includes groups that support Operations—Engineering, Accounting, Marketing, Personnel, etc.

The Central Office is highly automated and requires little attention. However, when failures occur they involve rather large quantities of communication facilities, and this dictates precise and rapid action. We have a number of network management centers that respond to overloads and failures with action that restores balance to the network. Our central office operations, therefore, do not involve the regular use of hand and power tools to the extent they are used by other operating telephone companies.

So, grouping our central office employees with traffic operations and staff and support people, about 95 per cent of our employees are working in a fairly low exposure environment.

Our outside plant employees have the highest exposure to accidental injury, since they are working in and around manholes, microwave towers, and construction activities. Although much of our heavy construction work is contracted out, an increasing amount is being performed by our own forces. Only five per cent of our employees work in this higher exposure environment.

Now, what about our accident experience? In the Bell System, in addition to occupational, we measure non-occupational accidents involving lost work days and motor vehicle accidents using both per vehicle and per mileage rates. Long Lines results for the first six months of 1975 compared with Bell System averages are:

	LL	B.S.
Occupational	.48	2.23
Lost Work Day	.16	1.40
Restricted	.03	.68
Medical Treatment	.33	.82
Non-Occupational	1.93	3.83
Motor Vehicle		
Per 100 Vehicles	.31	.71
Per 100,000 Miles	.24	.93

I also need to explain briefly the Long Lines Safety Program. I'm sure it is not too different from yours, but this diagram should orient you to the various elements.

Instructions and Procedures. We have two major instructions involving safety that apply to every employee in Long Lines. One is General Instruction 36A, or "The Long Lines Safety Plan." The core of our Safety Program, it covers the company's policy on all elements of safety. The other is General Instruction 25B, or reporting and recordkeeping. This covers the reporting procedure when an accident occurs, and the records that are required by the company and OSHA. All of our accident reports are initiated by teletype, converted to selected data for use in preparation of company and OSHA reports and analysis and stored in a random access computer in Kansas City, which is programmed to print out various reports and analytical data.

Training. Two types of overall safety training are required. They are, naturally, management and non-management. We are going to cover the non-management training in detail; but just a word about management safety training: Most line management employees are selected from non-management ranks, and therefore have already been thoroughly exposed to the non-management training. The management training consists of a two-hour segment of the one-week training course given to each new management employee. In addition, the involvement of management in the non-management training, as we'll describe in a moment, forces them to be completely familiar with that training and related instructions.

Reviews and Audits. This is a form of quality control to insure that field operations comply with company instructions and OSHA. We conduct in-depth field reviews in each one of our seven areas plus the headquarters departments. Each one takes a week, with immediate feedback to local management and a summary to top management.

The other elements are self-explanatory: consultation and investigation services; review of practices and legislation; and statistics, records, results and analysis.

Now, let's get back to the non-management safety training. We call it the Long Lines Accident Prevention Plan, or OJT85 for on-the-job training. It is a modular training course using programmed instruction, testing, and performance reviews. At present, there are four modules: Safety Fundamentals, given to all employees and a prerequisite for all of the others; Central Office Craftsmen; Traffic Operator; and Outside Plant. There are four others under development: Building Maintenance; Computer Operations; Administrative Service; and Construction. The program also includes the Administrator's Guide, which is provided to each first level supervisor.

The title of this presentation is "One, Two, Three—Integrated Safety Training." As I said at the beginning, there are three objectives that the Long Lines Accident Prevention Plan is designed to meet:

1. Inform employees of safe work procedures. It instructs employees uniformly and accurately, using a self-paced programmed instruction workbook and audio tape.

2. Measure employee understanding and ability to perform. It measures the employees understanding and knowledge, using a written test. Then it gets the employees commitment by having him perform selected tasks.

3. Assure continuing safety performance. It provides for daily observation

and regular review to assure the continuing ability of the employee to perform. It also requires the recording and retention of records by management.

Let's follow a new employee through the learning process. These modules are designed to be administered to the new employee the first week on the job. It is also required for the experienced employee who has changed jobs, when the new job is materially different from the old job.

The new employee is given a short orientation on his work location, hours, other employees, job responsibilities, etc. Then sometime within the first week the employee is given the Safety Fundamentals module. The supervisor gives the employee the workbook and a cassette tape recorder with the "A" module audio tape. The employee is given the answer immediately, to assure understanding. Then reviews are given periodically in the workbook on specific segments. Upon completion, the employee goes back to the supervisor where he/she is given a written test. The supervisor checks the test for incorrect answers. The only acceptable score is 100. If there are deficiencies, the supervisor reviews the correct answer with the employee. Then within the next two days he/she reviews the missed questions again with the employee to insure the employee knows the correct answer.

Once completed, and the supervisor is satisfied with the employee's knowledge, he/she asks the employee to perform selected tasks. The correct performance of these tasks clearly demonstrates that the employee not only knows, but understands, and is able to perform those key tasks safely. The last, and continuing, part of the plan is the daily observation by the supervisor. If the supervisor observes the employee not following safe work procedures, the supervisor corrects the employee immediately, and if observation indicates repetitive deficiencies, then these are reviewed with the employee on the next performance review.

Suppose this is an experienced employee, who has transferred to a new job which is materially different from his/her previous assignment. An example would be a traffic operator who is transferred to Outside Plant. He/she would already have received the Fundamentals and Traffic Operator Modules on the former job. He/she obviously doesn't need the fundamentals again, but must successfully complete the Outside Plant Module the first week on the new job. The sequence after that would be the same as for a new employee.

To assure the continuing performance of the employees, the supervisor is required to conduct performance reviews with the employee at regular intervals. The first performance review is conducted six months after the completion of the initial module, and annually thereafter. The performance review is conducted one-on-one, with the supervisor requesting the employee to perform selected tasks. The supervisor may use his own judgment on subsequent reviews by eliminating those tasks which observation shows the employee has mastered.

The supervisor records each review on a special form maintained in the employee's training file.

As all of us know, the telecommunication standards which became effective April 30, 1975 require that the employer train employees prior to engaging in the various work activities. Although we had been adhering to this long before OSHA, much of our training was OJT, using instructions and procedures integrated into the Bell System practices.

The Long Lines Accident Prevention Plan extracts selected fundamental safe work procedures from the BSP's and compiles them in a series of modules. So it provides a well-documented training system that is clearly identifiable and easily administered. New modules can be added as they are required, and individual modules can be modified as work procedures and/or environments change. It does not change Bell System practices or the safety procedures and precautions included in them.

The Plan provides some powerful learning methods:

1. Programmed instruction using self-paced workbooks and audio tapes.
2. A written test to measure the employee's knowledge.
3. A "hands on" reinforcement of the employee's knowledge by requiring him to perform selected tasks.
4. Continuing observation and regular "hands on" review to assure continued performance.

It also has some distinct advantages over on the job training with peers and/or supervisors:

1. Provides a uniform and accurate level of trainnig from which the supervisor can build, using other materials developed locally.
2. Reduces the training burden on the first level supervisor by lifting the new employee's knowledge to a level that is manageable.
3. Provides a point of reference in evaluating employee's safety knowledge on accident prevention reviews in the field.
4. Forces the supervisor to be as knowledgeable as the employee and stimulates the supervisor to seek additional information to respond to employee's questions.
5. Provides records of training that are responsive to company needs and the requirements of OSHA.

The Long Lines Accident Prevention Plan is a vital and viable non-management safety training system that is integrated into our Long Lines Safety Program.

FAULT CURRENT TESTS ON GROUND RODS

By ROBERT B. STAIB
General Supt., Production & Transmission Construction,
Ohio Edison Co., Akron, OH

I am sure that all the companies which you represent have safety rules and I am sure, without exception, those safety rules for people working around energized conductors and equipment include rules for grounding. We all know that the fundamental purpose of grounding is to provide a safe path to earth for the current that is available from accidental contact with energized conductors and thus keep the workman from being injured. We accomplish this by always working between grounds and by having a ground between the workman and every source of supply, so that any current flow is shunted into the earth before it gets to the workman. We know that in order to provide a good path into the earth, it is necessary that we establish a good ground. It is fundamental that, before working anything as dead, it be grounded: "not grounded—not dead." By inference, at least, the corrolary is accepted: if it is grounded, it is dead. These fundamentals of grounding show up in many grounding procedures; they show up in .he OSHA standards and are very widely held understandings of the purpose of grounding among the people subject to injury from energized sources. All are based on the principle that the main purpose is to dump the current flow into the earth. I want to challenge these concepts and promote as fundamental the control of voltage across parts of a man's body.

We filmed tests on ground rods which Ohio Edison Company had performed in A.B. Chance's laboratory in Centralia, Missouri. These were a portion of a test series whose purpose was to prove the current carrying capability of the hardware used in safety grounding by Ohio Edison Company employees. The ground rod tests were performed by driving the test rod into the earth a predetermined amount, measuring the ground resistance as we would in the field, then applying approximately 15 kv to the rod. The supply circuit had the capability of providing 20,000 amperes. Measurement of current flow during the test was made by oscillograph. Most of the tests were recorded on two movie cameras, one taken with color film at about five times projection speed, and the other with black and white film at about 50 times projection speed.

I would like to direct your attention to several elements of the data. First, there is the difference between the measured ground rod resistance prior to the test and the calculated resistance during the flow of test current. The resistance during test was always less than the measured ground rod resistance and was reasonably uniform and independent of the measured value—in the three to five ohm range.

These films showed the physical evidence of the dissipation of energy in the earth. Power is defined as the time rate at which energy is emitted. Electrical power is calculated as current times voltage. The physical evidence of energy dissipation evidences the existence of a voltage between the ground rod and the earth; for if the voltage were zero or very low, the power dissipation would be very low, instead of the 40 megawatts it was.

Test No. 1. Joslyn Toncon ground rod, depth of one foot in earth; Chance clamp No. G-3368. Measured ground rod resistance—17 ohms. Calculated resistance, including test circuit and ground rod during fault—2.75 Ohms. Voltage to ground—15.5 kv. Ground fault current—5,650 amperes. Total duration of test—19.5 Hertz.

Test No. 2. Joslyn Toncon ground rod, depth of six feet in earth; Chance clamp No. G-3368. Measured ground rod resistance—7.5 ohms. Calculated resistance, including test circuit and ground rod during fault—4.6 Ohms. Voltage to ground—15.5 kv. Ground fault current—3,370 amperes. Total duration of test—122 Hertz.

Test No. 4. Chance ground rod No. 8426, depth of one foot in earth; Chance clamp No. G-3368. Measured ground rod resistance—45 ohms. Calculated resistance, including test circuit and ground rod resistance during fault—5.84 ohms. Voltage to ground—15.5 kv. Ground fault current—2,650 amperes. Total duration of test—53 Hertz.

Test No. 5. Chance ground rod No. 8426, depth of six feet in earth; Chance clamp No. G-3368. Measured ground rod resistance—nine ohms. Calculated resistance, including test circuit and ground rod resistance during fault—4.3 ohms. Voltage fault current—3,600 amperes. Total duration of test—46 Hertz.

Test No. 9. Chance screw type ground rod No. 3370, depth of six feet in earth; Chance clamp No. G-3368. Measured ground rod resistance—17 ohms. Calculated resistance, including test circuit and ground rod resistance during fault—4.37 ohms. Voltage to ground—15.5 kv. Ground fault current—3,540 amperes. Total duration of test—123 Hertz.

Test No. 35. Chance screw type ground rod No. G-3370, depth of six feet in earth. Measured ground rod resistance before test—15 ohms. Measured ground rod resistance after test—90 ohms. Calculated resistance, including test circuit and ground rod resistance during fault—4.68 ohms. Voltage to ground—15.5 kv. Ground fault current—3,310 amperes. Total duration of test—31 Hertz.

Test No. 36. Two screw type grounds No. G-3370 connected in parallel approximately six feet apart, each rod six feet in earth. Measured ground rod resistance before test — eight ohms. Measured ground rod resistance after test—500 ohms. Calculated resistance, including test circuit and ground rod resistance during test—3.34 ohms. Test voltage—15.5 kv. Test current—4,640 amperes. Total duration of test—31 Hertz.

Test No. 37. Two screw type grounds No. G-3370 connected in parallel approximately six feet apart, each rod six feet in earth. Measured ground rod resistance before test—nine ohms. Measured ground rod resistance after test—70 ohms. Calculated resistance, including test circuit and ground rod resistance during test—4.06 ohms. Test voltage—15.5 kv. Test current—3,820 amperes. Total duration of test—61 Hertz.

Test No. 11. Chance all-angle clamp No. G-4228-10SJ. Conductor—4/0 copper cable (clear jacket). Test Voltage—360 volts max. Test current—19,600 amperes. Total duration of test—123 Hertz.

We have included the last test, which covered one grounding clamp test to show the lack of power dissipation when the voltage is held low by a low shunt resistance. This is in spite of the existence of about five times the current flow.

In a subsequent series of tests, we measured voltage in the various parts of the circuit and found that of the 15 kv applied voltage, over 11,000 volts appeared between the top of the ground rod and a point in the earth five feet distant from the rod under test. The full fault current, of course, flowed through the ground rod under test. Now, had we had a man standing with his feet five feet away from the ground rod and his hands on the rod while the fault current was flowing through the ground rod, he would have been exposed to about 11,000 volts. If we assume his body resistance was 11,000 ohms, then the current flow through his body would have been one ampere. O.K., we had a total of some 4,000 amperes flowing in the circuit; 3,999 of those flowed through the ground rod into the earth, so we did provide a good bypass (99.975 per cent effective) around our man for the flow of fault current. But what happened to the man? Well, he was killed. One ampere flowing through his body was plenty to kill him. We didn't really do much to protect him, did we?

What grounding must do to be effective is to limit the voltage to which the man is exposed. When protective grounding is applied to the transmission conductor for work on a tower, we attach our grounding conductor to the tower, to the earth, then to the conductor to be worked on as deenergized. A very low impedance then exists, shunting the workman, and we have effectively eliminated the possibility of an elevated voltage existing across his body and have, in fact, protected him. At the ground rod during fault, when we have the best conditions possible, say three, four, or five ohms of resistance in parallel with the man we are trying to protect, we do not prevent a hazardous voltage between parts of his body.

Let's move now to the practical application of this principle. When we have a vehicle parked under a line whose boom

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By ROBERT B. STAIB
General Supt., Production & Transmission Construction,
Ohio Edison Co., Akron, OH

I am sure that all the companies which you represent have safety rules and I am sure, without exception, those safety rules for people working around energized conductors and equipment include rules for grounding. We all know that the fundamental purpose of grounding is to provide a safe path to earth for the current that is available from accidental contact with energized conductors and thus keep the workman from being injured. We accomplish this by always working between grounds and by having a ground between the workman and every source of supply, so that any current flow is shunted into the earth before it gets to the workman. We know that in order to provide a good path into the earth, it is necessary that we establish a good ground. It is fundamental that, before working anything as dead, it be grounded: "not grounded—not dead." By inference, at least, the corrolary is accepted: if it is grounded, it is dead. These fundamentals of grounding show up in many grounding procedures; they show up in the OSHA standards and are very widely held understandings of the purpose of grounding among the people subject to injury from energized sources. All are based on the principle that the main purpose is to dump the current flow into the earth. I want to challenge these concepts and promote as fundamental the control of voltage across parts of a man's body.

We filmed tests on ground rods which Ohio Edison Company had performed in A.B. Chance's laboratory in Centralia, Missouri. These were a portion of a test series whose purpose was to prove the current carrying capability of the hardware used in safety grounding by Ohio Edison Company employees. The ground rod tests were performed by driving the test rod into the earth a predetermined amount, measuring the ground resistance as we would in the field, then applying approximately 15 kv to the rod. The supply circuit had the capability of providing 20,000 amperes. Measurement of current flow during the test was made by oscillograph. Most of the tests were recorded on two movie cameras, one taken with color film at about five times projection speed, and the other with black and white film at about 50 times projection speed.

I would like to direct your attention to several elements of the data. First, there is the difference between the measured ground rod resistance prior to the test and the calculated resistance during the flow of test current. The resistance during test was always less than the measured ground rod resistance and was reasonably uniform and independent of the measured value—in the three to five ohm range.

These films showed the physical evidence of the dissipation of energy in the earth. Power is defined as the time rate at which energy is emitted. Electrical power is calculated as current times voltage. The physical evidence of energy dissipation evidences the existence of a voltage between the ground rod and the earth; for if the voltage were zero or very low, the power dissipation would be very low, instead of the 40 megawatts it was.

Test No. 1. Joslyn Toncon ground rod, depth of one foot in earth; Chance clamp No. G-3368. Measured ground rod resistance—17 ohms. Calculated resistance, including test circuit and ground rod during fault—2.75 Ohms. Voltage to ground —15.5 kv. Ground fault current—5,650 amperes. Total duration of test—19.5 Hertz.

Test No. 2. Joslyn Toncon ground rod, depth of six feet in earth; Chance clamp No. G-3368. Measured ground rod resistance—7.5 ohms. Calculated resistance, including test circuit and ground rod during fault—4.6 Ohms. Voltage to ground—15.5 kv. Ground fault current—3,370 amperes. Total duration of test—122 Hertz.

Test No. 4. Chance ground rod No. 8426, depth of one foot in earth; Chance clamp No. G-3368. Measured ground rod resistance—45 ohms. Calculated resistance, including test circuit and ground rod resistance during fault—5.84 ohms. Voltage to ground—15.5 kv. Ground fault current—2,650 amperes. Total duration of test—53 Hertz.

Test No. 5. Chance ground rod No. 8426, depth of six feet in earth; Chance clamp No. G-3368. Measured ground rod resistance—nine ohms. Calculated resistance, including test circuit and ground rod resistance during fault—4.3 ohms. Voltage fault current—3,600 amperes. Total duration of test—46 Hertz.

Test No. 9. Chance screw type ground rod No. 3370, depth of six feet in earth; Chance clamp No. G-3368. Measured ground rod resistance—17 ohms. Calculated resistance, including test circuit and ground rod resistance during fault—4.37 ohms. Voltage to ground—15.5 kv. Ground fault current—3,540 amperes. Total duration of test—123 Hertz.

Test No. 35. Chance screw type ground rod No. G-3370, depth of six feet in earth. Measured ground rod resistance before test—15 ohms. Measured ground rod resistance after test—90 ohms. Calculated resistance, including test circuit and ground rod resistance during fault—4.68 ohms. Voltage to ground—15.5 kv. Ground fault current—3,310 amperes. Total duration of test—31 Hertz.

Test No. 36. Two screw type grounds No. G-3370 connected in parallel approximately six feet apart, each rod six feet in earth. Measured ground rod resistance before test — eight ohms. Measured ground rod resistance after test—500 ohms. Calculated resistance, including test circuit and ground rod resistance during test—3.34 ohms. Test voltage—15.5 kv. Test current—4,640 amperes. Total duration of test—31 Hertz.

Test No. 37. Two screw type grounds No. G-3370 connected in parallel approximately six feet apart, each rod six feet in earth. Measured ground rod resistance before test—nine ohms. Measured ground rod resistance after test—70 ohms. Calculated resistance, including test circuit and ground rod resistance during test—4.06 ohms. Test voltage—15.5 kv. Test current —3,820 amperes. Total duration of test—61 Hertz.

Test No. 11. Chance all-angle clamp No. G-4228-10SJ. Conductor—4/0 copper cable (clear jacket). Test Voltage—360 volts max. Test current—19,600 amperes. Total duration of test—123 Hertz.

We have included the last test, which covered one grounding clamp test to show the lack of power dissipation when the voltage is held low by a low shunt resistance. This is in spite of the existence of about five times the current flow.

In a subsequent series of tests, we measured voltage in the various parts of the circuit and found that of the 15 kv applied voltage, over 11,000 volts appeared between the top of the ground rod and a point in the earth five feet distant from the rod under test. The full fault current, of course, flowed through the ground rod under test. Now, had we had a man standing with his feet five feet away from the ground rod and his hands on the rod while the fault current was flowing through the ground rod, he would have been exposed to about 11,000 volts. If we assume his body resistance was 11,000 ohms, then the current flow through his body would have been one ampere. O.K., we had a total of some 4,000 amperes flowing in the circuit; 3,999 of those flowed through the ground rod into the earth, so we did provide a good bypass (99.975 per cent effective) around our man for the flow of fault current. But what happened to the man? Well, he was killed. One ampere flowing through his body was plenty to kill him. We didn't really do much to protect him, did we?

What grounding must do to be effective is to limit the voltage to which the man is exposed. When protective grounding is applied to the transmission conductor for work on a tower, we attach our grounding conductor to the tower, to the earth, then to the conductor to be worked on as de-energized. A very low impedance then exists, shunting the workman, and we have effectively eliminated the possibility of an elevated voltage existing across his body and have, in fact, protected him. At the ground rod during fault, when we have the best conditions possible, say three, four, or five ohms of resistance in parallel with the man we are trying to protect, we do not prevent a hazardous voltage between parts of his body.

Let's move now to the practical application of this principle. When we have a vehicle parked under a line whose boom

can make contact with that line, we at Ohio Edison Company have traditionally driven a ground rod or installed a screw-in-type ground rod and grounded the frame of the vehicle very solidly with a 4/0 grounding conductor and felt we were safe and could touch the vehicle at will. Recognizing that safety grounding requires that there exist a low impedance path around the workman, with adequate current carrying capacity to live through the application of the available short circuit current for the time permitted by the relaying, the resistance which exists between a ground rod and the earth fails to prevent a hazardous voltage between the vehicle and the earth.

An incident occurred on our system which gave graphic evidence of this gap in protection. I guess we can call it an incident rather than an accident, since no injury resulted. Involved were two vehicles, a bucket truck and a line truck. The line truck had a boom up in the vicinity of an energized 7200 volt line and made contact. Both vehicles were grounded to a common ground rod. We don't know the resistance of the ground, but have no reason to think that it was much different than those that were tested. When the line truck's boom made contact with the 7200 volt line, an arc flashed over the tires on the bucket truck which, if there is any question in anybody's mind, proves that the voltage of the ground rod and everything connected to it, was elevated above the potential of the earth by enough to have an arc flash over the tires on the other truck.

Ohio Edison Company has for a good many years had what we feel is a well written and very effective *Accident Prevention Handbook*, which contains the fundamental rules embodied in our Accident Prevention Program. My own department, the Construction Department, several years ago issued a fairly detailed set of procedures prescribing the methods to be followed in grounding facilities in order that they be worked on as dead. After reviewing the results of the tests and re-thinking the basic philosophy of grounding, we issued a revision to that Construction Department Grounding Practices and have in the mill revisions to our *Accident Prevention Handbook* which change the grounding procedures at the ground rod. We now require that in addition to grounding the vehicle, the vehicle be treated as if it was energized when it is in a position in which it could make contact with an energized source.

It is my understanding that there are different philosophies with respect to the grounding of equipment embodied in the grounding rules of various companies. Some companies do not require grounding of vehicles and do require that they be treated as energized. There is much to be said for that philosophy, in that having not grounded the vehicle, no impression has been created on the part of the workman that it is safe to contact. We elected, however, to continue the grounding of equipment for a couple of reasons; the grounding of the equipment will help protect the equipment itself from damage resulting from sustained high current flow, because it will help to get the relays to operate more quickly to get the line cleared, and shortening the duration of the time during which the vehicle is energized reduces the opportunity for contact with it.

There are many implications, of course, to a simple statement that you must treat the vehicle as energized, even though it is grounded. It happens that the majority of our equipment has the operating levers accessible from an operator's position on the equipment, not standing on the ground, but for those that do have the operating levers accessible to a man standing on the ground, an insulating platform, or insulating operating handles, or the use of rubber gloves, or whatever is appropriate to the voltage involved, to treat it as energized is in order and is necessary. Getting items out of storage bins on the vehicle requires the consideration due an energized conductor. Entering or leaving the vehicle assumes additional complications. Also, we must take the necessary precautions to keep the public from contacting our vehicles when they could become energized.

A recent experience has further confirmed the wisdom of the change in procedure. While stringing new conductor over an energized 4160 volt primary, contact was made with the primary by the new conductor. The new wire was grounded through a grounding sheave and the trailer mounted tensioner was

grounded. The crew was treating the equipment as energized and were staying clear or wearing rubber gloves. When the contact was made, no injury resulted, even though the fault hung on long enough to burn off the ground rods.

Included in the summary report by the Accident Prevention Committee of EEI of fatal accidents reported by the electric utility industry for 1973 were 87 fatalities, 49 of these cases involved electric shock and burns. Of these 49, six involved vehicles which became energized. The similar summary covering 1974 lists 74 fatalities, of which 46 were electric shock and burn cases. Of these 46, six or perhaps seven involved vehicles which became energized. Although little information about the details of these accidents is available, they do serve to demonstrate that this is a very real problem.

There is really only one fundamental that is important in protecting workmen from injury from accidental application of energy to a conductor being worked on as de-energized. That is the provision of a low impedance shunt across the parts of his body which could be exposd to a dangerous voltage, with enough current carrying capacity to remain intact during any fault.

In addition to recognizing the specific situation existing at a ground rod, I would like to suggest, for your consideration, the value of promoting a program aimed at recognizing shunting as the effective measure to protect workmen. Perhaps we should quit calling the general procedure "grounding," to prevent the continuation of a misunderstanding of what happens when a conductor being worked on as dead is accidently energized.

76 1160

THE FAINT METHOD OF EMERGENCY POLE TOP RESCUE AND RESUSCITATION

By HARRY FAINT
Safety Director, Henkels & McCay Co., Elkhart, IN

The need for a simple, one-man type pole top rescue and resuscitation method has led to the development of the Faint Method of Emergency Pole Top Rescue and Resuscitation.

Research of many attempted rescues using only the mouth-to-mouth method of resuscitation on the pole has revealed that no successful attempts were made. Several successful attempts were completed by using the old Oestereich method of manual resuscitation. This same experience was evident with professional lifeguards on ocean beaches. The Holger-Nielson method or the Silvester method were preferred over the mouth-to-mouth method due to the successful and unsuccessful attempts to save a drowning person.

The lack of any heart stimulation while using only the mouth-to-mouth method to ventilate the lungs has caused rescuers to revert back to the older, less effective, but more successful methods they had used in the past.

Pole top rescues presented even greater problems—two linemen were required up the pole, one lineman to give artificial respiration using the Oestereich method and the other lineman to rig the rope for the rescue. The reduction by most companies of linemen on a crew from six to eight to three of four man crews with only two linemen qualified to climb added a seemingly insurmountable problem for a quick rescue. A call for help was needed before a rescue could even be started.

The Faint method utilizes the mouth-to-mouth method with a cardiac compression method to stimulate the heart muscle and circulation to keep the brain oxygenated until the rescue can be accomplished.

Drs. W. B. Kouwenhoven and G. G. Knickerbocker researched the Faint method and conducted several training classes in the use of this method. Dr. Kouwenhoven felt that this method had enough merit to be taught and used to establish a field experience in order to properly determine the qualities of this method.

Clearing Victim from Hazards. Should the victim of an electrical shock still be energized, it is of utmost importance to clear or de-energize him first before any rescue or resuscitation can begin. Ascend the pole to a point below and within reaching distance of the victim's feet. Prepared with proper personal protection, including rubber gloves and sleeves, manipulate the body until it is free from all electrical hazards. This can be accomplished by grasping the feet and swinging the body free; the dee rings will act as a swivel allowing you to twist and turn the upper torso in order to dislodge arms, shoulders, or head from contact with live lines.

Proper Positioning for Rescue and Resuscitation. Climb up the pole beside the person by sliding your safety belt up the pole until you are in a position beside the victim with your head slightly above his shoulders. Do not waste any time by removing his climbers; seconds count when a life hangs in a balance between biological death, recovery with irreversible brain damage, or full return to a normal life.

Basic Life Support (unwitnessed)

Open the Airway. An open airway must be established by extending the head back to clear the airway. Place the palm of your hand on the forehead of the victim and carefully pull the head back, extending the neck back as far as possible.

Determine Breathlessness. Place your ear over the victim's mouth to feel or hear any acts of breathing and watch the chest for any attempts to breath on his own.

Provide Ventilation. Take a deep breath and cup your mouth completely over the person's mouth, hold the nose closed with the index finger and thumb, and blow forcefully until the lungs expand. Four full, quick breaths must be given as quickly as possible.

Obstructed Airway. Should the airway be obstructed by foreign material in the throat or trachea, reposition the head, tilt to be sure the airway is open. If an obstruction is still present, open the mouth with the two finger method and sweep your finger through the mouth, sliding your finger down the inside of one cheek, across the throat, and across the other cheek and out the mouth. If this fails to dislodge the obstruction, slap the person three or four times on the back between the shoulder blades. The Heimlich maneuver can also be used.

Determine Cardiac Response (Pulselessness). The status of the carotid pulse must be checked. While keeping the head tilted with one hand, place the index and middle fingers of the other hand on the Adam's Apple (larynx) and slide them toward yourself into the groove between the throat and the neck muscles, where the carotid artery can be felt for a pulse. No pulse and no breath indicates external cardiac compression is required.

External Cardiac Compression. Without changing position on the pole, wrap both arms around the victim's chest and pull the victim toward yourself until your nearest ribcage (breast, left or right) is in the center of his spine at the lowest tip of the shoulder blades. Locate the xiphoid process with the fingers of one hand and with the other hand make a fist, with the thumb wrapped over the top of the middle finger. Place the fist with the side of the index knuckle and finger on the sternum two or three fingers above the xiphoid process. Place your other hand on top of the placed fist and smoothly, but firmly compress the heart between the sternum and spine 15 times at a rate of 80 times per minute, using a numonix of 1 and 2 and 3 and 4 and 5, and 1 and 2 and 3 and 4 and 10, and 1 and 2 and 3 and 4 and 15.

Rigging Handline for Rescue. Using a rope one-half inch in diameter or larger, throw an end over the crossarm, bracket, fixture, or anything capable of supporting the weight of the victim. Make sure the end is long enough to reach down to within an area of your grasp. Thread the end from the front of the victim under one armpit around his back and tie a bowline knot at least one foot from his chest.

Allow the other end of the rope to pass downward between yourself and the victim. Pass the rope under your buttocks and up to a point where your one hand can hold both sides of the rope together as you sit in the loop. Work all the slack out of the rope from the bowline knot up over the crossarm or other support to the hand (furthest from the victim) that holds the two sides of the loop together. At this point your weight should counter balance the victim's weight. Using your free hand, cut his safety belt, utilizing a skimming knife and cutting away from yourself and the victim. The victim should not settle more than one inch as his weight is transferred from his safety and body belt to the rescue rope. Place your knife back in its storage position on your body belt and place your hand on the hand line directly above the bowline knot supporting the victim. You will guide the victim's body down to the ground with this hand, making sure he is free of all guy wires, communication lines, tree limbs, or brush as you lower him to ground level.

The hand that holds both sides of the loop around your buttocks will let loose of the main rope that passes between you and the victim. Fully extend your arm out away from your body and above your head, gripping the tail rope extending toward the ground with the palm facing up. Allow the rope to slip through your grip slowly as the victim's body descends to the ground. The speed of descent can be controlled by lowering the extended arm slightly to increase the speed or raising the arm slightly to slow the descending speed. As the victim's heels touch the ground, push out on the rope with your guide and and you are able to lay the victim on the ground face up (on his back) until you descend the pole and start normal unwitnessed C. P. R. This should be continued until entry into an advanced life support system can be accomplished.

This unwitnessed arrest procedure of vertical C. P. R. should take no longer than 15 seconds. The rescue should not be delayed. If the rescue cannot be completed in quick successions, continue the 15 to 2 cycle until the rescue can be accomplished. Any delay while the victim is still entrapped up a pole lowers his chances of ever regaining a normal life or

life itself.

These 15-second procedures of vertical resuscitation are only necessary to sustain an oxygenated brain until a successful rescue can be made. If a fast, safe rescue can be made without delays, such as clearing the victim from hazards to himself and the rescuer, no resuscitation efforts should be made up the pole. Get the victim to a horizontal position on the ground for Basic Life Support C. P. R. as quickly as possible.

Witnessed Arrest (Oxygenated Heart Muscle)

The witnessed arrest technic for Basic Life Support must be started within 60 seconds, and a precordial thump can be very useful in correcting an asystole or a very early stage of ventricular fibrillation. The rescuer must be within close proximity and start this technic within 60 seconds, while the heart muscle is still oxygenated.

Open the Airway. Immediately extend the victim's head to provide an open airway and palpate the carotid pulse at the same time.

Precordial Thump. Absence of pulse must be determined quickly. Pulselessness established is followed by a sharp, quick, single blow on the mid-sternum, utilizing the fleshy portion of the clenched fist. Check the carotid pulse; if a pulse is established, check for absence of breathing and follow with four quick, full breaths. If no pulse can be detected, proceed with the unwitnessed arrest procedure.

76 1161

LOW BUDGET VISUAL AIDS FOR SAFETY PROGRAMS

By GARY McCORMICK
Safety Supervisor, Salt River Project, Phoenix, AZ

Communication: where meanings are exchanged between individuals through a common system of symbols. To communicate: to express ideals effectively; to make a point; create happiness; arouse emotions; sway the masses; dramatize good and diminish evil. To create happiness, add laughter, ease sorrow. To bring man closer to nature, and nature closer to man. To add life to stillness and sound to silence.

Communication: where ideas are exchanged through the aid of symbols.

The above excerpts come from various audiovisual programs dealing with the subject of safety. They were all produced in-house by the Salt River Project.

We couldn't, in this small space, begin to describe all the facets of producing professional communication programs. We can, however, share some of the techniques we use in producing ours.

By motion picture standards, most of our programs would not win a film festival award. Then again, we're not trying to win awards. But our programs all have one thing in common: they get the job done and they get results. That, by far, is the single most important ingredient to consider when you judge the results of your product: does it work? It doesn't have to be polished, professionally produced, or costly—it just has to communicate. In fact, some of the most effective programs we've ever produced were the simplest and least expensive—but they communicated.

Where does it all begin—like magic, from a magician's hat? Not likely. Good visual communication begins at the hand of the originator—with the written word. What do you want to say, how do you want to say it, and to whom—what, how, and who. It sounds just like a scene from an Abbott and Costello comedy routine.

Scriptwriting, or converting ideas and objectives into words, takes a certain amount of psychological self-inducement. Start by getting yourself into a proper frame of mind. Gather your confidence and remember, both you and Truman Capote have one thing in common: neither of you has ever written an audiovisual presentation before.

Make an outline of the key points, then follow the principles of good letter writing: you need a salutation or opening, the text of your message, and a close. Write conversationally, not typographically. Keep it loose, and don't be discouraged if you don't get it right the first time. Good script-writing, like making pizza dough, takes a good deal of working-around, and you have to get your elbows into it for proper results.

Punctuation is important, but not critical. The person who invented the semicolon only got it half right: the subject as it sounds and looks to the audience is important—not how it appears on paper.

Pictures and hieroglyphic writings of Babylonian, Mayan, and Chinese cultures represented an extension of the visual sense for storing and conveying human experience. The distinction between the spoken or printed word and audiovisual presentations is the ability of visual communication to give pictorial expression to oral meanings, thereby utilizing two of man's five senses. While text speaks with words, the graphic figure speaks with form.

Armed with your message, use your imagination and give it form by visually conveying it to your audience.

Take a copy of your narration, select a key word, phrase, or important figure for each change of subject, and use a visual idea that best communicates the thought.

Graphics can be either photographs or artwork of people, places, and things—a combination of both—pieces of both—or variations of both.

Give your viewers a break. There seems to always be a little bit of Texas in every audience, so keep your visuals high

enough for people to see.

Horizontal format does not refer to the position of the audience after you conclude your program—it's how the image appears on the screen. Stick to a horizontal format and avoid a headless horseman.

Plan on using lots of numerical figures? Then either pass out binoculars or open up the front door and play like Batman, because everyone beyond the second row will be out of viewing range.

Break the information into sections, or show key numerical figures, or better yet, use a graph or bar chart.

One tip about image size: There is one image size for 35mm slides, and another size for television production. Unless you want unfavorable results, remember the format dimensions.

With a script and slides, you can deliver your message live, and for all practical purposes you are in the AV business.

But wait—what's that sound? Is it—could it—yes, yes it is—that's what's missing, Mantovani. No, Mantovani's not missing, his sound is.

The gentle sound of mood music, to lull you into a relaxed, serene feeling, prepare you for the important message that lies ahead—to pick you up, give you life, charge your batteries, spur you on to new, exciting, exhilarating heights and then, bring you down and with music take you to new places, faraway places, places reserved only for your imagination. Music, the universal language. Ah, what music can do for a communication program.

If you have recording equipment, you can have your speech narrated, add music, and perform absolute wonders for a communication program.

For a reasonable fee, professional recording studios will arrange for talent and perform the work for you. It's well worth the cost.

Producing a message is one thing, getting it to the audience is another. By far the most convenient to show—and the most dramatic medium—is 16mm film. It captures a motion, adds life to a subject, and only requires a projector and screen for showing. It's also the most expensive to produce, requiring professional filmmakers in almost all areas of production.

Slide presentations offer many advantages for visual communication. In its basic form, all that's necessary is a script, a slide projector with remote control slide changer, and a screen.

With relative ease, a live program can be converted to a slide/sound program. Start with an audio tape, then add an electronic impulse to a channel not being used for narration. When the audio tape passes through the projector, the impulse automatically changes the slide, giving you a smooth, controlled program. For individual viewing or smaller audiences, the slide program can also be converted to filmstrip format. With little equipment investment and a minimum of production expense, you can utilize one of the most efficient and economical methods of visually communicating your message.

Videotape is becoming more and more popular for industry application, and for good reason. Videotape can be shot in a studio or in the field and be viewed in the time it takes to rewind the recorder. The tape can be taken to your own or commercial studio, and together with an audio tape, make a professional product in cassette form.

Slide programs can be converted to video tape at a relatively inexpensive cost. A combination of 16mm film, videotape, slides, and original artwork can be made into one program in a matter of a few hours.

While the actual shooting of videotape for final showing in cassette format is the most convenient medium, television requires a certain amount of equipment, limiting its portability. In addition, due to the smaller screen size, audiences are limited to about 30 people.

In Greek mythology, King Cadmus introduced the phonetic letters into Greece, sowed the dragon's teeth, and they sprang up armed men.

The alphabet, when combined with papyrus, spelled the end to the monopoly of knowledge by a few, and extended the power of the word to the masses.

You now have the word, and with the capability of visual media, the means to sow your message and watch great things happen.

Then sit back and watch and listen, and join us in the world of communication, where meanings are exchanged between individuals through a common system of symbols. To communicate: to express ideas effectively; to make a point; create happiness; arouse emotions; sway the masses; dramatize good and diminish evil. To create happiness, add laughter, ease sorrow. To bring man closer to nature, and nature closer to man. To add life to stillness and sound to silence.

Communication: where ideas are exchanged through the aid of symbols.

 78 1162

UPDATE ON OSHA

By HARRY W. BECKER
Director of Safety, American Water Works Association, Denver, CO

Status of State Plans

When OSHAct became effective in April 1971, investor owned utilities were immediately covered by the law, and municipally owned utilities would be affected as the individual state plans and programs were approved by the Federal government. According to the latest information I received a few weeks ago, only 22 state plans are in effect, since four states have withdrawn their previously approved plans. Wisconsin, New Jersey, New York, and Illinois withdrew their plans this year. Mississippi, Georgia, Pennsylvania, and New Hampshire withdrew their plans prior to receiving approval by the Department of Labor. In addition, formal rejection proceedings have been instituted against the Virginia and New Mexico state plans, although Virginia submitted a plan change which may halt rejection proceedings, and New Mexico may submit a revised plan shortly. Kansas, Nebraska, South Dakota, Ohio, Louisiana, and the Trust Territories have not submitted plans. About 16 states and territories have submitted plans and have been notified by OSHA that the plans lack additional requirements necessary for approval. Of the 22 approved state plans remaining in effect, seven of these have attained operational status: Colorado, Kentucky, North Carolina, Oregon, Tennessee, Utah, and Vermont. The remaining 15 states and trust territories whose plans have been approved are: Alaska, Arizona, California, Connecticut, Hawaii, Indiana, Iowa, Maryland, Michigan, Minnesota, Nevada, South Carolina, Virgin Islands, Washington, and Wyoming.

As I stated, municipals come under the Act when the state plan is approved. Therefore, under the present law, if a state later withdraws its plan, the municipals in that state are again excluded, so we have an on again/off again situation. When the OSHAct was first introduced in Congress, the NSC established a position of being in favor of the state plan concept. However, after observing four years of effort to make the state plan concept work, the Council is not satisfied with the relatively poor performance of the states in the development and operational phases of the state plans. As I stated earlier, several states have withdrawn their plans and there is indication that some of the other states may withdraw by the end of this year. All of the evidence points to the fact that the long range future of state plans appears to be bleak. In view of the trend and the Council's increased dissatisfaction, the Board Government Relations Committee met in June to reassess the initial NSC position with respect to the state plan concept. The question before the Committee was, "What change should be adopted with respect to federal-state relationships under the OSHAct that would yield better performance in occupational safety and health?"

The Committee unanimously agreed on the following proposed position and recommended its adoption by the Executive Committee of the National Safety Council. It was approved by the Executive Committee at its June 26 meeting, and the proposed position reads as follows:

1. Retain the state plan concept as it now exists, but limit continuing approval of state plans only to those states that demonstrate exceptional performance in meeting the guidelines and deadlines prescribed in their own state plan—even though this may limit continued approval of state plans to substantially less than 50 states. The states should be required to adopt the federal occupational safety and health standards. Similarly, the states should be required to adopt administrative procedures no less effective than the federal procedures for the enforcement process and for obtaining variances.

2. Increase the incentive for states for the developmental and operational phases of state plans by increasing the current 50 per cent level of funding by the federal government for the states that do have approved state plans. Additionally, provide adequate funds for federal enforcement in all states that do not have an approved state plan.

3. The states, with or without approved state plans, should provide on-site and off-site consultative services on matters relating to compliance with applicable occupational safety and health standards, and the OSHAdministration should provide off-site consultation for the same purpose. The Federal government should provide 100 per cent funding for implementation of the state's consultation program.

4. There should be put in place an extensive program funded by the Federal government for the training and education of state consultants and employers in an effort to assist in achieving greater voluntary compliance with the requirements of the OSHAct.

Standards Proposals and Revisions

Of particular interest to the water utility industry is the fact that the Office of Standards Development has requested comments on a proposed revision of the present Confined Work Spaces Standard.

Issues of specific interest to OSHA include: scope of standards; difficulty of complying with present standards; monitoring of oxygen and toxic substances in confined spaces; procedures for, and methods of, atmospheric testing prior to personnel entry into confined spaces; need for, and responsibilities of, a full-time safety observer; control of ignition sources in or near potentially explosive atmospheres; and the oxygen level at which the atmosphere should be declared "oxygen deficient."

A list of other standards to be proposed in the next six months has been published by OSHA. These include silica, chloroform, coke oven emissions, hazardous materials labeling, chromic acid, lasers, inorganic mercury, asbestos, sulfur dioxide, cotton dust, ammonia, means of egress, gasoline nozzles, flammable liquids, electrical standards for industrial machine tools, monorail systems and underslung cranes, access to gantry cranes, welding, cutting, and brazing, personal protective equipment for agriculture, and salamanders. In addition to these 22 new standards hopefully to be proposed, OSHA intends to evaluate specific contaminants in six different chemical groups concurrently. These groups, which contain up to 18 substances in each, are: alcohol, ethers, alkanes and alkydes, halogens (sets H and I), and aliphatic nitrogen compounds and nitriles. OSHA also plans to complete its program of adopting appropriate Part 1910 general industry standards into Part 1926 construction standards and finish writing complete standards for air contaminants listed in Tables G1, G2, and G3 of 1910.93. Total exposure levels for these contaminants will not be changed. The completed standards will include provisions on record-keeping, sanitation, monitoring, exposure control, medical surveillance, and personal protective equipment.

Standards Most Frequently Cited

In concluding my remarks I would like to give you a brief outline as to the most frequently violated standards which will be helpful to you when inspecting your own facilities.

OSHA's recently published list of the 25 most-violated standards shows the National Electrical Codes (NEC) to be the most abused in general industry, by a five-to-one margin. This figure tends to be somewhat misleading, however, since many standards covering such diverse items as electrical junction box covers, improperly spliced extension cords, and grounding type attachment plugs are actually part of the Code.

An injury study conducted by the National Safety Council and the American Society for Testing and Materials (reported in the January 1975 issue of *OSHA Up to Date*) showed only five of a total of 5,000 injuries analyzed in this study of representative industries were due to any form of contact with electrical current. Does this emphasis indicate a possible neglect of potentially more hazardous, yet less obvious, threats to worker safety? The article concludes that OSHA may need to re-order some of its inspection priorities and emphases. According to OSHA, violations of the NEC ranked seventh in construction industry citations.

Other frequently violated general industry standards include: pulley guarding, work rest spacing from grinding wheels, storage and handling of com-

pressed gas cylinders, general machine guarding, exit marking, guarding open-sided floors and platforms, guarding horizontal belts and ropes, clean sanitary work areas, maintenance of portable fire extinguishers, exposed fan blades, guard design—abrasive wheel machinery, excess pressure—compressed air cleaning, machine guarding at point of operation, guarding vertical and inclined belts, abrasive wheel guarding, and marking —floor loading protection. The list was released to enable employers to eliminate the majority of workplace hazards by giving priority attention to conditions covered under these listed standards.

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