1964 National Safety Congress Transactions

Volume 1

GENERAL SESSIONS

ANNUAL MEETING OF MEMBERS

CONGRESS BANQUET

LIST OF EXHIBITORS

GENERAL INDEX OF ALL VOLUMES

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NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
Chicago, Illinois 60611

VOLUME 1 OF THE TRANSACTIONS
of the
52nd NATIONAL SAFETY CONGRESS

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American Society of Safety Engineers, 5 N. Wabash Ave., Chicago 2
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Ansul Co., One Stanton St., Marinette, Wis. 54143
Fire protection products.

Antrex Corp. 1, 2001 W. Willow St., Chicago, Ill. 60647
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Wire rope and slings.

Atlas Safety Equipment Co., Inc., 175-179 N. 10th St., Brooklyn 11, N. Y.
Industrial safety belts, harnesses, and straps. Ladder climber's safety device. Sky Genie descent cntrol.

B & K Instruments Inc., 3044 W. 106th St., Cleveland 11
Portable audiometer calibrators.

Bacharach Ind. Instr. Co., 200 N. Braddock Ave., Pittsburgh, Pa. 15208
Gas analyses instruments Humidity and temperature indicators and recorders. Multi-gas leak detectors. Air flow velocity indicators.

W. M. Bashlin Co., 119 W. Pine St., Grove City, Penn.
Linemen's and industrial safety belts, slings, high voltage rubber gloves, sleeves.

Bausch & Lomb Inc., 635 St. Paul St., Rochester 2, N. Y.
Vision and audio testing equipment.

Beam's Mfg. Co., 1327 N. Robinson, Oklahoma City
Automobile seat belts and shoulder straps.

Best's Safety Publications, A. M. Best Co., Inc., 75 Fulton St., New York 38
Safety publications.

Channing L. Bete Co., Box 112, Greenfield, Mass.
Scriptographic Booklets.

Bethlehem Steel Co., 701 E. Third St., Bethlehem, Pa.
Wire rope, sling and boom pendants, beam guard rial, and anchor safety nets.

Bliss-Rockwood, 38 Harlow St., Worcester 5, Mass.
Fire fighting and safety equipment, portable spotlights, foam liquids and fire fighting chemicals, fire protection systems.

H. L. Bouton Co., Inc., 320 Main St., St. Buzzards Bay, Mass.
Industrial eye protection, goggles, and spectacles.

Breath-O-Life Oxygen, 419 High Ave., Cleveland 44115
Emergency oxygen administration set.

Bright Star Industries, 600 Getty Ave., Clifton, N. J. 07015
Flashlights, lanterns, batteries.

Lester L. Brossard Co., 540 N. Michigan Ave., Chicago 11
Safety mirrors for industrial use. Liquid hand cleaner.

Stewart R. Browne Mfg. Co., 258 Broadway, New York
Portable explosionproof inspection lights.

R. H. Buhrke Co., 1403 W. Congress Pkwy., Chicago 7
Occupational safety equipment—safety belts, straps, assemblies, harnesses, and allied products.

E. D. Bullard Co., 2680 Bridgeway, Sausalito, Calif.
Safety hats, caps, and accessories, industrial first aid kits, safety hoist hooks, vehicle alarms, air purifiers, and ear plugs.

William J. Burns Detective Agency, 221 N. La Salle St., Chicago, Ill.
Burglary and fire protection equipment and devices.

CAH Industries, 10245 Pacific Ave., Franklin Park, Ill.
Self-extinguishing waste receptacle.

Campbell Chain Co., P. O. Box 1667, York, Pa.
Sling chains.

Canrad Sales Corp., 630 Fifth Ave., New York, N. Y. 10020
Spot-Lite glow in the dark paint and molding compounds, pressure-sensitive films and tapes.

Casco Products Corp., 512 Hancock Ave., Bridgeport 2, Conn.
Hand-portable pressurized dry chemical fire extinguishers.

Cesco Safety Products, 2727 W. Roscoe St., Chicago 18, Ill.
Safety glasses and lenses, cup goggles, special purpose goggles, welding helmets, face shields, respirators, plastic aprons, and hoods.

A. B. Chance Co., 210 N. Allen St., Centralia, Mo. 65240
Hot line maintenance and line construction tools. Hot line tools.

Charleston Rubber Co., 16 Stark Industrial Park, Charleston, S. C.
Rubber, plastics, and rubber coated gloves, aprons and sleeves.

Chrysler Corp., 341 Massachusetts Ave., Detroit
Safety features in 1964 line of automobiles and trucks.

David Clark Co., Inc., 360 Franklin St., Worcester 2, Mass.
Muff-type ear protection.

The Coca-Cola Co., P. O. Drawer 1734, Atlanta 1
Coca-Cola served through the courtesy and cooperation of the Coca-Cola Bottling Company of Chicago.

Columbus McKinnon Chain Div., Columbus McKinnon Corp., Tonawanda, N. Y.
Sling chains, hooks, and coupling links.

Converse Rubber Co., 392 Pearl St., Malden 48, Mass.
Safety toe rubber footwear, industrial rubber footwear, protective clothing of rubber and neoprene.

Custom Materials Inc., 279 Billerica Road, Chelmsford 1, Mass.
Static-free and permanently conductive polyolefin.

Davis Emergency Equipment Co., Inc., 55 Halleck St., Newark 4, N. J.
First aid kits, gas masks and breathing equipment, combustible and toxic gas analyzers, and protective hats.

Demp-Nock Co., 21433 Mound Road, Warren, Mich.
Pressure sensitive plastic film lettering kit.

Detex Corp., 76 Varick St., New York 13
Watchmen's clocks.

R. E. Dietz Co., 225 Wilkinson St., Syracuse 1, N. Y.
Lanterns, torches, flashers, barricades, and safety equipment.

Dockson Corp., 3839 Wabash Ave., Detroit 8
Spectacles, goggles, face shields, helmets, hats, and respirators.

Dow Corning Corp., Box 7038, Greensboro, N. C. 24707
Sight Savers, lens cleaning stations.

Carl Drescher Co., 1951 N. Ontario St., Burbank, Calif.
Electrified air filter unit, filter blower unit, air conditioner.

Duff-Norton Co., 100 Pioneer Rd., Box 1719, Charlotte, N. Carolina 28201
Hand chain hoists.

Dymo Industries, Inc., Box 1030, Berkeley 1, Calif.
Labeling device for use in office or shop.

Dyna-Quip Div., Stile-Craft Mfg., 1825 Macklind Ave., St. Louis, Mo. 63110
Pneumatic three-way slide valve coupler, hydro hydraulic quick disconnect coupler, natural gas coupler, water three-way slide valve coupler.

Eagle Mfg. Co., 24th and Charles Sts., Wellsburg, W. Va.
Safety cans, cigarette-cigar butt cans, drain cans, drip cans, brass oilers.

Edmont, Inc., 1205 Walnut St., Coshocton, Ohio
Coated and impregnated work gloves.

Electro-Beam Corp., Box 375, St. Joseph, Mich.
Warning lights, barricades, and accessories.

Electronic Specialties Co., Island Ave., Batavia, Ill.
Warning lights, barricades, and accessories.

Elkhart Brass Mfg. Co., Inc., 1302 W. Beardsley Ave., Elkhart, Ind.
Nozzles and other fire department supplies and fire fighting equipment.

Embossograf Corp. of America, 38 West 21st St., New York, N. Y. 10010
Sign-making machine.

J. H. Emerson Co., 22 Cottage Park Ave., Cambridge 40, Mass.
Resuscitation equipment.

Enco Mfg. Co., 4520 W. Fullerton Ave., Chicago 39, Ill.
Magnetic safety shields for machine tools.

Encyclopedia Americana Corp., 291 LaCienega Blvd., Beverly Hills, Calif.
Thirty-volume set of the revised Encyclopedia Americana.

Erdco Engineering Corp., 136 Official Road, Addison, Ill.
Gas vapor alarm systems.

Falcon Alarm Co., Inc., 20 Stern Ave., Springfield, N. J.
Fire alarms, sirens, horns, bells and other signaling devices.

Federal Sign and Signal Corp., 13625 S. Western Ave., Blue Island, Ill. 60406
Sirens, horns, bells, and warning lights for visual and audible signaling.

Fendall Co., 2222 Diversey Pky., Chicago 47
Spectacles, face shields, and cup-type and cover goggles.

Fenwal, Inc., Main Street, Ashland, Mass. 01721
Fire detector units, explosion suppression systems, smoke detectors.

Ferno-Washington, Inc., 6th and Pine Sts., Greenfield, Ohio
Emergency patient handling equipment and accessories for the first aid room.

Fibre-Metal Products Co., 5th and Tilghman Sts., Chester, Pa.
Safety hats and caps, face shields, safety masks, welding helmets, headrest and combination goggles.

Fine Organics, Inc., 205 Main St., Lodi, N. J.
Solvents, carbon removers, emulsion cleaners, polishers, and disinfectants.

Firewell Co., Aro Safety Prods., 3695 Broadway, Buffalo 25, N. Y.
Protective suits with self-contained liquid air back packs, sound reducing muffs.

Ford Division—Ford Motor Co., Box 658, Dearborn, Mich.
Ford passenger car with safety features.

Franklin Metal Products, 213-215 N. Des Plaines, Chicago 6, Illinois
Waste-cans and drum covers.

Frommelt Industries, Inc., 465 Huff St., Dubuque, Iowa
Wrap-around portable safety welding shield; portable welding screen.

Frost Paint & Oil Corp., 1209 N. E. Tyler St., Minneapolis, Minn. 54413
Slip-resistant safety paint.

Fyrepel Products, Inc., 160 S. Williams St., Newark, Ohio
High heat protective clothing and equipment for industry, space-military, and fire fighting agencies.

The Fyr-Fyter Co., 221 Crane St., Dayton 1, Ohio
Fire extinguisher, automatic sprinkler systems, electronic alarm systems.

General Fire Extinguisher Corp. 4444 W. Irving Park Rd., Chicago 41
Fire extinguishers.

Gentex Corp., Carbondale, Pa.
Safety helmets, life vests, sound reducers.

Glendale Optical Co., Inc., 600 W. Merrick Rd., Valley Stream, N. Y.
Eye and face protective equipment.

The Globe Div. U. S. Gypsum, 4000 So. Princeton Ave., Chicago 9
Safety grating, cable tray, channel and fittings, slotted angles.

Globe Safety Products, 125 Sunrise Place, Dayton 6, Ohio
Resuscitators.

Gojer Inc., Box 991, Akron 9, Ohio
Protective skin coat, skin cleaner, anti-seize and gasket compound.

Golden State Signs, 1260 San Fernando Rd., Los Angeles 65
Safety signs, danger and caution tags, badges.

B. F. Goodrich, Industrial Products Co., 36 Nichols Ave., Watertown 72, Mass.
Industrial rubber safety footwear, and protective clothing.

The Granet Corp., 25 Loring Drive, Framingham, Mass.
Coated fabric work glove.

A. E. Halperin Co., Inc., 20 Thorndike St., Boston 18
Stretchers, first aid kits, and accessories.

Hanover Aeronautical Engineering Corp., 107 Washington St., Hanover, Ill.
Safety cans for flammable liquids, oily towel bins, and excelsior storage bins.

Haws Drinking Faucet Co., 4th and Page Sts., Berkeley, Calif.
Emergency eyewash and showers.

Hazard Controls, Inc., 8127 Holman Ave., Delair, N. J. 08110
Warning lights, barricades, signs, reflectors, cylinder clamps, lockouts, ladder shoes, can carriers, flags, and barrier rope.

Warren Heim Corp., 222 N. 5th Ave., Mt. Vernon, N. Y.
Canvas buckets, bags, and protective covers.

Hild Floor Machine Co., Inc., 1217 W. Washington Blvd., Chicago 7
Explosionproof vacuum cleaners and floor scrubbing and polishing machines.

Hilti Fastening Systems, 360 Fairfield Ave., Stamford, Conn.
Power-assisted drive tools that fasten pins and threaded studs into concrete masonry and steel.

Himco (Hopfeld Industrial Mfg. Co.), 745 A St., San Rafael, Calif.
Safety ladders, and fiberglass safety diving boards.

Holland-Racine Shoes, Inc., 386 W. 15th St., Holland, Mich.
Horsehide and cowhide safety shoes in work and dress styles.

Hooker Chemical Corp., Buffalo Ave., Niagara Falls, N. Y. 14302
Cotton and rayon fabrics with fire retardant.

Hunter Mfg. Co., P. O. Box 153, Iowa City, Iowa 52243
Sure view accident prevention mirrors.

Hygiene Research, Inc., 684 Broadway, New York 12
Hand protective ointments and fogproofing cloth.

Hy-Test Safety Shoes, Div. of International Shoe Co., 1509 Washington Ave., St. Louis 66
Safety shoes and conductive and nonconductive footwear.

Illinois Glove Co., 7301 N. Lawndale Ave., Skokie, Ill. 60078
Industrial work gloves and lineman's gloves.

Industrial Gloves Co., 700 Garfield St., Danville, Ill.
Industrial clothing and accessories.

Institute of Industrial Launderers, 1025 Connecticut Ave. N.W., Washington 6, D.C.
Rental service for uniforms, wiping towels, etc.

International Film Bureau, Inc., 332 S. Michigan Ave., Chicago 4
Safety films available on a sales and rental basis.

Interstate Rubber Products Corp., 908 Avila St., Los Angeles 12
Traffic cone system for traffic control.

Iron Age Shoe Co., 1205 Madison Ave., Pittsburgh, Pa. 15212
Work and dress-style safety shoes and safety rubber footwear.

Jackson Products, 5523 E. Nine Mile Rd., Warren, Mich.
Goggles, welding helmets, face shields, safety hats and caps.

Jamul Safety Products Inc., 1125 Demonbreun St., Nashville, Tenn.
Reflective signs and other products.

Johnson-Williams, Inc., 2300 Leghorn St., Mountain View, Calif.
Portable instruments for detection of toxic combustible gases.

Jomac-North, Inc., 6128 Woodstck St., Philadelphia 38
Chemical and protective vinyl clothing and gloves, and terry cloth gloves and products.

Jones and Co., 861 Broad St., Providence 7, R. I.
Full-vision visor goggles and replaceable lenses.

Junkin Safety Appliance Co., Inc., 3121 Millers Lane, Louisville, Ky. 40216
Interlocking barrier gate guard for power presses; safety shields for grinders; stretcher cases and stretchers.

Justrite Mfg. Co., 2061 N. Southport Ave., Chicago
Safety cans, bench cans, plunger cans. Oily waste cans. Electric lanterns and flashlights for use in hazardous areas.

K & H Industries, Inc., Box 86, Angola, N. Y.
Safety lamp.

Karel First Aid Supply Co., 4342 Ogden Ave., Chicago 23
Medical equipment for industrial hospitals and first aid rooms.

Kennedy-Ingalls, Inc., 3735 N. 35th St., Milwaukee 16
Protective clothing.

Keystone View Co., Market and Center St., Meadville, Pa.
Occupational visual service, driver vision test service, and gas sensing and recording instruments.

Walter Kidde and Co., Inc., 675 Main St., Belleville 9, N. J.
Portable fire extinguishers, and accessories. Automatic carbon dioxide fire extinguishing system.

Kimball Safety Products Co., 9310 Wade Park Ave., Cleveland 6
Personal protection devices for employees in industrial plants.

Mathias Klein and Sons., Inc., 7200 McCormick Road, Chicago 45
Linemen's and electricians' hand tools, linemen's safety equipment, wire-pulling tools.

Knapp Brothers Shoe Mfg. Corp., 173 Spark St., Brockton, Mass.
Safety shoes.

J. Kunz Glove Co., 2141 W. North Ave., Chicago 47
Leather and rubber work gloves.

Walter G. Legge Co., Inc., 101 Park Ave., New York 17
Safety floor maintenance materials. Personnel and equipment grounding devices.

Lehigh Safety Shoe Co., First and Minor Sts., Emmaus, Pa.
Leather and rubber safety footwear including conductive and electrical hazard shoes.

L. M. Lind Engineering, 4432-36 N. Kedzie Ave., Chicago 25, Ill.
Safety device for press brakes.

Lineman Protector Co., P.O. Box 309, 1081 Eton Rd., Birmingham, Mich. 48012
Rubber protective equipment.

Louisville Ladder Co., 1163 Algonquin Pkwy., Louisville, Ky. 40208
Fibreglas and aluminum steps, platforms, extension trestles, aluminum planks and stages, steel warehouse ladders.

Lyn Products, Inc., 44 Industrial Road, Crystal Lake, Ill.
Magnetic safety switch.

Lynrus Finishing Co., Inc., South Water at Union St., Poughkeepsie, N. Y.
Flame retardant process for safety clothing.

Thom McAn Shoe Co., 25 W. 43rd St., New York 36
Safety shoes.

Julian A. McDermott Corp., 1639 Stephen St., Ridgewood, Brooklyn 27, N. Y. 11227
Warning and safety lighting for municipal, industrial and utility use.

McQuarrie Enterprises, 6029 Washington Blvd., Culver City, Calif.
Automobile safety belts.

Machinery Center, Inc., 1201 S. 6th West, Box 964, Salt Lake City 10
Sala Safety Block.

Madison Chemical Corp., 35 S. 19th Ave., Maywood, Ill.
Solvents, herbicides, organic digestives, degreasers, cleaners, detergents, winter chemicals, insecticides, water and fuel treatments.

Magid Glove Mfg. Co., Inc., 2201 W. Wabansia Ave., Chicago, Ill. 60647
Industrial gloves.

Martindale Electric Co., 1375 Hird Ave., Cleveland 7
Protective masks and refills, protective eyeshields, and electrical testing instruments.

Medical Supply Co., 1027 W. State St., Rockford, Ill.
First aid kits and accessories. Resuscitation training aids, stretchers.

Meyer Machine Inc., Box 114, Red Wing, Minn.
Safety products for the protection of person while climbing.

Micro Switch, A Division of Honeywell, 11 W. Spring St., Freeport, Ill.
Safety interlock switches and electric controls for power machines.

Miller Allied Corp., 2425 Santa Clara Ave., Alameda, Calif.
Material handling slings and adjustable lifting safety beams.

Miller Equipment Co., Inc., 13th and New Sts., Franklin, Pa.
Linemen's safety equipment and accessories.

Millers Falls Co., 57 Wells Street, Greenfield, Mass. 01301
Shockproof power tools.

Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8
Complete line of safety equipment for industry and mining.

Minnesota Mining and Mfg. Co., 2501 Hudson Road, St. Paul 19
Filter mask, heat reflective fabric, abrasive flooring, safety masking tape.

Mott Corp., 500 Shawmut Ave., LaGrange, Ill.
Safety mowers.

National Chemsearch Corp., Box 10087, Dallas, Texas
Safety solvent; cleaners; degreaser, disinfectants; weed killers detergents; insecticides; and water treatments for industry.

National Lead Co., Baroid Div., 2404 Southwest Freeway, Houston, Texas
Automatic gas detection and alarm system.

Newco Mfg. Co., Inc., 3636 Main St., Kansas City, Mo. 64111
Wire rope fittings, miniature slings, and a miniature crane demonstrating various lifts.

Nichols Enginering Co., 3816 West Grand Ave., Chicago, Ill. 60651
Safety access platforms and gang-ways for servicing tank cars, hopper cars, and tank trucks.

Nickel-Cadmium Electronics Co., 13711 East 7 Mile Road, Detroit, Mich. 48205
Batteries, chargers, flashlights, searchlights, emergency lighting.

Northern Signal Co., Saukville, Wis. 53080
Flashers and barricades.

Occupational Hazards, 812 Huron Road, Cleveland 15
Occupational Hazards Magazine.

E and J Resuscitators—Ohio Chemical and Surgical Equipment Co., 1400 E. Washington Ave., Madison 10, Wis.
Resuscitation and oxygen breathing apparatus.

Onox, Inc., 121 Second St., San Francisco 5
Skin-toughener solution for the treatment of athlete's foot.

Osborn Mfg. Co., Box 271, Warsaw, Ind.
Safety pliers, lockout devices, mufflers, and stretcher cases.

Oxygen Equipment and Service Co., 8335 S. Halsted St., Chicago
Resuscitator, inhalator, and aspirator.

Pac-Kit Safety Equipment Co., Inc., 1 Sensca Pl., Greenwich, Conn.
Industrial and vehicle first aid kits.

G. H. Packwood Mfg., Co., 1545 Tower Grove Ave., St. Louis
Hand cleaners, waterless cleaners, germicidal cleaners, sanitizing compounds, and maintenance cleaners.

Paralta Equipment Co., 105 Industrial Road, Hammond, Ind.
Flashing lights, barricades, traffic cones, vests, flags, trouble lights, signs.

Patent Scaffolding Co., Inc., 38-21 Twelfth St., Long Island City 1, N. Y.
Wood and light metal ladders and stages, steel and aluminum scaffolds.

Pedley-Knowles & Co., 533 Second St., San Francisco, Calif. 94107
Safety and work nets of manila rope and plastic.

The Pioneer Rubber Co., 1939 Tiffin Road, Willard, Ohio
Industrial gloves.

Pitman Mfg. Co., Grandview, Missouri
Hydraulic digger, derrick, and aerial devices.

John D. Plant Co., Branford, Conn.
Nylon and lightweight cotton industrial gloves.

Portable Light Co., Inc., 65 Passaic Ave., Kearny, N. J.
Portable searchlights, warning lights, and vehicular sirens.

Porto-Clinic Industries, Inc., 298 Broadway, New York 7
Complete portable driver testing and training unit.

The Positive Safety Mfg. Co., 440 Perkins Ave., Cleveland
Power press safety devices.

Power-Pak Products, 83 Clyde Ave., Buffalo 15, N. Y.
Fire extinguishers.

Prairie State Products Co., 3822 Lawrence Ave., Chicago
Industrial safety signs.

Protectoseal Co., 1920 S. Western Ave., Chicago
Safety containers for the handling, storing, and dispensing of flammable liquids.

Pulmosan Safety Equipment Corp., 644 Pacific St., Brooklyn, N. Y. 11217
Respirators, eye protection, helmets, protective clothing, asbestos and leather gloves, safety glasses, first aid kits, and face shields.

Pyrotronics, Div. Baker Industries, 2343 Morris Ave., Union, N. J. 07083
Fire and smoke detection and alarm systems.

RMC Canvas & Rope Co., 428 Atlantic Ave., Brooklyn 17, N. Y.
Safety nets and rope ladders.

Racine Glove Co., Inc., Box 38, Rio, Wis.
Safety gloves and apparel for industry and fire protection, safety specialty products.

Radiant Color Co., 461 W. Erie St., Chicago 10
Daylight fluorescent colors in paints, pressure-sensitive vinyl sheeting and papers.

Radiator Specialty Co., 1400 W. Independence Blvd., Charlotte 8, N. C.
Traffic guides; cones, lights, flags.

Rainfair, Inc., 1501 Albert St., Racine, Wis.
Wet weather and safety clothing.

Randolph Laboratories, Inc., 1450 Frontage Rd., Northbrook, Ill.
Fire extinguishers and automatic fire extinguishing systems.

Record Industrial Co., 3301 Arch St., Philadelphia 4
Industrial safety shoes, work clothing and work gloves.

Red Wing Shoe Co., 119 Main St., Red Wing, Minn.
Safety workshoes, oxfords, and boots.

J. C. Renfroe and Sons, Inc., 1926 Spearing St., Jacksonville, Fla.
Safety clamps for lifting steel.

Rite Hardware Mfg. Co., 540 W. Chevy Chase Drive, Glendale, Calif. 91209
Air-conditioned helmet systems.

Rockwell Mfg. Co., 400 North Lexington Ave., Pittsburgh 8, Pa.
Aetna Drivotrainer.

Roll-Ezy Mfg. Co., 7032 N. Tahoma Ave., Chicago, Ill. 60646
Fluorescent light tube breaker.

Rose Mfg. Co., 2700 W. Barberry Pl., Denver
Automotive seat belts. Industrial safety belts, lanyards, net, and ladder safety devices.

Safe-Cut, Inc., Div. Verkau Corp., 973 Market St., San Francisco, Calif. 94103
Steel band cutter.

Safeguard Mfg. Co., Pomperaug Ave., Woodbury, Conn.
Guard for power presses.

Safemaster, Inc., 115 West 7th Ave., Homestead, Pa.
Safety spectacles.

Safety Box Toe Co., 812 Statler Office Bldg., Boston 16
Steel toes for dress, semi-dress, and work shoes.

Safety Clothing and Equipment Co., 1990 E. 69th St., Cleveland 3
Safety clothing and equipment for industrial workers.

Safety First Products Corp., 175 Saw Mill Road, Elmsford, N. Y.
Portable stored pressure dry chemical fire extinguishers.

Safety First Shoes, Inc., 9th and Greenleaf Sts., Allentown, Pa. 18105
Safety shoes for industry, railroad, and military use.

The Safety Journal, Anderson, South Carolina
Safety publication.

Salescaster Displays Corp., 1010 E. Elizabeth Ave., Linden, N. J.
Illuminated moving message signs.

W. H. Salisbury and Co., 401 N. Morgan St., Chicago
Linemen's rubber protective devices.

Sarole, Inc., P. O. Box 97, Pompano Beach, Florida
Scoop stretchers.

Sawyer-Tower Products, Inc., 76 Stanley Ave., Watertown 72, Mass.
Industrial protective, and safety clothing.

Schuberth-American Div. of Tremount Corp., 471 Pompton Avel, Cedar Grove, N. J.
Helmets, safety hats, and caps, safety goggles, and wrap-around protective goggles.

Scott Aviation Corp., 225 Erie St., Lancaster, N. Y. 14086
Respirators, inhalators, and environmental protection equipment.

Searjeant Metal Products, Inc., P. O. Box 74, Mendon, N. Y.
Power press safety guards, and aluminum alloy hand tools.

Seco Mfg., Inc., 4461 W. Jefferson, Detroit 9, Mich.
Fire fighting equipment.

Seiberling Latex Products, 215 Plum St., New Bremen, Ohio
Industrial rubber gloves.

Sellstrom Mfg. Co., Highway 53 at U. S. 14, Palatine, Ill.
Eye and face protective equipment.

The Servus Rubber Co., 1136 Second St., Rock Island, Ill.
Rubber footwear of all types.

Shelter-All Safety Stations, Parkside Ave. at 51st St., Philadelphia 31
Highway safety stations for school children.

Showcard Machine Co., 320 W. Ohio St., Chicago 10
"Make your own sign" equipment.

Fred Silver & Co., 145 Sussex Ave., Newark, N. J.
Traffic Safety Mirrors.

Singer Safety Products, 860 Weed Street, Chicago, Illinois
Gloves, portable welding screens.

Snyder Mfg. Co., Inc., 1458 Fifth St., New Philadelphia, Ohio
Air suits, hoods, splash and dust suits, shoe covers, safety vests, flags, fabric and film laminations, and fiberglass containment closures.

Sonoscope, Inc., P. O. Box 155, Lansing, Michigan
Combination tape recorder and automatic slide projector.

Speakman Co., 301 E. 30th St., Wilmington 99, Del.
Emergency eyewash and showers.

Standard Industrial Products Co. of Ill., 3527 Farmington Rd., Peoria, Ill.
Dunking station smoking receptacles.

Standard Safety Equipment Co., 431 N. Quentin Rd., Palatine, Ill.
Acid and chemically-resistant clothing.

Standard Signs Inc., 3190 E. 65th St., Cleveland 27
Industrial accident prevention signs and road work area protection equipment.

Stearns Automotive Products Co., 92 Gomez St., Winnipeg 2, Man.
Frost and condensation shields for vehicle windows.

Stephenson Corp., Box 1000, Red Bank, N. J.
Radar speed control, breath test for intoxication, resuscitator.

Stephen-William Co., 2014 W. Wabansia Ave., Chicago 47
Safety signs and posters.

Stonehouse Signs, Inc., 842 Larimer St., Denver 4
Accident prevention signs and tags.

Stop-Fire, Inc., New Brunswick, N. J.
Fire extinguishers.

Surety Rubber Co., North High St., Box 97, Carrollton, Ohio 44615
Safety apparel, gloves, sleeves, aprons, and specialized protective equipment.

Survivair, Division of U. S. Divers Co., 3323 W. Warner Ave., Santa Ana, Cal.
Self-contained breathing equipment. Wet pick-up vacuum unit. Voice amplifiers.

S. G. Taylor Chain Co., Inc., 3-141st St., Box 508, Hammond, Ind.
Alloy steel chain and fittings.

Tisco Corp., 1643 Door St., Toledo, Ohio
Cleaning and repairing of work gloves and safety equipment.

Titmus Optical Co., Inc., 1015 Commerce St., Petersburg, Va. 23804
Safety frames, safety lenses and vision tester.

Tri-Tix, Inc., 100 N. Lake St., Port Washington, Wis.
Safety cones and traffic posts.

U-C-Lite Mfg. Co., 290 E. Prairie St., Crystal Lake, Ill.
Battery-operated electric hand lanterns, flashers and emergency lights.

Union Steel Products Co., 640 N. Berrien St., Albion, Mich.
Wire mesh "Palletainers" for storage, transporting, and handling of finished or in-process material.

United States Rubber Co., 1230 Avenue of the Americas, New York 20
Safety footwear.

United States Safety Service Co., 1535 Walnut St., Kansas City, Mo. 64108
Industrial eyewear and hearing protection.

A. G. Vara & Son, Inc., 53 Clark St., Hamburg, N. Y.
Octopus safety markers, safety flags.

Wagner Sign Service, Inc., 218 S. Hoyne Ave., Chicago 12
Changeable copy displays for employee relations and safety programs.

Watchemocket Optical Co., Inc., 232 W. Exchange St., Providence 3, R. I.
Safety goggles, respirators, face shields and safety signs.

Welsh Mfg. Co., 9 Magnolia St., Providence 9, R. I.
Respirators, safety spectacles, goggles, safety hats, faceshields, and welding helmets.

R. D. Werner Co., Inc., Box 580, Greenville, Pa.
Nonconductive fiber glass ladders, stages, and scaffolds.

Westinghouse Electric Corp., 2519 Wilkens Ave., Baltimore 3
Portable pneumatic pump-unit for closed chest cardiac resuscitation.

Wheeler Protective Apparel, Inc., 224 W. Huron St., Chicago 10
Industrial safety apparel.

Whelen Engineering Co., Inc., 42 Kirtland St., Deep River, Conn.
Emergency and warning lights, flashers, and beacons.

Williams Jewelry and Mfg. Co., 4544 N. Western Ave., Chicago, Ill.
Safety plaques, trophies, awards, emblems, badges, and incentives.

Willson Products Div., Ray-O-Vac Co., 2nd and Washington Sts., Reading, Pa.
Personal protective equipment for industry.

The Wilson Rubber Co., 1200 Garfield Ave. S.W., Canton, Ohio 44701
Rubber, neoprene, and plastic gloves.

Wire Rope Corp. of America, Inc., 609 N. 2nd St., St. Joseph 1, Mo.
Wire rope slings.

Daniel Woodhead Co., 15 N. Jefferson St., Chicago
Electric safety equipment.

Worklon, Inc., 63 New York Ave., Huntington, N. Y.
Special purpose clothing—acid-resistant, lint-free, static-free and fire retardant.

AFL-CIO, 1200-15th St., N. W., Washington, D. C.
Information on their safety activities with appropriate literature.

American Optometric Association, 4030 Chouteau Ave., St. Louis 10
Educational material on vision and highway safety, and industrial safety techniques.

Chicago Fire Department
Information on the work of the Fire Prevention Bureau.

Chicago Police Dept., Traffic Div.
Traffic safety.

Dept. Health, Education & Welfare, Public Health Service,
Third & C Sts., N. W., Washington, D .C. 20201
"50 Years of Protecting the Worker's Health"

Federal Safety Council, U. S. Dept. of Labor,
First & D Sts., N. W., Washington, D. C. 20212
President's Safety Award Programs.

Inter-American Safety Council, 2 Rector Street, New York
Safety publications, visual aids, and films, in Spanish for industrial, highway, and home.

National Fire Protection Assoc., 60 Batterymarch St., Boston, Mass. 02110
Information on the work of the Association with selected passout materials.

Prevention of Blindness Inc., National Society for the, 16 E. 40th St., New York, N. Y. 10016
Literature and information on industrial and vocational school eye health and safety programs.

President's Committee on Employment of the Handicapped, Washington 25, D. C.
Information on Hire-the-Handicapped Program.

U. S. Department of Commerce, Coast and Geodetic Survey, Washington, D. C.
Small craft safety.

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National Safety Congress Transactions

Volume 2

AEROSPACE; AIR TRANSPORT INDUSTRIES

NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
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Volume 3

AUTOMOTIVE and MACHINE SHOP; POWER PRESS and FORGING

NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
Chicago, Illinois 60611

AUTOMOTIVE AND MACHINE SHOP TRADING POST

By KENNETH L. LEWIS
Director of Safety, Delco-Remy Div., General Motors Corp., Anderson, Ind.

(Members of the audience who had safety ideas to present came to microphones stationed at either side of the front of the hall and in alternate and rapid-fire order described their ideas. Unfortunately, some of the ideas involved 35mm slides and could not be reported without reference to the visuals. For this reason some of the ideas have not been included in this summary.)

Dan Osborn, Gardner-Denver Company, Denver, Colorado—In our plant, we construct pennants about 20 inches long, similar to school pennants and use them to recognize departments for safety achievement. The pennants are painted safety green and on them is written "This department has gone 30 days without a lost-time injury." The pennants are fastened to chrome-plated pieces of conduit and placed in brackets that are provided over each department foreman's desk.

William Cavanagh, Michigan Mutual—Many automotive hydraulic hoists have a built-in, hinged, safety rod. One company removed the rod and fastened a "U" clamp at the top. Then the firm welded a chain to the rod so that every time an employee used the automotive hoist he had to walk out and get this piece of equipment, chain it into place, and put it under the lift.

William Krueger, Chrysler Corporation—At the third station of a three-station machine, a number of tack welds are put on a ring gear. We enclose the point of operation with an expanded metal guard. Around the welding operation we placed some welding glass in the guard so that job setters could observe the work without endangering their eyes.

L. B. Stanley, Delco Remy Division, General Motors, Anderson, Ind.—We had a problem with our battery-operated mobile equipment. First of all, we found that our employees were failing to lead the equipment. They held the handle in a nearly upright position. This would result in their running the equipment up on the base of the heel. We also had a problem when fingers got squeezed between the control handle and stationary objects in the plant. We contracted with an outside firm to construct a fiber glass guard which not only protects the hands from injury, but also forces the operator to walk safely and not cradle the handle.

L. K. VanSickel, Delco Radio Division, General Motors, Kokomo, Ind.—We have a device that is a sort of refinement of the old push stick. It's called a "wooden finger." It comes in two sizes and the idea is that you are supposed to use the wooden finger instead of one of your ten good fingers. The device is used for pushing or positioning parts in danger areas. The smaller version of the device is known as the 11th finger. It has a pocket clip on it and looks like a ballpoint pen. This 11th finger also has a knob which can be used for hooking or pulling objects.

Safety director, Fort Monmouth, New Jersey—We have a promotional gimmick which we think worked very well. As you know, there is always a problem of getting accidents reports. To give us more information on accidents we started an essay contest and gave a bond as a prize. The subject of the essay was "A Close Call I Had." As a by-product of the contest, we learned of many serious near-accidents that were not reported and we were able to close the gap on these.

Larry Riggs, General Electric, Richland, Washington—Each month, our supervisors are required to hold a 15 to 20-minute safety meeting. We started a contest in which we awarded a prize for the best safety materials presented. The prize was a monogrammed pen and pencil set from the National Safety Council. It is surprising how this little idea improved the quality of our safety meetings.

S. D. Brooks, Sandia Corporation, Albuquerque, N. Mex.—All of our first line supervisors are required to rotate on a two-week tour of duty in which they look for hazards in all departments. By spending some time away from their own home grounds, supervisors learn a great deal.

They also have the authority to write safety orders that require immediate attention.

Paul Tuz, Chrysler, Canada—I think the best place to reach workers is in their homes. The way we do this is to tie safety messages to current events and get this material published in local, small town newspapers. An example of the way a safety message can be tied to a current event is to quote an item about the number of soldiers who have been killed in Viet Nam and then tie that in with accident statistics from the local plant or industrial area.

Paul Stanisik, Ternstedt, General Motors, Detroit—Most driver-operated fork-lift trucks are painted orange. (At least, our trucks are painted orange.) In order to give our drivers better visibility, we paint the dash on the driver's side a flat black. We find that this has improved visibility immensely.

H. Von Seggern, Maytag Company, Newton, Iowa—We had automobile windshield snow scraper made with a "stop" sign on it. In the stop sign were the words "Stop Accidents at Maytag."

Les Stanley, Delco Remy Division, General Motors—Like many other organizations, we have a problem getting fork-lift trucks inside semi-tractor-trailers. The problem results from the overhead guards. Up till now, we have had to have special trucks available that can clear the top of the semis. However, we are now developing a convertible top fork-lift truck. The convertible top works on a hydraulic principle much like the convertible top on automobiles. Although we do not have any of these trucks yet, we have them on paper and there's no reason why they cannot be made.

Don Welter, Guide Lamp, General Motors, Anderson, Ind.—We all seem to have problems with industrial fork-lift truck visibility. The problem is to see over the dash of the truck. We have an arrangement with a mechanic who for $200 is able to convert older trucks to give greater visibility by reducing the top of the dash. (New triple-action dashes solve this problem.)

Tony Ruzich, Chrysler Corporation, Detroit—Several companies are putting out a disconnect attachment for electrical control panels that automatically disconnects pneumatic or hydraulic pressure. In the past, one had to put three locks—hydraulic, electric and pneumatic—on a piece of equipment to render it inert.

J. B. Graham, Dow Chemical, Golden, Colo.—In our company, it's mandatory to attend safety meetings. As you know, these meetings can get mighty dull. In order to add interest, we have changed the membership of the safety committee every three months. It's amazing how this change has added interest to our meetings.

David Vicker, Indianapolis Electric Plant—Epoxy resins can cause a sensitivity-type of dermatitis. We keep epoxy off workers' hands by two methods: First, we use hydraulic pressure to move the cement from drums forcing it through a hose to special spreading applicators which apply it to the surface. This technique reduced dermatitis by 50 per cent. Secondly, we added a black dye to the epoxy which had previously been colorless. No worker wants dirty, black hands, so they immediately wash any contamination off. This eliminated the dermatitis problem.

Ted Cobler, Thompson-Ramo-Woolridge, Cleveland—In order to oil some machines it is necessary for operators to climb up on the equipment. Often oil drippings on the equipment make this job hazardous. We weld grid struts to form step plates. That provides a surface that is non-slip and thereby reduces accidents.

Bill Goode, International Harvester, Chicago—In our Canadian operation, they play "Safety Bingo." The employees enjoy the game, but the question is: How do you make it promote safety? I suggested this idea and they bought it. Use an automatic telephone answering device. When employees and their families dial a certain number, they can get the bingo number, but before they get the bingo number, they must listen to a message on safety.

J. F. Bender, Westinghouse Air Brake Co., Wilmerding, Pa.—We ran a baby contest in our plant in which all employees having babies that were under one year of age could participate. The prize was a bond. We borrowed one of Yadlow's shoes (Yadlow is or was a giant who wore size 37 shoes), and asked participants to guess how many safety pins were in the shoe.

Bill, Brett Co.—Anyone who works with presses knows how poor the visibility is inside a die cavity. After removing the die, we cleaned the entire inside of the press and then painted it with a highly reflective white paint. This has increased visibility tremendously and has cut down on injuries.

THE 12 PER CENT

By RICHARD D. BYROM

Safety Coordinator, Car and Truck Assembly Group, Chrysler Corp., Detroit, Mich.

At the plants of the Chrysler Corp., safety is many things. It's security—It's profits—It's success—but most important of all—*it is people.*

For some time—we had placed our safety emphasis on three areas: tools—equipment—and facilities. And *still* the accidents continued.

This lack of progress demanded a complete reevaluation of our safety program, and showed us that our emphasis was misplaced.

Let me state as briefly as possible the car and truck assembly group concept of personnel representatives. Personnel men are assigned to the major production departments.

This enables us to divide a huge industrial complex—such as an assembly plant—into smaller and easier controlled areas. As a result, we achieved visibility and control of problems once *hidden* in the vastness of this complex.

At this point, we decided to apply this concept to our safety program. After all, you can't solve a problem until you identify it.

We found that our skilled trades employes were responsible for over 32 per cent of our lost time accidents—yet these same people represented only 12 per cent of our total work force.

Therefore, we knew that to improve our safety record we had to concentrate our efforts in this area.

We checked to insure that all tools and equipment were safe and proper. We covered the tools, we covered the equipment, it had to be the employes themselves.

Obviously, the employes had poor attitudes towards safety—which resulted in poor work habits—and accidents.

We had to change attitudes, and this has to be done from the top down. We know from past experience, that no program can succeed unless it is accepted by all management.

Group personnel helped to change plant management's attitudes, through meetings and correspondence. Once this was done, all efforts were concentrated on people. Not just any people—but our 12 per cent.

Training programs emphasizing accident potentials and their prevention, were presented—hammered and sold to skilled trades supervisors.

These efforts began to bear fruit—accidents in the skilled area began to drop.

In addition to this, we are constantly working on all other phases of safety and accident prevention throughout the group plants.

While much has been accomplished, we are aware that this activity requires constant effort and action to ensure the best possible safety condition.

With the support and the cooperation that we are now getting from all levels of group and plant management we anticipate a continued improvement in safety in all areas of the assembly plants.

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**Past General Chairman*

an additional die has been added so that we are able to do a first and second forming operation in each stroke of the press.

The piece is fed down the slide to the first die by gravity and automatically positioned in it. After a stroke of the press, the completed piece is raised out of the first die and again, by gravity, is fed down to a second die where a second forming takes place on the next stroke. After that, it is ejected out the back of the press.

The dies are completely enclosed and all danger spots where an operator may become injured are guarded. This, I believe, is a perfect example of a method of solving a power press guarding problem in a manner where we ended up with a solution which can be placed in the mature stage of development.

I have often heard the excuse made that by installing a certain type of guard, production would be adversely affected and, therefore, cannot, be justified. This is a very poor excuse for not providing 100 per cent protection. A properly engineered and well planned guarding installation will generally end up with an increase in production. The ultimate per cent of increase will, in many cases, be a very pleasant surprise. In our own case, we were able to increase production by as much as 300 per cent over the method which I described as being in the infancy stage.

I have also heard the argument advanced that, "ours is a little shop and cannot afford such elaborate changes." This I would like to twist around to say, "that you cannot afford not to make the change." We have been able to pay for all changes to the dies, to the press, and the making of the guards, in just an eight week period by the increase which was made in production.

I do not wish to convey the idea that the example which I showed you is the only method by which one can achieve maturity in a guarding program. It is realized that it cannot be applied to many operations. It is also realized that there are many other methods of guarding which offer as complete protection as this. The only point I wish to stress is this, are we all taking advantage of what is available and have you a guarding program where the safety of your operations can be trusted to stand by itself as completely as a fully matured, independent individual.

There are many power press guards on the market which offer complete protection. There are complete enclosure guards, air operated guards, electronically controlled guards and many others; all available to us. By careful selection and intelligent application of these guards a good mature program can be yours.

When at your plant I believe a survey of each power press would be in order. While making such a survey ask yourself the questions. "am I still in the Model T era or am I keeping pace with the changing times? and Are my power press guards in the infancy, adolescence or mature stage?" We should be satisfied with nothing but the best and the best is only that which is mature.

THE TEAM APPROACH TO POWER PRESS SAFETY

By F. P. MARRON

Supervisor, Industrial Engineering, Westinghouse Electric Corp., Beaver, Pa.

My part of the discussion will center around how power press safety is considered in the purchase of capital equipment and tooling which is used in this equipment.

To keep the equipment and tools properly associated with one onother, I will discuss four (4) categories:

1. Automatic Operation
2. Semi-Automatic Operation
3. Hand Operation
4. Miscellaneous

A. *Automatic Operation* refers to equipment and tools which do not require con-

The selection of themes for displays or demonstrations should be determined by the programming needs of an individual plant or location. It is recommended that consideration be given to the inclusion of activities which contemplate off-the-job accident exposures as well as those that apply to work-connected problems.

THE TEAM APPROACH TO POWER PRESS SAFETY

By WILLIAM J. KIRSCH
Supervisor of Safety, Westinghouse Electric Corporation, Beaver, Pa.

We have titled our program, "The Team Approach to Power Press Safety", because we believe that power press safety is not a one man responsibility or even solely a press room reponsibility. It must be a team effort and all departments must contribute. We will show you how the different staff groups in our plant assist in making our plant one of the safest in power press operations.

We believe we can speak with authority on this subject since we have approximately 190 power presses, and small bench presses too numerous to count. The bench presses are of the spring, air and hydraulic variety, with a good number of air operated, rivet squeezers thrown in for good measure. Practically all of these operations are capable of producing amputations or smashed fingers unless guards or other safety procedures are set up.

Incidentally, most of our problems concern these small presses. For many years Westinghouse has sponsored one of the most thorough accident prevention programs in industry. Our efforts are based on the premise that accidents are preventable and our experience has borne out this premise. By maintaining safe conditions and providing safe materials and equipment our company has been successful in substantially reducing the frequency and severity of accidents and injuries.

In our plant we follow the Westinghouse Six Point Safety Program. These six points are:

1. Organization and Administration
2. Hazard Control
3. Industrial Hygiene
4. Training
5. Motivation
6. Accident and Injury Statistics

Let us take a look at the first point "Organization and Administration." How does this point contribute to Power Press Safety?

Organization—I believe you will agree that for any safety program to succeed, you must have the complete cooperation and backing from top management. You cannot function efficiently without it. The head of our safety organization is our general plant manager. Next in line is the Safety Policy Committee. Members of this must be men who can make decisions and set policy. We have a 15 member committee with the works manager serving as chairman and I serve as secretary.

The other 13 members are on the general manager's staff or head up the various staff functions such as quality control, production, manufacturing, industrial engineering, works engineering, plant protection, and shipping and warehousing. This group, as the name implies, sets the plant's safety policy and provides the backing to make it work. The committee meets on the second Thursday of each month, and attendance is mandatory if the member is in the plant. I might add, no meeting has ever been cancelled in the ten years I have been a member of the committee.

Next we have the General Safety Committee. There are twelve members on this committee. All are line supervisors from the operating level of the plant. I am the chairman and there are three other permanent members. We rotate the eight remaining members of the committee. There are six supervisors from manufacturing, one from shipping, and one from the tool and die

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Volume 4

CEMENT, QUARRY & MINERAL AGGREGATES



NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
Chicago, Illinois 60611

RAILROADS

By DAVID HARTLEY
Division Superintendent, Taconite Minnesota Ore Operations, United States Steel Corp., Mountain Iron, Minnesota

Inasmuch as the principles of railroading are the same in both quarries and open pit mines, I am taking the liberty of using reference material from both sources for this presentation.

Safety first enters the picture of a quarry railroad operation at the planning stage. Such details as grades, curves and traffic patterns must be first considered from the standpoint of safety.

a. *Grades.* Generally speaking, the lesser the grades, the safer the operation. Accident experience has disclosed the desirability of limiting grades to a maximum of 3 percent. As a rule, economics promote safety by directing the selection of truck, conveyor or skiphoist haulage when grades exceed this figure. In fact, rail haulage is most attractive, both from the standpoint of safety and economics, if the grades are not in excess of 1½ per cent.

b. *Curves* require safety attention for two reasons:

(1) possibility of derailment and (2) visibility. For mainline quarry service, curvature not to exceed 7½° is recommended. Perhaps more important that the degree of curvature itself, is proper super-elevation, and transition from the straight track to the maximum curve. For a 7½° curve, a spiral lead-in of 200 feet is indicated.

The problem of visibility, or the lack of it, resulting from curved track can be overcome to some extent by providing a safe means for either the locomotive engineer or the brakeman to ride the leading end of the train.

In summarizing, the same observation that was made regarding grades will apply to curves; the gentler the better.

c. *Traffic Pattern.* In planning the operation, no effort should be spared to simplify the train movement, and to avoid areas and points of interference. Where merging or opposing traffic is necessary, adequate protection in the form of switch-tenders or block signal systems is required. When traffic volume justifies the installation, a properly monitored radio dispatch system can contribute to a safer operation.

A planned, formal program of maintenance of both track and rolling stock is indispensable to accident prevention.

a. *Track.* With the advent of automation of train operation and mechanization of track maintenance, fewer people, whose observations might indicate trouble spots requiring immediate track maintenance, will be on the job. If the operation is of such size that the supervisor is unable to make regularly scheduled inspections of the track system, such inspections must become the job of mobile track inspectors. Special attention must be given to condition of switch components, super-elevation of curves, low spots, observations, broken rail, etc. On high volume rail movements, this is a daily task.

b. *Rolling Stock.* A documented, periodic safety check of locomotives, cars and other rolling stock is indispensable to an acceptable maintenance program. This may be part of the routine maintenance check. To insure proper coverage, the schedule may be set up either on the basis of calendar days or hours worked.

More than any other method of transportation, the railroad requires a formal, comprehensive safety manual, or "rule book."

A copy of the manual in use at the Minnesota Ore Operations of United States Steel Corp. is available. It must not be inferred that this booklet is the answer to all your safety problems, or in fact, that it would even be suitable to your rail operation. Different situations call for different rules.

The manual is divided into sections as follows:

Responsibilities and Duties
General instructions
Signals
Movement of Trains

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CEMENT, QUARRY AND MINERAL AGGREGATES SECTION

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52nd NATIONAL SAFETY CONGRESS

Papers delivered in the

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intendent, the line supervisor most directly responsible, and the safety manager.

This review is designed to demonstrate the interest of top management in safety and to again impress all concerned with the seriousness of accidents in the plant. No one looks forward to having one of these plant manager reviews.

After completion of the investigation, the chairman of the committee prepares the Accident Investigation Report. The format includes the following:

1. Summary of the accident in brief.
2. Chronological presentation of the facts discovered during the investigation.
3. Principle cause of the accident.
4. Recommended action with assigned responsibilities.

After completion, the write-up is reviewed and approved by the safety manager and the manufacturing superintendent. The safety department then prepares and distributes the report. Follow-up on the recommendations is the responsibility of area supervision. This is generally handled through the department safety council.

One might ask what the use of the near-miss classification has accomplished for us. We feel that it has given us an additional and effective tool to use in our program of accident prevention. We feel strongly that properly used, it has been a contributing factor in a continual improvement in our safety performance as indicated by the Safety Index since 1960.

It has helped to convince the wage group of our sincerity in safety since very often the near-miss is used to investigate the *potential* for injury to our people. The near-miss is also one more approach that affords opportunity for participation and involvement of both wage and salaried employes in the overall safety program of the plant.

In conclusion, the near-miss classification of accidents is a fertile and little used area in industrial safety and accident prevention. We feel it has been very effective for us in improving our month-to-month safety performance.

In short, we like it and strongly recommend to you that you consider the use of the near-miss classification in your accident prevention program.

HANDLING NEW HAZARDOUS CHEMICALS

By DAVID T. SMITH
Supt., Protection Division, E. I. du Pont de Nemours & Co., Chambers Works, Penns Grove, New Jersey

One of the most challenging problems in our plant, the Du Pont Chambers Works, is the handling of new hazardous chemicals, particularly in starting up new operations. My objective this afternoon is to share some of our experiences with you, particularly as to procedures and protective equipment employed. The Chambers Works is the largest commercial Du Pont plant, producing a great variety of chemicals, involving many chemical processes and hazards. There has been a steady stream of new processes and products flowing from our research laboratories and pilot plants into the Works for manufacture in both new and old facilities. Our major design and construction work is performed by the Engineering Department of our Company, the minor jobs are designed and constructed by our Works Engineering personnel. However, what we do is fairly typical of other Du Pont units, regardless of size.

We are all striving to operate with complete safety in Du Pont as, I am sure, occurs in your company. It is the actual "WHO," "WHAT," "WHEN," "WHY," and "HOW," of accomplishing this that takes some doing, we have found.

WHY is this effort so important? Simply, to prevent injury to people, our people and the public. No persons have the right to engage in any endeavor without doing a conscientious job to prevent injury to the persons they enlist or direct in the endeavor, and to the public.

A second reason obviously is to save money, by preventing damage to property and business interruption.

A spectre that looms over the start of any new process is the fear that some serious hazard may have been overlooked. The operation may go along apparently safely for a long time . . . just waiting for the right set of circumstances to arise which will cause disaster to strike. This is why we feel thorough pre-operation safety work is so important.

The "WHO" is our case rests first on the line operating organization. They have the basic responsibility for the safety of the operation once it is going, so they must have the final say from the safety standpoint from the preliminary design stage, through construction to actual operation. They must have the authority to go with their accountability.

Second, they must enlist all appropriate staff services. This includes the research and development laboratory, pilot plant, engineering, medical, industrial hygiene, and safety personnel. We feel it is important that each contribute his "know how" at the appropriate times, so that expensive changes in design and construction can be avoided. With the present trend to develop final design of different parts of a new plant concurrently rather than stepwise, this takes extremely careful scheduling by the operating department and good followup by safety personnel.

We realize that neither the safety engineer nor any other one person has the skills nor the available time to check in detail every feature of safety that is involved in a new process and the design of the plant. Safety must be considered in every step of the process, in every step of engineering design. It would be foolish to have the safety engineer recalculate the steel dimensions required in a column, for example, and we would expect a chemist to find out the physical data needed on a chemical.

The safety engineer's job is to act as a consultant, to check on those points of greatest hazard, such as specialized safety equipment, and to check on those points where his experience will be of the most value. In addition, he must be the spark plug to see that the group effort functions to achieve an effective safety analysis, that there are no unanswered questions, and that the agreed on protective steps are actually carried out. Only in this way can he contribute the maximum to the achievement of safety in the new process.

The "WHAT" and the "WHEN" might be summarized as follows:

Before design work—find out the hazards of the chemicals and the process conditions. The laboratory people, the medical people, the industrial hygienist can lead here.

Before design work—plan to control the hazards. Everybody gets in on this stage.

During design work — specify approved methods for meeting the problems as they arise. Here the safety engineer can help as a consultant.

During construction and before start-up—check out and check up on facilities, personal equipment and training. Line organization, safety engineer, laboratory personnel and industrial hygiene all help here.

During start-up, and periodically thereafter—follow up.

Now let's take a look at the "HOW." There is an excellent feature report, "Designing for Safety" in the July 20, 1964, issue of Chemical Engineering magazine, "HOW" of design. I particularly liked the section by Allan Gilbert of Union Carbide in which he outlined the safety evaluation required before design in fifteen concise steps.

Somewhat along the same line, several Du Pont departments use check lists of various types. One is a list they can use starting with the first design discussions up to and including the follow-up after actual operation begins.

Let's consider a hypothetical new process. We first develop the data on the physical properties of the chemicals, including the following that deserve special attention. Let's assume these include:

1. Hydrofluoric acid, a very corrosive material.

2. Propane, hexane and toluene, flammable.

3. Chlorine and ammonia, toxic and irritating gases.

4. An extremely toxic gaseous by-product may be formed in small quantities which paralyzes the nerve centers. 0.01 parts per million is the thresh-hold value.

5. Cyanosis producing intermediates, final products and waste products.

6. Dermatitis producing intermediates and final products.

Taking a flow sheet, we review first the incoming raw materials, how they will be handled, stored and in what quantities. We continue through the various stages of reaction, purification and on to the final packaging of products, and disposal of waste gases, liquids and solids.

In summary, if we utilize the know-how we have developed on old processes, if we guard against the unknown but suspected possible hazards through the techniques we have available, we *can* fulfill our responsibility for complete safety.

Safety analysis of new process and equipment:

Chemical Hazards

List chemicals which are (1) flammable (2) explosive (3) corrosive (4) toxic (give effects) (5) have other special hazards (give hazard).

List whether (1) raw material (2) intermediate (3) final product or by-product (4) waste material.

List points where encountered in process, by-process description, equipment number and cross reference to operating process manual.

List significant physical properties. Include incompatibility with other chemicals, chemical reaction rates, conditions of instability and other pertinent problems.

Show source of data, and list available consultants on critical points.

Other Process Hazards

List maximum operating pressures under both normal and abnormal operating conditions.

What pressure relief is provided? Location of relief devices? Condition of relief devices? Tested when? Are personnel exposed by discharges of emergency relief devices?

List maximum permissible operating temperatures, sources of heat. What over-temperature controls are needed for abnormal operating conditions? What protection is provided for hot surfaces to prevent personnel burns?

Process Questions (Examples)

What are dangers if process reaction conditions are deviated from in the manner below, and how will we protect against each?

—abnormal temperatures
—abnormal reaction times
—instrument failure
—adding material at wrong stage
—wrong material added
—material flow stoppage
—equipment leaks, both out and in
—agitation failure
—loss of inert gas blanket
—error in valve or switch operation
—plugged relief line
—failure of relief device
—material spillage on floor, or to air

Waste Disposal

List gaseous stack effluents and concentrations, also smoke characteristics.

Height of stacks? Flare stack needed? Scrubbers, electrostatic or centrifugal removal of stack effluents needed? Prevailing winds and exposed areas . . . list.

What effluents are run to waste disposal, from what points in process, and how? What is their pH., toxicity, flammability, miscibility with water?

Can waste chemicals react with other waste chemicals in waste disposal system to cause difficulties? (Example, sulfide liquors meeting acid solution to evolve hydrogen sulfide).

Are all flammable liquids prevented from reaching sewers?

What special hazard solid waste products are there? How will we handle them?

Ventilation

Room air change frequency required? Checked by? Spot ventilation at what equipment points? Flow rates? Checked by?

Can ventilation intake pick up contaminants?

Piping Systems

Adequately supported with permanent hangers?

Proper material and schedule thickness for service?

Pressure tests for critical services and process scheduled when?

Bumping and tripping hazards protected?

Safe access to all valves?

Electrical Equipment

Hazardous classification locations and class, list.

Does all electrical equipment comply with above, including—

lighting

wiring and switches

instrumentation

intercoms, telephones, clocks, etc.

Does all grounding meet standard? Who checked and when?

General

Are two routes of access provided to all occupied parts of buildings, to meet state law?

Is one smoke-proof exit tower and one exterior steel fire exit stair provided to all occupied buildings?

Are standard railings with self-closing gates on all platforms over 42 inches on all occupied portions of roofs?

Are all moving parts of equipment properly guarded?

Fire Protection

Fire walls and cut-off locations? Protection of openings?

Who checked out fire doors? When?

Fireproofing of exposed steel supporting major equipment?

Automatic sprinkler protection systems? Manual sprinkler systems, special fire extinguishing equipment? Supervisor service?

Number, type and location of fire extinguishers?

Location of fire hydrants and hose boxes?

Location of fire alarm boxes? Building excavation alarms?

Are any flammable liquids handled in open?

Amount and location of flammables in operating buildings?

Amount, location and protection of flammable liquid and gas storages outdoors?

Exterior and inter-plant fire exposures and protection?

Personnel, Equipment and Facilities

Flame retardant clothing required?

Type safety shoes specified?

Type gloves specified for what jobs?

What special eye protection equipment for what jobs? (In addition to minimum of safety spectacles with permanently attached ventilated side shields for all operating and mechanical work.)

Air mask stations and system installed? Chem suit air stations located where?

Where are Air Paks located? Chemox?

(Safety or hard hats are standard.)

All men assigned two lockers in change house?

Number suits clothing issue required?

Laundry frequency?

Lunch room assigned?

Training

Date of completion of operating manuals?

By whom?

Job breakdowns completed for use by foremen?

Training schedules? Use of training records?

What spot check on effectiveness of training?

Health practices adequately covered?

Area and Plant Safety Rules posted?

JOINT SESSION WITH PETROLEUM SECTION

SAFETY PITFALLS IN AUTOMATION

By DONALD W. RICHMOND
Engineering Specialist, Monsanto Company, St. Louis, Mo.

It is frequently said that most accidents are preventable. While the accident rate in processing operations due to equipment failures appears to be fairly modest, occasionally a malfunctioning control system can lead to serious accidents resulting in deaths and a heavy destruction of property.

Efforts successfully have been made to shut down portions of an operation in a safe manner when instrument break-downs occur. Conscientious engineers have made great contributions towards reducing safety hazards in their designs.

Certain pitfalls in instrumentation which can lead to difficulties seem to appear all too frequently, however. Of course the mistake is always unintentional, but what's worse, these pitfalls invariably exist undetected—until something happens one day.

My purpose is to briefly present the most commonly overlooked safety hazards in automation. It is hoped that a study of the principles involved in the following discussions will enable the reader to improve his safety "batting average," whether his concern is design of new facilities or upgrading of existing ones.

Location of Equipment. The problem of location of controls is often put off until it is too late to effect changes. Sometimes the decision of location is left to someone who is not familiar with instruments. The complicated control loops may have been satisfactorily worked out on paper, but is it possible for maintenance personnel to remove the control valve safely? It is advisible to allow for complete drainage of liquids away from the control valve to permit safe removal. This is especially important when hazardous fluids are involved.

These same considerations should be given to the location of all field mounted transmitters, primary elements such as thermocouples and orifice plates and final control operators. Many chemical burns to personnel have been recorded as a direct result of such design oversights.

Unfortunately these accidents sometimes occur as much as a year or more after installation and the designer never knows about it. Unless an awareness of location hazards is developed, a repetition is likely.

Self-Acting Pressure Regulator. There are two basic types of pressure regulators. One is the type with the integral downstream pressure tap and the other has the external downstream pressure tap.

The first valve is a single seated valve which normally is used either with small flows and small valve sizes or on those applications involving small pressure drops. The other valve is double seated generally because of large flows or large pressure drops. Usually double seating begins at the 1½ inch size.

In both cases, however, the action of the spring is opposed to the pressure that is placed upon the diaphragm. The purpose of the regulator is to reduce a fluid pressure to a smaller value. Rupture of the diaphragm is the commonest cause of failure in both types of self-acting regulators. Should the diaphragm fail for any reason, the action of the spring will be to return the valve to the wide open position.

Because of its design, therefore, pressure regulators fail in the unsafe position, i.e., open. Upon such a failure full upstream line pressure can exist on the downstream side of the valve. This brings up the first rule about pressure regulators—they always fail unsafe.

Because of this inherent weakness, it is customary to find pressure relieving devices or safety discs installed downstream of self-acting pressure regulators to safeguard equipment from over pressure.

Pressure Relieving Devices. There are two commonly used pressure relieving devices. One valve differs from the other in

that the action of the valve plug is reversed and the diaphragm pressure connection is made on the upstream side of the plug instead of the downstream side. It is used for regulating purposes because of the throttling characteristics of the plug and spring. This valve is available in single or double seated bodies depending upon the pressure drop unbalance at the plug.

It is possible for tight shut off in the single seated design, but the double seated valve should never be considered for tight shut off service. As in the case of the downstream pressure regulator, a ruptured diaphragm is the commonest failure. Such a failure will result in a closure of the valve.

Because of this weakness, consideration should be given to a positive means of pressure release on the upstream side of the regulator in order to prevent equipment over-pressures.

The relief valve performs a similar service as the spring-diaphragm relieving regulator, but there are important differences. The upstream pressure at the relief valve is exerted on the plug only and all of the downward spring force is exerted on the plug.

To prevent valve chattering, a special plug design which presents effectively a larger cross section to the fluid after the valve opens, causes the valve to open more fully and remain open until the upstream pressure has dropped to a lower pressure than the initial opening pressure.

This valve is normally closed and opens only under emergency conditions in order to prevent the system pressure from exceeding a specified value. These valves are always single seated, are always designed for tight shut off and can be used on gases, vapors or liquids.

A common cause of failure is a blockage of the inlet. This occurs in many services involving condensation and freezing of vapors and in many chemical services. In some instances, the problem can be solved by mounting the valve closer to the vessel where freezing could be eliminated.

In other situations, particularly where corrosion is involved, the installation of a rupture disc between the vessel and relief valve will effectively protect the relief valve. In this case, the rupture disc is designed for the specified relieving pressure and the relief valve is set at a somewhat lower pressure.

One of the commonest mistakes involving relief valves however, deals with its location and the piping configuration upstream and downstream of it. Undersizing of either the upstream or downstream piping will cause chattering when the valve relieves. All too often the exhaust pipe is vertical with an open end. Any water which falls through this pipe lodges at the closed valve.

In subfreezing areas the resulting ice if it forms will prevent the valve from opening. Appropriate caps or a downturned pipe will prevent rain from entering the pipe. A reasonable alternate solution is the provision of a drain at the bottom of the exhaust pipe or the lowest section in the valve. Many valves are sold with plugged drain connections in the valve body. It is necessary only to replace the pipe plug with a downturned street ell.

Frequently, relief valves or rupture discs are installed for the mistaken purpose of protecting a system from the pressures of an explosion. This is a misapplication of these devices. An explosion disc is often used for this service.

The rate of pressure rise in any explosion is so rapid that it is very doubtful, at best, that a relief valve or small rupture disc could possibly prevent pressures from exceeding safe limits. The control of explosions is beyond the scope of this booklet.

Temperature Regulators. The actuator of a self-acting temperature regulator is a bellows motor in which the vapor of a fluid in a temperature sensitive bulb exerts its pressure. The bulb contains a liquid such as ether or alcohol. The temperature sensitive bulb is located in a tank or vessel which is to be temperature controlled.

The heating medium for the vessel passes through the automatic valve as the fluid pressure inside of the bulb increases because of an increased temperature. The pressure in the bellows motor will gradually close off the valve.

This action reduces the rate of heat input to the system and in that way the temperature is regulated. As in the case of the pressure regulator, a failure of the thermal system will cause the valve to fail in the wide open position because of the action of the spring.

These regulators with valve plugs on top of the valve seats are used on heating service. This brings up the same rule with regard to pressure regulators—all self-acting temperature regulators on heating service fail in the open position which is generally the unsafe position.

For cooling service, the same instrument is used by reversing the action of the valve. The plug is on the underneath side of the seat instead of the top side. A failure of the thermal system will cause the spring to close the valve, in which case the coolant is shut off. Therefore, self-acting temperature regulators for cooling service fail in the unsafe position.

Because of the inherent weakness of self-acting temperature regulators, some external temperature switch is required in order to protect vessels from overheating.

Single seated temperature regulators can be made to shut off tightly while double seated regulators cannot be relied upon for tight shut-off service. As in the case of spring-diaphragm pressure regulators, temperature regulators will throttle over a range of from 5F° to 20F°.

Closed Tube Temperature Control. The closed tube system temperature controller employs a temperature sensing bulb as in the case of temperature regulators. Close temperature control is available because proportional and proportional-reset control mechanisms can be added to the instrument.

The final control valve is usually an air operated diaphragm motor valve. The action of the controller is always reverse, but the choice of valve action is determined by the service. On heating applications, the normally closed valve is used and on cooling applications, the normally open valve is used. In either case the valve fails in a safe position upon a loss of the air supply.

This control system is not necessarily safe however. A failure of the thermal system will cause the measuring pen or pointer to fall hard against the zero end of the scale. The action of the controller, regardless of the set point position, is to move the valve to overheat the system. This disadvantage can be overcome by the use of a special bulb system.

Using mercury in the bulb system and a carefully selected piece of invar inside the bulb the pressure of the mercury drops upon a rise in temperature due to the differences in the coefficient of expansion of the invar, mercury and the stainless steel sheath.

Upon a failure of this closed tube system, the pen or pointer falls hard against the high end of the scale. The action of the controller, regardless of set point position, is to move the valve to cool the system off. This applies to heating and cooling systems as well.

Electronic Balance Instruments in Control Loops. Whenever a thermocouple or resistance bulb is used as the primary temperature measuring element, its voltage or resistance is almost always measured by an electrically operated potentiometer or bridge circuit. Upon a failure of the primary element, a choice of upscale or downscale movement of the pen or pointer is available. This choice allows the final control valve to move to a fail safe position in the event an open circuit appears at the primary element.

If there is a failure of the power supply, the pen or pointer will stop in its last position at the time of power failure. Whenever on-off control or throttling control employing automatic reset response is used, the final control valve will be either fully open or fully closed.

The failure position depends upon which side of the control point the measurement was at the instant of power failure. Statistically then only 50 per cent of the power failures at the measuring loop will result in a fail safe valve position.

There are many ways to overcome this difficulty in potentiometer or wheatstone bridge circuits. One way is to use electronic controls instead of pneumatic control. Since the electronic output derives its power from the same power supply, a failure of the power will return the output to zero.

If pneumatic control is employed, a solenoid valve in the pneumatic controller output line can solve the problem if care is taken to supply the power to the solenoid valve from the same circuit as that which supplies the potentiometer or wheatstone bridge. Upon a power failure the control valve can remain:

a) in its last position by using a tight shut off 2-way solenoid.

b) at one extreme position by using a 3-way solenoid with a vented third port.

c) at the other extreme position by using a 3-way solenoid with a specified pressure connected to the third port.

Quite often, an electrical to pneumatic temperature transmitter is used in order to employ an all pneumatic control scheme. Standard transmitters of this type result in a zero output pressure upon a power failure.

If a solenoid is not employed in the controller output signal, it is advisable to determine the safe output pressure upon power failure. On most temperature applications it is recommended to feature full output pressure on power failure. In this way, the controller will cause the control valve to fail in the safe position. If a high temperature alarm on heating applications or a low temperature alarm on cooling applications is built into the control loop, there will be an instant "abnormal temperature" warning whenever the electrical power supply fails.

Mass Transfer. In the transfer of liquids from one vessel to another, questions of liquid level in each tank become important considerations. Many means of level measurement are currently available. The transfer of liquid from one or more vessels to one or more vessels also raises questions of operating errors. One of the most prevalent operational errors is believing a valve is closed when it is open. This problem can be serious if there is a fire hazard.

If level alarms or switches are connected to each tank, a measure of safety has been built in to prevent spills. If the fluid does not readily permit weight or level measurement, some measures of safety can be built in by connecting limit switches to each drain or fill valve. The switches are electrically arranged so that only two valves can be opened at one time.

If a third valve is accidentally opened, the automatic feed valve shuts off. This arrangement requires that each valve is mechanically connected to a gang of switches in an enclosure. All switches are closed except one. There are as many switches as valves.

In practice, the solenoid is replaced by a relay which performs other functions including alarms. Other similar arrangements can be likewise worked out for other piping control schemes.

Electric Motor Failure. Electric motors have become the very pulse of modern processing industries. They provide the muscles to move gases, liquids, solids and heavy equipment. Upon a motor failure, production is usually shut down. Motor failure alarms are therefore very common in the design of interlock and annunciator systems.

Several safety pitfalls occur in motor interlocks. For example, if it is desired to protect a stirred pot reactor from loss of agitation, the method often used is the auxiliary contact on the motor starter. This procedure overlooks fractures of the agitator shaft. If the shaft breaks, the motor continues to run, and the system therefore is not protected against loss of agitation.

One way to overcome this problem is to use a current sensitive switch on the motor current. The reduction in current upon a shaft breakage is the signal to use.

Another example of an unsatisfactory interlock is the use of an auxiliary contact of a pump motor starter as the initiating device to represent a loss of flow through the pump. The flow through a centrifugal pump or blower would be zero if a block valve in the line is closed. The motor would continue to run, yet there is no interlock action. One way to resolve this problem is to use a switch directly from a flow sensitive or measuring device, since it is the loss in flow that must be guarded against. If the fluid is difficult to measure, a pressure switch is often satisfactorily used since pressure is an indirect result of flow.

In most cases, motor failure alarms are perfectly appropriate, but before deciding upon a procedure to provide safety, consideration should be given to the following:

1. Define the system requirements.
2. Make a list of probable and possible failures together with the consequences.
3. Make a list of methods to solve the problems in step 2 above.
4. Ask yourself if there are any ways in which the suggested methods in step 3 would fail to function.

High Voltage. Much reliable information on the dangers of high voltage is so commonly available that it seems as if nothing

more can be said on the subject. Perhaps this argument would be acceptable were it not for the continuing records of accidents involving electrical shocks. Suggested for serious considerations are the following list of do's and don'ts:

1. Don't use voltages over 115 volts on instrument interlocks and switches or on instrument panel boards.
2. Do take care to enclose wiring behind instrument panels.
3. Don't use exposed terminals in instrument cabinets or panels if terminals carry 115 volts.
4. Do take care to identify areas of high voltage such as using appropriate color paint and the appropriate warning signs.
5. Use 3-wire power connections to panel instruments and use the third wire to ground the case. This is especially important if the panel is non-metallic or ungrounded.
6. Make simple provisions to remove power from instruments to facilitate maintenance.

Conclusions. The safety pitfalls described herein represent those most commonly encountered in the process industries. While the devices illustrated and described were deliberately simplified for the sake of clarity, it should be emphasized that the principles involved in the unseen hazard constitute the underlying purpose of this booklet. The reason for the emphasis of these principles lies in the countless repetition of the same principle designed into so many apparently different control loops.

SAFE ELECTRICAL EQUIPMENT IN OUTSIDE AREAS HANDLING FLAMMABLE LIQUIDS & GASES

By DR. RICHARD Y. LE VINE
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Many years ago, in the far off city of Baghdad, there lived three blind brothers. Now it came to pass one day that a merchant of India visited Baghdad with an elephant. And the blind men who were curious about the elephant asked to touch it. The first blind man felt the elephant's leg and said, "Verily, an elephant is like a trunk of a tree." Then the second blind man felt the elephant's trunk and said, "Nay, brother, you are wrong, an elephant is akin to a snake." And finally, the third blind man felt the elephant's ear and said, "Nay, brethren, you are both wrong, an elephant is like a huge palm leaf." And all the assembled peoples laughed because the blind men could not agree on what the elephant was like.

While this parable dates back many thousands of years to ancient Persia, it has meaning for us here today in the supposed controversy between the petroleum and chemical industries on the subject of safe electrical equipment for hazardous areas. Just as each of the blind men judged the elephant by his own narrow viewpoint, or shall we say, feelpoint, so each of the industries has approached the problem exclusively in terms of its own experience, operations and needs.

The chemical industry with its many batch processes and much of its equipment and operations still indoors, has favored electrical equipment suitable for the highest degree of hazard. The petroleum industry on the other hand, with its continuous processes, closed systems and its outside plants has been an advocate of electrical equipment suitable for a considerably lesser hazard. The controversy, however, has about run its course, for as the chemical industry goes more and more to continuous processes and to outdoor plants, it will, for economic and technical reasons, have to take an approach not unlike that of the petroleum industry.

Just what such an approach should be and how it would provide adequate protection against fire and explosion in outside plants

processing flammable liquids and gases, is our subject for today.

Article 500, the section of the National Electrical Code which deals specifically with hazardous locations, tells us that locations where explosive concentrations of vapors or gases may develop are called Class I locations and that Class I locations are divided into Class I, Division 1 locations and into Class I, Division 2 locations. Division 1 locations are locations where hazardous concentratons of flammable vapors or gases exist continuously, intermittently or periodically under *normal* conditions of operation, maintenance and leakage. Division 2 locations are 3 types; 1) locations adjacent to Division 1 locations which may occasionally be reached by hazardous concentrations; 2) locations where flammable volatile liquids or gases are handled, processed or used but where hazardous concentrations are *not normally* present due to confinement of the materials in closed systems; and 3) locations where hazardous concentrations are normally prevented by positive pressure ventilation. These locations become hazardous only in the event of accidental rupture of vessels or piping or breakdown of ventilation.

Division 1 locations then are locations where we can *normally* expect explosive concentrations for extended periods of time and Division 2 locations are locations where explosive concentrations occur only under *abnormal* conditions and thus only occasionally and for relatively short periods of time.

Since in outside chemical plants, materials are handled in closed systems; open air ventilation prevents accumulations of vapors; and explosive concentrations occur only under abnormal circumstances, most areas of an outside plant are legitimate Division 2 locations under the National Electrical Code. There is therefore no reason why Division 1 explosionproof equipment should be used throughout an outside plant as was so often done in the past. On the other hand, there are a number of very cogent reasons why explosionproof equipment should not be used indiscriminately. Let us take a look at some of them.

One of the basic principles of explosionproof technology is that entry of vapors into unpressurized electrical equipment cannot be prevented even with the tightest of gaskets. Given enough time in an explosive atmosphere, the equipment will breathe in that atmosphere and an explosion may occur.

Electrical equipment for Division 1 locations, where we can normally expect explosive concentrations for extended periods of time, must therefore be designed *"explosionproof."* This means that the equipment is enclosed in a case which is strong enough to withstand an internal explosion of a specified vapor. It must also by proper design of all joints and seals, prevent the ignition of the specified vapors surrounding the enclosure by heat and flame from within. Finally, the equipment must operate at an external temperature such that the specified vapors will not be ignited by it.

Note that we have several times indicated that the equipment is satisfactory for a specified gas or vapor. As explosionproof motor enclosure for example which can withstand an internal explosion of a gasoline-air mixture cannot necessarily withstand an explosion of a hydrogen-air or acetylene-air or even an ether-air mixture since these mixtures develop considerably higher explosion pressures. The National Electrical Code and the Underwriters' Laboratories which lists approved electrical equipment, take cognizance of this by grouping materials on the basis of their hazardous characteristics.

Class I, Group A equipment is satisfactory for atmospheres containing acetylene.

Class I, Group B equipment is satisfactory for atmospheres containing hydrogen and gases of equivalent hazard such as manufactured gas which has a high percentage of hydrogen.

Class I, Group C equipment is satisfactory for atmospheres containing ethyl ether, ethylene and cyclopropane.

Class I, Group D equipment is satisfactory for atmospheres containing gasoline, hexane, naphtha, benzine, butane, propane, alcohol, acetone, benzol, lacquer solvents and natural gas.

Unfortunately, many of the chemicals with which we are concerned in present day chemical manufacturing, are not to be found listed in the groupings. For example, such common modern day chemicals as ethylene oxide, acetaldehyde and hydrogen sulfide to name only three which are quite troublesome are not listed. And sometimes when the chemicals are listed there is only a limited

amount of approved explosionproof electrical equipment available. For example, there are no approved explosionproof motors for acetylene and hydrogen.

It is *not* permissible to select electrical equipment on the basis of an analogy drawn between an unlisted chemical atmosphere and other listed chemical atmospheres. It is also *not* permissible to use Class I Group D equipment for Group A, B, or C atmospheres on the basis that Class I Group D equipment is the best available. True, such a procedure has been followed for years—when in doubt use Class I, Group D. However, the use of Class I, Group D equipment in unlisted atmospheres is a violation of the National Electrical Code and may lead to a disastrous explosion since the Class I Group D equipment may not be able to withstand the pressure of an internal explosion of the unlisted material or prevent the propagation of flame therough the joints and seals of the equipment to the surrounding atmosphere.

Why, if this is so, have we not had more explosions due to the use of improper explosionproof electrical equipment? The answer probably lies in the fact that there are so few true Division I areas in the sense that an explosive mixture exists continuously throughout an entire area. The ventilation, which is necessary to allow employees to work in an area, tends to limit the concentrations of vapors and gases and confine the explosive mixtures to the immediate vicinity of the vapor or gas source. And since the allowable concentrations for indusrial health are usually far lower than the lower explosive limits, there is a built in safeguard in almost all atmospheres in which people must work.

For example, the lower explosive limit for ethyl ether is 1.9 per cent vapor concentration in air and a concentration as low as .2 per cent causes acute intoxication after several hours of exposure. Similarly, the lower explosive limit for benzene is 1.4 per cent and a concentration of .75 per cent is dangerous after one half hour of exposure. If you wish to consider the MAC value as the top concentration in any area, then the margin of safety is even greater. Thus, in most cases, if people are working in an atmosphere, there is little immediate danger from a fire or explosion. Essentially then what we have done in the past is to use Division 1 explosionproof equipment in Divison 2 areas and while this is legal and unlikely to get us into trouble, it is costly and unnecessary.

For the true Division 1 locations, the limited number of tested materials and the limited amount of approved explosionproof equipment for Groups A&B are serious technical handicaps to designing a plant with fully explosionproof electrical equipment.

Maintenance is also a difficulty with explosionproof equipment. Although it is likely to require maintenance less frequently than ordinary equipment, once repair is necessary, it must be done by a thoroughly trained man with loving and exacting care, otherwise the reassembled equipment may no longer be explosionproof.

Finally, explosionproof equipment is very expensive. I know of one $3,000,000 outside chemical plant where the increased cost for a fully explosionproof installation amounted to seven per cent of the entire project and because of the materials being handled, the use of explosionproof equipment did not improve the safety of the plant.

To recapitulate, then, the full explosionproof equipment approach and certainly the classic Class I, Group D approach is neither desirable nor economically and technically feasible for most outside chemical plants.

We cannot, however, write off explosionproof equipment because in every outside chemical plant, there are some Division 1 areas. Among these are—

1. Open below-grade areas such as pits, sumps and trenches and all above-ground areas within dike walls where vapors may accumulate. Electrical equipment should be kept out of such areas or should be Division 1 with proper seals to prevent vapors from communicating to otherwise safe locations.

2. Pumphouse and compressor houses with restricted ventilation which handle flammable liquids, vapors and gases. Because of the continuous nature of most outside chemical plants, shutdown for repair is not always immediately possible and explosive concentrations may build up suddenly from leakage around packing and bearings. Where solvent pumps are located outside, Division 2 motors are permissible.

3. Locations where equipment must be opened regularly and frequently for repair

or for the addition of materials to the process and where the release of large volumes of flammable vapors cannot be avoided.

4. Locations where a failure of process, storage or other equipment will cause an electrical system failure simultaneously with the release of flammable liquids, vapors or gases.

5. Areas immediately around flammable liquid loading and unloading racks, drum filling buildings with restricted ventilation, and areas immediately around storage and process tank breather vents.

All these locations, in my opinion, should be considered Division 1 areas. If the materials being handled are listed, then we can use approved explosionproof equipment but what do we do in these Division 1 areas when the chemicals being handled are not listed and we have no approved explosionproof equipment? Well, we can use any equipment which is approved for all 4 Class I Groups—A, B, C&D. It is most unlikely that there would be any gases or vapors that are worse than the combined bad properties of acetylene, hydrogen and ethyl ether.

While this is not strictly according to Hoyle or, shall we say, the National Electrical Code, taking this small liberty is absolutely essential if we are to be able to place any electrical equipment in a Division 1 area where unlisted materials are handled. We cannot possibly eliminate all electrical equipment from every Division 1 location and this approach gives us such necessary general explosionproof equipment as conduit fittings and boxes, lighting fixtures and fittings, snap switches and motor controller push-button stations. Beyond this equipment, we must take a different tack to solve the problem.

Intrinsically safe equipment is one possibility. By definition, intrinsically safe equipment and wiring is incapable of releasing sufficient electrical energy under normal or abnormal conditions to cause ignition of a specific hazardous atmosphere. Again, you will note we are talking of a "specific" atmosphere. A piece of equipment which is intrinsically safe for one atmosphere is not necessarily so for every atmosphere. Each gas and vapor has a minimum ignition energy which must not be exceeded in normal or abnormal operation of a piece of equipment, otherwise an explosion may result. Intrinsically safe equipment can be used advantageously for instrumentation, for control circuits and for communication equipment but it is not a solution to the overall problem.

Remote location of electrical equipment is another approach. It is often possible by the exercise of a little ingenuity to locate some of the electrical equipment in less hazardous Division 2 areas or in nonhazardous areas. Transformers, switchgear and starter panels can often be located in nonhazardous areas so that ordinary equipment can be used. Remote location, while it has wide application, is also not a complete answer to the overall problem since some electrical equipment such as pump motors, lights and switches must necessarily be in the hazardous area.

A third approach is purged and pressurized equipment, cases, enclosures, rooms and buildings. The provision of an air pressurized control house for an outside chemical plant is rapidly becomilng a standard practice. As much of the electrical equipment as possible is put into the control buildings: instruments, control devices, switchgear, circuit breakers, starter buttons and even the instrument and process air compressors and motors. Since the building is kept under positive pressure at all times and vapors cannot enter, the electrical equipment can all be nonexplosionproof. It is essential, however, that the air for pressurization be drawn from a location where it cannot become contaminated with either toxic or flammable vapors. It is also necessary to provide an alarm to warn of loss of pressurization so that the electrical equipment can be shut off if a hazardous situation is developing.

Pressurized motors are very valuable tools and are approved by the Code for Division 1 locations as an alternate to explosionproof motors. For hydrogen and unlisted materials for which there are no approved explosionproof motors, pressurized motors are the only solution. A totally enclosed motor is provided with positive pressure ventilation from a source of clean air or inert gas and is so arranged that it cannot be energized until it has been thoroughly purged. It is

also so arranged that it will automatically deenergize if the pressurizing supply fails. These totally enclosed motors must also have safeguarded external surface temperatures so that they will not cause ignition of the vapors in the area.

Pressurized cases and enclosures for instruments and control equipment have similar safeguards against high temperature and loss of pressurization and in addition should be designed so that the power must be cut off before a case can be opened.

The final way to solve the problem is also suggested by the Code. You will recall that a Division 2 location is a location where flammable liquids, vapors or gases ar handled, processed or used but where they are normally confined in closed systems or where hazardous concentrations are normally prevent by positive mechanical ventilation. Therefore, if we can upgrade Division 1 areas to Division 2 areas by proper ventilation and/or by closed systems, we can use Division 2 electrical equipment just as we will use Division 2 equipment in the greater part of our outside plant. Just what is Division 2 electrical equipment and what degree of safety can we expect from it? Division 2 equipment is essentially ordinary, low temperature electrical equipment which is nonsparking or which has its make or break contacts immersed in oil or contained in hermetically sealed chambers. Explosion-proof equipment is used when nonsparking devices are unavailable.

In order to have an explosion from this type of equipment, it is necessary to have an explosive concentration for an extended period of time and to have a simultaneous failure of a piece of electrical equipment which results in a spark. In a true Division 1 area, such equipment miglit under adverse conditions cause an explosion. In a true Division 2 area, where explosive concentrtions exist only under abnormal conditions and therefore only very rarely and for relatively short periods of time, Division 2 equipment is more than satisfactory and gives adequate protection against fire and explosion.

Ideally, when designing electrical equipment for an outside chemical plant, any and all of the methods that we have outlined should be investigated and possibly used. While we have listed intrinsic safety, remote location of equipment and purged and pressurized equipment as alternates for Division 1 locations, they work equally well for Division 2 locations and may be less expensive. Flexibility should therefore be the keynote in specifying electrical equipment for outside chemical plants. That flexibility will not only produce the most economical installation, it will in the long run produce the best protection against fire and explosion.

EXPLOSION VENTING OF BUILDINGS AND TANKS

By WILLIAM H. DOYLE
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I want to discuss the explosion venting which will permit a combustion explosion, originating at atmospheric pressure, to take place inside a building or tank and, because of the venting devices or system, cause minimum damage to the building or tank, minimum injury to personnel, and, in the case of the tank, result in retaining most of the liquid even though it may be burning.

Explosions involving explosives are not being considered here. They are a subject for study in discussing barricades rather than vents.

Detonations of combustible mixtures are likewise a subject of barricades. To distinguish between detonations and explosions, in this sense: detonations progress at a speed exceeding that of sound while the speed of flame in uncompressed mixtures of gases or vapors with air is only some 2 to 10 feet per second. The speed of flame travel increases rapidly as pressure builds up.

and that is one reason for choosing to neglect explosions originating at pressures other than atmospheric.

In 1933, two bench mark papers were published. The first, by the Department of Agriculture, covered venting of explosions in grain dust and starch dust, both in air. This paper was the result of continuing work since the first report on dust explosions by the U.S. Department of Agriculture to the National Fire Prevention Association in 1922. The second, by the Bureau of Mines, discussed experimental work done cooperatively with the Western Electric Company on venting explosions of acetone vapor in air. The Department of Agriculture work reported on the pressures that could build up with various dust concentrations in a closed bomb and in structures with open vents. The Bureau of Mines work reported similarly on pressures in a closed bomb and a bomb with open vents but then continued on to investigate the different situation that existed when the vents were closed with diaphragms made of various thicknesses of aluminum, tin and lead.

The above two papers, both now old enough to vote on November 3, 1964, give adequate background and formulae to permit safe design of buildings and tanks to resist explosion when the protection is by means of open vents. This is not, however, a practical approach in most cases, although N.F.P.A. Standard No. 652 on magnesium powder plants, suggests that two walls of any pulverizer room be constructed of doors that may be kept open during operations, and modern design of chemical plants and some dust-producing plants emphasizes weather-proofing of equipment and its installation in the open to bypass the problems of explosion venting.

Until 1950, it was general practice, although the limitations of the procedure were well recognized, to use pressures reached by explosion tests in equipment having open vents as a design basis for venting buildings using weak walls, glass areas, hinged sash and doors and similar closed vents. Eventually, however, the effect of vent closures on resultant pressure for dust explosions was investigated by the Bureau of Mines and the results were published in 1946.

Up to this point, I have intentionally omitted specific figures on concentrations, pressures, etc. Let us now consider some actual results from these papers. What open vent ratio is needed for example, to keep the resultant pressure from exceeding 2 lbs./sq. in.? The answers are:

For a "mild" dust explosion 1 sq. ft. of vent for each 65 to 70 cu. ft.

For a "severe" dust explosion 1 sq. ft. of vent for each 16 to 18 cu. ft.

For an optimum acetone mixture 1 sq. ft. of vent for each 6 to 7 cu. ft.

Why did I select 2 lbs./sq. in.? Because that is 288 lbs./sq. ft. and the resistance of typical structural walls to lateral pressure (10′ x 10′ panels), determined by the dead load method of the Bureau of Standards, is about as follows:

8″ thick high strength brick	125	p.s.f.g.
8″ thick medium strength brick	48	"
8″ thick medium strength brick (best workmanship)	60	"
8″ thick clay tile	40 to 64	"
8″ thick concrete block	25	"
3 7/8″ thick glass block	91	"
3″ thick vermiculite between sheet steel panels	227	"
10″ thick 2-4″ concrete block with 2″ air space	50	"
8 1/2″ thick reinforced brick with tile backing	203	"
Wood frame	273	"
10″ thick reinforced concrete panels	430	"

This means to me that venting must, except in the case of reinforced concrete or specially designed structures, be adequate to keep the explosion pressure below 2 lbs./sq. in. In fact, for most 8″ masonry structures, it should be kept below 1 lb./sq. inch.

Why am I not more precise and why do I not recommend venting to limit the pressure to a certain fixed per cent of the wall test pressure? Now we are getting into the area where venting becomes more of an art than a science. At this point, I will only point out that the Bureau of Standards' test applies a dead weight while explosion loading is a transient where inertia plays a considerable part so that a mathematically correct expression would involve functions of the dead weight wall resistance, the maximum possible pressure in a closed bomb test, the maximum rate of pressure rise, the ratio of vent area to volume and the ratio (possibly weighted) of the inertia of the vent closure to the inertia of the fixed section of the wall. Adequate research on this complex interrelationship has not been

done. However, there are other factors of great practical importance.

First, let us consider the factor of concentration. In the Bureau of Mines Report on acetone, it was indicated that an open vent ratio of 1 to 6 or 7 was needed to keep the resultant pressure below 2 p.s.f.g. However, this was for a mixture of 5.5 per cent acetone vapor by volume in air. The lower explosive limit for upward propagation of an acetone explosion with spark ignition is about 2.15 per cent. A 3 per cent mixture gives a good explosion but a vent ratio of 1 to 52 held the pressure to 2 p.s.f.g. This means, practically, that it is not necessary to consider the worst possible situation when designing explosion venting because the worst possible situation is difficult to obtain when trying to test for it under laboratory conditions and is practically impossible to obtain under field conditions. Certainly the overpowering order of acetone at even 1/2 of its lower explosive limit would have prompted workers to open windows and doors, turn on fans and wash down spills long before an entire work room could be filled with even a lower limit mixture. At any rate, such a supposition is necessary to justify the thinking that vent ratios of from 1 to 35 to 1 to 60 are adequate for most flammable liquid exposures. This, of course, although the fact is sometimes overlooked, means that automated operations require either a more stringent approach to explosion venting or mechanical devices, such as flammable vapor indicators, to substitute for the absent workmen as detectors of incipient hazardous conditions. Such mechanical devices can start ventilating fans or sound alarms as conditions may indicate.

The factor of concentration with respect to dusts is somewhat different. Dust clouds have no detectable upper explosive limit, but usually the cloud that is ignited is near the lower limit. This produces a mild, easily-vented explosion but also stirs up any dust lying on the floor or shakes down that on overhead surfaces. An explosion in this secondary dust cloud or in a similarly formed tertiary cloud is usually much more severe because the cloud is larger. However, the first explosion will have displaced vent closures so subsequent explosions occur with open vents. Incidentally, the Bureau of Mines points out that when vent closures are of the type that swing shut after relieving pressure, the rapid cooling of the hot combustion gases remaining in the building may cause an external pressure of as much as 800 p.s.f.g. For this reason, as well as to have open vents to relieve a secondary explosion, venting devices, such as doors, hinged windows and swinging panels, require stops to hold them open whenever they operate.

At this point, it seems in order to take up the matter of increase in pressure caused by vent closures. The Bureau of Mines' report on acetone explosions is not pertinent, in this case, because the tests were designed to examine the venting of heavy equipment and pressures examined were in the 5 to 70 per square inch gauge range.

The 1946 Bureau of Mines report on relief vents, as related to dust explosions, is good, but the authoritative report is one made in 1950, again by the Bureau of Mines, titled "Pressure-Relieving Capacities of Diaphragms and Other Devices for Venting Dust Explosions." The data and conclusions in that report are equally applicable to vapor explosions. This material is published in N.F.P.A. Standard No. 68 and I have included the table and charts which, cover, as you will note, only frangible materials or materials which will blow completely out of a vent. Use of vent closures of either of these types does away with the problem of keeping the vents open to avoid secondary damage because of the vacuum effect. There is, however, the disadvantage that the entire closure, or fragments of it, may become dangerous projectiles. This is more of a problem with materials such as glass, rigid paper laminates and metals, and less serious with materials that are flexible or which tear in place. A piece of cardboard can be sealed quite a distance but a piece of paper must be folded into an airplane shape before it can be thrown very far.

One common vent sealer is, of course single strength window glass. However, because of projectile danger, its use is less frequent than it used to be. Where it can be used with reasonable safety, as where windows face toward an embankment or a blank wall, scoring the glass diagonally will reduce the pressure at which it will relieve. When this is done, it must be remembered that the effect is a function of the sharpness of the V at the bottom of the scratch and that the

silicates in glass are just sufficiently soluble so that continued wetting with rain and dew will cause the scratch to heal, that is, assume a U shape, so that over a period of five to ten years scored glass will regain most of its original strength.

Implicit in the above remarks concerning frangible and blow-out vent closures is the assumption that each individual device closes only a relatively small opening. Individually large closures are almost invariably of the blow-out panel or swinging panel (or door) design. With small closures, the consideration of designing them to remain closed during high winds (explosions should operate them but winds should not) is a relatively small problem. However, as vents increase in size the need to design them for an internal load of 25 to 30 lbs. per square foot without opening, pretty well eliminates the possibility of using paper and flexible plastics. Vent closures thus become large and rigid and operate by moving as units rather than by rupture or by pulling away from their fastenings as they stretch. With closures of this type, the inertia of the unit tends to become the most important measure of its effectiveness. Vents of this nature which have a relatively high mass, and therefore a high inertia, can be used only when the explosion to be vented is one that has a relatively low rate of pressure rise. My physics professor, some 37 years ago, forced me to learn that F equals M x A (force equals mass times acceleration) and promised that if I would remember it, all problems would be clear to me. For vents of this nature he was entirely correct. The next time anyone tries to talk you into a counterweighted hinged vent, remember inertia, F=MA; smile in a superior fashion, say "no" and mean it.

With respect to safety, large vents that move as a unit are probably better than the small frangible closures such as glass. Because of their greater mass, they will travel farther, particularly if they plane, but they are very much fewer in number.

Another point about explosion venting that has been investigated is the effect of relative location of the vents. English work at the Fire Research Station, Boreham Woods, Hertshire, reported in 1959 under the title "Reliefs for Gaseous and Vapour Explosions" indicates that pressures and flame speeds may be up to 50 times greater when the ignition source is remote from the vent than when it is less than three hydraulic diameters away. This effect was reported previously by the Bureau of Mines as a qualitative matter but the equation and the mathematics first appeared in the English work. Recognition of this effect has resulted in requirements in several N.F.P.A. Standards. For example, No. 656 on "Spice Grinding Plants" requires that no part of a grinding room be farther from a vent than 1.1 times the least horizontal dimension of the room.

In a rather rambling fashion, I have now covered background information with respect to strength of structures, explosion pressures, relieving capacity of vents and factors affecting vent selection and location. Now I would like to give a few specific instances illustrating modern practice in design of explosion relief facilities for buildings. In the publication "Occupational Hazards" for June 1961, there was a report of a hydrocarbon vapor explosion in a development laboratory of the Dow Chemical Company at Midland, Michigan. The area was "surrounded," vent ratio unspecified, by panels of foamed "self-extinguishing" polystyrene. Ten to 12 panels blew out and others melted in the subsequent fire. Explosion damage was nil.

Use of foamed plastic for such a purpose is relatively new. The panels are light weight so have low inertia; they are good for thermal insulation and they have low mass so they do not fly far and what they hit, they hit gently.

When Parke, Davis & Company built a new plant in Holland, Michigan, in 1961, exterior walls were designed to give explosion relief venting in ratios varying from 1 to 30 to 1 to 80. Walls consist of concrete grids with openings about 1', 1" by 1', 7". The openings are closed with 1/16" thick cellulose butyrate plastic bowed with the convex surface toward the exterior and caulked in place. The bowing affords good wind resistance. This seems like an excellent design but I know of no field experience with it. Incidentally, this was reported, with pictures, in the January 22, 1962, issue of "Chemical Engineering."

The Eastman Kodak Company uses an insulated metal wall for explosion relief in

areas where temperature and sweating must be controlled. The panels are mounted in metal frames and held in place by bolts or pins of such design and number that the panels will blow out at an internal pressure of about 30 p.s.f.g. The top of each panel is connected to the building structure by a chain having considerable slack. This last feature is, of course, to minimize the chance of personal injury.

The Manufacturing Chemists' Association publishes, as you probably know, case histories of accidents reported by members. Case History No. 994 reported successful operation of explosion venting. When I asked for more details, I was told that the explosion relief construction consisted of 1/2" thick corrugated asbestos cement panels 4' x 8' attached to the steel beams of the building using "Top Seal" explosion relief bolts 3" long x 3/16" diameter with 3/8" heads, 3/4" neoprene coated aluminum washers. Under stress, the washers gave and, in this case, the siding fell off intact. This particular fastening system is made by the Fabricated Products Division of the Townsend Company, West Newton, Pennsylvania.

The job assigned me back last spring was to discuss explosion venting of buildings and tanks. With respect to tanks, there is little I can say. The previously mentioned Bureau of Mines Report on acetone vapor explosions and work done by Cousins and Cotton in the Factory Mutual Engineering Department Laboratories in 1950 and reported by them to the American Society of Mechanical Engineers in 1951 as Paper No. 51-PRI-2 both indicate that tank rupture can be avoided only by making the tank strong enough to contain an explosion, which means designing it to contain about 100 p.s.i.g., or by making the entire end of the tank an explosion vent or by some intermediate combination of the two. Design to contain is used in rare cases where the cheaper approach of keeping the vapor space inert is not practical. When containment is used, the design must be such as to keep the hydraulic radius of the vapor space as near unity as possible with respect to container length. The reason is that ignition of a combustible mixture at one end of a pipe will cause compression of the unignited mixture further along the pipe. When the heat of compression causes ignition of this compressed mixture, pressures of up to 700 to 800 p.s.i.g. can readily result. Therefore, the tank designed to contain an explosion must look as little like a pipe as possible.

When it comes to making the entire end of the tank an explosion vent, this is certainly not advised for horizontal tanks. Not only would the burning contents be discharged violently but the tank body would have a tendency to rocket. With vertical tanks, however, use of a cone roof with a weak seam where the roof joins the shell will provide satisfactory explosion relief, provided that the tank is so located that neighbors will not some day call up and ask that the strange tank roof on their property be retrieved by its rightful owner. In this respect, construction of a cone roof tank in accordance with the standard of the American Petroleum Institute will automatically result in a tank with a weak roof to shell seam. Where dome roof tanks are concerned, satisfactory results have been obtained by grinding down the top peripheral weld.

In summary, most of the basic work on explosion venting was done in the 1930's and 1940's.

Best current thinking with respect to building venting results in use of:

1. Concrete grids sealed with blow-out sheets of plastic.

2. Structural frames sealed with foamed plastic.

3. Insulated or uninsulated panels attached to structural frames by specially designed fastenings.

4. For tanks, design to contain or use an A.P.I. cone roof tank.

PREVENTIVE MAINTENANCE TO PREVENT ACCIDENTS

By D. W. FLAGLER
Supt. of Maintenance, Davison Chemical Div., W. R. Grace & Co., Bartow, Fla.

When organizing a plant operation, management, among numerous objectives, such as showing a profit, usually desires to set up a preventive maintenance program and an accident prevention program. Today we will discuss the relationships of these two programs.

First of all, let's define preventive maintenance as a method of controlling outages of equipment so that they occur at the most advantageous time for operations and maintenance. A polite term for a "breakdown" is an "unscheduled equipment outage."

Plant design can help a program of preventive maintenance by building into the plant in-place spares and by-passes so that equipment can be repaired while the plant is operating.

The degree of maintenance always must be at some point between the absurd extremes of having a complete spare plant, and repairing everything after failure. In the final analysis, this degree of maintenance is what management wants and for what it is willing to pay.

The closer operating factors are desired to 100 per cent, the more spare parts must be carried in inventory; the higher the caliber of supervision and workmanship, and the higher the numbers of maintenance people, and the total hours spent on the job.

Economically, management must be willing to settle for something less than perfection. Total preventive maintenance, which means dismantling each piece of equipment at frequent and regular intervals, is something few plants can afford because of excessive down-time and excessive labor costs.

Practically, the program arrives, through experience, at classifying equipment into groups which need inspection at daily, weekly, monthly, or semi-annual intervals. When equipment is scheduled for inspection sufficient time must be allowed to make such repairs as may be needed, or sometimes a temporary repair until parts and time are available.

The experienced maintenance man, whatever his title, will make daily trips by the equipment for which he is responsible. He will use his skill, and experience, and his senses of hearing, sight, smell and touch to anticipate the condition of most machinery quite accurately and will know fairly well what to expect when the equipment is dismantled. He should have on hand, or know where to quickly obtain, the parts and materials he will need for the repair.

Most maintenance men seem to have the inborn instincts of a "pack rat" and by over-ordering spare parts usually manage to accumulate enough material to put together whole assembled units. This procedure not only reduces down-time for repair, but also allows the rebuilding of assemblies as fill-in work.

Needless to say, when maintenance supervisors are assigned so much paper work, expected to attend so many meetings, and required to talk to so many visitors that they rarely visit the plant, the preventive maintenance program is bound to be ineffective.

So far we have been talking about material things. Now let's apply this same type of thinking to accident prevention to the welfare of human beings.

While management will evaluate a preventive maintenance program and go on record as to the operating factor they expect—which may be as low as 60 to 70 per cent in a multi-product plant which can economically switch to an alternate product temporarily; when it comes to accident prevention, the position must always be that only 100 per cent performance is acceptable.

It follows that accident prevention means that we will attempt, in every way, to control the unscheduled event resulting in personal injury or worse, which we term an "accident."

Plant design can help an accident prevention program by building into the plant all possible safeguards.

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52nd NATIONAL SAFETY CONGRESS

Papers Presented in the

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caution, ability to use judgment, ability to reason—all these tend to suffer in proportion to the degree of intoxication, fatigue, or illness.

Non-temporary physical conditions that may influence unsafe actions include visual defects, hearing defects, chronic illnesses, poor coordination, malnutrition effects, and many others. Many such conditions are correctible, either completely or to an appreciable degree, when given professional diagnosis and treatment.

2. Mental conditions influencing unsafe actions: Mental conditions that may cause or influence unsafe actions include preoccupation with feelings of hostility and resentment; worries about health, marital affairs, money problems, and other matters; day dreaming brought on by monotonous work and personal frustrations; mental disabilities caused by physical conditions; and even temporary mental disturbances.

All these conditions interfere with a man's ability to concentrate on his work and to be alert to hazards. They cause people to become "wrapped up" in themselves, preoccupied with thoughts unrelated to the work on hand. When such mental states prevail, men are very susceptible to unsafe actions. They don't hear signals or warnings. They assume hazardous positions without realizing what they are doing. They act mechanically and often blindly. In extreme cases, they seem almost oblivious to what is going on around them.

It is difficult to estimate how many accidents are caused by abnormal or deficient physical and mental conditions. That's partly because accident investigations are generally weak in trying to establish such underlying causes, and also because such causes are difficult to establish with confidence.

Most safety experts agree, however, that the role of such physical and mental conditions in causing accidents is greatly underestimated. Supervision needs to be more conscious of the relations between accidents and such physical and mental conditions.

SAFETY IS A MATTER OF DECISION

By E. M. CARTER
Safety & Protection Supervisor, E. I. du Pont de Nemours & Co., Inc.,
Film Department, Old Hickory, Tenn.

I stand before you as a safety supervisor who could be one of the most successful in the world except for one thing—that is injuries.

But isn't that the story of our lives? None of us, whether we are supervisors of production or safety or even if we are an ordinary citizen driving along the highway, intend to have an accident. In fact, the basis of most of our accidents is the belief that the accident will happen to someone else.

During my preparation for this talk I naturally looked over the statistics for the bituminous coal industries and find that they are one of the highest in industry. After reviewing these data for many industries I came to the conclusion that about the only safe thing I could do to reduce the injuries in this field would be to give you one safety rule: "Get out of this business and go into the communications field because they have an injury frequency of only 1.03." Unfortunately we can't solve our problems by wishful thinking.

It is said that the basic purpose of a safety management is the preservation of human resources. Due to the widespread destruction of property and lives because of accidents there is no question but that this must be considered one of the basic reasons for safety. However, after one lives through an accident, including the hospitalization or funeral, the suffering and heartbreak, as well as the cost, one rapidly comes to the conclusion that there are many side effects which a successful safety program can make most gratifying.

There is no question that all industries have made a major contribution to safety over the past 50 years. However, when we

read the newspapers or review the most recent accident rates it is obvious that we have a long way to go.

I believe it is generally true that the reduction of industrial injuries to date has been brought about mainly through engineering improvements. By this I mean that installation of improved equipment, guards, procedures, safety rules, proper training, drills, etc., have been quite effective in the reduction of injuries.

In our own Company careful study reveals that approximately 88 per cent of all injuries are caused by human error. I am confident that an analysis of injuries in other companies would reveal similar figures. Therefore, it is apparent that if we are to make further substantial reductions in injuries we must learn how to motivate people in such a way that they will be determined to work safely.

I am not in any sense implying that there should be less emphasis on improved engineering methods; in fact, I feel this should be pressed even harder. However, I am emphasizing that the personal approach to the individual worker is a must if we are to make substantial improvement. When there is an injury one gets little satisfaction from the fact that the injured man disobeyed a safety rule, instead of blaming it on the inadequacy of a guard. The suffering to the individual and the cost to the Company is the same in both cases.

The first step in approaching this problem is that the entire organization must decide to have a safety program which will reduce accidents. This applies to all of us from the president of the company to the lowest paid wage roll employee. It cannot be obtained by a resolution passed by top management that hereafter the plant will operate safely. If this were true I am sure that none of us would have any problems in safety.

One of the greatest problems is that all of us in supervisory positions are not thoroughly sold that we should apply principles passed on to us by top management.

I said earlier that in order to reduce injuries further we must learn to motivate people so that they will sincerely want to work safely. I would like to dwell primarily on this subject because I think it is the most important. The barriers to perfect safety programs are psychological because we have accepted the fact that many organizations or industries are dangerous and nothing can be done about it, that there will naturally be occasional accidents, that to say accidents can be eliminated is idle talk.

I would like to refute this viewpoint. I would like to make the statement which may seem ridiculous to some of you; that the nature of the product or the nature of the operation has little if anything to do with the accident frequency. Our company makes high explosives, corrosive acids, nylon yarn; our people operate an atomic energy plant, high pressure systems, computers, and typewriters. Our safety performance shows that in some of the most dangerous activities the safety performance is best and in some of the seemingly safest operations the performance is poor.

It therefore follows that the first thing that must be accomplished is to sincerely conclude that "accidents can be prevented" regardless of the type of operation which we may be engaged in.

Examination of records in any activity, I believe, will disclose that a relatively small group of people have most of the injuries while a large portion of the work force have few injuries. In every group the majority of people will wear their goggles but you will consistently have difficulty with a few people. These are the same people that break other rules. They are also probably the same employees who have an unreasonable attitude about procedures, the chronic medical section visitor, the belligerent and uncooperative employee, the chronic agitator, and the people who consume most of the time of the supervisor. These individuals are found everywhere in our society—in industry, in churches, and schools and their behavior is but an overt expression of a woeful lack of proper motivation and discipline.

The most alarming behavior found in these individuals is that generally speaking they have succeeded best in evading their responsibilities. The supervisor finds that the easiest way to carry on his job is to allow them to continue to evade their responsibilities. This of course, increases their tendency to progress along this line. They continue to disobey safety rules and they continue to have injuries.

Medical research has demonstrated that perfectly healthy individuals put at bed rest

will begin to deteriorate physically in a short time. On the other hand exercise and work will increase stamina. The same principle applies here. If these individuals are encouraged and forced, if you will, to accept their responsibilities and to respect discipline they also will tend to grow stronger as good employees.

These individuals who cause us the greatest problems in safety cannot be spotted in a crowd and they cannot be described by their shape, size or personality and, contrary to common beliefs, their behavior is not due to heredity, or conflicting instincts, or to material insecurity, or world tension, or irregular shift work, nor by any of the common excuses. The simple answer is that they have been allowed to continue their activities without discipline. They have not properly recognized authority, nor are they able to maintain a proper submission to authority.

Discipline is the life blood of every organization, the base of every vital program and enterprise. When we permit employees to treat instructions as suggestions whether or not these instructions pertain to safety or quality, we are perpetuating the system that produces problem employees.

We must keep our work rules and safety rules up to date and insist that they be followed. Supervision should be quick to recognize any attempts by employees to evade their responsibilities. If such attempts are promptly corrected the supervisor gains the respect of good employees and unsatisfactory employees tend to progress toward a more satisfactory level. Consistent and insistent handling of offenders will bring about a state of mental health and build an "esprit de corps" that the group will be proud of.

After an accident has happened it is too late to prevent the injury, although complete analysis of the condition leading to the accident is necessary for the future. One never can develop a good safety performance by studying past history. Therefore, a philosophy of preventive safety must be developed rather than after-the-fact correction.

An analysis of how the operator performs the job will pay greater dividends than a thorough study of how the accident happened. Safety rules which are obtained by reasoning with the cooperation of the supervisor and operator before the accident happens are much more valuable safety rules than those placed in the books as an alibi after an accident.

I am sure that many of you will immediately have the impression that I have used harsh words in describing some of the elements of a successful safety program. I am also sure that many of you will feel that this is totally impractical in present day terms of getting along with one another and having a good employee relations program. I admit I have used firm procedures but if I were to describe a successful employee relations program, even though I am certainly no expert in that field, I believe I would incorporate most of the things I have said in that program also.

History shows that successful men are constituted to show extremes in their nature. Jesus in his teachings and actions was a man of extremes. He drove the money changers out of the temple and yet He was tenderhearted when He came to dealing with a well known sinner. A good foreman will inevitably be described as a fair and kindly man, but firm or tough. So, in order to have a successful program in safety you, too, must be a person of extremes.

What I have been trying to say is that an effective safety performance is not a matter of luck or happenstance, but most of all it is a matter of decision.

In summary I would like to point out briefly the essential ingredients of a successful safety program.

1. Management must sincerely believe that injuries can and should be prevented.

2. Management must have a sincere desire to prevent all injuries.

3. The success or failure of a safety program depends on line supervision.

4. The nature of the work has little to do with safety performance.

5. A few of the people have most of the injuries.

6. Every employee must accept the responsibility for his own safety.

7. Effective discipline promotes the organization's health.

8. Use preventive safety instead of after-the-fact correction.

PLANNED MULTIPLE SEAM MINING

By C. D. BOWLING
Plant Eng., Semet Solvay Div., Allied Chemical Corp., Longacre, W. Va.

The Harewood Mine of Semet-Solvay Division, Allied Chemical Corp., is located two miles east of Montgomery, W. Va., along the Kanawha River. The Division, hereinafter referred to as Semet, purchased the Harewood Mine from the Kanawha & Hocking Coal & Coke Company in October 1938. The property consisted of several leases and tracts of fee lands, with several old mines located on them. Kanawha & Hocking was mining in the Eagle Seam and its tipple was on the Kanawha River, with a railroad siding on the New York Central. Coke ovens were located at the plant and in adjacent townsites of Longacre and Carbondale. Coal was loaded into barges for river shipment and into railroad cars for shipment to coke ovens.

The Eagle Seam was being worked by hand loaders and had been advanced through a fault area where the coal was relatively clean. The seam thickness was about five feet.

The Number 2 Gas Seam had been worked extensively on the north side of the property, but at the time of purchase was not being worked. This was due primarily to a large thick rock parting which had been encountered in the seam. The same could be said of the old mine just east of the Harewood Mine in the Eagle Seam. Heavy rock, which is high silica sandstone, had been encountered, and the old mines in this seam had been abandoned.

In 1938, Semet's job was primarily to furnish coal to its own by-product coke ovens and to the local beehive ovens. It was decided that we should install a Chance cone cleaning plant to clean the 4 x ¼ product. The ¼ x 0 uncleaned slack was to be fed back and blended into the cleaned product. With an increase in mechanization it became necessary to install fine coal cleaning in 1947. Deister tables were installed to clean the ¼ x 0.

The three seams presently being mined are Number 2 Gas, Powellton and Eagle. The Number 2 Gas is the top of the series. The immediate roof is shale but overlaid with massive sandstone. The floor is a firm gray shale. The interval between the Number 2 Gas and Powellton varies between 20 and 60 feet.

The Powellton Seam varies in thickness between 38 and 50 inches, with a number of slate partings throughout the seam. The roof varies from a shale to a sandstone, with streaks of conglomerated shale and sandstone, with a number of small concretions in them. The floor is soft shale or fire clay which distintegrates upon contact with water and does not support pillar extraction very well. The interval between the Powellton and the Eagle varies from 120 to 160 feet.

The Eagle seam varies in thickness from 35 to 100 inches. The 35-inch seam is one bench of a series that makes up the Eagle Seam. In one area we mine the top two benches and in another area we mine the bottom two benches.

The cover varies from 0 to 1,000 feet or more. The mountains in our area that overlie the above three coal beds contain a number of hard sandstone benches, particularly those above the Number 2 Gas bed. In some cases, the sandstone comes down to the upper split of the Number 2 Gas. The cover is such that it is not uniform in depth, due to the valleys and ridges in the area.

The Number 2 Gas strata contains a number of thick sandstone benches. The immediate roof is usually a hard, gray shale and makes a good immediate roof. The roof support in the Number 2 gas in the face area consists of roof bolting. A typical section consist of six headings on 75-foot centers with crosscuts on 75-foot centers. The equipment dictates the number of crosscuts between loading points.

If we are loading with an 11 BU Joy Loader, we usually have three crosscuts between the loading points. All of our sections load the coal from shuttle cars directly into mine cars. We install 60-lb. rails on wood ties on the loaded side and 60-lb. rails on steel ties on the empty side. If smaller

units are used, such as 14 BU Joy Loader, then we have two crosscuts between the loading points. We use the same projections in the Eagle. In the Powellton, the entries are 60-foot centers and crosscuts on 76-foot centers.

In the Powellton Seam the immediate roof varies from a sandstone to a gray shale. It is hard to describe the many changes we have in the roof in this one seam. We have from excellent to very poor roof in any area we work. We roof bolt in most areas and supplement this with straight timbering. I recall in one section we were working, we were driving six headings in a butt entry. The three on the left were in sandstone and the three on the right in shale. We were roof bolting the shale, supplemented with straight timbering, and only timbering on the sandstone side.

The Eagle roof is a hard, gray shale and we consider it to be very good roof. However, we do encounter some trouble in this bed in the roof, and reasons will be given for that later.

The problem of multiple seam mining divides itself into three problems. One is the effect of subsidence, both on the surface above the coal seam and upon the coal seams that overlie the seam mined; second, the consideration of coal left in place for support; and third, the prime consideration of the effects of mining in one seam upon another.

In multiple seam mining, roof control is most important. This is done by artificial support. The influence of mining method is a controlling factor in roof subsidence. In the longwall system you have gradual subsidence of the roof. The immediate roof support is close to the face, but the overall subsidence is over a large area, once you get your face established. In the room and pillar system, where complete extraction is practiced, the floor control is somewhat different. The entry and rooms are driven up and allowed to stand for a while. Some subsidence takes place in this allotted time.

The roof control in the longwall system varies from the control in the room and pillar system. Subsidence is greater in the room and pillar system than in the longwall system. The initial coal removed from the seam in the room and pillar system is approximately 50 per cent, while that of the longwall is smaller, depending upon the size face you established.

In the room and pillar system of mining, which we basically follow, there are two systems. In some cases, the lease a coal company has will dictate the system they will use. If the lease requires full extraction, and reasonably good conditions prevail, then complete extraction will be followed; if not, then most companies use partial mining.

At Harewood we are faced with mining three seams. In two areas we were confronted with overlying seams being mined first. Both of those areas were mined by other companies. In our case, it was the Number 2 Gas Seam mined by others while we were mining in the Eagle Seam. The strata between the two seams contained a number of coal streaks and streaks of massive sandstone. The roof over the Eagle is a hard, gray shale.

In areas where we were mining before getting to where the overlying seams were mined out, we were successfully holding the immediate roof with 30 and 42-inch bolts and straight timbers. When we entered the area where the overlying seam had been mined, out, we encountered disturbed roof conditions and had to start using 72 and 84-inch roof bolts with heavy timbering. In order to keep our haulage roads open we had to start setting 10 x 10 headers on 10 x 10 legs, and then it was a continual problem of timbering.

In several areas we encountered excessive weight. The best reason we could give for this was that pillars were left in the overlying seam. It is a known fact that pillars left in the upper seam will take the weight of the overburden and transmit it to the strata below. This will cause an excessive pressure on areas on the seam below being mined.

The difficulty encountered with mining the top seams first can be seen by the above, namely the transmitting of pressure to the underlying seams, causing bad roof conditions and in some cases crushing or sloughing of coal and causing the bottom to heave. This will be in an area where the roof is strong. If you have a strong, hard floor, usually a roof failure will be encountered with the crushing of the coal itself.

In extracting pillars under a seam that has previously been mined, consideration must be given to the possibility of water from the worked-out overlying seam. If water is in the overlying seam it is possible, if you break the main roof, to get large amounts of water in the working area. We have pillared in one area where the interval is the largest, and we have encountered water in our faces along the pillar line.

We have driven active entries into areas where the overlying seams have been mined out, and some minor water problems have been encountered. In both cases, the overlying seams were mined by the other companies and we were not sure what was left in the old or upper seams. We had attempted to explore them, but in pillared-out areas it was impossible to check them.

The basic seam in our plan of mining is the underlying seam. When Semet took over the Harewood Mine, the Eagle Seam was the only seam being mined. The other seams were added at a later date. We have mined some Eagle coal in areas that are overlaid by Powellton and Number 2 Gas, but in most cases, we have tried to mine the Eagle in areas where the Number 2 Gas and Powellton are not mineable or have been mined.

We have found that where we have mined the underlying seam first, we encounter some bad roof conditions at the point in the upper seams where we cross from solid to pillar works below. Once we get through this area of bad roof and get into where the subsidence has settled down, the roof is usually stable and not too bad. However, it is not as good as if it were in solid work.

Separation of the individual layers of strata is possible. In one case in the Powellton Seam we encountered a separation of the coal from the roof. The coal separated from the roof about 2 inches in some cases and in others less. This does not usually cause any difficulty in mining, but could cause some trouble in ventilation.

Cracks between the seams can cause some difficulty in the ventilation system. It is possible to pull air from one seam to the other. This can cause the fans in the respective seams to buck each other and cut down on their efficiency.

In areas where the underlying seam has been pillared, it is possible to get serious disturbance in other seams where isolated pillars or a small group of pillars are left in place. The results of this are basically the same as results from pillars being left in overlying seams.

The importance of controlled pillar work cannot be stressed too much; it is very easy to run off from a pillar today, but someone at another time can very easily suffer. It has been shown that isolated pillars abandoned in underlying seams cause severe damage. No preventative measure can be taken to avoid this disturbance if the bed has been mined at some previous time, other than anticipate and be prepared for the disturbance while mining the superjacent seam.

It must be realized that voids are created by mining the underlying seams. It is necessary that they become filled with fallen rock so that the condition in the overlying beds becomes stabilized. The time required for stabilization following subsidence varies greatly. The factors that affect stabilization are the thickness of the seam and the nature of the strata overlying it. Some people are of the opinion that a 5-foot seam takes 5 to 10 years to stabilize. It has been reported that in areas where the Beckley seam has been mined and pillars extracted, the seam has not stabilized after a period of 12 or more years. The Beckley seam in most cases was extremely thick.

In the mining of more than two contiguous seams, the method of mining and interval between seams appears to have more important bearings than any other factors. The effects of mining on not one but all seams must be considered. Collapse of strata caused by mining in the lower seam may well cause subsidence which would harm the upper seams; this could in turn set up stresses which would be transmitted down to the adjacent workings in the lower bed. Mining of the upper seam usually takes precedence over the lower seam.

While development work or first mining could be done in either seam without any great regard to the other, it is generally considered best that pillar extraction be done in the upper seam first. This removes the danger of subsidence and subsequent damage that would be produced if the pillars in the lower seam were mined first.

In cases where the interval is small and the roof weak, pillar falls in the upper seam led to caving of entry work in the lower seam. For this reason and others, a system of correlating pillar lines in the two seams is generally attempted. This involves keeping the two lines parallel, with the line of the upper bed slightly in advance of the lower. This is very difficult to do with modern mechanized mining.

If the pillar line of the upper bed should lag behind the lower, it would be endangered by subsidence from the lower bed; if it should be too far in advance of the lower seam pillar line, there would be a possibility of damage to the lower seam. The usual practice is to keep the upper seam pillar line not over 100 to 150 feet in advance of the lower pillar line. When the interval between seams is less than 75 feet, difficulties are likely to be encountered under the best of plans.

In nearly all mines where two or more seams are being mined, there is some disturbance in either one seam or all of them. For this reason, we sometimes turn to a system of partial mining. Certain precautions must be taken in the utilization of partial recovery system as well as any other. The relative quality of the two seams must be considered in order to decide whether one or both shall be partially mined. The amount of coal which is left for support of the other seams must be determined, and is it important that the coal left for support be left uniformly. While partial recovery mining cannot be regarded as the solution to the problem, it has appeared quite successful.

In most multiple seam mining areas, the amount of coal left for roof support is determined through practical knowledge and experience of others. If a known per cent has been proved successful, then that percentage should be used. However, some rules of thumb have been used, such as: with overburden less than 100 feet, 25 per cent of the coal should remain; from 100 to 175 feet overburden, 40 per cent of the coal should be left; excess of 175 feet of overburden, 50 per cent of the coal should be left in the remaining pillars. One important thing here is that the pillars should be left uniform in size and shape.

In conclusion, it is realized that certain difficulties arise in mining vertically adjacent bituminous coal beds. Several factors have been shown to have an influence on the presence and amount of disturbance in multiple seam mining. It appears that the proximity to each of the seams is the most important.

The next factor is the method of mining in all seams concerned. Of great importance in the amount of disturbance to a subjacent bed is the amount of overburden on the upper bed. Other factors are nature of strata, thickness of coal bed, passage of time since mining, dip of beds and strength of the coal and adjacent rocks.

Mining lower seams first can create a hazard for upper seams, particularly if the lower seam is gaseous. Gas can be pulled off old works through cracks into active workings. Working the upper seam first can create a water problem if the upper seam is not properly drained, and it is here where the dip of the bed becomes important. From a safety standpoint one of the most important things is the roof condition created by the pressures on the adjacent roof and floors.

Regardless of the method of mining for the recovery of contiguous beds, the importance of careful planning cannot be emphasized too greatly. A plan of mining best suited to the situation can be projected and worked. Careful planning in advance of the actual mining will reduce the difficulties in multiple seam mining, thereby producing a more feasible safety program. It is important that each of us understand the problems of multiple seam mining today because more and more companies are being faced with this problem.

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1964

National Safety Congress Transactions

Volume 9

ELECTRICAL EQUIPMENT

NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
Chicago, Illinois 60611

specifications which you have established on firm electrical principles, will insure against unfortunate and avoidable electrical accidents or fatalities. Most basic of all is vigilance and constant checking of equipment and installations.

ARE ELECTRO-MAGNETIC HOISTS FOOLPROOF?

By MYRON L. MILLER
Supervising Safety Eng., Westinghouse Electric Corp., East Pittsburgh, Pa.

With over 25 years experience in the use of electro-magnets, with almost half of this time being spent in miscellaneous material handling applications, we have yet to experience a magnet failure which resulted in a disabling accident.

Until October, 1963 we had not had a disabling accident which involved an electro-magnet hoist. In October last year we had our first one; however, it was not due to magnet failure but rather to human failure.

A "hook-on" man was loading small steel plates side by side on a pallet by use of an overhead electro-magnet crane hoist. He failed to stack the plates evenly which caused the magnet to slide off the pile when the power was released. The sliding magnet struck the man and fractured his leg. He was involved in two unsafe practices which were within his power to control, namely, unstable stacking and failure to stand clear of the load.

Electro-magnet hoists have been used safely in steel storage yards and over iron scrap areas for rough handling for many years. Power failure has not been considered a significant factor because the areas were isolated and with little or no exposure of people. Safety men have been reluctant however, to consent to their use in manufacturing areas.

About 12 years ago we faced a problem of handling parts and scrap material from our large automatic burn-out tables where we were flame-cutting irregular shapes from heavy steel plate. We were using chains, wire rope slings, safety clamps, and miscellaneous special handling devices to move the cut-out parts and to pick up the remaining scrap to load into gondola cars. This was hazardous work and we were experiencing frequent accidents resulting in serious injuries. In fact, during this period, the incidence of hook-on accidents was the highest of any occupation in our plant.

After a survey of others' experience in this area of material handling, we decided to try an electro-magnet hoist. We have been pleased with the results. In the past 12 years we have extended the use of the electro-magnet to many handling jobs.

It is our feeling that with properly controlled work conditions and with strict adherence to safe work practices, many material handling jobs can be done quicker and safer with electro-magnet hoists.

Let's consider a few applications.

Heavy steel plates may be handled safely and quickly by single unit magnets. The usual capacity range of this type magnet is from one to thirty tons.

Where heavier or more bulky loads are to be handled, two or more magnets may be arranged with spreader bars to distribute and to stabilize the load.

When handling long, thin steel sheets it may be necessary to use magnets of large, cross-sectional area separated by a spreader bar to distribute the load and prevent "peeling-off."

Either small battery-energized magnets or large overhead crane magnets may be used to load steel plates on burn-out tables. After the parts have been cut-out, they may be removed by the magnet and the remaining scrap may be picked up as well.

The electro-magnet provides a safe means to load ferrous metal scrap into railroad cars. Our experience over the past 10 years has proved this to be much quicker and much safer than by other conventional methods.

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1964

National Safety Congress
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Volume 11

GLASS and CERAMICS; RUBBER INDUSTRIES

NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
Chicago, Illinois 60611

SAFETY—A PLANT MANAGER'S VIEWPOINT

By ROBERT K. EBY
Plant Mgr., Dearborn Glass Plant, Ford Motor Co., Dearborn, Mich.

The title of plant manager is the most widely misused of any organizational description. It designates the operational head of large and small components engaged in all varieties of operations. So before you get that brief look at safety from this plant manager's viewpoint, I want to establish what the title means in my individual situation.

My job is to manage the Dearborn Glass Plant, a manufacturing operation of Ford Motor Company, which is an organization of approximately 1,300 employes. The company manufactures plate glass and fabricates automotive windshields.

When Roy Seltz, manager of Ford's Nashville Glass Plant, spoke to you two years ago, he pointed out that the Nashville plant was the largest automotive glass producing plant in the world. Not to be outdone by my Southern colleague, I can state that to our best knowledge, the Dearborn Glass Plant is the largest single-plant producer of automotive windshields in the world.

This year, we will manufacture in excess of 1.5 million windshields of which 20 types are installed in Ford products. The balance is produced for the windshield replacement market. We fabricate 125 different models and types for General Motors, Chrysler, American Motors, and International Harvester vehicles.

You may be looking through Ford glass as you drive any model car built since 1955, if that car's windshield required replacement since original installation. We also supply flat glass to a windshield fabricator who supplies approximately 50 per cent of the current production requirements for American Motors windshields.

Our plant is organized as a completely independent entity. We have our own manufacturing engineering, plant engineering, controller, production control, quality control, and industrial relations personnel. Under the Ford profit center system, we sell our products at competitive prices and are expected to meet or beat the return on investment experienced by other glass manufacturers.

Our safety activity is a part of our industrial relations organization. Organizationally, our safety representative is only two steps away from the plant manager. We feel that this establishes the safety function at a level where it can be most effective in our daily operations. Safety personnel at division and corporate level functionally direct the plant program.

So much for our organization and my job. Now let's examine your job and what I feel you might do to become more effective in your efforts to assist plant management.

I want to warn you at the outset that my comments are not going to consist of flowery phrases glorifying the importance of safety engineers in the operation of a manufacturing plant. All of you are aware of the importance of your respective jobs. The question is, have you convinced the management in your plants or companies that safety is as important as you believe it to be?

Let's examine, for a moment, the tools you have available to sell safety to plant management. Through the years you have developed a statistical evaluation of safety which when reduced to its simplest form, amounts to a determination of whether an operation has improved or declined in its safety performance.

In Ford, and I am sure in many other companies, management is periodically informed as to injuries experienced and lost time accidents incurred as compared to the prior month and prior years. Relative company standing for each operating unit is reported on a monthly basis. These data give plant management a quick look at trends and relative safety experience. This is a well-developed program and I am sure has resulted in safer manufacturing methods and practices.

First of all, in your field you are dealing with a subject against which no basic disagreement exists. There are no "anti-safety"

human beings. To my knowledge there are no "pro-accident" members of management.

Plant managers have humanitarian traits although they can't display them too frequently. Even tough, hard-boiled production and maintenance supervisors recognize that unsafe practices can't be tolerated. You don't have to convince management that an injury to another human is an undesirable event.

Two tools, statistics and emotion, have been well developed and sold to management by safety personnel. Can you rely on these tools to support a long-range program of safety in a manufacturing operation? I don't believe you can hope for more than routine acceptance by management unless you expand your safety selling program. Put your program into a form which fits the pattern of the basic objectives for manufacturing management. To be very cold-blooded about this, have you ever heard of a manufacturing manager being fired solely on the basis of a poor safety record? Conversely, you have undoubtedly heard of managers who were fired even though they ran a plant which had the best safety record in their company or industry.

Doesn't this explain, to some degree, why safety problems often receive relatively minor attention from many members of manufacturing management?

Perhaps it would be well to review the prime objectives of management in a manufacturing operation so as to better understand how to present your safety recommendations and fit them into these prime objectives. Simply stated, these prime objectives can be summarized in one phrase—make a quality product, in scheduled quantity, at competitive cost.

You can expand that statement into many detailed objectives but it still results in quality, schedule, and cost. An excellent management team meets all three objectives every day, every month, and every year.

A management team may perform in an acceptable manner for two of these objectives but fail, miserably in the third and soon you will find new faces in the organization. I am not here to recommend that you attempt to establish safety as a co-equal objective with quality, schedule, and cost. I doubt very much if you could convince me that it is of equal importance. But perhaps we can relate safety to these three objectives and thereby more firmly establish your program as a dynamic part of the job of managing a plant.

Take quality for example. In glass manufacturing we are continually plagued with quality problems. Our product scratches, chips, distorts, and when you drop it, it breaks.

The losses incurred for these reasons alone are staggering. Many instances occur when a piece of glass is damaged because an employe feels that the prescribed method of handling is unsafe and therefore he deviates from the method to avoid injury. In so doing, he causes a reject.

Suppose he is right. Can you as a safety engineer get more management attention by pointing out that the method is unsafe or would you be more successful if your investigation included the amount of rejected material generated by the employe who is trying to avoid an unsafe method?

If your case is solely based on the fact that the method is unsafe, the most likely response you will get from the foreman is, "We've been doing it that way for 12 years and no one has been hurt yet." Sound familiar? Let's assume you could tell that same foreman that you might save him twenty, thirty, or forty pieces of scrap per day. If you could time your contact properly, you might catch him on the way back to the job from a quality "chewing-out" in the superintendent's office. I'm sure you would get a favorable reaction to your suggestion.

Safety as related to output is an even better field for study. Every plant has well-trained operators whose individual productivity exceeds that of workers performing similar tasks. If that key operator is working under unsafe conditions, can you state the possible loss in terms of productivity rather than injury statistics? Try it a few times and I'm sure your proposals will get more attention. One unsafe practice cost in excess of 250 thousand square feet of glass but never appeared in any safety report. (Rolling machine-raking spout).

Safety related to cost is a "natural." What is the cost of an injury in your plant? Your plant manager may be enjoying the number one position in the company for the best safety record. At the same time, he

may be under pressure to reduce costs in order to meet competition. The cost of an accident has had a phenomenal rise during the past ten years. Plant management is genuinely interested in costs involving:

1. Lost productivity
2. Training replacement employes
3. Poor quality resulting from use of untrained personnel
4. Improper use of equipment
5. Medical services costs
6. Workmen's compensation
7. Overtime to cover absentees

All of these cost elements can be identified and reported for every safety hazard *before* the accident occurs. Get better acquainted with your cost analyst or controller. You can certainly benefit if your ideas and recommendations have a "dollar sign" attached. It costs money to be safe, but it costs more to be unsafe.

The approach you take in relating safety problems to the objectives of manufacturing management must be tailored to your individual plant or company. When your management recognizes the co-equal objective of quality, schedule, and costs, your problem is much simpler than if the management leans heavily to one of the three.

Don't try to sell safety from a productivity standpoint when the immediate plant problem is quality. Keep your ear to the ground and know what the plant problems are. Design your sales talk to match the plant problem.

One of the popular conceptions of a safety representative is that he is a "worry-wart," a "prophet of doom," a "negative personality," and a "Monday morning quarterback." Quite frankly, I have dealt with individuals who fit this description. I have never felt that they effectively contributed to plant operations and I'm sure that the cooperation they received was limited. I am proposing that you avoid this tag and become an active part of management.

Continue your statistical reporting but look for more positive ways to sell your safety program. Speak the same language as your foremen, your superintendents and your manager.

Show that safe practices, safe equipment, good housekeeping, and safety consciousness can be, and are, vital contributors to the success of a well managed operation. You will find, if you are willing to look, that your program can be related to management's objectives of quality, schedule, and cost.

When you establish this relationship, your job will be made easier and your management will be more interested in your recommendations and thereby more safety minded.

WHAT'S ALL THE NOISE ABOUT HEARING LOSS?

By J. S. SHARRAH
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Hearing loss is an affliction which has existed throughout the history of mankind. Disease and traumatic injury probably accounted for a considerable portion of the cases of hearing loss, but one can imagine the levels of sound produced on the ear by the constant ring of a broadsword or a mace being brought down heavily on a metal helmet.

Also, the Bible states that the walls of Jericho fell when the invading armies' trumpets were blown, and all the savage tribes usually used some manner of noise to frighten or upset their opponents when in battle.

It is reported that a short time ago words were exchanged in the House of Commons in Britain between the English members and the Scots where the English interjected the skirl of bagpipes into a discussion on noise, and the Scots countered, suggesting that the English may not have an ear for music. However, hearing loss or a decrease in hearing sensitivity resulting from noisy occupations has been known for over 100 years.

Prior to 1948, hearing loss was not regarded as a significant factor in Workmen's Compensation. Also, since most of the claims were for traumatic injury in the past years, hearing loss was not concerned with Workmen's Compensation since partial loss of hearing due to noise was not ordinarily considered compensable. This was due to the fact that many years of exposure are usually necessary to create a significant hearing loss.

The development of hearing impairment is usually a slow process and the date of injury is difficult to establish. Very often a hearing impairment did not result in a loss of wages and therefore, in general, the compensation laws did not apply. In those stated where hearing loss was compensable, as an occupational disease, the number of claims were limited by the requirements that there must be a wage loss, the hearing loss had to be total, or there were limited provisions for the establishment of the date of injury.

However, in 1948, the New York Workmen's Compensation Board ruled that the schedules for loss of hearing existing in the law was applicable to both accidental injuries and occupational diseases and further ruled that a claimant was entitled to an award even though his partial loss of hearing did not affect his earning power.

In 1951, a precedent was established in Wisconsin when the Industrial Commission ruled that the date of injury was the last day of work before filing a claim. Since the Wisconsin Law covered occupational diseases this made the case compensable even though the hearing loss was only partial and the claimant was still employed and had lost no wages.

In 1955, a legal precedent was established under the United States Longshoremen's and Harbor Worker's Compensation Act. This act makes no distinction between accidental injury and occupational disease. The defense argued that compensation for loss of hearing should be paid only when there was a wage loss. The courts held that occupational loss of hearing was compensable even when not accompanied by a wage loss.

In 1959, the Missouri Supreme Court held that the loss of hearing is an occupational disease and compensable under the disability schedules in the Missouri Law.

Also in 1959, in two cases in Maryland, the courts held that no compensation could be paid as long as the claimant is not actually incapacitated from performing his work and had no wage loss.

In 1962, a significant decision was made by the courts in Georgia. The Georgia Law provides that injury shall not include disease in any form. There is a schedule of benefits for total loss of hearing in one or both ears.

As in other states, a section of this law lists the occupational diseases included by the law. The defendants argued that loss of hearing was an occupational disease, but the court ruled that the loss of hearing was the cumulative effect of a succession of traumatic injuries suffered by each sound impulse on the air. The court therefore allowed the claim and accepted the medical evidence presented in this case whereby it was stated that a 51 per cent impairment represented a total loss of industrial use of the ear.

There are three main legislative precedents the Wisconsin, New York, and Missouri laws.

The major points of the Wisconsin law are:

1. Occupational hearing loss is compensable and is listed under a separate schedule;

2. The last employer is liable for the entire hearing loss if exposure is proved, unless he can show a prior hearing loss;

3. No claim for benefits under the schedule may be filed until six consecutive months of removal from the noisy environment after date of injury. The date of injury is defined as follows:

(a) Transfer because of occupational deafness to non-noisy employment

(b) Retirement

(c) Termination of employment

(d) Lay-off—provided it is complete and continuous for a year.

4. Separate provision is made for compensating an employe who, because of occupational deafness, is transferred to other noisy employment, thereby sustaining a wage loss, subject to a maximum of $3,500.

5. There is no formula in the law for the measurement and evaluation of hearing loss. However, there is an administrative

ruling which describes a formula recommended by the A.A.O.O. and the A.M.A.

The major difference between the New York Law and the Wisconsin Law lies in the area of apportionment of liability. The Wisconsin Law relieves the employer of liability when he can prove a prior hearing loss, whereas the New York Law holds the last employer liable for the total hearing loss. However, in the case of the New York employer, he does have some subrogation rights if the exposure existed within a previous three year period.

There are two main differences in the Missouri Law from the precedents in New York and Wisconsin:

(1) There is a statutory requirement requiring the use of a formula for the measurement and evaluation of hearing loss.

(2) As part of this formula, it requires an allowance for the average hearing loss that accompanies age in the population, or as this is called, persbycusis.

The Council of State Governments has recommended certain state legislation which would include:

(1) The six month waiting period

(2) Measurement of hearing threshold levels at 500, 1,000, 2,000 cps

(3) An allowance of 1/2 decibel per year for ages over 40 for persbycusis.

It has been estimated that as high as 8 per cent of the employe population may be suffering from hearing loss so it can be seen that the problem is widespread.

The common definition of noise is unwanted sound, so it can be seen that the difference between sound and noise is one of psychological response rather than the physical characteristics. For the purpose of further discussion, these terms will be used synonymously.

There are two distinct types of deafness —conductive and perceptive deafness, and these also may be found existing together.

Conductive deafness results in abnormal conditions in the middle ear and is not believed to bear any causal relationship to excessive noise. Perceptive deafness is due to many causes, among which is excessive noise.

Certain prenatal diseases and childhood diseases often cause perceptive deafness as well as certain drugs of the streptomycin and salicylate group. However, the most common cause of heavy loss is the degenerative process that takes place in the cochlea during the process that takes place during the physical process of aging, or persbycusis.

It is comparatively easy to distinguish between conductive and perceptive hearing loss, but it is impossible to determine from examination alone that a given cause of deafness is due to excessive noise. However, as with many diseases, the medical history, the evaluations of exposures, etc., will lend the expert very valuable clues to determining the responsibility of hearing loss.

Usually high frequency noises are more injurious than low frequency noises when they are of similar intensity. The most damaging to hearing is the noise in the bands 600-1,200 cps and 1,200-2,400 cps.

The organ of hearing possesses considerable recuperative power. For example, when the ear is just subjected to reasonably excessive noise, there is a threshold shift which may return to normal when the exposure is discountinued. This is called the T.T.S. or temporary threshold shift. With continued exposure over a considerable period, this may become a P.T.S. or permanent threshold shift or loss of hearing.

The most important function of the human ear is to hear and discriminate between speech sounds. These sounds usually lie in to 500 to 1,000 cps and the 1,000 to 2,000 cps bands. Consequently, testing for deafness often is done at the 500, 1,000 and 2,000 cps levels.

When we wish to measure noise, it must be considered that noise has two significant qualities, intensity and frequency. Many states and/or agencies have criteria for overall sound levels without regard to the separate octave bands in the sound spectra. Consequently, these levels will vary between 85 to 95 decibels, the unit of sound intensity.

Actually, it is far better to measure the intensities of the various octave bands to more correctly gauge the degree of exposure. Most criteria indicate that a threshold limit should be established for broad band, continuous noises for five or more hours per day at 85 decibels, as the average for the 300-600, 600-1,200, and 1,200-2,400 cps levels.

If it is established that noise is excessive in an industry or in specific instances, there is a suggested method of attack which is similar to that which is used to attack other industrial problems.

A. If a new plant is to be built, the plant should be planned in such a manner that no excessive exposures are created.

B. If plants are already built, the substitutions of quieter equipment, processes or material may be considered.

C. The first method of noise reduction which should be considered is noise reduction at the source.

1. The driving force of vibrating surfaces may be reduced by:

a. Reducing the forces

b. Minimize rotational speed

c. Isolation

2. The response of vibrating surfaces may be reduced

a. By damping

b. By additional support

c. By increasing the stiffness of the material

d. By increasing the masses of the vibrating members

e. By shifting the resonances

3. The radiation from the vibrating surfaces can be reduced by reducing the effective area of the radiation—

a. reducing overall size

b. perforating surfaces

4. Utilize the direction of the source.

5. Reduce velocity of fluid flow (air).

a. Increase cross section of streams

b. Reduce the pressure

6. Reduce the cross sectional area of the air jets.

7. Reduce the air turbulence.

D. Reduction of noise by reducing the transmission through air.

1. Isolate by creating enclosures

2. The use of sound absorption in area

3. The use of sound absorption along transmission path

4. Sound absorption by resonators

5. Sound absorption by mufflers

E. Sound cancellation

There are also two kinds of personal protection against noises: the ear muffs and the ear plugs. The ear plugs, if fitted properly, will reduce the noise levels in the three important octave bands about 30 decibels, the ear muffs about 35 decibels and a combination of the two about 45 decibels.

When considering the noises which one encounters in the ceramic industry, one of the noisy operations are the forming machines. In a previously unpublished report, it was found that in the octave bands from 500 to 4,000 cps the sound levels ranged from 94 to 99 decibels as the average intensity in several plants at the various levels at the operator's position. Our own experience indicates that we have found the intensity levels at these operations to be somewhat lower than these levels.

However, the first report shows that with ceiling muffling, enclosures on the fans, and air valve mufflers, a reduction of from 6 to 7 decibels in the important octave bands can be effected at the operator's position, 20 feet from these forming machines and a similar reduction is indicated 30 feet away, and on the cat walk, across the feeders. A 3 to 15 decibel reduction is found in this same region in the forming basement and a 5 to 16 decibel reduction can be found in the combustion blower gallery.

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Basics of Safety

LIGHTING FOR PRODUCTION AND SAFETY

By M. HENRY KRUGER
Vice President, Smithcraft Corporation, Chelsea, Massachusetts

This subject matter is not simple. Neither is it complex—or perhaps mysterious or maybe just a vague problem without substance or body where results must rely on empirical methods rather than calculated processes.

It is more like that bothersome controversy of a woman's hat: Does she wear it to look pretty—or to keep her head warm—or maybe just to hold her hair in place—or to brag about her husband's income, a status symbol—or perhaps to be proper and ladylike—or because it's the latest style and merely the thing to do?

Now, your wife will give you a multitude of answers to this question, and you will find that no single one of these answers will be sufficient, but it is going to take a collective group of these answers to satisfy your query.

Lighting is just like that. The problem of how lighting can affect production norms and improve quality and safety is only answerable by a lot—and then still more—of little bits of knowledge.

The nice thing about this is that most of you have a lot of these "little bits of knowledge," but you are just not using them.

What I am going to tell you, show you, and demonstrate to you is mostly not new—but you will, I hope, be encouraged to use this knowledge—or rather, put it to work at once instead of letting it reside in the back rooms of your cranium.

One other facet about the subject matter of my talk: it must be obvious to you that illumination has absolutely no effect on the machines and tools we use and operate; therefore, we are concerned only with the affects of lighting on the human being.

Bearing this in mind, let us first examine some psychophysical and psychological aspects of vision or sight and show how these might have an effect on safety and production.

Then, we will consider light and illumination relative to this, and I will finally show you some results and accomplishments of good illumination.

Obviously, we can have no vision without light—and although the eye is the receptor of light rays creating vision, it is the brain that interprets what the eye sees. An interesting fact is that the brain does not always interpret correctly what the eye sees—and similarly, the eye often lies when it sends its message of what it sees to the brain.

The eye may be a fabulous piece of equipment, but often it may be contrary, and it is far from perfect.

The eye is imperfect for many reasons. Let's examine some of these. *First*, its response to visual acuity decreases with age.

Secondly, while the eye adapts itself to tremendous variations of brightness of surroundings, it does not do this quickly. In fact, under some conditions, such as from light to dark, this adaption is quite slow.

When our eyes are adapted to a bright sunny day, we do not instantaneously discriminate details. But as the adaption of the eyes take place, these details gradually become pronounced. An example would be the experience during a bright day of driving into a tunnel. The adaption time then is quite long.

Third, the eye does not see objects in correct proportion relative to each other—as an example—common perspective. This is, perhaps, the most obvious case of where the brain relying on its interpretation, training, and experience relays to our intelligence the concept of distance and depth—even though what a person is looking at may be a picture on a single plane without any depth whatsoever.

Fourth, the eye sees things that simply are not there. Perhaps, one of the greatest recurrence in accidents by seeing is com-

plicated by the problem of so-called 'After Image'.

Fifth, what the eye sees are oftentimes distortions and hallucinations. The eye always, without exception, sees vertical lines and objects as longer than horizontal lines.

Meanwhile, how about the brain? How does it contend with these misrepresentations and discrepancies? This mechanism has been trained over the years by repetition of experience and by memory, to interpret to our intelligence what the brain thinks the eye was supposed to have seen.

Now, I must grant that in most cases, the multi-functions between the eye seeing an object—relaying what it thought was an accurate picture to the brain which interprets this to our intelligence—works out fine. But how about those few cases when this coordination falls down? Does this result in an accident or slowdown? We must admit the potential has been created.

We can now draw this conclusion: the ability of the eyes to do a job while primarily dependent upon the visibility of the work is modified by the human being himself. We know that visual acuity is affected by age, subnormal vision, and the state of adaptation. Fortunately, such conditions benefit with an improvement in illumination, and subnormal vision gains far more percentage-wise over normal vision with this improvement in illumination.

So, let us turn our attention to lighting—and particularly to industrial lighting. The purposes of industrial lighting are to help provide a safe, visually comfortable environment; to provide efficient and correct seeing as an aid to all types of operations; and to aid in the conservation of vision and energy.

It is one of the best investments available which will benefit not only the production schedule and quality of the product—but also the morale, well being, safety, efficiency, motivation, and health of the employes.

This sounds good—but let us consider the amount of light and the quality of lighting found in industry today.

Some industrial plants are lighted with 1,000 footcandles which is more than the amount of light outdoors in the shade of a building on a sunny day. It is not uncommon to find plants using 100 to 200 footcandles throughout their operations.

Most of these lighting installations provide good visual comfort for the worker.

There are, however, still many industrial areas lighted with only 30 footcandles or less—and these plants are not enjoying the benefits of modern industrial lighting.

In modern industrial plants, it is interesting to compare office lighting with lighting installed in the manufacturing area.

Often the office lighting is good and meets the current minimum footcandle recommendations. However, the manufacturing areas in these same plants have lighting levels much lower than the offices. Often less visual comfort has been built into many factory lighting installations—and the lighting may be produced by glaring fixtures designed with practically no shielding and poor brightness control.

This occurs—even though the visual tasks in the factory usually are much more difficult—and dangerous. Also, more costly mistakes can result from poor seeing while better seeing in the factory can contribute directly to greater safety, a higher quality product, and also increased production.

What is the optimum quantity of light for the factory?

The desirable quantity of light for any particular installation depends primarly upon the work which is being done. In most cases, as the illumination of the task (and hence its brightness) is increased, the ease, speed, and accuracy with which the task can be accomplished are increased.

However, the brightness requirements which will produce optimum seeing conditions are materially affected by the degree of accuracy required, the fineness of detail to be observed, the color and the reflectivity of the work, as well as by the immediate surrounds.

Lighting recommendations, therefore, are based—not only on the performance requirements, but also on the characteristics of the visual task, and economic considerations.

The Illuminating Engineering Society has been responsible for intensive research in determining the footcandles necessary for various types of tasks.

The recommended level of illumination for medium assembly or machine work is 100 footcandles. For fine assembly or machine work—500 footcandles are recommended

Very fine work calls for 1,000 footcandles. By way of comparison, the current recommended illumination level for offices is 100 footcandles.

Since these footcandle recommendations are based on considerable research, it is difficult to understand why industry tolerates low footcandle levels and glaring luminaires in manufacturing areas which would be totally unacceptable for office areas in the same plant.

Let us now consider the quality of lighting.

All lighting systems are, of course, intended to provide illumination that permits easy seeing. Merely making tasks more visible and easy to see, however, is only one part of the story. The visual comfort of the installation must also be considered.

In creating the visual environment for the worker, it is necessary to first consider how most people perform visual tasks. Studies show that people performing visual tasks never continually fix their eyes on any one point. Even though the task is one that requires great concentration, a person's eyes have a tendency to move from the task to some portion of the surrounding area.

Therefore, the best seeing conditions require that the brightnesses of all areas in a room be in balance. This means in balance—not only between the task and immediate surrounds—but also for the fixtures and their surrounds, the vertical surfaces of the room, and in fact, all areas which fall within the visual range. The higher the level of illumination, the more important it is to balance brightness.

Room surfaces, ceilings, walls, and floor are a major part of the visual environment. The reflectance of these surfaces affect visual comfort. A ceiling with poor reflectance, for example, may absorb so much light that the fixtures become uncomfortably bright against its background. The total efficiency of the lighting system is also lower because of the loss of light through absorption by dark surfaces.

Recommending white ceilings in industrial areas is not a fantasy. Even though the area may be one of heavy dirt accumulation, the white ceiling will never get as dark as one of lower reflectance. Walls also fall in the same category.

Controlling reflectance of all surfaces contributes to the balance of brightness which is a must for comfortable visual environments.

A wide range of colors fall within these reflectance values. In general, lighter colors create a pleasing visual environment and contribute most to the utilization of light within a space.

Colors of a cool quality—light gray-greens or light grey-blue-greens generally are best suited to manufacturing areas for walls and backgrounds. Sharp contrasts, such as dark painted wainscots, moldings, and contrasting colors create distractions and should, therefore, be avoided. As opposed to this, rest rooms, reception, eating and recreation areas should incorporate warm tones and contrasts—because in these areas, distraction acts as a muscular relief and stimulates interest and friendliness.

While a monotone effect in manufacturing areas is desirable and must constantly be borne in mind, machinery, racks, etc. should be painted a color just one step closer to the yellow center of the spectrum.

Thus, if the walls are green, the machinery, etc. should be yellowish-green; and if the walls are greenish-blue, the machinery should be green. Objects that might be bumped into should be painted still closer to the yellow center of the spectrum. Changing the color toward the yellow center of the spectrum tends to advance the colors, so that the object stands out—rather than recedes into the background.

The same affect can be created by the use of more intense saturation of the same hue. Therefore, let us use color to help create depth perception as an aid to safety.

The selection of lighting equipment can either produce a pleasant or an uncomfortable visual environment. Well-designed equipment should meet certain basic requirements. Since the primary purpose of a luminaire is to deliver light to the task, this is the first design criterion.

Reflector designs which provide good shielding and permit a generous amount of upward light will contribute greatly to the over-all comfort of the system. The upward light balances brightnesses between the fixture and the surroundings. Good shielding will prevent direct view of lamps

within the normal viewing angles—thus, avoiding direct glare which is the main cause of interference with vision or eye fatigue.

An additional benefit derived from open-top luminaires is less dirt accumulation on the inside of the reflector. Convective air currents produced by heat generated by the lamps in the fixture are permitted free flow past the lamp and through the reflector. Most dirt and dust are thereby carried through instead of being deposited on the inside of the reflector. This is particularly important in areas where light loss from dust and dirt accumulation is substantial.

Matching the lighting system to the task is also important. Where the seeing task is bright and shiny, such as metal stampings, bright, small light sources—such as incandescent or mercury vapor lamps—should be avoided.

Large diffusing elements—such as fluorescent fixtures—will usually provide greater comfort, since the light strikes the surface of the task from many angles, instead of essentially one.

All bright surfaces make excellent mirrors which will reflect the image of the lamp, even though the luminaire is well shielded. Shielding only serves to hide the light source from direct view within certain angles.

With a black background—one adapts oneself to a low brightness when working. When the operator looks up, there will be areas of greater brightness to which he will quickly adapt himself. If his attention now returns to his work, some time elapses before the adaptation to the lower brightness level is made. So, even this is not the ideal solution—and this is why a balanced higher background brightness is required.

Previously, we mentioned that direct glare from fixtures that were not well shielded resulted in discomfort, fatigue, after-image, and other reasons for interference with vision. Windows giving natural illumination must be given the same consideration and should be shielded when they are in a direct line of vision.

Adding this all up, the best lighting system is on that provides illumination without becoming in itself obtrusive. If, upon entering a room, the first thing you see is a ceiling full of bright fixtures, then the system has not been properly selected.

Fixtures should blend in with their surrounds. Careful selection of fixtures is required to obtain these results. Good shielding and fixture brightness control are prime requisites.

Let us now consider economics. Benefits obtained from modern lighting to the worker can also be measured in profits. In factory after factory, it has been shown that better lighting brings improvements in productivity.

Production increases have ranged from a few per cent to over 25 per cent. Often more important than increased production, the factory owner also realizes benefits from fewer rejects, greater accuracy in workmanship, reduction in accidents, less eye strain, higher morale, better order and plant cleanliness. These benefits must be considered in calculating the cost of the lighting system.

What does it cost to own and operate a lighting system? Plant and equipment costs include indirect non-production costs such as supervision, research and development, and engineering and drafting services, etc. Typically, these costs are the largest portion of production costs.

Labor includes fringe benefits, etc., and is typically the second largest cost.

Poor light costs about two cents per man-hour and good lighting is four to six cents per man-hour.

Of course, costs for specific installations vary. Studies have shown, however, that the average hourly cost of lighting is about one cent per footcandle per hour for each 10,000 square feet of factory space. This covers installation, operation, maintenance and amortization of lighting equipment over a ten year period.

So, even for really good lighting, the hourly cost per 10,000 square feet of area works out to be less than the hourly wage rate for a janitor and the improved lighting would benefit all of the productive employes.

Not only production processes benefit from good lighting. Slow or improper storing and handling of materials often are a cause of customer complaints and accidents. Farrel Lines in Brooklyn, New York, has at least three piers lighted with fluorescent

lamps providing about 50 footcandles for easier handling and storing of material. Without enough light, equipment may easily be tipped over or damaged with a fork lift because the operator would be unsure of its position.

There are times when it is either not practical or economical to use only a general lighting system for a difficult task. At *Deluxe Coils, Inc., Wabash, Indiana,* about 600 footcandles are provided on the task. A general lighting system provides about 100 footcandles to provide a pleasant visual environment. Four hundred footcandles are added by the luminaires suspended over the tables. The magnifiers contain small fluorescent lamps for the other 100 footcandles. Wire, finer than human hair, is used in winding coils in this area.

There are certain pitfalls which must be avoided when using supplemental lighting. Brightness control is important. If only the task were lighted to 600 footcandles in this case—and the rest of the area ignored, eye fatigue would quickly result. As I said previously, balancing brightness between the task and its surround, and also with the general room area, is most important.

Lighting levels—even higher than full sunshine—are sometimes required for special tasks. An example may be in a place where over 10,000 footcandles are provided in a small area by superimposing the spots of 500 watt reflector spot lamps.

The task is seeing where to start an electric weld. With the mask down, the welder is blind until he strikes the arc. If the arc is struck with the mask up, the welder is temporarily blinded by the flash—and his eyes may be damaged. The 10,000 footcandles that are produced permit the welder to see the task with his mask down. The lighting in this case, is controlled with a foot switch—so that it can be turned off as soon as the arc has been struck.

The benefits here are obvious. The weld is placed exactly where it is desired. Chipping and machining are minimized which saves time in production and better appearance results.

There are times when the general lighting is blocked out by large equipment. Seeing is difficult for both the operator and the rigger. Supplemental lights mounted on the equipment would provide light—not only for rigging—but for safety, also.

It is easy to see how a new system can create employe stimulus, give greater flexibility to the production space and make more floor space usable.

It is also always interesting to compare the old and the new during the transition period. The contrasts are so much easier to evaluate.

WHY SAFETY IN AN INDUSTRIAL ORGANIZATION?

By W. C. MOSER

Plant Mgr., Nylon Plant, E. I. du Pont de Nemours & Co., Inc., Chattanooga, Tenn.

A speaker in a conference like this should be an expert on his subject. I'm going to be a departure from the norm. I'm going to admit that I am not expert—nor is my Chattanooga organization. Always when I'm preparing a talk on the subject of safety, I am reminded of an old decrepit story.

I have no desire to cast myself in this fellow's image. I am not going to talk today about how you get good safety performance—there are many good ways to obtain this, some probably better than we use on our plant—but rather why I believe safety is a major challenge and why I, responsible for the management of one Du Pont plant, am so deeply committed to safety.

Why is safety so fundamental in an industrial plant?

Because in our concept of running an organization, whether it be a research and development organization or a manufacturing organization, safety is (a) an excellent

vehicle for accomplishing nearly everything we have to accomplish; (b) and even more, it is a brutally sharp, quantitative measuring tool for telling us the results we are—or are not—getting.

I think the problem of good safety performance starts much earlier than how you go about getting good performance. I think too often, in too many places, we have started out to get safety performance—because it's a popular idea—or because we think we should.

It's going to be obvious that I think the most important starting place of a safety program is the positive intent to have good safety performance. If this is present, the rest will come. And in order for this to be present, each of us must come to his own reason why safety is important to us.

Many visitors who come to our plant—look around and then ask me the question—how much money do you spend on safety? They are usually surprised when I say that I don't really know. Then they ask—how can you possibly justify the amount of money you obviously do spend? If we were to look at what is commonly regarded as safety, we probably couldn't.

But we think the investment we make on safety earns us a very handsome return.

There are really three separate considerations that make safety a deeply personal and important matter for me. While these three are separate, they are so completely interrelated as to be almost indistinguishable.

I might describe these three briefly as:

1. Philosophical considerations
2. Economic considerations
3. Organizational effectiveness

First—the philosophical matter—that safety is humane, ethical and Christian. These are factors that we in business—who often are pictured as cold and calculating—need to cultivate not just as an image—but as a fundamental belief. We accomplish through individuals—and we must be constantly aware that they are individuals and not machinery. Why? We are dependent upon each individual accepting *his* responsibility for doing *his* assigned task.

Let me tell you about our plant just a minute. We produce nylon filament yarn—almost 100,000 individual packages a day. We guarantee the performance of every one of these packages. Our process is not very highly automated by many standards. We employ over 3,000 employes and by calculation there are some 500-5,000 chances of human error on every single one of these packages.

We have a supervisory-to-operator ratio of 20-30 to 1. Do you see why the individual is so important to us—why *his* acceptance of responsibility is one of our most important needs?

Safety is a continuous reminder to management and to the individual that regardless of the pressures of other factors, that the individual is paramount—and the soundest success of the whole is threatened by or based upon the success of the individual. It matters little why *he* accepts his responsibility—but accept it he must. And safety is a good vehicle to start this process.

Our newest employe, when hired, doesn't really believe in safety—and doesn't even conceive generally what we mean by safety. He is confused and distrustful and suspicious and skeptical for many weeks and months that we really mean safety first. I don't mean safety first when convenient; quality first and safety second, cost first and safety second, production schedules first and safety second. I don't mean safety first in concept and second in practice. If you can't believe and set safety first—then you are better off forgetting about safety altogether.

You may agree with me that safety is not something special over and beyond the job. It is a part of the job. Safety first doesn't imply that nothing else is important, but the consequences of setting safety second are damaging.

Because today's new employe, and many of the old employes, suspect that you mean safety first when convenient—and when you give him evidence this is so—then you are a hypocrite who can't be trusted—and you're going to have a difficult time convincing him that your motives with regard to safety, or to any other aspect of the job are not something that he should always question.

I believe—and our company believes—that no job will be done until we *think* that job can be done safely—and at some point the employes come to understand that we mean

this—and when this happens—he's working for a company who thinks of him as an individual and this, we believe, gives us the best employe—an employe who gives us an edge on competition. That makes us look like better business men. That makes me look like a better manager than I really am.

We try very hard to make a man's safety a very personal thing to him—his personal responsibility. If he has so little pride and respect for himself that he won't put out the effort to be safe, there just isn't much question that he will have any fundamental respect for his employer, his equipment, his costs or the quality of his product.

There is something else very important: I don't believe a young man is naturally safe. We are brought up believing it's manly to take chances—and wear the scars of the chances which didn't come off—as medals of honor.

If we can teach that kind of individual to curb our human nature to act first and analyze afterwards—we have a man who will to a great extent—do likewise when he operates his equipment.

We can't see inside a man's mind, but we can see if he is doing the job safely, and if he is, chances are he's also disciplined himself to do his quality job right during the large percentage of every day when we can't be looking over his shoulder. To me good safety and housekeeping are inseparable.

Housekeeping is extremely important in our concept for a very simple reason. Through this we believe we come to convince people that small, seemingly insignificant details are important and we are looking for the total job to be done.

I have said a lot about safety first. I haven't and won't say, "safety at *any* cost." The cold, hard profit aspect of safety is one which as business men is a second important consideration. Over a period of ten years we invest approximately $10,000 in the training of every one of our 3,000 employes. This is a third of a billion dollars.

I estimate for our business—as I am sure you would in yours—that while we can train a man to run a machine in any time between two month and two years—he doesn't become an employe trained to our way of doing business for five years or more. If that man is hurt or disabled, we not only have lost the investment in him, but have to underwrite the investment in a new employe of an equal amount. This can amount to hundreds of thousands of dollars—and nobody has gained.

As many of you know, we as a company pay disability wages for employes unable to work. This rate is equivalent to, or slightly higher than, his regular wages. Over the past eight years our plant payroll has been of the order of $120,000,000. Would you care to guess how much disability pay we have paid for on-plant injuries during that same period of time. About $2,000—less than 1/1000 of one per cent.

This kind of performance has put us in the position to insure ourselves. I don't know how many of you know how many dollars your company spends for this kind of insurance, but I can tell you that the difference between our costs and that of a commercial insurance policy is many thousands of dollars each year.

Similar facts are available in regard to fire insurance. Over the past 40 years, our company has increased its earnings by nearly 100 million dollars thru self-insurance. This doesn't mean that we are against insurance companies. We still use their services when it is profitable to do so. But we are responsible and accountable for maximizing earnings, and this is one way in which we discharge that responsibility.

These are cold, hard business facts for those business men who care little about the first consideration I discussed. I believe in both—and a third—which to me is of at least as much value in discharging my job as the others.

Safety is to me almost a perfect vehicle for measuring individual section manager or individual supervisory performance in a large organization. Does this surprise you?

There are two factors which make it so. The first is probably still unique—even in this sophisticated day and age—the charge laid before us by the president of our company:

"There is no consideration, however major, that can be permitted to outweigh personal injury, however minor."

This means that in this facet of safety—and perhaps this alone—compromises are

not necessary. The objective is completely clear.

We have many measuring sticks that we use daily, weekly and monthly to measure a supervisor or foreman's effectiveness—but each of these involves compromises of the moment—for example, we say the foreman must produce good quality—but we mean quality at a reasonable cost—we say he must control his costs—but he cannot do this with too little attention to quality—thus compromises—and a balance which is never the same—one year to another.

But if we say we must eliminate personal injury in our section or group, the objective is completely clear and unchanging.

And the second important factor is—that the *attainment* of this objective requires the same exact supervisory and management *approach* as the attainment of any other objective. We used to call this approach the scientific approach.

It requires:

1. An objective analysis of the present day status or situation.
2. The supervisory need to anticipate potential problems.
3. The development of a specific program to eliminate or head off these problems.
4. Effective communication of the *objective* and *program*.
5. The establishment of follow-up controls is being carried out.

In safety—the results are so easy to measure—no guesswork if a man is in first aid or in the hospital.

What better yardstick to use to measure organizational effectiveness than this one in which the objective is so painfully clear. And if an individual cannot get consistent results under this environment he will not get results through people on any of the other job requirements. And I think each of you would agree that the extent to which we can get this approach used on every type of problem is the extent to which we will have competent supervisory organizations.

This approach must start with us—not the employe. It has to start with the willingness to make an honest analysis of our strengths and particularly our shortcomings—starting at the top. Look at our performance—as it is—not as we would like it to be.

Each of us try and do this daily, weekly and monthly, in our audits and inspections. At Chattanooga we have found that a *formal written* analysis once each quarter is a very fruitful and revealing study.

We are almost always surprised—when we finish this quarterly analysis—that our performance is as good as it seems to be on the record. This discovery usually nourishes our attitude properly—to take another step forward.

Would you be interested in what we usually find—

1. That we make many more errors of omission than of commission.

2. That we've been "too busy" to do the whole safety job. This simply means we don't understand the objective.

3. That we find we have a lot of talk about people accepting their individual responsibility — some of it meaningless — because we have not taken the time to define what this means and translate it into specific words that our people understand. Let me give you a simple example—

How many of you are full time safety engineers or supervisors? How many of you have formal written job descriptions which you and your boss and the plant manager have agreed upon.

Now let me go back to the way we say we must tackle any problem.

To define the problem—problem finding.

To plan a program, communicate it—problem solving.

Honestly now—what per cent of your job is problem finding and what part is problem solving? Is problem solving 90, 75, 50 per cent of your job?

I believe a safety supervisor's job ought to be at least 75 per cent problem finding. Let me ask you—how many of you see your top plant management face to face to discuss safety each day. How many—two per week—two per month?

I don't know what the right frequency on your plant is—I thing on our plant it ought to be every day. But I know this—that if safety performance is truly an indicator of everything else we do—you better have specific understanding with management and if you don't—you'd better take the initiative to get one.

4. That we don't use the supervisory tools we have: Too many otherwise capable members of supervision gradually persuade themselves that they are far too experienced to use the fundamental tools of standing still to observe, discipline, and letting the operator know precisely what is expected of him.

5. That we do a lot better job of disciplining ourselves and our people after someone gets hurt than we do when we see the same unsafe act performed without an injury.

We have missed the opportunity to problem find—now we have to problem solve.

6. We forget that the training of ourselves and our people is a dynamic function —no job—or no individual remains the same for even a six-month period.

These are the problems—the program to correct this is usually simpler to face than an honest appraisal. When you take these things back to their basic components — the circle is completed.

Before we can get people to accept the responsibility for their individual safety — we have got to accept ours—in an honest and positive way.

This is a whale of a lot easier if we all agree on *why* safety is important to us.

Now if you will review mentally the three reasons why safety is important to me:

Philosophically, financially, as a yardstick to supervisor effectiveness. You can see why I consider safety a major challenge and why I consider it a great management tool. It isn't academic, it doesn't look at somebody else. It looks at both today and the future. It is a direct measure of *our* ability to do our job to get results, to manage, to supervise.

Safety isn't just for the employe. It isn't for the safety supervisor. It's for us. In this age of cynicism and what passes for sophistication, are we willing to stand up before that honest mirror?

A NEW LOOK AT INDUSTRIAL HOUSEKEEPING

By B. L. CLOUD
Production Manager, Hughes Tool Co.—Houston, Texas

Have you ever wondered why all the fuss about good housekeeping? I have, and I am just now beginning to appreciate the values.

You hear it at home and at the plant. There is probably more data available on housekeeping than any other single subject. And the data ranges anywhere from such statements as, "absolutely necessary to a successful accident prevention program," to complete chapters in some of the books and literature.

But why such treatment in a sophisticated industrial society? We live in the atom and space age, with computers and data processing equipment, and with machines which operate at the direction of a tape or the wink of an eye. One would think that good housekeeping had served a long and useful life, and was no longer needed, or that industry had outgrown the need.

Nothing, however, could be further from the facts: Good housekeeping is still a very necessary part of the industrial accident prevention effort. Men and women in industry, even in this so-called sophisticated society, still trip over loose objects on floors and stairs, are hit by objects falling from overhead, slip and fall on wet and greasy surfaces, and we bump into projecting and poorly placed materials and equipment.

The latest edition of *Accident Facts*, at least to my satisfaction, seems to support this view. In the analyses *Source and Cost of Compensable Work Injuries*, 40.9 per cent of all disabling injuries and 29 per cent of those which produced fatal or permanent disability came from the following sources: Falls—same and different level; struck by falling or moving objects; and, stepping on or striking against objects. While the data

does not isolate housekeeping as the specific source, certainly housekeeping was an underlying factor in each category. If we should need further proof as to "why" good housekeeping is still a very necessary part of the accident prevention effort, we have only to examine the recent accident which resulted in injury to Lt. Col. John Glenn. Here is a man who pioneered space without incident, only to slip on a simple bathroom mat.

Although we consider housekeeping essential to production, it really does not do anything to enhance the value of our products. However, our customers are impressed either favorably or unfavorably by the housekeeping they see in all of our plants. We have at Hughes a steady flow of customers and visitors touring our plant daily, and our plant housekeeping conditions will either give them confidence in our products or will leave them with questions about the value and the quality of the products we produce. We also have family visitation one day per week. If housekeeping activities did not reduce accident costs or increase production, we would still be forced to consider them a necessity. A clean shop towel, a machine pan free of cuttings and shavings, or a neatly trimmed hedge or lawn, or a sparkling drinking fountain are hard to measure in terms of value received. But it is there, just the same. Just try it the other way and see what happens to your accident rate. Our plant is a shining example and we are proud of the housekeeping progress and the housekeeping programs which have been very helpful in making our sales efforts successful.

For many years at Hughes we had a large housekeeping and janitorial department. This department not only handled all of the office housekeeping duties, but also performed a large number of services in the factory areas, such as floor sweeping, cleaning, rearranging, and assisting in general clean-up campaigns. As time passed and the general wage increases were granted, we found ourselves with a very expensive operation and some divided responsibilities. We also believed that some improvements could be gained if we consolidated some services. We therefore took a new look at our housekeeping duties from a cost and control viewpoint.

In recent years we have contracted the sanitation and cleanliness portion of this work including all maid and janitorial services. All factory housekeeping duties and services were given back to line management in the plant. The janitorial contractor is responsible for the locker rooms, lavatories, offices, drinking fountains, etc. — almost everything except the production area services.

Without going into detail, I can assure you that the change brought a rather sharp rise in office housekeeping complaints. Perhaps we had our people spoiled. But I would rather think it was due to the quality of the services we received in the beginning. People who are accustomed to good housekeeping are sensitive to a reduction in quality and will react accordingly. It was therefore necessary for the contractor to train his personnel to meet our standards and our needs. And since this was done, this change has saved us several hundred thousand dollars each year in costs. The only way that this program can be successful is to have a contractor who is a real specialist in this field and who will meet your standards.

The housekeeping program in our factory is really quite simple. Monthly inspections are made of the entire production and factory areas by a team of three people: One from the fire department, one from the medical and safety department and one from plant supervision. The factory member of supervision is rotated each month so that each member of supervision has an opportunity to see what other departments are doing. This also helps to build a competitive spirit. The primary purpose of the inspection is to evaluate plant housekeeping. However, the committee is also concerned with violations of general plant safety rules and regulations and any other unsafe conditions and practices in general. A report of the results of each inspection, with recommendations, is submitted to the medical and safety services department. Copies of the reports are then sent back to the respective departmental supervisors and factory management for consideration and action.

Follow-up action is a responsibility of the medical and safety services department. A good housekeeping plaque is awarded each month to the department judged by the inspection team to have the best housekeeping.

We also publish a semi-monthly house organ called the *Hughesnews*, and once a month pictures and write-ups are published outlining the progress and the inspection report which has been made by this team. Additionally, each member of the supervision is sent, each quarter, an inspection form or guide. The supervisor is expected to inspect his own department, complete the inspection form, and return it to the medical and safety services department for review.

This is our procedure at Hughes. It is probably quite similar to the procedure followed in your plants. Since the particulars of scrap and waste disposal, material storage, floor condition, tool and equipment storage, and aisle space are also more than likely similar to what you are now doing, additional discussion at this point seems unnecessary. Let me point out, however, that if the effort is to be of value and produce satisfactory results, then, obviously, it must be done with great detail and with a positive attitude and in a professional manner.

Housekeeping means more than just cleanliness. Somewhere in the literature, I read where, "A house is in order when there are no unnecessary things about and those that are necessary are in the proper places." This definition appeals to me. It also causes me to wonder, speaking from my personal experiences, just how much valuable floor space all industry is now using to store obsolete, scrap or otherwise unnecessary materials and equipment. And if we knew, I am sure that the figure would probably stagger the imagination. Many such items are probably moved, cleaned, rearranged and counted several times each year and many will never again serve a useful purpose. Conditions such as this produce accidents, and accidents produce injuries and cost. Also these items are denying to us valuable production and storage space. Good housekeeping suggests that we do something about them; to do otherwise is false economy.

Although most of us expect each employe to keep his or her own house in order and clean; housekeeping—good housekeeping—is a basic management responsibility. This is fundamental to good management. It should get full support, with proper preparation, meditation and dedication to a successful undertaking. After all, management must provide just about everything but the actual implementation: this would include planning for the location and arrangement of equipment, material storage areas, storage facilities for equipment and materials, disposal containers, time for inspection and clean-up. Additionally, management must provide the incentive or motivation, and training, and the supervision to see that such activities are part and parcel of the daily routine.

It will not succeed any other way. An occasional clean-up campaign is a poor substitute for this important management responsibility.

Although to this point we have not discussed the individual employe's responsibility in good housekeeping, it is, nevertheless, important. The very best of plans and intentions, be those plans for housekeeping or what have you, will fall short of the goal if not properly implemented at the worker level. Each person must do his or her part. A spectacular effort on the part of a few will not produce satisfactory results. The individual must be properly trained and directed from the very first day of employment and such training must be repeated as often as necessary. We all know from our experience with children that people can be taught to be good housekeepers. Should we do any less with our people in industry?

We at Hughes have made housekeeping a part of the responsibility factor in all jobs in the factory including supervision. It is written into each job description and is therefore a factor of job level. The employee may perform the duties required or he may see to it that action is taken as required. Every employe is a part of our program.

The advantages of good housekeeping in the fire prevention effort are rather obvious; however, I sometimes get the feeling that, because of this, the matter plays second fiddle to the slips, trips and falls. While the possible consequences to the employe are quite similar in each situation, this does not generally hold true for fire damage to machinery, materials—both finished and in process—buildings and the like. A serious fire could put us out of business indefinitely; even so-called "minor" fires can cause major business interruptions.

We are probably more fortunate than many companies, because we have several

full-time fire department personnel on duty at all times and they serve on our plant inspection team. This brings a knowledgeable person with fire experience and training into our good housekeeping program. In our plant we use many types of flammable gases and liquids and we find this assistance quite valuable. If similar assistance is not available to you, then I would certainly direct your attention to such things as a careful examination of all liquids and gases, even solids, used in or permitted in your plant, to determine whether they are toxic or flammable; a detailed examination of the are of use; final utilization equipment; electrical and heat producing devices; and, of course, housekeeping. Detailed attention to such matters today could well be the assurance that you will be in business tomorrow. Good housekeeping? I consider it such.

Good housekeeping is just as much a part of the total accident prevention effort today as it was many years ago. The industrial situation—and even the home—will probably never see the day when the need will pass into obscurity. The facts supporting the need are just as valid today as they were 25 and even 50 years ago.

Generally speaking, the industrial injury experience in any establishment will be consistent with the level of housekeeping. Although many parts of our plant are quite old and most of the buildings are of wooden construction, through our good housekeeping and maintenance efforts, we have been able to maintain a high level of efficiency and a good safety record. Our industrial injury experience will compare favorably with any in the country, and we have won several national awards.

We feel that we manage a pretty clean house and our people are trained to recognize the value of housekeeping in the total production effort—and this includes accident prevention. Our employes and supervisors are in tune with both the need and our program, and respond accordingly.

Our top executives not only want a clean house; they insist on it. We invite both customers and prospective customers into our plant. What better advertising could one want for a product, the people who manufacture that product and the conditions under which it is manufactured, than good housekeeping?

In taking a new look at industrial housekeeping, I heartily recommend that the housekeeping functions be made a permanent factor in each employe's job or position, and also that you review your cost and control against the results.

SAFETY SAMPLING—1964

By VINCENT POLLINA
Assistant Corporate Director of Safety, A. O. Smith Corp., Milwaukee, Wisconsin

We are all working hard toward our common goal—to reduce all types of accidents which will prevent human pain, human suffering, and property damage.

You know industrial injuries need not be a by-product of manufacturing. How can you eliminate them? By putting into effect a good basic industrial accident prevention program. It should include safety planning and engineering, safety education and safety enforcement.

In the planning phase, you must work with your engineers to make sure equipment is designed with consideration for the human element—the end result being machinery tooling and equipment engineered reasonably safe for your employes. Safety education for all of your employes—to assure they are properly trained before they start their jobs in your plants.

In giving instructions to your employes, they must understand how to do each step of their job.

Safety enforcement, as you know, is the follow-up by the foreman to assure his employes are following instructions. Your

basic industrial accident prevention program must include those activities of your plant designed to prevent all types of accidents.

How do you keep the basic program alive? There are dozens of ways! If you are like me, you have tried all sorts of gimmicks—posters to green stamps. I've never found anything as dynamic as Safety Sampling.

Clark Woodward our corporate safety director, defines it: "Safety Sampling is a constructive analytical approach to the accident prevention problem." It is patterned after the work sampling technique which has been used by quality control engineers in quality sampling—also by industrial engineers in determining indirect labor effectiveness and manpower requirements.

You must become acquainted with the laws of probability to carry out this new approach. You will be able to predict coming events by evaluating facts of the immediate past. For one moment visualize a bucket full of marbles of different colors. Look away, reach in and pull out a handful. You can estimate the number of marbles of each color in the bucket from the ones you pulled out.

As you know, industry for many years has used this technique on items received. The quality of the shipment is determined by the random sampling of a few items. Your sample must be large enough to give statistical reliability. Your degree of accuracy will control the number of random times you want to carefully inspect.

You can apply this principle to determine the percentage of safe and unsafe work activity in your operations. Safety sampling pinpoints areas of supervisory responsibility needing attention. It places the accident prevention responsibility on the line supervisor.

In addition, it ties this responsibility to his supervision at all levels. It is a safety performance appraisal of management. This evaluation can be made of your operations any time you want it—hourly, daily, weekly, monthly, or yearly basis.

How do you put Safety Sampling into operation?

1. Develop your own safety sampling code. To do this, you will have to make an analysis of:

(a) All unsafe acts and conditions which resulted in:

1. Disabling injuries
2. First aid cases
3. Near misses

As you progress with your program, you add the unsafe acts and conditions from your own experience that result or could result in injuries.

(b) You then categorize the unsafe acts and conditions. This will make it easy to readily identify and record the unsafe acts and conditions in your operations. In compiling your safety sampling code, consider "the act of allowing an unsafe condition to exist while an employe is actively working at his job."

You might consider such items as: 5.03 in our code Permitting Pits or Holes to exist without providing guard rail protection or suitable barricade. 12.14, Allowing bare electrical wires to remain after making an installation or repair.

You are now ready to make a preliminary survey of your entire operation. This is necessary so you can determine the number of observations needed to give you statistical reliability. Each observation is an employe doing some sort of work. These are random observations taken at random times in your operations.

The formula used to determine the number of observations is taken from the latest edition of *Work Sampling* by Ralph M. Barnes. This book is published by John Wiley and Sons, Inc., New York. After you have completed the preliminary survey, it is simple to figure out how many random observations you will need.

Your next step will be to make the required observations and record them on the "Safe Practice Observation Form."

You will need a theater counter, a pencil and the recording form. Click off the safe observations on the counter and record them on the form. The unsafe ones are recorded then on the form under the proper code.

You then figure the safety performance of each foreman, general foreman, and superintendent of each division by shifts.

You are now ready to put this information into a form which will give the total performance of your operation.

How do you go about putting this program into effect? You must prepare a little training program to familiarize your management. Give them full details on safety sampling.

Following this training program, you can start in a small section of a division. Start slow and sell. Then gradually expand until you include the whole plant. You will get better acceptance of this program if you send sectional and divisional reports. This will give the line management a chance to become familiar with the program. It also will allow them to take necessary action to improve their performance.

What do you do when you have a safety sampling program working throughout your plant? Distribute your report for about three months to your line management. This will give them a chance to put their house in order. Then send the complete report to top management. This will give them an insight of their accident potential problems. You will get corrective action!

Where else can you profit from it?. What results can you hope to get from this program in your plant?

When this program was in operation for a complete calendar year, the Milwaukee Works results were:

First aid cases decreased 25 per cent

Disabling injuries lowered 50 per cent

Frequency rate reduced 50 per cent

Severity rate cut 50 per cent

Overall accident costs slashed 50 per cent

Do you think Safety Sampling is worth it? Safety Sampling can be a successful program for you, if:

1. You have a sound basic accident prevention program operating in your plant.
2. You study this new technique and adapt it to your operation.
3. Familiarize your management with its potential in controlling the effectiveness of your safety program.
4. Start slow and sell!

HOW ACCIDENTS CAN HELP YOUR SAFETY PROGRAM

By O. C. HAIER

Mgr., Safety and Workmen's Compensation, Standard Oil Co. (Ohio), Cleveland

There are a number of ways that accidents can help your safety program.

Safety engineers have for years been preparing monthly, quarterly, semi-annual or annual accident summaries for review by company management and operating supervisors. These summaries usually show number of disabling injuries, number of days lost, frequency rate, severity rate by department, plant, operation, or company in the case of large, multi-company organizations.

Sometimes charts or graphs are made to accompany the statistical tables to more adequately or dramatically portray the trend lines. There are two primary reasons for sending these reports and charts: (1) they tell in a way how things are going in the accident occurrence field and (2) they provide some measure of competitive spirit to encourage those with experience not so good to improve their performance.

Periodically, as an appropriate occasion arises, such as the occurrence of a particularly severe injury or accident, a full-blown investigation is made. The plant manager, general superintendent, chief engineer, superintendent of maintenance, safety engineer and other important people will take part in this investigation. The report is circulated in the plant and to other plants, and the injury or accident will be discussed by first-line supervisors with their men. It will get a lot of attention and action, and invariably there will be a good effect upon various aspects of the safety program.

Occasionally such a report will reach the president of the company and if the facts

are presented in such a way as to excite him and his interest, he will exert his influence everywhere, and then things are likely to happen. This type of influence also is good for the safety program.

Then there is the information that comes from industry or trade associations, particularly those having good, active safety and fire protection committees such as the one I belong to, the American Petroleum Institute.

We get comparative injury frequency and severity rates, fire loss and frequency rates, vehicle accident rates and descriptions of fatalities, and serious fires and explosions. We send them to the plant management and safety engineers as well as various engineering groups. We make great use of them in spurring on our plant and departmental management to compare favorably with others in the industry. We also review our practices, our equipment specifications, and our engineering standards as a result of these descriptions and we make changes where they are indicated.

But by and large, the mainstay of a plant's or a company's safety efforts is its own experience and the results of analyses of various kinds and severities of accidents and injuries.

An analysis shows that falls on level are frequent, so efforts to prevent falls are instituted and made a part of the safety program. An analysis shows that eye injuries are numerous in certain areas, so efforts are made to prevent eye injuries and these efforts become part of the safety program.

Most plants or companies of any size generally look longest and hardest, and sometimes exclusively, at the disabling injury experience.

There are many plants and companies with extremely low frequency rates—so low in fact, that they may be approaching the point where the frequency rate no longer can be affected very much by the things I have just been describing to you.

Thus, if the frequency rate is not affected very much, how can you determine that the level of safety of your plant has changed—either improved or deteriorated?

Suppose you had a plant injury record of zero, one, two, or even three disabling injuries during several successive 12-month periods. Would you consider that the safety activities were successful? Could you say with authority at any one point in the succession of months that some particular effort, drive, promotional scheme or educational program was particularly effective in *preventing injuries?*

If, after operating for one or two years with zero or one disabling injury, and then your plant jumped to three, would you say that your program, your efforts, your drives were no longer effective?

We've been faced with that situation in several of our plants. We asked our operating research group, the professional statisticians, what they thought about it.

They did a lot of researching and studying and finally concluded that on a short-term basis, no one could say that efforts, programs, drives, etc. were any more or less effective—if you just look at experience such as *ours*—where the number of injuries would vary from 0 to 3 every twelve months.

They offered as an example the following proposition: Suppose you were able to devise a new, perfect approach to injury prevention and you applied it. You would then record zero disabling injuries for a number of months in succession. Could you then say that the new approach was responsible for the latest succession of zero frequency months? They said "no"—because if you simply would look at past history you would find that there were many successive months when the frequency was zero. Thus, even without this new approach you could expect this result more often than not. So there would be little rational justification for claiming *any* accomplishment due to our new approach.

They said we'd have to look at greater numbers of injuries to tell anything about program or effort effectiveness on a short-term basis.

So we devised what we have called the Sohio Serious Injury Index. This index is made up of five kinds of injuries:

1. All disabling injuries according to ASA Z16.
2. All non-disabling eye injuries from work produced objects or corrosive liquids requiring treatment by a doctor.
3. All non-disabling fractures.
4. All non-disabling lacerations requiring sutures.

5. All other non-disabling injuries for which the attending physician prescribes work restrictions or motion limitations.

These I am sure you will recognize as types of injuries about which there will be little or no trouble in recognizing once they have occurred because they are severe enough for the injured person to have to request medical attention. You might consider these five as a combination of disabling and potentially or nearly disabling injuries.

Now I know a lot of people are wondering—why pick out just five kinds of injuries—why not all injuries? I can answer that in this way:

1. We felt that if employes got the idea we were looking too closely at their minor injuries, they might not feel as free to report them, and

2. We felt that every last minor injury wasn't being reported now.

We've been looking at and studying our so-called Sohio Serious Injuries now since late 1954 and we can see reductions in all kinds of injuries, first aid cases, doctor cases, and serious injuries, although in several of our plants the number of disabling injuries has remained constantly low. I'd like to urge you to look beyond disabling injuries. Don't be satisfied just because many of your injuries don't involve loss of time.

Think of the many times men have fallen at work only to get up, limp a little for a few steps, or rub their arms or hands or shoulders for a few minutes and then go about their work. Or how many times such falls have resulted in strains of the shoulder, or leg or arm muscles which have kept them from doing their full jobs for a few days or even longer. They are the same kinds of falls which sometimes result in broken arms or legs, cracked ribs, fractured skulls—so why not look into them more deeply and intensify your efforts to prevent all falls.

Or how about the number of times men have bumped into things or have had parts of their bodies caught between two objects and have sustained lacerations which had to be stitched up (sutured—say the doctors) instead of badly fracturing bones or amputating fingers or hands or toes or otherwise more seriously injuring themselves. I can assure you in most cases it is very nearly impossible to tell how serious an injury will result, once the accident cause has started on its way.

And how much time and effort goes into explaining why a man lost time from work, or even why he doesn't have to lose time because there is work he can do without aggravating his injury. How much more productive that same time and energy could be when used in preventing more and more accidents and thus preventing more and more injuries of varying degrees of seriousness.

This basically is what is behind our own efforts in promoting the concept of "serious" injuries, both disabling and non-disabling. We make no claims that our system is the last word, but I think we are preventing more injuries than we ever did. Perhaps you don't have the same types of injuries that we have, but I feel sure that if you looked long and hard at all your injuries you would see a number of recurring types which could be the basis of your own serious injury index.

Of course, your own objectives will determine which way you will go. If you are satisfied with the disabling injury frequency rate as your measuring stick—fine. If you are not, then here is a suggested system.

For ourselves, we think it has helped us to reset our sights on the goal of preventing injuries rather than largely on the prevention of loss of time from work, as important as that is.

When you have plants which experience from zero to three disabling injuries per year, year after year, you have a rough time trying to overcome the feeling that eventually will come—"this is easy"—"We've got it made"—"There's no safety problem here."

The fact that we threw the spotlight on more than just disabling injuries added considerable impetus to our accident prevention efforts throughout the organization. Supervisors were forced to broaden their views of what was going on around them. They were forced to look at working conditions and work practices much more closely and analytically.

But we put these Sohio "serious" injuries to additional use. We adopted quality control chart techniques plotting serious injuries per million man-hours monthly. We used a standard formula for determining upper and

lower control limits to show the amount of random or chance variation in the monthly figure which could be expected to occur if there was no change in the effectiveness of the injury preventing activities.

As with any quality control chart, when our "serious" injury frequency stays within these control limits, the frequency is considered to be under control.

Or, another way of looking at these variations of the index within the control limits is the effectiveness of what we are doing in the way of injury prevention is about the same as long as the index is within the control limits. If the index, however, goes above the upper control limit, something has probably gone wrong in our prevention activities, and we should begin to try to find out what did take place so corrective measures can be instituted.

Likewise, if the index goes below the lower control limit, something special probably has taken place to give us such a good performance and we should try to find out what it was, to continue and expand its use.

Through these control charts then, we should be able to detect when effective or ineffective accident prevention activities are in use or certainly when they remain in use for a relatively short period. This is something we could not detect by the use of disabling injury frequency rate alone. When plants such as ours operate with but one or two disabling injuries in a year, and sometimes without any, the statistics are just too meager to interpret, and, as I said before, this can lead to complacency.

We think it has been a useful and effective tool in spurring injury prevention activities, and in helping us to direct our safety efforts where they will do the most good.

We've also been flattered by the response of the many, many safety directors who have written to me for more information since we published our first article in the Journal of the A.S.S.E. in 1956. Apparently many companies are using our approach and seeing things which were not apparent before.

I urge you to take a good look at it, try it and see if you don't experience renewed activity in preventing injuries of all kinds.

1964 National Safety Congress

SAFETY INSPECTIONS—SAFETY CATALYST

By J. R. STONE
Director, Safety and Suggestions,
Oldsmobile Div., General Motors Corp., Lansing, Mich.

The well planned safety inspection serves as a catalyst and a control medium in a safety program. This presentation is based on the premise that the safety program to which we will refer is aimed at the control of accident causes—namely unsafe acts and hazardous conditions—and that the program has adequate top management backing. If your particular safety program does not meet these requirements, an inspection program would be superfluous and probably misunderstood.

To be of any value in the prevention of accidents a safety inspection must be an undertaking arising out of sincere commitment and genuine desire to make safety a reality. Safety engineers the world over are tiring of frequency and severity as a means of rating progress and regress in their safety programs. The reason is that these two factors are entirely negative in that they are based on mistakes, not accomplishments.

In more and more cases today's safety programs are accident-cause-oriented, instead of lost time-accident-oriented as in the past.

A well planned safety inspection activity can be a super comprehensive tool in controlling accident causes.

But to make the inspection have the desired effect on safety, there are certain "building blocks" necessary to form a foundation upon which to establish ground rules for the inspection. To get appreciable results in a safety inspection, certain understandings and conditions must be made to exist. They are the building blocks for good safety inspections and must be given careful attention in preparation for such a program.

The building blocks are:

Unquestionable top management support.

Well-understood distribution of safety responsibility.

Facilities to make safety possible.

Commonly understood safe practices and safety policies.

Well-informed safety personnel.

General knowledge of total plant objectives and policies.

Sincere interest by those doing the actual inspection.

Knowledge of services available to the supervisor in the safety program.

Good communication with supervisors relative to the mechanics of the inspection.

Understanding that safety work be done promptly and safe practices implemented with minimum delay.

Water tight, factual data for written inspection report.

Dignity of all concerned with respect to the safety program and the safety inspection.

To reach maximum potential in the safety inspection program, the building blocks must be framed and developed with care and conviction because it is in this area that the program acquires strength and capability. Without this foundation, the program can be nothing more than ordinary.

Now the question arises, what should a safety inspection cover? What is covered depends on the safety philosophy surrounding the area being inspected. It is designed to check actual performance against ground rules.

To be a manageable function, an accident-prevention program must be a well defined aggregate of specifically assigned responsibilities with clear-cut starting and stopping points.

Accidents (injuries) are the result of mixing people with hazards. Take away either the people or the hazards and no accident (injury) will result.

This can be expressed in a simple formula:

$$H + P = A$$

(Hazards + People = Accidents)

Since the factors involved in all accidents are hazards and people and since the safety inspection is directed at the prevention of

accidents, it is clear that the inspection must center around these two factors.

Inspection brings to light instances where it is obvious that these factors are not being considered in the management of a department or the supervision of a specific job. Inspection covers hazards and people relative to their association with one another. It also determines whether or not safety responsibilities are being carried out according to plan. This information is necessary in order that prompt action can be taken to change such conditions in behalf of safety.

The next question to be answered is, Who should inspect? Safety inspection must take on the image of being a service to the general purpose of running the plant, namely, producing the product. It should be considered an important part of a waste control program, primarily aimed at holding to a minimum inefficiencies brought about by accidents.

There are other beneficial aspects to accident prevention activity, but they are intangible for accounting purposes; for example, the humanitarian benefits of the accident that was prevented. However, the most comprehensive atmosphere for a safety inspection associates the inspection with common operating problems. Poorly controlled accident factors must be rightfully considered inefficiencies, having an adverse effect on the economic success of a plant or a department.

This being the case, the inspection should be made by a team of persons having a stake in the success of the area or the facility being inspected. The foreman whose area is being inspected should certainly be in the group and the general supervisor of the foreman should help inspect.

With these two supervisors at the immediate scene of the safety problem, action can be taken without delay or misunderstanding. Inspection gives the general supervisor an ideal opportunity to evaluate the on-the-job safety performance of his subordinates.

The safety engineer must be in the group to spearhead the activity. He is in his most productive role during a safety inspection project because it is here that he coordinates the safety program and teaches by first hand contact with supervisors using on-the-spot, factual examples. The fire protection representative is another person having much at stake in this activity. He should be a member of the inspection team for much the same reasons as the safety engineer. However, his interests center around fire prevention and fire protection security.

When the personnel of the inspection team is chosen, it should be composed only of those with much at stake and with the authority to act when out-of-line conditions relative to safety are noted during the inspection.

The next question would probably be What are the mechanics of a good safety inspection? The plant is inspected at least once each month. In small plants, this can be accomplished by a single inspection team made up of the following:

The foreman of the department being inspected, the general supervisor of the foreman, the safety engineer (who serves as captain of the team), and the fire protection representative.

In large plants, two or more of these teams may inspect simultaneously to get the job finished more quickly. Inspection is completed in one week, as the data in the printed inspection report should be current, to give the program impetus. It is suggested that the safety engineer take all the notes that will ultimately appear in the report and that the safety department prepare, duplicate and distribute the report to everyone connected with the operation of the plant. Specifically responsible foremen are listed in the report in conjunction with the exact location and full description of each unsafe condition or unsafe act noted. Responsibility for each unsafe item noted is determined during the inspection by the inspection team as the items are written into the notes. In this manner, each foreman knows how he stands as the inspection progresses.

I am sure this will be the next question Do you use a "check list" for the inspection?

This is the check list used:

The 14 Basic Hazards

1. Pinch Points
2. Catch Points
3. Shear Points

4. Squeeze Points
5. Flying Objects
6. Falling Objects
7. "Run-in" Points
8. Electricity
9. Gases
10. Heavy Objects
11. Chemicals and Flammables
12. Hot and Cold Objects and Radiation
13. Sharp and Pointed Objects
14. Slippery Surfaces

One or more of the basic hazards is present in any accident and becomes the "h" or "hazard" factor in the accident formula, hazards + people = accidents. Hazards are manageable in that they can be changed, guarded or eliminated. Since hazards are present in all accidents, it must then be recognized that accidents can be forestalled through the management of hazards. This being the case, the 14 basic hazards are the best possible check list for a safety inspection.

Checking for the control of basic hazards and the association of people with them, is the whole purpose of the inspection.

Another question that is bound to come up is What instructions are given the inspection team?

Since the safety engineer serves as captain of the inspection team, these instructions are directed primarily at him. Keep in mind the fact you represent safety to all people whom you contact during the safety inspection and that the sole purpose of the inspection is to throw light on safety and fire hazards. Stick strictly to safety—do not get into other areas such as politics and personalities. Do not "whitewash" data by omitting items that are tenacious problems to the supervisors involved. Ride tenacious problems hard. Standardize the terminology in data submitted for report.

Do not be a "lazy writer," and, on the other hand, do not "over describe." Give enough information so that the hazard can be understood and definitely located. Remember that you actually saw the hazard, where persons reading the safety inspection report did not. Notes must be legible, accurate and data must "hold water"—do not exaggerate for emphasis. Do not "save up" hazards to expose during the inspection. Do not generalize—be specific. Do not follow the aisles—get out between the machines and in the corners.

Remember that the privilege of criticizing the safety performance of others carries with it the responsibility for making suggestions for improvement and helping such suggestions become a reality. The inspection must be interpreted and used as a tool to get a job done and not as a means of passing judgment on individuals. Point out what is unsafe about a practice or a condition, emphasizing the hazards involved, and then suggest a disposition. This practice will add to the educational value of the inspection. When these factors are considered by the inspection team, the inspection becomes a positive activity with a minimum of negative aspects. Since a comprehensive safety inspection program is based on the premise that all hazards are manageable, each hazard noted as being out of control must be the responsibility of some specific member of management. This is how specific responsibility is determined.

The plant is divided into geographical areas, each supervisor being held responsible for safety within the boundary lines of his area. He is the "prime mover" in all safety matters developing in this area, and must take the initial step in correcting all unsafe conditions or behavior in this area. When his own men are involved in unsafe acts, he is responsible to detect the fact and take the necessary action to change the practice.

When employes, supervised by another foreman, enter his department and work unsafely, it is his responsibility to call this fact to the attention of the other foreman, so the other foreman can take corrective action. When hazards exist in his own department, it is his responsibility for noting the hazards and issuing written orders to have the conditions changed so the hazards are either eliminated or guarded. If another foreman's employes do work in his department and hazards are created by the way the work is done, it is his responsibility to contact the other foreman, so the other foreman can make such conditions safe.

In short, each foreman is held responsible for the control of all unsafe conditions or unsafe acts in his area and must serve as

"prime mover" to change the conditions to make them safe.

In safety inspection, a foreman is charged as being responsible for all unsafe acts and hazardous conditions in this area, regardless of origin or supervisional authority involved. This method of responsibility distribution is based on the premise that well-defined, specific individual responsibilities are usually better understood and more consistently executed than dual or group responsibilities. Furthermore, it eliminates areas of "no responsibility."

During the inspection, in cases where a foreman can show proof that he has officially served in his capacity as "prime mover" and has written orders to service departments to have a hazard corrected, he is commended by the inspection team as having met his basic responsibility, relative to the hazard.

If a hazard has gone unnoted by the foreman until disclosed during the inspection, it is pointed out by the inspection team and indicated in the report that he has not met his basic responsibility in regard to the hazard. When a hazard has obviously existed for several work shifts, all shift foremen who supervise the area are held responsible, and this fact is noted in the report.

It is emphasized by all participants in the inspection activity that the various service departments exist primarily to service the manufacturing departments, but must be alerted by the manufacturing supervisors before their services can be obtained. The foreman must serve as "prime mover" in all cases where such services are needed. This is his basic responsibility in the safety program.

If you happen to be a foreman, and I am sure some of you are foremen, I am certain you are asking this question.

"How does the foreman get safety work done in his department?"

When the safety program is backed up by top management support, provisions are made for adequate service of facilities when safety hazards develop. A foreman needing safety work done in his department, should merely have to call upon a service department, and the service should be forthcoming. Work requested by foremen, in behalf of safety, must be considered urgent and warranting special handling by service departments to expedite its completion.

Delay in completion of safety work, once it has been requested by the foreman, is interpreted as an indication of management insincerity by hourly workers and must be avoided. To prevent delay, those orders must be earmarked and given special handling in the service departments that ultimately do the work. Naturally, a priority rating must be established, even with a backlog of safety work orders, because only one such order can be placed at the top of the list in scheduling. This being the case, a suggested pattern for prompt completion of work orders is as follows:

The foreman writes a work order requesting safety work and routes it to a central clearing point, usually the plant engineering department. The safety department reviews all work orders at the clearing point and earmarks safety orders by stamping all copies, *"this is a safety work order,"* or *"fire prevention order,"* as the case may be, and retains one copy for the safety work order backlog file in the safety department office. The order is then forwarded to the service department. Where it is placed in a "special handling" category in the work schedule. The priority of safety work orders is determined by the supervisor of the service department along with the safety engineer.

The estimated completion date of the order is determined by the supervisor of the service department. The backlog of incomplete safety work orders is reviewed with applicable supervisors during the monthly safety and fire prevention inspection. Supervisors are held responsible for following up to see that work is done satisfactorily and promptly. The status of safety work order backlog is reviewed each month with the general manager and staff.

Each superintendent reports in the monthly operating safety meeting concerning the status of safety work orders issued by supervisors in his division. All service departments issue a safety and fire prevention work order status report to all superintendents each month (prior to the safety meeting), indicating estimated completion dates for all incomplete safety and fire prevention work orders.

The report of monthly safety and fire prevention inspection carries a complete list of incomplete safety and fire prevention work orders at the time of the inspection. The safety work order backlog is reduced and made current by actual floor check during the monthly safety and fire prevention inspection. As you can see, a safety work order, once it is written by the foreman, is given priority and is expedited through to completion.

Guarding standards are in a perpetual state of review and are upgraded frequently as technological changes are made in the plant. Many are upgraded after accidents prove them unsatisfactory. Some safety standards are written into safe practice pamphlets and general safety rules. Others are written into specifications for such items as conveyor installations, purchased machinery and equipment and machine control arrangements. However, many "standards" are nothing more than clear-cut, well-understood, unwritten agreements, relative to basic safety hazards and safe behavior patterns aimed primarily at the satisfaction of safety in the operation of a plant.

There are two kinds of safety standards, written and unwritten. Both are equally important and both are directed at the same objective, the control of accidents. Written standards usually involve static hazards of a common nature, while unwritten standards are those discussed by the foreman and the employe as a part of the job instruction and supervision process. Instructions, relative to employee safety on specific jobs, frequently include both written and unwritten material, with the added impetus of verbal communication between the two parties involved.

We have used the catalyst program at Oldsmobile for 11 years and feel that the inspection, and the follow-up associated with the inspection, put us in better contact with first line supervisors who in turn are in direct contact with the employes.

If we were asked the question "Why safety inspections" we would give a dozen reasons—here they are:

• To Check The Results Against The Plan.—When the planning behind a safety program is sound and well implemented results should be noticeable and measurable. The safety inspection brings to light misunderstandings, foggy areas, omissions and lack of attention to conditions that lead up to accidents. Even with a good safety program, it is often necessary to make amendments to the plan, because of changes in conditions in the plant and personnel reassignments. The safety inspection serves as an instrument for frequent and thorough audits of factual conditions right at the scene of the problem.

• To Reawaken Interest In the Safety Problem.—It is human nature for people to become so engrossed in other problems that their interest in safety wanes. Periodic safety inspections of each supervisor's department forcefully call safety to his attention on a scheduled basis. This activity reawakens his interest in the problem and adds impetus to his safety efforts.

• To Re-evaluate Safety Standards And Policies.—A good safety program is progressive, encompassing new developments in safety devices and personal protective equipment as soon as they are made known. By the same token, outdated safety policies should be revised to match conditions on the job. The safety inspection offers an excellent opportunity to consider this problem.

• To Teach Safety By Specific, Tangible Example.—The safety inspection is a very capable educational medium. Through on-the-job discussions of tangible factors, contributing to specific unsafe conditions and practices, a more definite understanding of safety is developed in both the employee and supervisory groups.

• *To make an open and conspicuous display of sincerity relative to safety.*

The fact that scheduled inspections are made and that concern for safety is expressed by management representatives through their participation, has a positive influence on hourly employes. This fact, coupled with prompt correction of unsafe conditions noted during the inspections, spells management sincerity in the minds of the workers.

• *To detect and re-activate unfinished business.*

Procrastination must be held to a minimum in safety matters. The safety inspection is frequently instrumental in spotlighting unfinished safety projects, that, for lack of

systematic follow-up, have come to a halt. Once pointed out, such projects can be reactivated without delay.

• *To collect current safety data for up-to-the-minute reporting.*

On the higher rungs of the management ladder, the actual scene of the safety problem is far removed. However, it is extremely urgent that these persons be kept informed relative to the accomplishments of the safety program. Current data, recorded during safety inspections, is helpful in getting and holding top management interest and support when channeled to them in reports and presentations concerning conditions in the plant. Management expects to be called upon to make decisions in the safety program, but will not be imposed upon by being asked for decisions without sufficient factual background information. Safety inspections are ideal for preparation of such data.

• *To note and act upon unsafe behavior trends.*

Since a comprehensive safety inspection involves observation and evaluation of employe work patterns from the standpoint of safety, it is possible to detect and correct unsafe practices before the occurrence of accidents. This is a "before-the-fact" approach and greatly reduces personal factor accidents.

• *To reach, first hand, on-the-spot agreements with responsible parties, relative to action on safety problems.*

With the inspection team, including supervision directly responsible for maintaining a climate of safety in the area being inspected, agreements on corrective action can be reached on the spot, with a minimum of debate. This practice reduces, to a bare minimum, the delay in getting correction underway and results in prompt disposition of safety problems.

• *To improve safety standards.*

Safety standards are subject to constant change, due to technological changes, plant rearrangement and the introduction of new processes and products. The inspection program puts safety standards to test by comparing the standard with actual plant conditions. When the standard is obviously inadequate, it can be upgraded to better suit the current safety problem.

• *To check new and rearranged facilities for employee association.*

In many cases, an arrangement appearing ideal on a plant layout drawing, presents safety problems when the layout has been carried out and employes placed at work in the area. A safety inspection should include consideration of actual layouts relative to employee association and resultant safety hazards. In some cases the actual arrangement varies from the intended layout and unpredicted hazards result. The inspection will bring to light such discrepancies and immediate correction can be made.

• *To play down any feeling that safety programs are, in effect, a "cat and mouse" activity.*

A safety inspection should be made in an atmosphere of cooperation. There should be no choosing of sides because control of the safety problem requires a plant-wide effort, with common objectives. During the inspection, there is an opportunity to draw closer together the point of view of supervisors and safety engineers. The supervisor of the department being inspected should not go on the defensive, and he is not to be treated as a "bad boy" by other members of the inspection team. The safety engineer, on the other hand, must avoid the "father-knows-best" attitude. The whole inspection must be conducted with intelligence and dignity. The net result will advance rather than retard the safety movement by upgrading the supervisor's ability to recognize hazardous conditions and apply corrective action.

With this positive, before-the-fact attack on the causes of accidents we have come to view accidents *before*, not *after*, they occur.

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1964 National Safety Congress Transactions

Volume 13

LABOR SAFETY

NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
Chicago, Illinois 60611

52nd NATIONAL SAFETY CONGRESS

Papers delivered in the

LABOR SESSIONS

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CONSOLIDATED REPORT OF LABOR CONFERENCE

(Presented at labor session, Monday, Oct. 26, 1964, by Victor E. Whitehouse, immediate past chairman of Labor Conference, and Safety Dir., Int'l. Bro. of Electrical Workers, AFL-CIO, Washington, D. C.)

This consolidated report only highlights committee and conference activity for the past year.

Awards Committee:

The committee met three times this year. In August the committee held its judging and granted eleven labor safety awards for outstanding accomplishments during 1963. Twenty-four applications were received from labor organizations. The winners will receive their awards at the Thursday morning session.

Those labor organizations which did not qualify this year received a letter from the chairman, offering suggestions on how they could improve their safety program so as to be eligible for an award next year and they were urged to re-enter.

Six Public Information Awards were granted to labor press publications for outstanding efforts during 1963. These awards were presented in conjunction with the spring meeting of the Labor Conference in Toronto, Canada, last May.

The committee has set up a plan whereby a special award certificate will be presented to union organizations which are affiliated with the National Safety Council and whose contracted company has won an NSC award.

The committee will again intensify its publicity and promotion of the award program for the coming year.

Congress Program Committee:

The committee met three times in 1964. They worked hard all year on preparing an outstanding program for the 1964 Nation Safety Congress and Exposition, and feel that the program to be presented to this year's delegates will be of outstanding interest and educational value to delegates.

The committee has arranged for ushers to assist at all labor sessions and to welcome speakers on their arrival.

The attendance record cards this year carry a questionnaire form on the back asking delegates for their opinion of the sessions and also suggestions for speakers and programs for next year.

As was done last year, the committee will again compile the attendance record cards signed by delegates attending labor sessions only into a list which will be sent to the sponsoring bodies, thanking them for sending representatives. The committee realizes that for local unions, in particular, this involves considerable expense, travel and lodging for the week, and wishes to acknowledge their cooperation with a letter of appreciation.

Special publicity and additional promotion of labor sessions was carried on this year. A special "meeting call" was sent by the Vice President for Labor to all labor organizations affiliated with the National Safety Council. AFL-CIO also conducted a special promotion to build up attendance and sent a letter to approximately 300 state and local bodies in Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin, urging attendance.

Labor delegates are urged to attend not only every labor session but also to attend the afternoon industrial sectional meetings that pertain to their own area of industry.

Labor delegates are also urged to visit the special labor educational safety exhibit in the Conrad Hilton hotel in the North Hall at Booth N-8.

Fire Safety Committee:

The committee's major project this year was preparation of a special Fire Brigade Plan for use in industry. The first draft has been circulated among Labor Conference members and their comments will be incorporated into a second draft. The final publication will be printed in the "Labor Safety Newsletter" and extensively circulated.

Throughout 1964 the "Labor Safety Newsletter" carried articles specially written for it by members of the Fire Safety committee. Assignments are now being set up for the coming year and specially qualified members

will be asked to prepare articles on specific subjects.

Government and Labor Agencies Committee:

The committee is continuing its efforts in three major areas as follows:

1) That safety be made a high priority item on the programs of AFL-CIO national and state central labor bodies;

2) That AFL-CIO headquarters establish a safety department to work with state central bodies and international unions; and

3) That international unions establish safety departments to aid locals and state bodies.

At the May, 1964 meeting in Toronto, the Labor Conference approved the request of this committee to change its name from "State Labor Departments" to "Government and Labor Agencies" committee, as being a more appropriate name for this group.

Membership Committee:

This committee is pleased to report an increase of 67 new members since a year ago. In the past five months we gained 54 new members. The greatest gain in membership is due to drives conducted by the Auto Workers and International Brotherhood of Electrical Workers among their locals.

The common annual renewal date established by this committee last year has facilitated follow-up letters being sent by international union presidents to their locals, and the results have shown that this is mainly responsible for continued local union renewals. The committee recommends continuing this method of renewal and follow-up.

In the area of fund raising and contributions made by labor unions to the National Safety Council's Trustees Fund, the committee is pleased to note that over $2,500 has come in so far, and additional unions will be solicited. The response has been very good to date.

Efforts will be made at this Safety Congress to contact guest observers from labor unions and inform them about affiliating with the National Safety Council.

Occupational Health Committee:

An article on the subject of dermatitis from exposure to coolants appeared in the "Labor Safety Newsletter." This was specially written by the committee chairman. Another article in preparation is on hearing loss from occupational exposure.

A project in progress is conducting a study of state safety laws and codes. This project has been started in the Office of Occupational Safety of the U. S. Dept. of Labor and will be finished in the next year or year and a half.

Off-the-Job Safety Committee:

Off-the-job safety articles appeared regularly in the "Labor Safety Newsletter" this year and reaction has been good.

The Labor Day Safety Campaign was conducted for the sixth year in cooperation with the AFL-CIO standing Committee on Safety and Occupational Health, the United Mine Workers of America, labor auxiliaries, labor press and other interested labor groups. This year the National Safety Council sent out over 24,000 promotional flyers which were requested by participating unions and other organizations. Over 6,000 packets of campaign materials were mailed in answer to requests. Twenty recognition certificates were mailed to labor unions for conducting an outstanding campaign this year. The Labor Conference voted to continue the campaign for another year.

The Chairman of the Labor Conference has been authorized to set up a special study committee to explore the possibilities for developing and using the National Safety Council's "Driver Improvement" program among various unions. The study committee will make recommendations at the spring 1965 meeting of the conference.

Regional conferences for civic leaders have been held thus far in Kansas City, Columbus, Ohio; Wilmington, Del., and Atlanta, Ga. Labor organization representatives who attended were enthusiastic about the sessions, and attempts will be made to secure a larger attendance at future civic leader training conferences.

Publications and Newsletter Committee:

The committee is inaugurating a special safety cartoon contest to run throughout 1965. An outstanding safety cartoon from the labor press will appear in every issue of the "Labor Safety Newsletter." This means six cartoons a year. A $10 prize will be sent to every cartoonist whose work appears in the newsletter.

The committee was pleased to run articles this year in the "Labor Safety Newsletter" which were specially written by members of the Fire Safety committee.

The National Safety Council has just made a substantial price reduction for the book called "Safety Guide for Unions." A promotional drive is now underway and the committee will contact presidents of all international unions, urging them to take advantage of the price reduction by ordering in quantity.

A special off-the-job safety column appeared regularly this year in the "Labor Safety Newsletter." This area will continue to be covered in future issues because of its overall importance to union people.

Radiation Safety Committee:

The committee is preparing special articles for the "Labor Safety Newsletter" which will cover radiation incidents, and articles designed to clarify misconceptions in the field of radiation hazards.

Members of this committee met with the chairman of the Occupational Health Hazards committee of the National Safety Council's Industrial Conference yesterday for the purpose of seeking a joint common approach on radiation hazards. It is felt that these two counterpart committees should work together in exploring problems in this field and arrive at solutions and recommendations.

The committee studied the radiation report prepared by the Canadian Labour Congress, and additional materials will be forwarded to our chairman.

The committee is studying the subject of radiation safety in collective bargaining and progress on workmen's compensation for radiation injury.

Safety Training Committee:

This committee has been working hard all year on several projects. Among them is the handling of assignments to prepare questionnaires for every chapter in the "Safety Guide for Unions" to be used in the Home Study Course. Most of these assignments have been completed in their first draft. The committee is starting its planning for promotion of the course, which is expected to be released during 1965.

A training slidefilm entitled "Safety in the Union Hall" was completed during 1964 and is available on free loan to any and all unions requesting a copy. The committee urges that local unions write directly to the National Safety Council to book the film. This is a 35mm. slidefilm which illustrates and describes how the union hall can be utilized for effective safety training which will prevent painful and costly accidents to members and their families.

The survey which the committee conducted this year throughout the 50 states to update obsolete information on safety training courses available to union people is completed. The Canadian Labour Congress is cooperating with our committee in making a similar survey which will be completed soon. The information will be incorporated in a revision of the "Directory of Safety Training Courses Available to Union Members."

RADIATION SAFETY IN INDUSTRY

By ALAN F. BURCH
Asst. Dir., Research and Education, International Union of Operating Engineers, AFL-CIO, Washington, D. C.

I know that some of you feel we spend too much time discussing radiation hazards when there are so many other industrial hazards to be dealt with that affect more people.

Perhaps in a sense you are right, but the radiation safety problem is one of the areas in which we have been able to work, almost from the start, with the various groups and agencies who write the rules and regulations. If we can keep these regulations up to the highest standards of safety, we

shall have done our first job in achieving maximum security for those workers who work with, or near, radiation in industry.

We are not, in the present context, overly concerned with safety in nuclear reactor plants, where all factors are at least capable of rigid control; or, to a lesser degree, in fuel fabrication and processing plants where the presence of knowledgeable personnel and restricted access to danger areas make good safety practices possible, if not always so observed in actuality; but in the increasingly widespread uses of radiation in industries where these new techniques have been but recently introduced.

Radiation techniques have cut costs and solved baffling problems in almost every industry, and radiation devices presently in use in industry are numbered in the tens of thousands. This use so far represents only a small percentage of their potential. Indeed, many older industries are dependent on these methods today, and new industries have sprung up which were impossible prior to the introduction of the technology.

I believe it will not overly exaggerate the possibilities to state that in a few years' time radiation-using machines will be as commonly encountered as the electric welder is today. For example, radiation density gages are almost universally used in the cigarette and food packing industries, level gages in the petroleum and chemical industries, flow rate meters, leak detectors, radiography, moisture control, wear studies and many other techniques using radiation are commonly used in the manufacturing, service and construction industries.

In the new industry category, perhaps the prime examples are the pasteurization and sterilization of food, and the polymerization of plastics both by massive irradication. The foregoing is only a brief exposition of an already large, and rapidly growing list of everyday uses of radiation.

It is well to remember, at this point, that many of the devices and techniques so far mentioned have had no control exercised over them by the AEC or any other federal agency, and the record of states in this regard does little to calm one's fears. An effort to overcome this shortcoming was begun last year, when the Secretary of Labor published a proposed radiation safety code to be made part of the Health and Safety Regulations under the Walsh-Healey Act.

While it is true that these regulations apply only to those federal supply contractors who hold contracts for ten thousand dollars or more, this nevertheless represents a large segment of industry and is, in addition, a giant step in the right direction. Organized labor through a committee chaired by Hunter Wharton, President of the Int'l. Union of Operating Engineers, and a group from the AFL-CIO Subcommittee on Atomic Energy and Natural Resources, had a large part in revising the new regulation to its present form which is compatible with the AEC regulations as expressed in 10 CFR part 20, and are, in the main, good regulations in the light of present day knowledge.

A corollary advantage gained in this effort was the extension of some previously denied protections of part 20 to the employes of AEC operating contractors. On the other hand, much political and other pressure has been brought to bear on the Department of Labor on the question of whether or not the states who have agreements by reference should have the authority to enforce the new regulations. We do not know, at this point, what the answer to this question will be, but the hope for true, uniform regulations appears diminished.

Perhaps it would better serve our purpose to digress for a few moments and give a brief explanation of what we are discussing —radiation.

A radioisotope form of an element is a form which emits alpha, beta, gamma or neutron radiation. For the present, we will ignore neutron radiation and expand the definition of gamma rays to include x-rays, which are in fact the same thing, differing only in origin. You should bear in mind this fact, that whatever is said of gamma radiation holds true for x-radiation. Each individual radioisotope has a specific and unique "half-life," which can be defined as the time it takes for a given amount of radioisotope to decay to half its initial radioactivity.

The half-lives of the more than 1200 radioisotopes vary from extremely small fractions of a second to billions of years. A wide variety of radioisotopes is available, mostly at low cost.

The most common types of radiation emitted by radioisotopes are, as we have said, alpha particles, beta particles, and gamma rays. Alpha rays, which are identical with helium nuclei are emitted at high velocity, mainly by certain of the heavier isotopes such as radium and uranium. They are the least penetrating of the three types, being absorbed completely by an ordinary sheet of writing paper. In general, alpha radiation is less often used in industrial application than beta or gamma radiation.

Beta particles are high energy electrons emitted by radioisotopes. In ability to penetrate matter, beta radiations are intermediate between alpha and gamma rays. A beta particle with an energy of one million electron volts can penetrate about twenty thousandths of an inch of steel, while a one tenth Mev beta will be stopped by about 8 ten thousandths of an inch of the same metal.

Gamma rays are electromagnetic radiation, a part of the same spectrum as radio waves, visible light rays and x-rays, with useful photon energies ranging from one-hundredth of a Mev to about 10 Mev. They are very penetrating; nine-tenths of an inch of steel will reduce only by half the intensity of gamma rays from cobalt-60, one of the commonly used radioisotopes.

Careful attention must be paid to possible personnel hazards when working with radiation-producing substances or devices. These hazards may be divided into two types: 1. radiations striking the body from an external source, and 2. possible inhalation or ingestion of radioactive material, thereby entering our bodies without the protections provided by our clothes, our skins or other modes of shielding.

When this occurs the alpha emitters then become the most dangerous of the several radionuclides, as all of the alpha particle energy is absorbed by the body in a short distance, thereby doing more localized damage than either beta or gamma radiation.

If radiation emitters are handled carelessly or without proper precautions, serious harm can occur, as is the case in using chemicals, electricity, automobiles or fire. Our main problem lies in the fact that while the proper precautions for handling radiation emitters are well established, they are nothing like as widely known as those for fire, electricity or automobiles. In many instances, special instruments and techniques are required, but they can be handled without undue risks if the proper procedures are understood and followed.

Adding enormously to the difficulties of establishing realistic controls over radiation hazards, is the truly apalling lack of knowledge on the part of the general public, about the biological effects of radiation. A good deal of confusion has been caused by those extremists who make utterances designed solely to fit their own special causes and ignore the known facts. The arguments over the so-called threshold and linear theories of radiation damage are typical. No one concerned with the field of radiation safety has seriously advanced the notion that there is a threshold dosage below which no radiation damage occurs, as a basis for control programs for many years now.

In spite of the fact that no one really knows whether or not it is so, the basis for all radiation regulatory programs and control methods is that any radiation may be harmful, regardless of how small in quantity, and these are certain limits beyond which dosages must not be allowed to go.

The goal of the radiation safety officer is the minimum dosage possible, not the achievement of the maximum amount. The tremendous benefits of nuclear energy and its accompanying phenomena, to our civilization must be balanced against some degree of hazard. This is equally true of nearly all the fruits of our advancing industrial technology.

Why should we expect anything different from radiation techniques simply because they seem less familiar than more conventional advances? We must try to keep the problem in perspective and, neither overemphasize nor unduly ignore whatever hazards might be involved. It is helpful to bear in mind that we are not discussing exposure to a hazard that may be completely avoided. We live our lives in an environment in which exposure to radiation is inescapable.

All of us are constantly being bombarded by radiations from radioisotopes which occur naturally in many materials (including our own bodies), cosmic rays, and since 1945, fallout from nuclear explosives. What we have under question is some additional small exposure exclusive of necessary diagnostic

and therapeutic medical uses. We would not, indeed we could not, abandon the use of electrical energy simply because it entails acceptance of some degree of hazard. We accept the hazard and try to keep it within bounds by establishing certain controls over its use. Radiation is amenable to the same kind of treatment.

Our knowledge about the biological effects of radiation is limited. We know certain effects resulting from massive overdosages but practically nothing about the long-term effects of very small but relatively continuous doses. We know equally little about the genetic effects in spite of enormous amount of speculation in the news media. We have no real knowledge of the mechanism of how even the few known effects are caused. The uncertainties far outnumber the certainties.

We must do the best we can to see that whatever regulations and controls are established are the best possible in terms of current understanding. As our knowledge increases and the veil of mystery is slowly withdrawn, we must be ever alert to revise and amend those safety criteria in the light of the new data. We must retain a flexible approach and never allow ourselves to fall in such rigid posture that we accomplish nothing but the defeat of our own purposes.

RADIATION SAFETY IN INDUSTRY

By EDWARD J. LEGAN

International Representative, International Brotherhood of Electrical Workers, AFL-CIO Washington, D. C., Co-chairman Radiation Committee, Labor Conference, N. S. C.

To most people, radiation safety appears to be a very confusing business; that is—it is entirely new, and very little is known. This, however, is not true. There has been an awareness of the problem dating back to the turn of the century and an organized radiation protection program for more than thirty years. In order to better understand where we are today, it is necessary to briefly review what has taken place in the past.

The first organized attempt to promote radiation protection was made by the British Roentgen Society in 1915 when it issued its "Recommendations for the Protection of X-ray Operators." At that time, no attempt was made to set a dose.

The first attempt to define a dose was made by the British X-ray and Radium Protection Committee in 1921. It established the concept of maximum permissible dose without setting out any numbers for such a dose.

In 1922, the report was essentially adopted by the American Roentgen Ray Society. Both reports restricted their recommendations to the thickness of lead barriers.

In 1925, a scientist recommended a maximum permissible dose that later calculations indicated to be equivalent to about .2 roentgen per day.

The International Commission on Radiological Protection (ICRP) was formed in 1928. Upon recommendation of the ICRP, the U. S. Advisory Committee on X-ray and Radium Protection was formed in 1929.

In 1934, the International Commission on Radiation Protection endorsed an occupational tolerance dose of .2 roentgen per day, and a total accumulated dose of 60 roentgen per year. The U. S. Advisory Committee, however, came out in favor of an occupational dose of .1 roentgen per day and a total accumulated dose of 30 roentgen per year.

In 1946, the name of the U.S. Advisory Committee was changed to the National Committee on Radiation Protection and in 1958, "and Measurements" was added.

In 1950, the ICRP made a revision in its recommendations and recommended a level of .3 rem per week and a total maximum accumulated dose of 15 rem per year. This value was also adopted by the NCRP until 1954 when the NCRP issued a report recommending 300 mrem per week to the whole body with a possible maximum of 900 mrem

per week, providing the total of thirteen consecutive weeks did not exceed 3,000 mrem (3 rem). On this basis, it was permissible to accumulate a total exposure of 12 rem in one year.

In 1957, the NCRP again revised its recommendations and suggested the limitations of radiation exposure at 3,000 mrem (3 rem) per thirteen consecutive weeks and a maximum of 12 rem per year. To limit the total accumulated radiation exposure to a recommended average of 5 rem per year for the individuals' working lifetime, the formula 5(N—18) where N is the age of the individual, was devised to assist in carrying out the NCRP recommendation.

Bearing in mind that we have been talking about recommendations by the various committees, the logical question we might ask is—What are the Official Radiation Exposure Standards in the United States? In the Atomic Energy Act of 1954, the Congress placed upon the Atomic Energy Commission the responsibility for regulating, through a system of licensing, private atomic energy activities to protect the health and safety of the public. The Atomic Energy Commission also has its own facilities and programs to regulate.

On the basis of NCRP recommendations, the AEC issues specific mandatory permissible levels of radiation exposure for personnel employed in AEC facilities to its contractors through the AEC Manual Chapters. The total accumulated dose is controlled by use of the formula 5(N—18) with a maximum in any calendar quarter of 3 rem for the whole body. Copies of the "Notice to Employees—Radiation Protection Standards" (form AEC-9) must be posted so that employees may observe a copy on the way to or from their place of employment.

The AEC, through its licensing and regulating functions, has developed and placed into effect basic standards for licensed operations. The regulations of the AEC are published in the Federal Register and become a part of the Code of Federal Regulations (CFR). (They are the law.) Title 10 CFR Part 20 "Standards for Protection Against Radiation" states that an exposure of 1.25 rem per calendar quarter to the whole body is not to be exceeded unless special conditions are met. If the conditions are met, the quarterly exposure is not to exceed 3 rem for the whole body and the accumulated exposure is not to exceed 5(N—18). The regulation also provides for a "Notice to Employees—Standards for Protection against Radiation" (form AEC-3) to be posted so that employees may observe a copy on the way to or from their place of employment.

A Radiation Section was placed in the "Safety and Health Standards for Federal Supply Contracts" of the Walsh-Healey Public Contract Act (41 CFR Part 50-204). An exposure of 1.25 rem per calendar quarter for the whole body is not to be exceeded unless special conditions are met. When these conditions are met, the quarterly exposure is not to exceed 3 rem per quarter and the accumulated exposure is not to exceed 5(N—18).

The above regulations are national in coverage and in 1959, Section 274 of the Atomic Energy Act was amended to allow for the transfer to the states certain licensing and regulatory authority with respect to by-product, source and special nuclear materials, in quantities not sufficient to form a critical mass.

To date, Kentucky, California, Mississippi, New York, Texas, Arkansas, Florida, North Carolina, and Kansas have made agreements with the AEC. The programs are essentially the same as the AEC regulations. All of the state regulations specify that a "Notice to Employees" poster is to be posted so that the employees may observe it on their way to or from their place of employment.

All of the regulations we have been talking about require that appropriate personnel monitoring equipment be supplied, such as film badges, pocket dosimeters, etc. Employees are to be instructed in the Safety Problems associated with exposure to radioactive materials and the precautions and procedures to minimize exposure.

In conclusion, it must be pointed out that rules and regulations do not in themselves make a good radiation safety program; it requires the cooperation of both the employee and the employer and to use all means available in order to keep exposures to the minimum.

SAFETY AND THE TROUBLED AIR

By ARTHUR C. STERN
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I am glad to have the opportunity to discuss the problem of community air pollution at this National Safety Congress, for the inclusion of air pollution in these proceedings is another encouraging indication that we are coming to recognize this problem as one which touches on a great variety of the challenges facing this nation today.

It is not an oversimplication to say that man, all too often, tends to see social and environmental problems as isolated and compartmentalized. It is this tendency, perhaps, which causes many people to overlook the obvious connection between air pollution and public safety, just as they may fail to see a connection between air pollution and health, air pollution and urban decay, air pollution and the squandering of economic wealth—indeed between air pollution and a host of assaults upon the public well being and the national vitality.

The reasons for our sometimes too narrow view of the ramifications of community air pollution probably could be found among the ancient roots from which contemporary life has sprung. Man has traditionally faced problems in what seemed the best possible way, perhaps the only way, of dealing with them—as individual challenges to be wrestled one at a time. Hindsight permits us to see the limitations of such an approach, but no one could deny that it has produced spectacular and even miraculous results for the more fortunate peoples of the world. We need only look about us to marvel at our success in eliminating famine, pestilence, the infectious diseases associated with filth and insanitation, mass poverty and illiteracy, and a host of ills which have plagued mankind for nearly all of recorded history.

But the roots from which modern life has grown have also given rise to the complex fabric of contemporary society in which we can no longer treat our problems as discrete entities, separable from all other aspects of civilized life. The problem of community air pollution is not seen whole unless we recognize the association between it and human health, economic welfare, individual and public safety, urban planning, industrial activity, and many other facets of our increasingly complex way of life.

Air pollution is as old as man himself. We can imagine the emotions experienced by our cave-dwelling ancestors condemned to breathe the noxious fumes from great fires as the price of protection from the cold and inhospitable world outside the cave. We can imagine, too, the relief that the cave-dweller must have felt each morning when he stepped into the relatively pure air of his prehistoric world.

This daily relief from smoke-filled caves, though it was a way of escaping the air pollution problem, afforded only a temporary solution. Man was destined to dominate the world, not to cower in it. He moved out of caves and into villages, towns, cities, and great metropolises. No longer did fire provide security and warmth—as well as polluted air—for a dozen or two persons huddled together in a cave. By the dawn of recorded history, tens of thousands of persons were crowded into ancient cities, their fires numbering in the thousands, their smoke mingling to form pockets of pollution scattered in many corners of their proud cities.

The Contemporary Problem

Let me not give the impression that the contemporary air pollution problems are the same as those of the ancient world. On the contrary, we have learned how to foul the air in ways that ancient man could scarcely have imagined. In our era, mankind has literally revolutionized its capacity to pollute the environment. The industrial revolution transformed almost overnight the fires of caves and ancient cities into the infernos which power our modern technological world.

Quietly in the middle of the eighteenth century, England began to change the course of human history. Old theories about the use of machines to do the work of men began to be translated into practical reality. Steam provided the means of converting

the vast resources of the earth into power, power to make cloth, power to make things out of iron and steel, power to transport people and goods, power to heat and light great cities. Mankind had come a long way from the world of the cave where escape from air pollution was a few yards away from the fire. Man, by the late nineteenth and early twentieth centuries had learned how to transform whole cities into smoke-filled caves, from which the city-dweller seldom if ever escaped.

Some may be surprised that so little was done about an air pollution situation which, I assure you, today we would not tolerate. But when we remember that only two generations ago, our grandparents lived in fear of death from infectious diseases or unsafe food, it is not surprising that they felt little inclined to worry about polluted city air. Air pollution was an unwanted but seemingly unavoidable price to pay for prosperity, and knowledge of public health was far too primitive to raise the suggestion that air pollution might indeed be a major contributor to disease and death. Tuberculosis, yellow fever, influenza seemed to be, and probably were, far more important threats to the public health. Not until these and other health problems were brought under control could people be expected to give thought to what long-term effects air pollution might be having on their health.

In fact it was not primarily health considerations which led to the anti-smoke programs which sprang up in England and the United States within the last 60 or 70 years. Instead it was the sheer nuisance effect of dirty air that prompted London, Pittsburgh, St. Louis, Chicago, and a few other heavily industrialized cities to try to control smoke. To a remarkable degree, the anti-smoke efforts of such cities were successful in getting rid of much of the most obvious, visible smoke pollution. Technical means were developed and applied to prevent the discharge of dense black smoke from coal-burning furnaces in factories and homes. Needless open burning was reduced, more efficient use of coal was made mandatory, and in some cases the use of certain coals was prohibited.

The control of smoke pollution reached its highest level of achievement in the 1940's, but at that same time evidence was appearing to suggest that smoke was only a part of the contemporary air pollution problem. In Los Angeles in the mid 1940's people began to complain of the eye irritating smog that occasionally hung over the city. They chose the word "smog" probably out of the notion that they too were being afflicted by the infamous smoke and fog of London, which gave rise to the term. But investigations in the years that followed proved how wrong this early impression was.

Smog in Los Angeles was found to bear little resemblance to the air pollution of London. Unlike London, Los Angeles burned no coal either in home or industry. The haze that became almost a daily inhabitant of the Los Angeles Basin, was found to be the product of a complex series of reactions in which gases produced by the burning and evaporation of petroleum were changed by sunlight into even more irritating and destructive pollutants.

Los Angeles provided, in a vastly accelerated form, a picture of the changing air pollution pattern that was taking shape in cities in all parts of the United States. Many old sources of visible smoke remained, despite the real strides that had been made against this problem, and to their emissions were being added a host of new pollutants, the by-products of new industrial activity, greater use of motor vehicles, greater amounts of refuse to be burned, and a wide range of technological changes which combined to charge the air with a host of chemically unknown and biologically untested pollutants. It was becoming clear in the 1950's, that major community air pollution problems could and did exist in places where dense smoke was absent or relatively well controlled.

The Federal Role

It was at this time that the federal government actively entered the air pollution field. In earlier years the federal government had been only very little engaged in activities relating to this problem. However, with the passage in July 1955 of the original federal legislation relating exclusively to air pollution, the federal government, through the Public Health Service of the Department of Health, Education, and Welfare, began to develop and carry out a com-

prehensive program of research, training and technical assistance whose prime purpose was the control of atmospheric pollution.

In the years between 1955 and 1963 understanding of the air pollution problem in terms of its causes, effects, and potential for control underwent a profound change. Both the general public and those individuals and organizations responsible for air pollution control came to recognize that this environmental hazard was worsening at a rate much faster than had been anticipated. Furthermore, it became clear that the cities and states, which have always been primarily responsible for the control of air pollution, were not devoting sufficient manpower and resources to this problem. By 1963 it was clear that the federal government would have to reshape its program to offer much more in the way of assistance and stimulation to the local and state governments throughout the country.

This reshaping is now in progress as a result of the adoption last December of the new federal Clean Air Act of 1963. This act offers an unprecedented new opportunity for the nation to mount an attack on air pollution consistent with the growing seriousness of this problem. In addition to expanding the existing federal program of research, training, and technical assistance, the Clean Air Act authorizes the federal government to provide financial assistance, in the form of matching grants, to local, regional, and state air pollution control agencies to help them initiate or improve their programs. The act further provides for federal abatement action in instances where interstate or certain intrastate air pollution problems are not being adequately dealt with at the local and state level of government.

The provisions of the Clean Air Act and the resources it makes available for the struggle against air pollution can mark a major turning point in this nation's efforts to solve a critically important environmental problem. But if the provisions and resources of the Clean Air Act are not used to the fullest possible extent by the cities and states, the opportunity to strike a heavy blow against air pollution will have been missed and the consequences in terms of unnecessary human suffering and economic loss will be tragic.

Safety and the Troubled Air

You may ask: "What does all this have to do with a broad discussion of safety?" In answer, let me reiterate what I suggested at the beginning of this discussion. Unless the nation realizes that polluted air is as much a threat to the public safety are are auto accidents, industrial accidents, boating accidents and any other hazard which our contemporary environment affords, then we will fail to match the problem of air pollution with the effort it demands.

It requires not mental gymnastics to think of the air pollution problem in terms of safety. All of us here recognize that poor visibility on a highway or above a congested air terminal increases the risk of accidents. But in a broader sense, man's environment is being made unsafe by the air he breathes. His chances of developing a crippling or fatal respiratory disease are increased each time he fills his lungs with polluted urban air.

It is sensationalism to say that the act of breathing constitutes a safety hazard in the usual sense, but if we broaden our perspective to think of public safety not only in connection with specific hazards but with the very facts of contemporary life, then we have to acknowledge that polluted air is among the prime safety hazards to which millions of Americans are exposed more or less constantly.

I cannot help recalling a statement made before the 1958 National Conference on Air Pollution by Dr. James Dixon, who was then Commissioner of Health for the City of Philadelphia and is now the president of Antioch College. He said, "If gas masks are not to become as common in a hundred years as shoes are today in the civilized world, we should do well to heed our somewhat submerged instincts of self-preservation and remember that—whatever other uses man may devise for it—air is still essentially for breathing."

Probably few persons attending this Congress think of themselves as involved in the effort to control air pollution. But I suggest that we are all involved, and that we attending and participating in these deliberations ought to be especially involved. Safety, I think we can agree, is in part a social challenge, in that it requires public understanding and public action as well as tech-

nical innovation. This is no less true of air pollution: solving this problem, even making sufficient strides toward its solution, will require public understanding and community action, as well as continued technological development. The public must be made aware that it holds the key to air pollution control. The people will have to see to it that their governments accept fully the responsibility, and the opportunity, for air pollution control, that they apply their resources to the problem and bolster them with the assistance which the federal government can offer.

In this task of strengthening local and state efforts throughout the country, every authoritative voice which joins in the call for action brings that action one step closer to realization. Those of you who are in a position to speak to large segments of the national community can accomplish much by pointing to the need and opportunity for great progress against air pollution. You will not be alone, for organizations in every part of the country are seeking community action to clear the air. Voluntary health organizations, service organizations, committees of leading scientists all are engaged in the effort to forge a concerted national program of air pollution control through strengthened State and local control programs.

Those of you whose concern for the public welfare centers on problems of safety can contribute measurably to the national air pollution control effort by helping to guide public understanding to a recognition of the relationship of air pollution to safety.

The challenge to protect and preserve the safety of our environment falls squarely on the people of the nation, acting through their agencies of government. It is our task to help and encourage the people to act wisely and promptly, for the hazard of air pollution will surely increase unless we move to prevent it.

HEALTH & SAFETY ASPECTS OF AUTOMATION

By R. W. OSTLING

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Research for source material suggests that although there is substantial information on automation and its application on the industrial processes, its economic effects etc., there is, in fact, a dearth of data and other information available concerning the occupational health and safety aspects of automation. Therefore portions of this paper will necessarily be of a speculative as well as a factual nature and will relate primarily to the pulp and paper industry of which I have some knowledge.

It has been my experience that although substantial progress has been made in promoting industrial safety, occupational or industrial health its causes and effects are not well known in many cases to employees of industrial undertakings.

Since I was invited to become a member of the Standing Committee on Occupational Health and Safety of the Canadian Labour Congress I have begun to suspect that many tragic illnesses and crippling diseases could have been prevented if knowledge and education had been available, especially to the workers involved.

How much more important then, is it that we acquire as much knowledge and education as is possible to make automation a boon to mankind and not a curse, as I believe can easily happen.

Perhaps I should state here my definition of "automation" within the context of this paper. "Automation" in its fullest sense of the term has four essential elements:

a) Automatic machinery with a preset cycle of operations.

b) Integration of various automatic machine operations through automatic transfer equipment which provides continuous flow.

c) Automatic control or "feed back" and

d) Computers which are used primarily to compile, store and analyze data at high speed.

A great many extremely important technological changes and mechanization are not "automation" in the strictest sense, but their impact on working conditions is at least as great. For example, diesel locomotives and the chain saw have had enormous consequences for workers in the railroad and logging industries respectively. For this reason, this paper will discuss a number of important technological developments associated with health and safety which are not literally "automation."

I suppose that it could be said that automation will reduce exposure to hazards, that technological changes appear to offer significant opportunities for making working conditions safer due to the elimination of heavy physical effort and reduction of exposure to excess heat, fumes, and noise.

However, automation and mechanization also could cause enormous problems concerning safety because of the fantastically ever-accelerating rate that the application will affect every aspect of our daily lives.

Perhaps it would prove of interest to first discuss the safety improvements created by automation.

In the pulp and paper industry, over which my union has considerable jurisdiction, "woodrooms" are considered one of the most hazardous areas in a paper mill. Workers still continue to be in danger of injury from falls on wet surfaces, from being caught in conveyors and other moving equipment, from being struck by logs, also from strains and back injuries incurred while lifting and positioning heavy logs. New equipment and new processes have in many cases reduced danger from these hazards.

The elimination of hand barking and hand knotting operations and the introduction of mechanized equipment has removed a hazard from sharp cutting knives, a particularly troublesome source of injury.[1]

The introduction of huge pumps which create a water current which in turn moves logs from "log ponds" to conveyors called jackladders has eliminated a source of injury from the long spiked poles which were used to sort and route logs along the "pond" to conveyors. Since the number of employees using these "pike poles" has been substantially reduced, the number of injuries has fallen correspondingly.

Continuous pulping systems are found in most of the newly constructed pulp and paper mills. These pulping systems are also replacing the "batch" cooking systems in a number of older mills. The significant occupational change which has resulted from the continuous pulping process has been the reduction in manual jobs involving physically demanding tasks and repetitive manipulation of machinery.

Compared with the batch system, there is little doubt the continuous pulping installation is a safer work place. There is less danger of workers being injured by flying chips and wood dust. Since the work of the "capper" and "diffuser dumper" in the digester operation have been abolished, there has also been a reduction of muscle strains and serious back injuries.[2]

In finishing and shipping departments of newsprint mills major changes are replacing manual, or semi-manual, operations by automatic conveyor systems for paper roll finishing and handling. Automatic wrapping, heading banding, and moving of rolls to pre-selected areas is producing a significant result in the decline in frequency and severity rates of injuries. Although the absolute number of injuries increases correspondingly with increased employment in finishing rooms, the relative frequency of sprains, bruises, and other injuries per employee is reduced accordingly.[3]

Closed circuit T.V., the centralization of controls through the installation of graphic control panels situated in clean, air conditioned rooms, are obviously providing safer working conditions with the added bonus of comfort.

[1, 2, 3] Impact of technological change and automation in the Pulp and Paper Industry U.S. Department of Labour.

It is also probable that with the introduction of automation, enclosed equipment and remote control will tend to reduce medical problems where they are related to chemicals, noise, heat and fumes.[4]

Safety Hazards of "Automation"

While it is true that extensive, highly mechanized conveyorization reduces heavy physical effort, it also incurs danger, in that "high speed" conveyors, driven by powerful electric motors, are a hazard source that does produce serious injuries.

The introduction of more powerful chemical bleaching agencies as a result of technological change has created additional potential hazards to working conditions in the pulp and paper industry.

Because ionizing radiation lends itself to automation its use in industry has grown rapidly. Because radiation presents a very real, potential, health hazard it is necessary that all workers and those in authority have a knowledge of this hazard since with adequate safeguards and proper regulations, experts tell us, it can be handled safely.

It is not my desire to cry "wolf" regarding this very real and dangerous hazard but I am convinced that the general lack of knowledge concerning the dangers of radioactive isotopes presents a very acute safety problem.

For example practically every important producer in the pulp and paper industry now uses radioisotopes. The most common use is as a measuring device, or gauge, on paper machines for continuous gauging of weight, and thickness of paper especially laminated, coated, and impregnated products. Yet employees who work in the immediate vicinity of these gauges have little or no real understanding of the potential danger, and therefore must be provided with adequate protection.

It can be stated that most radioactive isotope installations in industry present a low hazard unless someone tampers with the source material. For this reason workers should be made *aware* of this fact.

It is interesting to speculate how automation will affect large and small manufacturing, construction, and public service industries. Factual statistics indicate that large companies have achieved much better improvements in accident frequency rates than have small companies.[5]

It has generally been accepted however, that automation is mainly possible in large firms, therefore improvement can be expected in the years ahead concerning accident prevention, since automation, in many instances by reducing the number of employes, automatically diminishes accident probabilities.

A consensus of opinion is that for years to come, technological change will not cause the disappearance of smaller firms in the construction, trade, and service industries. Since accident records indicate that these industries have the highest accident frequency rates, it is reasonably safe to assume that unless there are revolutionary developments in these smaller firms, automation will have little beneficial influence in this field of accident prevention.

Occupational Health and Automation

Limited studies have been conducted on this subject much of which is still speculative in nature and can only be confirmed by experience. However, sociologists and members of the medical profession have come to some disturbing conclusions on how automation will affect workers psychologically.

A study group sponsored by the International Labour Organization states that a factor of great psychological importance in evaluating the effects of mechanization and automation on health of workers is the reaction to the fact of change itself. . . . It is not difficult to imagine the feeling of frustration and futility which some older workers may suffer in watching a machine perform operations in which they, the older workers, have gained knowledge and skill only after years of training and experience.

The anxiety producing impact of automation on employes has in many instances caused an uneasiness created by the nature of the change. This has been described by one authority as follows:

"It is quite sufficient to talk with anyone in those affected areas to notice the unrest and the anxiety which is awakened by the fact that automation seems to enter their lives . . . here, for the first time we have

[4] The anticipated effect of Automation on Industrial Medicine. John H. Fougler M.D.

[5] 1963 Summary of accidents compiled by Quebec Compensation Board.

to do with a machine that not only replaces human muscle, but which actually replaces the human brain and which, therefore, has a considerably deeper impact on human pride. In other words, there is something far more uncanny about automation than there has been about the ordinary type of industrialization. That all this has an immediate and direct influence on psycho-pathology can be proved by a fairly recent experience. It has been shown that workers who work for machines have a far higher incidence of neurotic pathology than workers who work for other men.

"Fear of the unknown, myths which have developed around the capacities of new machines, allied to basic fears about job security and skill displacement can undermine the confidence of workers and may, in some cases seriously affect their mental health."[6]

The preceding quotation I believe is equally applicable to office workers as well as factory employes.

Although the safety and occupational health aspects of automation presented here refer primarily to "factory" and "office workers," it is interesting to note that automation is and will continue to affect management as well, especially in what is commonly referred to as middle management. Competing with computers and other thinking and decision making machines is bound to have a psychological effect similar to that of workers in the office and factory.

How do we solve the additional health and safety problems created by automation when obviously we have not realistically resolved existing occupational health and safety problems? This is not to say that there have not been tremendous strides in the promotion of safety and accident prevention, of which the National Safety Council can justly take its share of credit. However, how can we rationalize success in this endeavor when over one-half of the industrial plants in the United States lack basic industrial hygiene control measures,[7] when my sources of information indicate only five of ten provinces in Canada have active occupational health agencies?[8]

Education, information, and especially research, on a far larger scale than is presently existent is urgently required to help us anticipate and prevent accidents and also to detect at the earliest moment the harmful effects of automation.

Early and complete information is the surest way to dissipate fear. Effective and continuous consultation with employe organizations such as unions or other factual sources of authentic information is, I believe, an absolute necessity.

While automation can provide the promise of release from hazardous work, it, however, creates a multitude of social problems of adjustment. The safety and health aspects of automation will depend largely on how we use this new technique.

6. Dr. Edurado Krapf, Chief of Mental Health Section, World Health Organization. 1957.

7. Report of the Committee on Environmental Health Problems to the Surgeon General.

8. Report to C.L.C. committee on Occupational Health and Safety.

HEALTH AND SAFETY ASPECTS OF AUTOMATION

By PERCY BAXTER
Recording Secy., United Auto Workers Local 122, Twinsburg, Ohio

In 1950, when a Ford Motor Company executive coined the word "automation" which means the supervision and regulation of the production process by self-operating mechanical, hydraulic, pneumatic, chemical, electrical, or electronic devices, we doubt that he could possibly have envisioned the tremendous controversy and impact this single word would interject into the mainstreams of industry.

Automation was introduced to the public at large and proclaimed to be a new and significant labor-saving method and process to increase production by automatically controlled machines. The public relations program citing automation as evidence of the virtue of American management ground to a halt, however, when trade unions not only agreed that such technological advances were worthy of notice but moreover had the effrontery to quote these management proclamations in support of union demands for a share in the increased productivity gains caused by automation.

From that point hence, management reversed itself. In some instances, automation was represented as more old than new. In others it was deprecated or ignored. It went so far in some management circles that even the mention of 'this word' was regarded as most unbecoming conduct.

Labor realized automation had changed the nature of typical factory jobs so as to weaken the common bonds which historically provided a source of union strength. A publication was issued out of Solidarity House in 1955 under the heading "The Impact of Automation" in which organized labor welcomed automation, although it was realized by organized labor that automatically controlled operations replaced machines and manually paced jobs with the result that there was a decrease in the importance of the traditional methods used by work groups to control their work pace.

When the intensity of physical effort no longer controls the level of output, and automation sets the pace, we in labor cannot permit ourselves to overlook or disregard the safety aspect involved when non-thinking electronic devices determine and control the loading and unloading of machines.

These automatically motivated instruments of productivity were primarily instituted into the industry for the purpose of increased production. There were very few, if any, accommodations for safety methods from the off set, but the trend toward safety has been moving steadily to the front and must attain the position of top priority if automation is to survive as a basic part of our increasingly complex culture, and the saying that "the dollar is more important than safety" must become a phrase of the past.

Let's take the Chrysler Mound Road plant in Detroit for example. Some years ago this plant which produces engines for the Chrysler Corporation, decided to move into the pastures of automation and in making the move the safety aspect of automatically controlled operations took a temporary back seat to production. In a very short period of time, this particular plant moved to the number one spot in the corporation for 'on the job accidents' which caused many of our members long and painful months of confinement and loss of pay.

The Union moved vigorously toward the core of the many problems involved, employes submitted ideas, chief stewards wrote grievances thus causing the Mound Road engineering staff to spend many many hours of research which proved to be fruitful. At this time, the Mound Road engine plant is no longer a place where men are constantly being injured on their jobs, suffering untold pain and losing undetermined amounts of monies, but instead it has become one of the safest engine plants in the industry. This plant is evidence for all that safety need not be sacrificed in order to make a profit.

Safety is rightly recognized to be everybody's business, from the production worker to whom safety is a constant necessity, to the plant manager who makes periodic tours through the automated areas with visiting brass. Between these two, there should be safety committees consisting of both management and hourly people working in unison with safety as their goal.

Some of the automated industries are dangerous from the standpoint of a high accident rate. The percentage of accidents varies from plant to plant in the same industry. This variance is due to the degree which the various plant managers employ the safety provisions. So, it is plainly evident that many workers are unnecessarily exposed to danger.

These unsafe and unhealthy conditions exist because some firms are reluctant to incur the expense of modern protection devices and safety programs. Putting it bluntly, their greed for profits is much greater than their consideration for the health and safety and lives of their workers.

In this automated age, we cannot overemphasize the absolute necessity for active industrial health and safety committees in our shops. For altogether too many years,

too many wage earners have paid with their lives and their bodies for whatever progress has been achieved in safety.

Such "progress through tragedy" must be stopped. It can be stopped. It can be stopped by genuine Labor-Management cooperation. It can be stopped by effective education and proper safety training of every trade unionist. It can be stopped by realistic safety legislation which will provide minimum protection to both the unorganized and organized workers.

The supervisor has the responsibility for the safety of his workers, including providing a safe working place within his authority. He must demonstrate that safety is important in his department and that the safe way is the accepted way to work.

When automated equipment is not functioning properly, then it is within the supervisor's authority to determine whether the impropriety constitutes an unsafe operation. After making this determination, it is his additional responsibility to apply whatever preventive methods are necessary to render the operation "safe."

Stewards, safety committeemen and other union representatives must also take a responsible attitude toward safety. They must be just as alert to *unsafe practices* of members as they are to unsafe working conditions. Overlooking a dangerous practice by a worker is to be condemned as strongly as failure of a supervisor to correct the worker.

With automation being such an important factor in today's industrial environment, it must be emphasized that the observance of unsafe conditions cover both fundamental methods of preventing injuries. A safety committee chairman has truly said "safety is not a one-way street." The development of safety should have the same green light as the development of automation. A safe working force would proceed rapidly under the joint leadership of union and company officials.

Workers working with and around automated equipment should be thoroughly instructed and familiarized with the hazards of its operation. Proper guards, protective devices, extractors, and ejectors are so essential in safe operational procedure. These procedures are based on a plant's overall automated system and could be applied to any specific plant operation.

When there is a close mixture of the human element and a mechanically motivated element, accidents could be numerous. Preventive measures to circumvent these accidents should be given the highest priority by this body, for when an accident is prevented on an automated operation, it is because someone had the foresight to apply proper preventive methods.

Labor fully realizes that the potential benefits of automation are great, if properly handled. But, in looking ahead to the many benefits which automation can produce, we must not overlook or minimize the many problems which could inevitably arise in making the adjustment to the new technology. It is indeed important that safety continues to be everybody's business for without safety, the potential benefits of automation, though great, would be of little value to a crippled and maimed society.

INDUSTRIAL NOISE PROBLEMS AND HEARING PROTECTION

By HAROLD J. BUOY

Assistant to the International President, International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers, and Helpers, AFL-CIO, Washington, D. C.

The problems involved in this subject are so vast and the protection so varied, so different—and in some cases so limited that you just couldn't begin to touch them in a short article.

Yet the problem daily becomes increasingly more important and labor has such a vital stake in it that it just can't be glossed over. So I thought I might limit myself to the problem of hearing conservation and what

labor is trying to do in the field and supplement my remarks to you with certain prepared statements of recommended standards and suggested noise control programs.

That the subject matter is important is illustrated by an article in this month's *Reader's Digest*, October 1964, entitled "The Rising Tide of Noise" in which it is said, and I quote, "The United States is the world's noisiest country, and every year it is getting noisier. . . . People subjected for long periods to sounds of 120 decibels may suffer permanent ear damage or become seriously upset physically and psychologically. It is estimated that the sound levels to which we have been exposed have increased on the average one decibel per year for the past 30 years. As machines proliferate and population increases, universal din is expected to engulf us at an even steeper rate. . . . New studies indicate that workers in factories and offices with high noise levels carry a burden of resentment and irritation, have more 'social conflicts' at home and on the job than workers in quieter surroundings."

In another article I read recently I found this amazing statement: "If you could get the eight million in the city of New York together in one spot and have them say in unison and simultaneously 'Good morning, Mayor Wagner, happy birthday to you,' you would get the same noise levels from all these people speaking at one time as you now get from one jet aircraft."

And so with new things constantly coming into our environment, with motor traffic, airplanes, air conditioners, the loud television commercials, lawn mowers on Sunday morning, chain saws and all the new motor complex of our society, the problem becomes more acute each working day. We people, representing labor, should be vitally concerned. We are concerned. From many different angles are we involved.

First of all we are concerned with the natural fear of noise. Every individual is born with a natural fear of noise. We are born with only two fears, the fear of falling and the fear of noise. All other fears we are educated to.

But the fear of loud and sudden noise is with us all our days. A baby in a crib will scream when frightened by it. A workman on a job becomes startled by it and drops something onto a fellow worker. Or the worker becomes startled by it and falls off the ladder or from high places. He becomes irritated by it, he suffers anguish from it, and sometimes it is more than he can humanly bear.

Secondly, we are concerned with noise from the standpoint of the worker not being able to hear instructions or getting his instructions garbled.

Only recently in Virginia a wrench dropped into the water where some workmen were repairing a large noisy pump. One of the workers, 21 years of age, volunteered to retrieve it. The boss told him to wait until the pump was shut off and left the job site to shut it off. Before the pump was shut off, the worker jumped into the water and was immediately sucked into the pump and drowned. When it was over the boss said, "I guess he didn't hear me."

What a tragedy. A two dollar wrench and a 21 year old boy killed over it. Yet we feel that getting instructions properly are a part of any job.

And then last but certainly not least, we, the workers, are vitally interested in the hearing loss, deafness, ear impairment and psychological impairment of our people left by this noise.

To my union it long has been a problem. For many years, the name of occupational loss of hearing was Boilermaker Deafness.

Today this name is no longer appropriate because the problem is so widespread and affects not just one craft or trade but nearly all of the workers in our shops, our mills and our plants.

Records for claims (compensation for hearing loss) date back to 1931. Claims were accepted in 1939.

Although compensation claims have been recognized for over thirty years, a New York Court Decision in 1948 (Slawenski Case) influenced top management of insurance companies and industry to begin appraisals of the hearing loss problems of workers exposed to noise.

Most emphasis is still on the compensation phases of the problem with a very great lag in the practical applications of noise control and hearing conservation programs. The results are certainly not commensurate to the great fund of knowledge accrued and

if there are improvements, they are not reflected in the compensation claims.

The laws today do not encompass a comprehensive program and basically recommend the shielding of the worker against the effects rather than make provisions for the control of the hazard. They also indicate a non-uniform approach and indeed divergent ideas as to standards.

Except for the International Brotherhood of Boilermakers, Iron Shipbuilders, Blacksmiths, Forgers, and Helpers, AFL-CIO, the major role of the unions has been oriented toward the improvement of state workmen's compensation laws dealing with injuries due to exposure to noise; and rightly so. If, however, progress is to be made in hearing conservation, it will require the full cooperation of employer, employe, and those interested or concerned with hearing conservation or noise programs.

Labor's main role is to guide, sell, convince employe and employer of the wisdom and economy of proper hearing conservation programs. Labor, particularly international unions, can exert a unique leadership in this field simply because of the widespread and diverse membership. Their members have also a much greater economic stake in a hearing program than any other group.

Much is still to be learned about the relationships of hearing loss and noise exposure; however, the large volume of experience and information gathered through years of research and observation are a good enough basis upon which to establish hearing conservation programs.

Although there is still much to be learned about the relation of hearing loss to noise-exposure, we have accumulated enough information through experience and research to enable us to organize and conduct conservation programs. This basic information is, in brief:

1. Many noise-exposures can produce a permanent hearing loss that may affect communication by speech.

2. Noise-induced hearing loss may be temporary, permanent or a combination of temporary and permanent.

3. Permanent noise-induced hearing loss is due to destruction of certain inner ear structures which cannot be replaced or repaired.

4. The amount of hearing loss produced by a given noise-exposure varies from person to person.

5. Noise-induced hearing loss first affects man's hearing of sounds higher in frequency than those essential for communication by speech. Therefore, most early noise-induced hearing losses pass unnoticed unless they are detected by suitable hearing tests.

6. Four major factors characterize noise-exposure.

(a) overall noise level
(b) composition of the noise
(c) duration and distribution of exposure during a typical work-day
(d) total time of exposure during a work-life.

7. Both hearing ability and noise-exposure can be measured reliably by competent, properly trained personnel. (The measurement and evaluation of impulsive noises, which are produced by explosions, drop hammers, riveting guns, etc., present special problems.)

8. To be effective, a hearing conservation program should include:

(a) a noise-exposure analysis
(b) provision for control of noise-exposure
(c) measurements of hearing

The indication of a hearing conservation program should be considered whenever persons have:

1. Difficulty communicating by speech while they are in the noise, or;

2. Head noises or ringing in their ears after working in the noise for several hours, or;

3. A temporary loss of hearing that has the effect of muffling speech and certain other sounds after several hours of exposure to the noise.

As we plainly see from all of the foregoing, there is a great deal of work to be done in this field.

The International Brotherhood of Boilermakers has submitted recommended standards through the Standing Committee of Occupational Safety and Health, AFL-CIO, for adoption by the Secretary of Labor as requirements under the Walsh-Healey Act.

These standards have become the official recommendation of the AFL-CIO.

My organization is convinced that noise is an acute problem affecting the health and welfare of our people. This is evidenced by the fact that compensation claims for hearing loss due to noise exposure are increasing rapidly. Regrettably, comprehensive surveys of the extent and the rate of growth of this problem in industries are lacking. This uncontrolled, environmental noise hazard which can cause permanent disability among workers, greatly adds to the number of poverty stricken.

Our International President, Russell K. Berg, intends to ask the Secretary of Labor to appoint a balanced study group to fully explore the extent and the rate of growth of the noise problem in industries so that a solid foundation can be laid for the development of realistic hearing conservation programs.

We need your help. We need the solidarity of all the International Unions working together in this cause. We need these standards and we need national legislation. We ask that you join with us in this matter for the welfare of all our members.

HEARING AND HEARING LOSS

By DR. ARAM GLORIG

Director, Callier Hearing and Speech Center, Dallas, Texas

The accepted definition of noise is that it is unwanted sound, and I think the reason for this is quite obvious when you realize that some people complain about one noise but the same noise will not be complained about by others. There is something else to it—that it is an unmusical, unrhythmic type of sound. So remember the definition of what we are going to talk about.

If you go back in the literature you can find records of noise induced hearing loss or acoustic trauma as far back as 1802, when it was first reported in blacksmiths. We have had it now for over a hundred years and it took us over a hundred years to realize that something should be done about it. Whether or not it was due to the magnitude of increase of the problem or what, I do not know.

There are two terms we use when we talk about this problem. One is acoustic trauma and the other is noise-induced hearing loss. You will notice if you will read the older literature, that damage from noise is called *acoustic trauma*, if the damage is to the ear.

We have tried to separate these terms, and reserve the use of *acoustic trauma* to indicate the kind of hearing loss that occurs from a single incident, like a blow to the head, an explosion, gunfire, or a burst of riveting gun noise inside of a tank, or something similar, where the injured man can say that, "up until the time of the incident my hearing was all right. Since then I have noticed a hearing loss." Now this is correctly called acoustic trauma.

The kind of loss one gets from steady noise-exposure to which most of us are exposed, either through our social activities or our occupational activities, we call *noise-induced hearing loss.*

Now why do we differentiate between these? Because there are important differences. Acoustic trauma produces a different kind of hearing loss with respect to the audiogram shape, with respect to its permanency, and with respect to its temporary characteristics. Noise-induced hearing loss comes on very gradually over a period of years. It is so gradual that most people don't even know they are getting a hearing loss until it is bad enough to cause difficulty hearing speech.

At any rate we use these different terms because of their legal and medical differences. There are also medical differences related to the pathology and the etiology.

Remember *acoustic trauma* for the single incident cause of loss, and *noise-induced hearing loss* for the gradual loss due to long exposure.

Now let us talk about the health effects of noise, exclusive of a hearing loss. I heard a previous speaker state that noise will produce irritability, nervousness, fatigue and tension. I'm not saying that these do not occur but I am saying that up to today there is no concrete evidence that all these things result from exposure to noise. It is well recognized that noise may be an additional stress; and, that as part of many other stresses that occur, noise may add weight to everyday stresses.

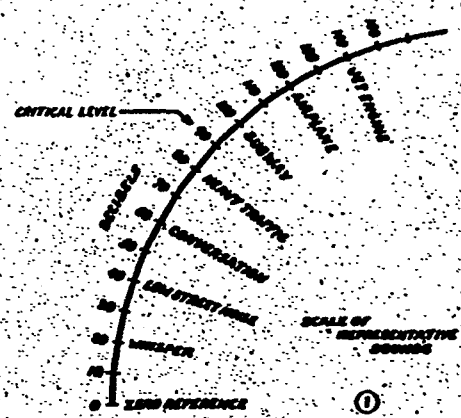
However, we have no concrete medical evidence, that we can discover by present methods of medical examination, to support such a statement. Or that it causes stomach ulcers.

There are individuals, of course, that can be affected by almost anything. I'm talking about the average man who walks the street. There are some studies, reported in Germany, that indicate some of these things are happening. But, when one looks at the reports it is apparent that the studies are not well controlled, and the data are questionable.

Our laboratory personnel feel that we have done enough with respect to hearing loss problems and we are starting to investigate some of the other physiological effects related to noise-exposure. I'm talking about the kind of noise one encounters in ordinary industrial situations; not the noise that will be produced by trans-sonic airplanes. We expect the noise level to go to 170 or 180 dB. I'm not talking about exposures that accompany several jet engines when the level is close to 160 decibels. We don't know what these exposures would do; but we expect that man can't take this kind of exposure continuously for very long. There is too much energy involved.

But as regards ordinary industrial exposures, the sort you people are most interested in, we do not, as of today know of any ill health effects except those which relate to the ear. However, considering that hearing is extremely important to daily living, we should consider the function of hearing more carefully.

Figure 1 shows a general curve which gives you a little idea of the kind of noises we are exposed to in our daily lives. You will notice zero is about the least amount of sound the best ear can hear. Then the levels

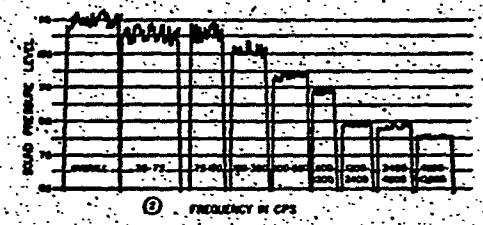


increase up to the rocket engine of the future. Notice that most of the noises we are exposed to range from approximately 70 dB in heavy traffic to subway noise, ordinary airplane noise and up. Industrial noises vary somewhere between 80 to 100 dB in general. The numbers indicate overall level. They represent the total energy of the noise regardless of the spectrum.

Notice the word decibel. The meaning of this is very difficult to explain to a lay audience. But let me illustrate it this way. Notice that a subway generates about 100 decibels—this is one train running through a subway tunnel. If two trains passed your measuring point, you would not have 200 decibels because there were two engines or two trains. The increase in overall level would be only three decibels.

The general rule says that when we double the energy we increase the noise level by only three decibels. Now let us illustrate this in one of your shops. If one engine generates 95 decibels, and you start another engine, the noise level increases only three dB to 98. Each time the energy source is doubled, the level increases by 3 dB. This is why measuring the noise level of one engine is not much different than measuring noise in an entire shop where there may be 20 engines because the decibel scale is not a linear scale—it does not measure in units like inches or feet. It is a logarithmic scale and every number represents a change of tenfold. If you remember this simple rule, you will not be misled by numbers that are frequently used erroneously.

Now what about the spectrum of the noise, the character of the noise, and the pitch of the noise? Figure 2 illustrates octave band levels. What is an octave band? Well, if you're familiar with the piano you will remember that middle "C" is approximately



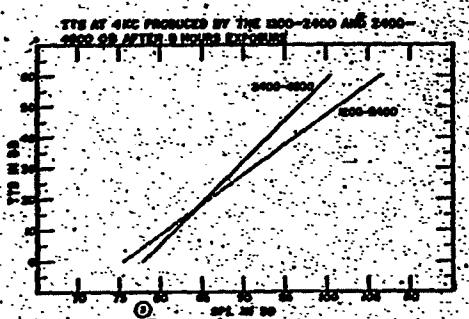
250 cycles per second. Cycles per second mean, roughly, 250 changes in atmospheric pressure due to a vibrating body. The particular octave band that includes middle "C" would be 150-300 c/s.

Notice that the numbers are doubled as the noise increases in pitch and halved as it decreases in pitch. An increase of one octave indicates a doubling of frequency and increase in pitch on the piano by one octave; i.e., from middle "C" or C to the next "C" would be a frequency change from 250 to 500. Frequency or cycles/second determines the pitch of the noise. This gives the noise its quality, timber, and character, whether it is high or low pitched.

Now why do we measure frequency? Because it is very definitely known that some frequencies have more effect on the ear than others and this must be considered when standards are evolved. We know, for example, that the frequencies from 300 to 4800 have more effect on the range of hearing that we are interested in than the frequencies below 300. (We don't know what the reason is for this.) Frequencies from 300 to 4800 become the most important frequencies when criteria for noise control are considered.

Figure 3 shows other factors of noise that we must learn about. What level of noise is necessary to produce a hearing loss? Perhaps it would be better to ask, "what noise level will not produce a hearing loss?" Because of many difficulties accompanying field studies, we had to go to the laboratory and run experiments on normal hearing young college men and women.

For example, Figure 3 shows that when we expose a group of twenty men to approximately 80 decibels (the lower ordinate)

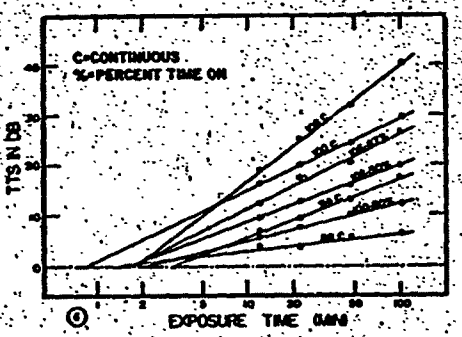


for eight hours there is no change in their auditory threshold as a result of the eight-hour exposure. But as we increase this exposure level to 85, 90, 95, 100 and 105, the subjects began to show significant increases in threshold at the end of eight hours. The exposure signal was part of a white noise, it sounded like hissing steam. These exposures produce the changes shown. Notice that when the noise level reaches 105 the hearing loss (temporary, of course) increased to 60 dB.

You are probably wondering why we did this to young men. The loss is a temporary loss and if the exposure is not continued too long, recovery takes place by the next day or two. This is why we can use these subjects for experiments. We know they will recover if we expose them under controlled conditions.

We now have a lower level that can be considered a safe level for the average man. In other words, if the level is kept below 85 decibels, we know that an average person will not have a significant hearing loss for everyday speech 15 or 20 years later.

Figure 4 shows the relation of time to energy. Notice the graph designated 106 C.



It indicates that these subjects were exposed for various numbers of minutes to 106 decibels of continuous noise. At 50 minutes the hearing increased to approximately 32 or 33 decibels. Next we interrupted the noise. On for 2 minutes and off for 2 minutes. Now, after 50 minutes of exposure (half time on and half time off) the hearing level is only about 20 dB. You will say, "Of course this would be true because there is only half the amount of energy," but if you will follow the time line one more step from 50 to 100 minutes you will find that 100 minutes of "half on—half off" does not increase the hearing level to very little more than half as much as 50 minutes of continuous exposure.

It becomes quite obvious that time distribution is an important factor in noise control. We know that when a person is exposed for a specific period that is followed by a specified period during which the noise level is below 85 dB, he will not need ear protection. The rest period acts as a protective device. We can now work time into our criteria for noise control.

Figure 5 shows a section through the human ear. The external ear, where the arrows are, is not of much use to most of



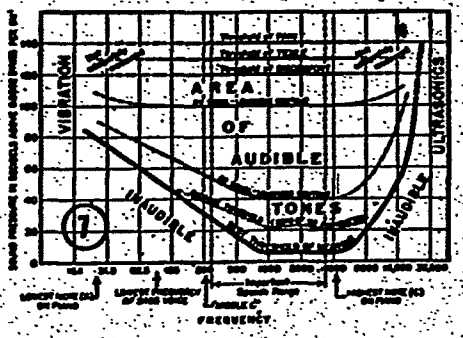
us except to carry sound to the drum head. The middle ear lies between the broken lines.

To the right of the second broken line is the inner ear, called the cochlea because it looks like a snail. Within the snail shaped bone is the sense organ of hearing. It is here that damage from noise exposure occurs. The middle ear is not affected in any way by noise exposure unless the noise happens to be an explosive type. The force of the wave front may dislocate the little middle ear bones. Industrial noise commonly produces an inner ear change which results in damage to the nerve endings. It is permanent. It cannot be treated; *it must be prevented.*

Automatic audiometers or, more correctly, self recording audiometers are used to a large extent in industry. There are probably more manual audiometers, however. The results from these are completely comparable.

All of you should think seriously about testing hearing. No one should be employed without a pre-employment or a pre-placement hearing test. This is important to the employee as well as the employer. It is important to know whether the employee has a hearing loss already, or has normal hearing. Not that the man who has a hearing loss is a greater risk. Actually the man with a hearing loss is not a greater risk, as far as noise exposure is concerned. We have definitely shown this in spite of the fact that some people will argue about it.

Figure 7 gives a few important facts about the ear with respect to its sensitivity



and range. The heavy line indicates the sensitivity of the best ear in sound pressure level. The line with the closed circles indicates the present American reference level for audiometers. Notice that it is a little higher than the best ear. This is the present reference standard used to determine if a subject's hearing is within normal limits.

The ear can operate within a dynamic range of intensities that extends from very faint sounds to the sounds of a jet engine (about 140 dB). At this level the listener notices pain. Please understand that damage is not commonly associated with pain. Noise causes damage to hearing long before pain

is experienced. Most noises are not painful, but many noises will produce a hearing loss.

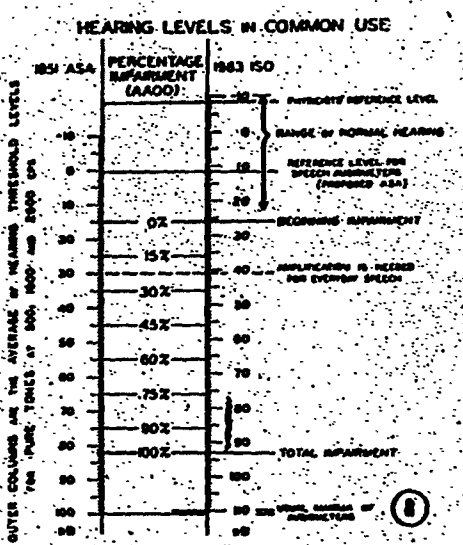
The ear is so sensitive that a 1000 cycle tone (about two "C's" above middle "C"), barely heard will move the drumhead about the distance of one-tenth the diameter of a hydrogen molecule.

To put this in more familiar terms, if one-tenth the weight of a flea is dropped on the drumhead, the brain will respond. This gives you an idea of how sensitive the ear actually is. Therefore, it needs care and protection from noise exposures whose octave band levels are above 85 to 90 decibels. The frequency range of the ear extends from about 20 cycles on the low end, which is the lowest note on the piano, to approximately 16—or 20,000 cycles on the high end. Notice the ear is less sensitive to low frequencies (below 500), and high frequencies (above 3000) than it is to the central frequencies. The frequencies that are necessary to hear speech are those that the ear hears best.

High frequency loss is most common in everyone and is very interesting because people will spend a great deal of money for hi-fi equipment, (out to 16—and 20,000 cycles), but by the time they are old enough to have money enough to afford this kind of equipment, they can't hear it, because aging is accompanied by a high frequency loss. I'm always reminded of the old lady who was interviewed by one of Kinsey's reporters and after the interview said, "This man wasn't interested in high fidelity, he was interested in high frequency."

The importance of high frequencies from our standpoint is small. We don't need high frequencies for much of anything unless we happen to be a piccolo player or flutist. And even many musicians have significant losses in the high frequencies.

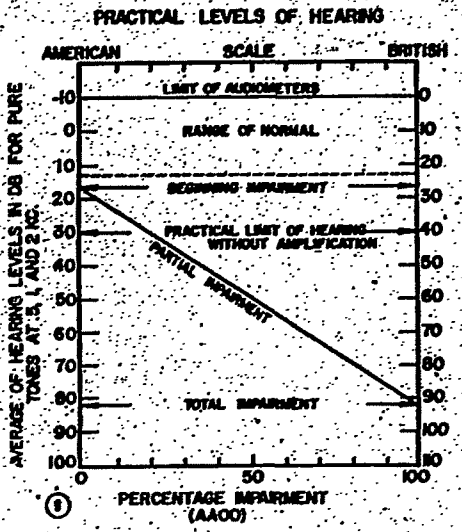
Figure 8 brings up the problem of reference standards for measurement of hearing. I point this out to you briefly because a new standard audiometer zero is being suggested that is about 10 decibels lower in intensity than our present American standard. During the transition period some difficulties will arise, because up to now we have used 15 dB re present audiometer zero as the upper limit of normal hearing for speech. When the new zero reference is standardized the upper limit of normal hearing for speech will be 26 dB.



The reason for the apparent increase is due to lowering the reference level from 15 dB SPL (re 0.0002 dyne/cm²) to approximately 5 dB SPL (re 0.0002 dyne/cm²). Actually the upper limit of normal hearing for speech is approximately 25 dB SPL (re 0.0002 dyne/cm²), regardless of audiometer zero. The crux of the problem lies in the fact that hearing handicap for speech is related to sound pressure level, the reference for which is 0.0002 dyne/cm², whereas audiometric zero is based on a statistical average of the hearing in a sample of young (18-25 years old) otologically normal ears as a function of frequency. This is an important point to explain because you will undoubtedly have some problems with it later on.

Figure 9 indicates various levels of hearing that are related to a person's performance with respect to hearing in everyday life, not necessarily on the job. You will note that the range of normal hearing includes up to 16 dB re present standard and 26 dB re proposed new standard. People who have no difficulty hearing speech may fall anywhere below this level. When the hearing level increases above this point, hearing impairment begins.

Some frequencies are more important for everyday speech than others, as Figure 9 also shows. They are 500, 1,000 and 2,000



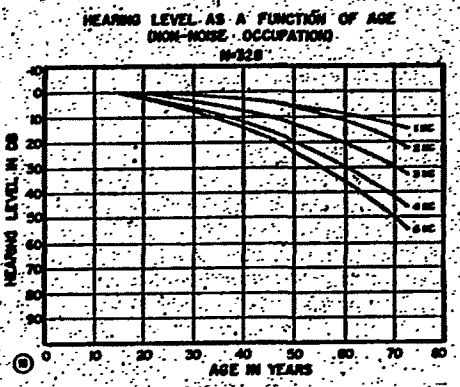
cycles/second. Remember, these are also the frequencies for which the ear is most sensitive. Any criteria for evaluating impairment is usually based on the average of the loss at these three frequencies.

Total impairment is reached when the average of these frequencies reaches 82 dB re present zero, or 92 re new zero. This does not mean total hearing loss. It means that under ordinary circumstances, a person with this hearing level cannot carry on a satisfactory conversation. Such a person can hear, but the human voice cannot maintain this level long enough to carry on a satisfactory communication. Impairment then, lies between these two hearing levels.

Audiograms indicate the general kinds of hearing losses that occur. These depend on where the pathology is. You will recall I mentioned the middle ear. If damage occurs here for any reason, a conductive hearing loss results. When hearing is measured with an earphone over the ear, and an elevated threshold is found, but when measured with a vibrator on the skull, which bypasses the middle ear, and a normal threshold is found, this indicates the pathology is in the middle ear, the loss is called a conductive hearing loss.

When the hearing measured via the skull and via the ear is the same, the pathology is in the inner ear and the loss is called a sensori-neural loss.

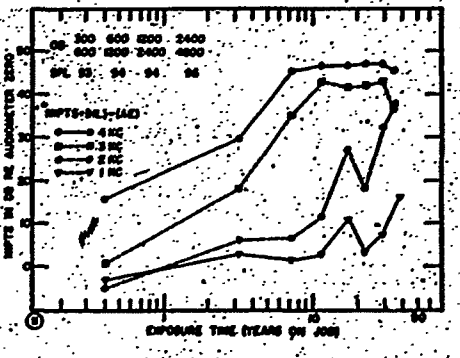
Figure 10 illustrates hearing loss due to age. The age factor in hearing loss is an important one from a research standpoint. This graph indicates how much loss one can



expect in the average person as a function of age. Notice that the speech frequencies (we left out 500 c/s because it is the same as 1,000 c/s) show only slight change with age. Age does not produce a communication problem provided the central (brain) mechanism is capable of interpreting the auditory signals. Therefore we do not feel there is any need to correct audiograms for age prior to determining compensation for hearing impairment.

Now what happens to ears when they are exposed to noise?

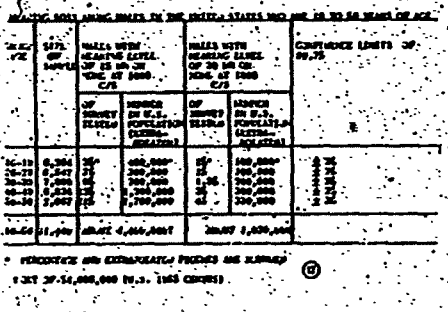
Figure 11 shows a summary of thousands of records. Notice 1,000 and 2,000 cycles, the important speech frequencies. They show



increasing loss during the entire 30-year exposure. We have people who have been exposed up to over 40 years. Notice that the higher frequencies (3,000 and 4,000) lose during the first 10 or 15 years and then show no further loss except what would be expected from age. Of course, if the noise level is increased, the hearing threshold will be elevated proportionately.

When we first discovered that high frequencies reached maximum loss in 10-15 years, we thought we wouldn't need to worry about hearing conservation after 10 years exposure. Unfortunately this did not apply to the important speech frequencies. We believe that these frequencies will also reach a maximum loss eventually, but with the noise levels generally found in industry the average man will not work long enough to reach this point.

Now what about population statistics? Figure 12 indicates that approximately 4-1/2 million males between 10 and 59 years of age have hearing levels of 15 dB or greater



at 1000 c/s and over a million of these men have need for some sort of assistance to hear ordinary speech. Notice particularly that 3 per cent of males between 50 and 59 need assistance according to this general population sample.

Statistics taken from a sample of a noise exposed population show that 26 per cent of the males between 50-59 years of age need assistance, an increase of over 20 per cent when compared to the general population. This is concrete evidence that we should do something about protecting men who work in noisy occupations. And I can say categorically, that a good hearing conservation program will reduce this to a negligible number.

Permitted Weekly Average Exposure

S-1.6-1960	Frequency Band c/s	Hours Per Week 0.1	0.3	1	3	10	40
63	20- 75	135	135	125	115	110	105
125	75- 150	135	130	120	110	105	100
250	150- 300	135	125	115	105	95	95
500	300- 600	130	125	110	100	95	90
1000	600-1200	125	120	110	100	90	85
2000	1200-2400	120	115	105	100	90	85
4000	2400-4800	120	115	105	100	90	85
8000	4800-9600	120	115	105	100	90	85

S-1.6-1960—American Standards Preferred Frequencies for Acoustical Measurements.

FIGURE 13

Figure 13 is a table showing the hearing conservation criterion that has been proposed by the Bureau of Labor. It is a fairly sound proposal. There are some technical faults that could be corrected to make it somewhat better. It is a little more conservative than necessary.

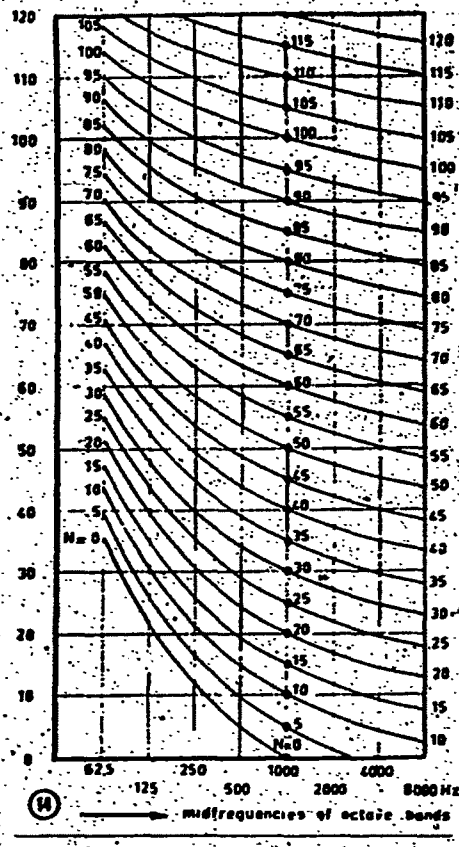
This criterion is based on the equal energy law, which states that no matter how a noise is distributed over a day, (continuously or intermittently), as long as the total is the same, the effect will be the same. This is not quite true, but as I say, it is conservative and we won't object too strongly.

I happen to be Chairman of an International Standards Organization Working Group that is working on the problem of rating noises for various purposes.

Figure 14 shows a series of complex curves which can be used to rate noises. Today we're interested only in the one for hearing conservation. If a noise is on for five or more hours per day, (for practical purposes this is an all day exposure), five days a week, for 10 years or so and, if the level of noise exceeds the curve designated as 85 at any point along its entire length, a hearing conservation program should be considered.

It's amazing how many countries have accepted these levels independently. Russia, France, Germany, Austria, Australia, Britain, Japan and many more are using this curve to designate the need for hearing conservation when the exposure is continuous for 5 hours or more per day.

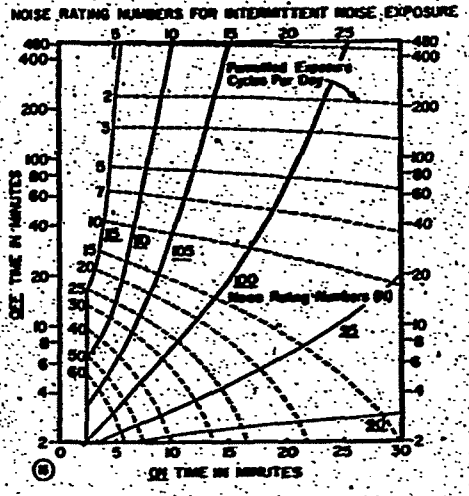
Figure 15 indicates what can be done about continuous noise that is *on* for less than 5 hours per day. If a person is to be exposed for less than 120 minutes, the criterion curve changes as indicated in this slide.



Average level of 300-600 600-1200 and 1200-2400 c/s band	On-time per day (minutes)
85 dB	Less than 300
90 dB	Less than 120
95 dB	Less than 50
100 dB	Less than 25
105 dB	Less than 16
110 dB	Less than 12
115 dB	Less than 8
120 dB	Less than 5

FIGURE 15

Figure 16 indicates what can be done when the noise exposure is intermittent. If the noise is rated as 100, and the man is to be exposed for 15 minutes, we want to know how much quiet he needs before he can take another 15 minutes of exposure. (Quiet is defined as any noise rated below 85). Merely follow the 15 minutes "on time" ordinate to where it intersects the curve designated 100 and determine what "off time" ordinate crosses close to this intersection. If these approximate "on times" and "off times" are adhered to, no significant hearing loss will occur over an average work life.



If you cannot meet these general guide lines with respect to intermittent noise, you should seriously consider a hearing conservation program.

A hearing conservation program consists of (1) noise-exposure analysis, (2) noise-exposure control and (3) measurement of hearing. You should have gathered from my talk that noise-exposure analysis is more than just measuring noise. You must know what the exposure is. A noise level can be 180 dB and if there is no one around it doesn't matter. On the other hand, a noise level can be 85 dB and if a man is exposed only half the time he is all right, but if the exposure lasts all day, he will undoubtedly sustain a hearing loss over a long period.

Now what about noise control? Noise can be controlled at the source. This is theoretically easy to say, but believe me it is not nearly as simple to do. We have looked at many noise sources with respect to noise control. Many noises can be controlled to a degree where they will not be nearly as harmful, but very few of them can be reduced to the point of no damage.

We encourage you to do all you can to control noise at the source in any way you can that is reasonable, but do not expect that you will eliminate the problems except

in unusual cases. For example, take a drop hammer. The noise from a drop hammer can be controlled but the machine cannot be operated when the changes are complete.

Third, but by no means least, is measurement of hearing. The two measurements that are most important are pre-employment tests and recheck tests every 12-18 months on men who work in noise. Pre-employment examination does not apply only to those men who will work in noise. We feel that everyone should have a hearing test. You never know when a man will be transferred into a noisy job.

Briefly, that is a hearing conservation program. We have stated that most industrial noises cannot be reduced to a safe level by control at the source. What can be done? The obvious answer is control at the ear. This can be done by enclosing the man (sound control booths) or by covering the ear. The two most common methods are by ear plugs or ear muffs. A third which will soon be available is neither a muff nor a plug. It will close the opening to the external ear without covering the ear flap or inserting into the ear canal.

It is important to know that any ear protector will be uncomfortable for a short while when it is first used. The problem is to get protection with as little discomfort as possible.

I am frequently asked, "Which is the best ear protector?"

My stock answer is, "The best ear protector is the one that is worn."

No matter how good a protector is, if the men will not wear them because of an inordinate amount of discomfort, they are not much good.

Despite lay opinions, ear protectors will not make it impossible or even more difficult to hear warning signals or spoken commands when they are worn in a noisy environment. In fact, the reverse is true. It is actually easier to hear when protectors are worn while in noise.

The choice of a protector is based upon the place where it will be worn and the acceptability by the wearer. All protectors are relatively equal in attenuation (amount of protection). Cotton gives very little, if any, protection. As with all maner of safety devices, many objections to wearing ear protectors will be raised. None of them is valid nor important enough to excuse anyone from wearing protection.

Hearing is a priceless gift. It is worth keeping.

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WHAT TO DO WHEN THE BAG BREAKS

By RALPH W. NETTERSTROM
Chief, Division of Maritime Safety, Office of Occupational Safety, Bureau of Labor Standards

While I realize that the majority of you are a long way, operationally, and in most cases, geographically, from the waterfront, all your plants are at both ends of the transportation pipeline and to some degree must deal with chemical hazards and similar problems. Certainly those of you who are engaged in land transportation have many identical problems.

The Bureau's specific interest in maritime safety arises from the fact that it administers for the Secretary of Labor Public Law 85-742, passed in 1958. This act gives the secretary the responsibility for promulgating and enforcing safety regulations and otherwise promoting safety in employments under the Longshoremen's and Harbor Workers' Compensation Act. These employments include mainly longshoring and ship repairing aboard ships and in some cases ship-

building and shipbreaking on vessels afloat. The act does not cover members of the crews of vessels nor does it cover waterfront workers on the pier or in the yards and shops ashore. These latter are under state compensation and safety jurisdiction just as are the majority of you.

Longshoring is the term used to cover the work of loading and discharging cargo into and out of ships and barges. Stevedoring is a term also often applied to the same work. In the event that some of you are among the many people who find the two confusing, stevedoring technically includes the planning of the stowage of cargo to ensure the safety of both the vessel and the cargo, while longshoring covers the skills and efforts involved in actually doing the job. The simplest means of distinguishing the two is to remember that there are longshoremen's unions and stevedoring companies. Since both the compensation act and our safety program are directed toward the protection of the workers, we refer to the operation as longshoring.

In longshoring, as in other phases of the transportation industry, there should be no chemical hazards despite the fact that all of the chemical products which are manufactured and used in industry, many of them toxic, corrosive or flammable, are transported by land and sea, and some by air. The reason that I say longshoremen and transportation workers normally are not exposed to these chemical hazards is that the hazardous chemicals are packaged to contain the product. The transportation worker as well as the men on the loading dock or in the warehouse handles the sack, drum box or other package, and not the product itself.

Exposures to chemicals in longshoring aboard ship or in any other form of transportation is in itself an accident. Except for dusty cargoes in bulk or in loose mesh sacks, the only exposure occurs when the container leaks or is ruptured. Accidents of this type are not infrequent but the vast majority of exposures have been either quite harmless or had very minor effects.

To the best of my recollection, in the United States over the past 20 years, there have been two disastrous cargo fires which took men's lives aboard ship. Two men were killed by carbon dioxide used as a refrigerant in one incident about 15 years ago. There have been two cases, one on the ship and one on the dock, of large chlorine cylinders developing massive leaks which resulted in many longshoremen suffering varying degrees of exposure. Some of them required hospitalization. There have also been several cases in which men were exposed to fumigated grain or baled cargo which had not been properly aired out before being loaded aboard the vessel. In these cases, also, there were no lasting ill effects.

There are among any group of men a few who are especially allergic to a specific product. Castor beans is an example. A number of years ago several cases turned up in which the entire gang developed allergic and toxic symptoms from a castor bean product. Then there have been many cases in which one or two men in a gang suffered burns, rashes, and other toxic effects, few of which required hospitalization.

I do not offer the above summary of fatal and serious cases as being complete and I hope you do not infer that I consider the chemical hazard to be unimportant. I am merely trying to show that despite the large variety and tonnage of chemical products handled every year there are very few serious injuries. To be specific, last year of the total of 22,500 injuries reported to the Bureau of Employes' Compensation, 375 or 1.7 per cent involved exposure to fires and hazardous chemical cargoes.

Both the Coast Guard, and the ICC through their control of packaging and stowage and the Department of Labor through its safety regulations, which place requirements on the stevedore, are working to reduce the hazards to the lowest practical minimum.

For example, stringent regulations have been placed by the Coast Guard on the handling of ammonium nitrate to prevent a repetition of the Texas City explosion disaster. The hazard of CO_2 from dry ice was eliminated by prohibiting its being stowed below deck. The Department of Labor now requires the stevedore to make certain rather than assume that fumigated cargo has been properly aerated.

We worked with the International Longshoremen's Association, the Coast Guard and the importers to ban shipment of un-

treated castor pomace and to improve the packaging to further reduce the exposure to dust of castor beans.

In the case of the chlorine leak aboard ship, we found that we shared in a very widespread ignorance of some of the precautions necessary upon discovery of a leaking cylinder in the hold of a vessel. We studied the problem thoroughly and worked with the Chlorine Institute in developing a pamphlet which was distributed to the industry. We believe that the application of this information can prevent a repetition of this massive leak and the consequent dangerous exposure of large numbers of men. The pamphlet also emphasizes the need for extreme care in handling the cylinders to avoid fracturing them by dropping, which was the situation on the dock.

You may work in a plant that uses chlorine daily and be fully familiar with all of its properties, hazards and means of preventing leaks and protecting against exposures. You may say, why doesn't the stevedore know all about this stuff? There are two reasons. One is that he may never handle this product. The other is that he may have handled the cylinders from time-to-time over a period of years and very possibly never even smelled the chlorine because the cylinders performed their function and allowed none to escape.

We recognize that this chlorine was a good example of the situation with which the employer is faced in regard to all of the chemicals he handles: a wide variety of products, many of which he never handles; most of them in relatively small quantities in a given lot; and the fact that rarely are the longshoremen exposed to the toxic products they handle. But still there can be and are accidental exposures and the question remains as to what to do when the bag breaks.

Most longshoremen, like the rest of us, become wary in the presence of a strong, unfamiliar odor, may be hesitant to slop around in a liquid which burns on contact and aren't likely to pop bits of unknown material into their mouths. Also, like the rest of us, they are likely to be guided by their senses—put up with an odor if it is not too unpleasant, wipe up something by hand if it doesn't hurt the skin right away, and not worry too much about breathing and swallowing a little dust if it does not taste bad or choke us.

Unfortunately, our senses do not give us timely warnings of many chemicals, and we are in some degree of trouble before we detect the fact that the substance is harmful. We wanted to find a practical means of supplying the necessary information and warnings before the emergency arose so that men would not rely on their senses to avoid exposure.

Labeling on packages is, of course, one solution. The Manufacturing Chemists' Association has developed a set of recommended labels for use on many specific products and a number of manufacturers use them. We are strongly in support of this practice not only for the protection of transportation workers but of workers in the plants that use the products and of the individual consumer. The Department, however, has no authority to require the use of labels in the United States, let alone by shippers abroad. The familiar red, yellow, green and white labels required by the Coast Guard and ICC on many hazardous cargoes are certainly of great value but they cover broad categories of products and simply cannot give all the information which we believe to be necessary. Language differences in international trade is a problem that the ILO has been seeking to overcome through international adoption of a uniform set of pictographs to indicate flammables, corrosives, toxics, etc. They, again, while certainly of value, are limited in the amount of information they can convey.

You might say, why not simply require the stevedore to obtain the information any way he can as long as he gets it? As a matter of fact, we made a preliminary proposal of a regulation along these lines. It does not now appear to be practical because of the present difficulty faced by the stevedore in obtaining the necessary information in all cases. We try, even though we can't convince everyone of this, to make our regulations practical. We want them to be observed in time to prevent injuries—not simply to use them to club an employer with after his failure to follow them has resulted in harm to a longshoreman. We therefore looked elsewhere for a solution.

As I indicated earlier, the Coast Guard and the ICC both have regulations prescrib-

ing the packaging of hazardous materials. The Coast Guard regulations are contained in Part 146 of Title 46 of the Code of Federal Regulations. They are entitled "Explosive or Other Dangerous Articles and Substances and Combustible Liquids on Board Vessels." As you can well imagine the publication is proportionate in size to the length of its title, covering as it does more than 1800 specific items.

In addition to specifying packaging requirements, the regulations also cover the stowage requirements aboard various types of vessels. Some products must be on deck where they can be watched and, if necessary washed over the side, some must be protected against heat, as from the boiler spaces, and others must not be stowed with products with which they would react if mixed. The regulations indicate which cargoes must be labeled.

The regulations also contain some information on the hazardous properties of the substances and general precautions to be taken. Finally, the regulations require, not that the chemical name of all products be necessarily placed on the package, but that it be listed on the manifest with identifying marks on the cargo so that the ship operator and the stevedore will know what the product is.

These manifesting requirements apply to imports as well as to exports. They have been in existence for many years and are to a large extent adhered to. These documents are available to and used by the stevedore in planning his work.

What we are endeavoring to do is to develop a pamphlet which will indicate, for each of the commodities listed, the hazards produced by and the precautions, including emergency equipment, necessary for handling leaking or ruptured containers under the conditions which prevail in handling cargo aboard ship.

It will indicate those commodities which could develop flammable atmospheres and whether the gas or vapors would tend to diffuse through the open hatch or to accumulate in the bottom of the hold; what incipient fires can be extinguished by pouring the contents of the water container on it and what fires would be spread or enhanced by doing so; what commodities will do little harm in brief and infrequent skin contacts and which ones must be avoided entirely; what specific type of respiratory protective equipment should be worn and the conditions under which it is unlikely to be needed. We plan to include information on symptoms of over-exposure and first aid treatment, with particular reference to those cases which should receive medical attention.

It is our present intention to provide the employer with the pamphlet. We will require him to check the dangerous cargo manifest for the names of commodities he may have to handle and the marks on the cargo by which he can identify it. Referring to the pamphlet, he will have the needed information to pass on to his supervisor and (when necessary) his employes as to what to do in any situation which may arise in terms of protective clothing, respirators, gas masks or other respiratory protective equipment to be worn, and precautions which should be taken in cleaning up and disposing of spilled material.

We hope in this way to help the employers avoid any increase in the cases of injury from toxic and flammable cargoes despite an increase in the variety and tonnage of chemical products being carried. We are sure that this ready source of information will find use in other forms of transportation also. We hope also that our efforts along this line will further stimulate manufacturers to make similar information available to their customers. Knowledge of the chemical name of a substance, rather than a trade name, must be available before any one can determine the hazards and the necessary precautions.

I must mention one important chemical hazard which exists aboard ship as well as in many plants and warehouses. It is not a hazard created by the cargo but one created by the stevedore's equipment. This is the exhaust gas from internal combustion engines in lift trucks used aboard ship. A ship's hold can be likened to a warehouse with about one-third to one-half of the roof cut away in the center. The trucks may work on surfaces anywhere from 8 to 30 or 40 feet below the hole in the roof. While the general tendency of the hot exhaust gases to rise through the hatch in many cases prevents a dangerous concentration of carbon monoxide, the natural circulation is

often too limited. Men have been exposed to dangerous concentrations. Here again most of them left the hold before they were seriously harmed, but a few have required hospitalization. About 0.5 per cent of all injuries last year involved carbon monoxide.

Carbon monoxide is one of those chemicals about which what the nose knows is of no help. It is odorless. We require the stevedore to make periodic tests of the atmosphere in which internal combustion engine powered equipment is operating. He must see that through forced ventilation or otherwise the concentrations of carbon monoxide stays below the generally accepted threshold limit value of 100 parts per million.

If concentration goes over this value, he must get the men out until he can again bring the concentration down. Through an educational process we are getting both men and management to recognize that a man feeling headaches, nausea or other symptoms should not be allowed to climb out of the hold. The greatest danger of a fatality from CO aboard ship is that of a man, deprived of oxygen by the carbon monoxide in his blood, not being able to quite make it to the top of the ladder and falling to his death. It hasn't happened and we hope we have headed it off.

To get back to the chemical cargo hazards, I think you can recognize the fact that we have embarked on a project that will take some time to complete. I am happy to say that, in the meantime, progress is being made toward solution of these chemical hazard problems. Through our promotional efforts more and more stevedores and longshoremen are recognizing the potential hazards of spills. The men tend to be more wary and the stevedore is beginning to call in a chemist to advise him on the degree of hazard and the means of overcoming it.

The Coast Guard has recently contracted with the National Academy of Sciences for assistance in dealing with hazardous cargoes, particularly the increasing number of them which are being or will be carried in bulk. Two of the Academy's committees—that on Hazardous Materials, and the Advisory Center on Toxicology are working on the project. The results of their studies will provide the technical data needed by the Coast Guard in developing regulations to protect vessel operating personnel, men who handle loading and unloading, and the general public from exposure to chemical hazards.

We are also happy to see that the Manufacturing Chemists' Association is publishing a series of placards which are to be used on shipments to provide necessary information to cope with an accident on the highway.

In conclusion I offer my apologies to those of you who came expecting to learn specifically what to do when the bag breaks. I honestly can't tell you about more than a few bags, but I am going to learn and hope our work will help you learn also.

WINNERS OF 1963 LABOR CONFERENCE SAFETY AWARDS

Presented at labor session by Hunter P. Wharton, Vice President for Labor of the National Safety Council, and General President, International Union of Operating Engineers, AFL-CIO, Washington, D. C.

In 1960, the Labor Conference of the National Safety Council approved an award plan designed to give tangible recognition for outstanding safety efforts by union organizations and individual members of the labor movement.

The first such awards were presented at the 1961 National Safety Congress, honoring union organizations and individuals for outstanding efforts carried out in 1960.

The award for labor organizations has been designated The Harry Read Memorial Award for Labor Organizations. The award was named in honor of the late assistant to the secretary-treasurer of AFL-CIO for his work in promoting labor participation in organized safety, for his service on the

National Safety Council's board of directors, and for his work as one of the founders of the Labor Conference of the National Safety Council.

There are three categories for the Harry Read Memorial Award. These are:

a) Award of Honor
b) Award of Merit
c) Award of Commendation

There are three citations awarded to individuals in the labor movement. They are for:

a) Distinguished Service to Safety
b) Outstanding Service
c) Meritorious Service

Citations are granted to union people who have contributed outstanding work on behalf of accident prevention.

This year we are pleased to announce that 11 of these coveted awards have been granted to seven union organizations and four individuals, as follows:

1. The Harry Read Memorial Award of Commendation is awarded to Oil, Chemical and Atomic Workers Local No. 8-12058, of Niagara Falls, New York.

The committee warmly commended them for their efforts and stated that they have a good foundation for carrying on a well-rounded safety program.

Here to receive the award on behalf of the Local is Stanley Kasprzak, and the entire safety committee of the Local.

2. The Harry Read Memorial Award of Merit goes to Bakery and Confectionery Workers Local Union No. 3 of Long Island City, N. Y.

The local launched an extremely successful program which has continuity. They did this within a short period of several years, and the judges particularly noted that efforts such as this will insure constant improvement in the safety and health of union members in this local.

Here to receive the award on behalf of the local are Murray Miller, Coordinator of the Health and Safety Committee and Harry Gordon.

3. The Labor Conference's Citation for Outstanding Service to Safety is awarded to Murray Miller, Coordinator of Health and Safety Committee of Bakery and Confectionery Workers Local Union No. 3 of Long Island City, N. Y.

Brother Miller has been a tireless worker whose efforts and dedication in setting up the safety program for his Local were commended by the committee. He also did an outstanding job in establishing relations between the Local and the Bureau of Labor Standards of the U. S. Dept. of Labor, the New York State Dept. of Labor, the City Dept. of Health, the N. Y. City Fire Dept., and the National Safety Council.

4. Citation for Meritorious Service to Safety is awarded to William McCullough, of Ontario Hydro Employees Union Local 1000, of Toronto, Ont., Canada.

This is the first time that an award has been granted to a member of the Canadian labor movement.

The judges spoke particularly about Brother McCullough's work as a member in his own local, and also as a member of the Canadian Labour Congress's committee on occupational health and safety, and their radiation subcommittee; also the Ontario Federation of Labour's committee on welfare and safety; also with the Canadian Nuclear Association's safety committee. Brother McCullough is also a member of the National Safety Council's Labor Conference, where he is bringing the Canadian viewpoint to the work of the Radiation committee on which he is an active member.

5. Harry Read Memorial Award of Honor goes to International Brotherhood of Electrical Workers (headquarters Office), Washington, D. C.

This is the first time that the Award of Honor has been granted twice to the same organization.

To list only a few of the outstanding accomplishments of this union:

—they have a full-time safety department
—they maintain a comprehensive accident reporting system
—they have formed minimum safety standards under which electrical craftsmen work
—their safety dept. participates in the formation of state electrical safety standards and in the establishment of joint labor-management safety committees at the local level

—they are particularly active in the field of radiation safety.

The committee took many other factors into consideration and decided that the intensified efforts and expanded activities of this international union merited receiving their second "Award of Honor."

Here today to receive the Harry Read Memorial Award of Honor on behalf of the International Brotherhood of Electrical Workers is: Victor E. Whitehouse, Safety Director.

6. Harry Read Memorial Award of Honor goes to International Union of Operating Engineers Local 150 of Chicago, Ill.

It would take quite some time to enumerate the many activities in the field of safety that this local engages in.

Safety training is an important aspect of their overall program. The local publicizes safety information regularly in its own publication. Their safety coordinator has taken the AFL-CIO four-week safety training course and has since put the information to practical use in the local. They have printed many safety booklets and job instruction materials particularly adapted to their work.

Many other factors were taken into consideration by the awards committee, but the above should suffice as an indication of the excellent job this union is doing.

Here to accept the award on behalf of Local 150 are Bob Farrell, Safety Coordinator and William Martin, president.

7. Harry Read Memorial Award of Honor is awarded to International Assn. of Machinists Lodge 851, of Joliet, Ill.

This local lodge received an Award of Merit for 1962. The committee recognized not only the continuity in their program but also the accelerated activities which made it possible for them to qualify for the very highest honor which can be granted them.

They have a joint labor-management safety committee which meets monthly. Safety is included as part of their regular union meetings. They actively participate in community safety programs. They have been promoting the use of auto seat belts among their members. They have done a good job in publicizing off-the-job safety.

It's a pleasure to welcome them back as a two-time winner and present the "Award of Honor" at this time.

Here to accept the award on behalf of Lodge 851 is Donald Storm.

8. Harry Read Memorial Award of Honor goes to Goodyear Local No. 2 of United Rubber Workers, Akron, Ohio.

This local has been doing an outstanding job in accident prevention and the committee particularly commended them for the extent and quality of their program and accomplishments. They have an active safety committee, with monthly meetings, their members receive special safety training on a continuing basis. They also carry on a fine off-the-job safety program.

Their entire safety committee is here attending the Safety Congress. Their safety chairman, Thomas J. Hemsley will accept the award on their behalf.

9. Harry Read Memorial Award of Honor is awarded to Firestone Local No. 7 of United Rubber Workers, Akron, Ohio.

This local, too, qualified for the very highest honor which can be granted to a union under the awards program. Again, it is not possible to recite everything they are doing, but their very active safety committee has monthly meetings; they conduct safety inspections; safety training is an important part of their program; and off-the-job safety is an especially effective activity of the local. Their members participate in regional and national safety meetings, as well.

10. Citation for Distinguished Service to Safety goes to John R. Kumpel, Special Representative, Safety and Compensation, of United Rubber Workers Int'l. Union, Akron, Ohio.

It is logical at this time to call John Kumpel to the platform. The awards committee, at its judging this past August, was particularly pleased to acknowledge the truly outstanding efforts of Brother Kumpel by granting him the Citation for Distinguished Service to Safety—the very highest honor which can be given to an individual under the awards program.

John has headed the safety and compensation activities of the United Rubber Workers since 1944. He has directed approximately 300 safety and compensation workshops since 1945 for union districts,

district council conventions and locals. He has spoken on many occasions on safety and workmen compensation and also presented this subject for 14 years at Akron University.

He has been a dedicated and tireless worker on behalf of the National Safety Council, including serving three years on the Council board of directors. He was instrumental in establishing the Labor Conference within the Council; and has played a key role on the Labor Conference's executive committee continuously from 1957 to the present.

He has been an active participant as well as serving on steering committees for many sessions of the annual All-Ohio Safety Congresses.

11. Citation for Distinguished Service to Safety is presented to Lloyd D. Utter, Director, Industrial Health and Safety Dept. of United Auto Workers (international office), Detroit, Mich.

Brother Utter has many plaques for safety activities hanging on his wall, but the awards committee hopes he will regard this award with special fondness. Over the years Brother Utter's dedication to the cause of safety has been remarkable and all of us in labor are deeply indebted to him.

Lloyd, too, is one of the founders of the Labor Conference and has been one of its hardest workers—and leaders—since it was established in April of 1956. He served the conference with distinction as vice-chairman in 1956 and 1957; then became chairman in 1957 and 1958. As vice president for labor of the National Safety Council he did a job with dedication, and, in addition, served continuously as a member of the Council's board of directors since 1956.

His work as director of the United Auto Workers industrial health and safety division since 1949 saw the inauguration of an outstanding safety program in that union.

Among other activities, the committee noted his service as president of the Detroit Society for the Prevention of Blindness as most commendable.

It is impossible to mention all the organizations in which Lloyd has been active in the field of safety, but the committee specifically stated that it is through efforts like his that we are able to realize constant improvement in the safety and health of union employes all over the country.

SUCCESSFUL UNION SAFETY PROGRAMS

By MARTIN J. HORAN
Pres., General Industrial Workers, Local #146 AFL-CIO, Linden, N.J.

Although the type of audience I have today is quite different than I usually have, there is, however, at least one area in which we have unanimous agreement; the endorsement of safety and safety programs.

First of all, we are all safety conscious and are horrified at the abnormally high incidence of loss of life and limb through avoidable accidents. The Department of Labor in Washington, D. C. recently published a report and stated that many more man days have been lost in industry because of accidents than are lost due to strikes.

We in the labor movement have a vital interest in preventing loss of life or limb to workers, while at work and elsewhere. The pain, suffering and loss of earning power fall heaviest on the worker and his family. No amount of money can ever compensate a worker and his dependents for a serious disabling injury.

Over 100,000 men, women and children, a large majority of whom are workers, lose their lives annually from accidents. Annual injuries to workers from all accidents affect more than 4,000,000 people (figures published by the National Safety Council). The pain, suffering and economic loss to these millions of workers cannot be evaluated in dollars and cents.

The problem of industrial accidents and accidents on the streets and highways is

not a local problem but concerns the nation as a whole and continues to grow larger each year. Today, Americans suffer the highest rate of accidental deaths in the world. It is hard to believe that in such a rich and expanding economy our rate of accidents is so much greater than in countries where the living standards and health conditions are relatively poor. The safety and health resolution adopted by the 1957 convention of the AFL-CIO declared that the deaths of more than 100,000 Americans and injuries to many millions of others annually is a national disgrace.

While working people make up a large segment of the country's population, organized labor's interest is in the welfare of all people. We have become involved in safety because workers and their families have the biggest stake and can achieve the greatest benefit from promoting safety. More important than the dollars and cents are the happiness and the welfare of the working man. Accordingly, unions have assumed the obligation to take an active part in the prevention of accidents. I might add that in our plant in Linden, N. J., we have consistently had one of the finest safety records in the United States.

Effective participation in the safety movement must, of necessity, require that every international union and its affiliates and national councils maintain an active safety program headed by executive committees to conduct a continuous and affirmative program, both in the plant and in the home. The supervision and direct responsibility of the committee's activities should fall upon the shoulders of a designated union official preferably of the rank of president or vice president. It is essential that the highest union officials become intimately involved in safety programs in the same manner that the president or other high ranking official of a company assumes such responsibility.

Our local union represents some 1,350 employes at the Linden, New Jersey plant of General Aniline & Film Corp. We are vigorously participating in a joint program with the company to reduce and eliminate accidents and to investigate and explore new methods of prevention of avoidable injuries.

Our union safety committee consists of seven members who are either officers of the local union or members. The chairman of this committee is designated by me, as the local union president, with the approval of the union's executive board. We appoint members to this committee who, in order to qualify, must demonstrate their intense interest in safety and who are willing to devote many hours outside of their working schedule to maintain and promote safety programs in and out of the plant.

The chairman of the safety committee is called upon to make a report to the membership at its monthly meetings. This report is followed by open discussion with the membership. Frequently, discussions on safety problems will take up a substantial portion of the meeting. Because these problems are of major importance to our members, we do not limit discussion with the safety committee chairman. We find that these unrestricted discussions on safety problems tend to promote a consciousness of safety among the workers and brings to light conditions which potentially could prove to be dangerous. After all, isn't this the main objective of a safety program?

In the plant, our committee collaborates and meets regularly with its counterpart, the management safety committee. While we in the labor movement have no desire to take over management's responsibility to operate the plant, we are obligated to see that management carries out its responsibilities to provide a safe working environment.

We are likewise aware that safety is not a one-way street since it is not the sole responsibility of management to avoid accidents. Union officials and individual employes are obligated to think and work safely. Cooperation between labor and management is a fundamental essential to a good safety program, and the education of *all personnel* is no less important to achieving sound safety practices and procedures.

The drive for increased profits must not be the cause of depriving workers of a safe environment, and workers, in turn, must learn to work safely once that environment is provided. Union efforts must be directed in two principal areas. First, the union must maintain active vigilance in tracking down and alerting management to unsafe conditions and unsafe practices. They must never overlook or condone any condition that could possibly present a danger to their

fellow workers. I will concede that management alone can never fully vindicate its obligation for safety without the cooperation of its employes. Union safety committee men and officers must always insist upon the observation of safety rules and safety procedures by its own members and not hesitate to reprimand or discipline the habitual offender.

Mutual understanding between labor and management is the basic requirement necessary for eliminating accidents and has led to the achievement of outstanding safety records.

Our local union realizes that it is good business for the company to have a joint labor management committee, and it certainly promotes the well being of its members. I am sure that we here are against unsafe conditions as we all might say "we are against sin." But merely repeating these hackneyed statements will not generate good safety conditions.

In our efforts to eliminate accidents and human suffering, our safety committee has been in existence in the plant for the past 17 years. It was created by mutual agreement rather than the result of collective bargaining negotiations. The members of the committee are highly respected by company management and act as an advisory committee to the executives. They meet once a month with management to review accident reports, if any, and also to discuss methods of prevention and avoidance of a reoccurrence.

Serious accidents, though infrequent, are highlighted through departmental bulletin boards so that the membership may read of them. The details of the accident are presented, and a statement is made as to how the accident could have or should have been prevented. Much of the committee's time is taken up by communications with the employes on safety matters. Reminders are sent out not less than once a month through departmental bulletins, and literature is mailed to the homes of the employes by the union. The entire plant is divided into individual areas, and each member of the safety committee is put in charge of one of these areas. He assumes the responsibility to pursue safety complaints in his area until the condition is rectified. The committee member makes frequent tours and reports unsafe conditions or practices, whether engaged in by supervision or the workers themselves. It then becomes his responsibility to eliminate the condition or the practice. It has been said "To err is human and to forgive is divine," but this has no place in the factory or plant. Nobody can be forgiven for making a stupid error or violating a safety rule. No employe should ever forget that he must work in a safe manner and must take all precautions which have been explained to him. Every man in the plant is his brother's keeper, and if he finds a fellow worker consciously or unconsciously creating an unsafe condition, it is his duty to put a stop to it. Employes should work together as brothers and guard against each other's negligence or mistakes. Our committee has also sponsored safety essay contests in our schools. We feel that if the education starts in childhood, the young men and women will long remember these lessons. Many of these children are our future workers or supervisors of tomorrow, and the deep impressions that are made in childhood are carried through in adult life. We award prizes to those students presenting the best essays on safety. The contests are judged by city officials and schoolteachers. Widespread publicity is given to these contests, and we try to arrange for as many prizes as possible so as to increase active participation by the youngsters. Recently, we have awarded bicycles, cameras and other valuable items so treasured by our youth. The cost of the prizes is divided equally between the union and the company. Underlying all these activities is the unanimous cooperation that we receive from our membership in these programs—regardless of cost.

The union has on occasion paid the expenses of the safety committee chairman to meet with committee chairmen in other plants in order to exchange ideas and discuss new methods of prevention. The results of these meetings are reported to the membership.

As I previously stated, the existence of our safety committee and its relations with the company were reached not through negotiation but by mutual agreement and conviction that safety is of major importance in the plant. It is hard for me to believe that a union should be compelled to make

safety an issue of labor negotiations. Because of the mutual understanding that we have achieved with our company in the area of safety, we have accomplished so much.

Safety meetings are also held on lower levels at our plant. About every two weeks there are departmental meetings on safety. These sessions last anywhere from 15 to 20 minutes—sometimes a little longer. These meetings are held on company time, and the employes are compensated for this time.

Our plant is not considered a small one—it employs approximately 1,600 workers and is spread over many acres of land. These frequent area meetings cover many problems and help to alleviate accidents and unsafe conditions without waiting for a high level meeting.

SUCCESSFUL UNION SAFETY PROGRAMS

By CURTIS L. COLLISON

Personnel Relations Mgr., General Aniline & Film Corp., Linden, N.J.

I have been a personnel manager for 28 years in the machine tool, textile, iron and steel, and now chemicals industry. The comments that I have to make are drawn from this experience.

I feel there is one very important reason, from a management standpoint, as to why safety is so important. I will express this one point as follows: "The plant with a good safety record is a plant which is efficiently run, highly productive and profitable."

Getting to the specific subject, that being the values achieved with a joint labor-management committee and a complete program of labor-management working relations in the field of safety, I first want to express what in my opinion are the pros and cons of such a relationship. First let me cover the negative side of such a program and I list them as follows:

1. The recognition by management that the union has a part in the administration of a safety program, leads only to the union and its members constantly bringing to management's attention petty gripes and complete over-emphasis of extremely minor safety problems. *Comment:* As to whether or not this negative reason is sound is completely and wholly dependent upon the leadership given by management to its safety committee work.

2. Some managements consider that a close working relationship with the union in the area of safety results in unwarranted demands by the union to spend large sums of money on projects under the cloak of safety. In respect to this concern, our labor-management safety committee is set up as strictly an advisory committee and does not have any decision rights. However, bonafide logical suggestions emanating from the labor-management safety committee are given prompt attention by management.

In relation to the positive side of a labor-management program on safety, I list the following:

1. It is fundamental that the success of a safety program is based upon the complete understanding by all employes of the reason for such a program and the desirability of maintaining a safe plant operation. If this recognition of the importance of *understanding* in a sound safety program is clear, then the method of achieving this understanding becomes most important. This brings the logical thinker to the point of recognition of the stature of the union in our plants—its strengths and its weaknesses. Certainly in analyzing its strengths one must arrive at the conclusion that communications and attitudes are, to a high degree, in the hands of the union officers.

In an attempt to build a sound safety program, if Management overlooks this, they are violating a very basic principle. It is then up to management to create an atmosphere where these great strengths of a Union are used constructively.

After many years in personnel work, it is my firm opinion that over 90 per cent of accidents which occur could be prevented by the man who was injured. The main

question, therefore, follows: How do you motivate each individual employe to so conduct himself that he will not be injured?

I recently read an article in one of our safety magazines giving the case against joint labor-management safety committees. One of the headlines was "Any management that has a joint safety committee is weak. The joint committee is an insult to the safety director who is willing to get out and work." After reading this article I smiled, had many thoughts which I will not repeat here. However, my last thought was a pathetic concern for this point of view.

As a matter of interest, I inherited a safety engineer who worked with this point of view. The plant was literally plastered with safety signs, all prefaced with the word "don't." In the six months that he stayed with me we had 65 lost-time accidents in a plant of 600 people. This man was an excellent safety technician, but as a safety director he was a complete failure. We replaced him with a man whose basic skills were training and sales. He had no qualms about asking a chemist the hazards of a certain chemical. He had no qualms about asking a pipefitter how to prevent an acid leak. He had no qualms about asking a janitor what type of wax to use to polish an office floor. He had no qualms about asking an 18-year-old clerk-typist what should be done to cement stairs to prevent a re-occurrence of a girl catching a high heel and falling.

Under the definition of this article, as I understood it, this new safety director was weak and lazy. However, the results he obtained were phenomenal.

2. The second reason for having and believing in a joint labor-management safety committee program is that a safety director must have the skill to multiply himself with employes who have a sincere and dedicated approach to safety. In our plant we have 1,600 employes spread out in 55 different buildings over an acreage of 175 acres. It is physically impossible for him to be every place at all times. Therefore, he must use every possible way to get other people sold and acting as safety lookouts.

3. In the labor-management relations area, the discussion of and the sincere working relations on the subject of safety creates a basis of discussion which can only result in avenues of sound working relations in many other areas of labor relations.

The recognition that Labor and Management must work toward common goals if job security, good wages and good working conditions, from the union standpoint, and good business operation, high profits, and long-time success are achieved from a management standpoint are realized.

I repeat, a sound, sincere working relationship with a union in the area of safety can only produce sound, sincere working relations in the other areas of the operation of a business in which unions have a very important place.

Commenting on this further, I was told by one of our union men who attended your conference last year, there was actually a strike over the one basic subject with the company not agreeing to establish a labor-management joint committee on safety. To me this situation can only be extremely indicative of very deep-seated problems in other areas of the plant so effected.

While I believe that a joint labor-management committee on safety should not be a part of the works agreement between the company and the union, nevertheless, the recognition that the union has a prime stake in the safe operation of this plant is fundamental. In no way does this abrogate the basic principle that the company is responsible for the successful operation of the plant.

4. Recognition by management that the union has a very important part in the safety program makes a union more responsible and more effective. This is a very important aspect of any sound labor-management relations, as a responsible union, constructively motivated, is a very positive force in the proper conduct of a sound business.

5. Specific programs, such as contests, community safety programs in schools, home safety programs, traffic safety programs, etc., have been devised and created by the joint safety labor-management committee. Actually, it has been our experience that at least 75 per cent of our programs used were the ideas put forth by union members.

6. In relation to the necessity for disciplinary action against employes who violated safety rules, the union has actually concurred in and fostered disciplinary action because they have realized that a man not only can injure himself but can injure his fellow

employes as well. In our last fifteen disciplinary actions for violations of safety rules the union has challenged only one, and this challenge only in the area of the severity of the disciplinary action taken.

7. The whole philosophy of our joint labor-management safety working relationship is built on the philosophy that 95 per cent of our employes are good, solid, hard working people. These people have good homes, good families, and understand the necessity for working safely and giving a days work for a days pay. The effect of the union leadership on the small per cent of negative employes that are present in every plant is most important if management will give the union leadership proper recognition in dealing with 95 per cent of sound, stable employes.

In summarizing, I have the following comments to make:

a. In the administration of our joint labor-management safety program our position of safe workmanship is more productive workmanship.

b. A joint labor-management safety program in no way relinquishes the right by management to manage.

c. I believe that a joint labor-management safety program contributes to the building of a responsible union membership.

d. In a labor-management safety program we are tapping union leadership which is a substantial source for the good of this program, especially as it applies to first-hand communication.

SUCCESSFUL UNION SAFETY PROGRAMS

By EUGENE M. ROEDDER
Business Mgr., International Brotherhood of Electrical Workers Local 1439, AFL-CIO, St. Louis, Mo.

Local Union 1439 considers it a great privilege to speak to you today about the joint safety program negotiated between the Union Electric Company and Local Union 1439 of the International Brotherhood of Electrical Workers. As I understand it, the assignment suggested for today is to speak to you on a tried and true safety program. The words "tried and true" leave me somewhat concerned lest they give you the impression that we in Local 1439 have achieved the ultimate in safety records, in safety progress, or, for that matter, in a safety program. We actually have not.

We have, however, in this joint safety agreement, a piece of machinery that to date has worked extremely well. This agreement has enabled us to make progress in safety. Progress in instilling, in many of our members, a greater safety consciousness. Progress in improved safety records in many areas. Progress in faith in trust between the company and the union. And lastly, progress in true joint cooperation between the company and union in matters of safety.

In our opinion, faith, trust and joint cooperation are as important in todays successful safety program as the invention of the wheel was to civilized man.

Now I would like to talk to you a little bit about ourselves. Local union 1439 of the International Brotherhood of Electrical Workers has approximately 1650 members who are employes of the Union Electric Company, an electric public utility. The work our members perform involves some of industries neatest hazards.

The electric utility industry is an industry which had in its earlier years a safety record which left much to be desired. Line construction work in those early years spent lives with reckless abandon.

However, through the introduction of safe work practices, safety programs, and education, the industry, as a whole, has made very substantial improvement in its

accident severity and accident frequency records. The frequency rate ranks 15 out of a possible 42 and the severity rate ranks 32 out of a possible 42. This is based on information contained in the 1964 edition of *Accident Facts* supplied by the National Safety Council. So you see that, as of today, our job is not finished.

The program I propose to discuss with you in just a few minutes was not our first program. In the past the company and union members developed programs which to a large extent failed. They failed for a number of reasons.

Looking back, we see that they contained no provision to provide the originator of a safety suggestion with a timely reply. They failed because they made it possible for a form of pluralistic leadership in the conduct of the safety meetings. They also failed because specific standards for recording and measuring work injury experience were not included as a part of the program.

They perhaps also failed because the safety meeting, which was conducted at times by the union member, or by the supervisor, or both, degenerated into a gripe session rather than a safety meeting. Much of the time was spent discussing matters which should more properly have been resolved through the grievance procedure. And last, but perhaps most important, was the fact that one previous program was not a signed agreement.

Therefore, the local union being cognizant of the fact that the safety program was a proper matter for negotiation, undertook to negotiate improvements in the safety program which could become a part of the labor agreement. Having failed to accomplish a satisfactory agreement during the negotiating sessions, the membership then voted favorably on a company proposal which eliminated the cooperative participation and certain of the responsibilities of the union members in the safety program. These members then chose to rely on the grievance machinery to satisfy the remaining provisions of the labor agreement, as they related to safety.

These provisions, then, were as follows:

"The company will cooperate with its employes so as to ensure that reasonable rules and provisions are made for the safety and health of employes during hours of their employment."

Another section identified as "B," works on 480 volts. "The company agrees to continue present work practices on 480 volt work."

Another Section "C" work on 2,400 volts and over. "When a journeyman is working on energized circuits or equipment of 2,400 volts and over, it shall be the policy to have a journeyman, a third stage apprentice, or other qualified employe assisting him."

Exceptions to the above provisions are: 1) Using transformers, 2) operating switches, 3) untying, tying and skinning installation incidental thereto, and 4) transferring conductors when taps are not involved.

The installing and lifting of live line plants and clearing circuits, the application of this sub-section to new or changed techniques will be determined by negotiations between the company and the brotherhood.

And another section identified as "D," (work on 5,000 volts and over) provided, that whenever it was necessary to work on conductors energized at voltages in excess of 5,000 volts, such work shall be performed with the use of live line tools.

The membership also felt that its position in any case of arbitration was further supported by a statement of policy from Mr. J. W. McAffey, president of the Union Electric Company. In part, this policy statement provided responsibility and authority for the action necessary to prevent accidents rests with each supervisor and the leader as an integral part of this job. And further, in a letter of interpretation accomplished in negotiations, the vice-president in charge of labor relations included the following sentence, "Since the foreman has the responsibility for safe performance of the work, he should have the authority to provide the journeyman with safety assistance whenever it is his considered judgment, that is the thing to do."

Then after the lapse of several months, following failure to satisfactorily resolve the safety issues during negotiations, the executive vice president of Union Electric Company, Mr. Gamble, contacted the union

and suggested that we meet and discuss the possibility of resolving the safety problems. This for Local Union 1439 was a most fortunate set of circumstances for it was at this point that we again began to build on a concept of the safety program which needed complete cooperation.

We found ourselves, after the meeting began, to be men of kindred minds and we had one single objective. Whereupon the local undertook the study of material and help available through the International Brotherhood of Electrical Workers.

It happens that we are fortunate that the International Brotherhood of Electrical Workers was actively pursuing safety and safety helps for the local unions. They have continued to work in this area and supply considerable help to our local unions. Our international staff for some unions has provided schooling and training sessions that have to do with radiation and the related problems and atomic energy problems.

We are also greatly aided by the National Safety Council. Much of the material that the National Safety Council makes available to members was found to be and continues to be extremely helpful to local unions such as ours. If I can speak from my heart for just a second I would like each and every delegate and person in attendance here to take back to make known to their local unions the need for participation in the National Safety Council. In our opinion, membership in the National Safety Council is one of the best bargains that any local union can avail itself of.

And we were further aided through the reports of the President's Conference on Industrial Safety. Now it happens that the reports of the president's conference very often gave emphasis and meaning to the word "cooperation." Sufficient stress was placed on cooperation in the reports studied to indicate cooperation was very much the cornerstone of a successful safety program.

The National Safety Council's *Manual for Supervisors*, and its *Accident Prevention Manual for Industrial Operations* were particularly helpful in drafting of a proposed safety agreement, which was then submitted by the union to the Union Electric Company.

After a number of meetings between the company and the union representatives, a stipulation was drafted, submitted for membership action and following ratification, the agreement was signed. Copies of this joint agreement were then printed by the union and distributed to each union member.

It appears to some of us that one fault remains in a program such as this and conceivably it stems from a fundamental human weakness. I don't suppose for one minute that this is unique, I would believe that this is a problem that concerns itself with any safety program.

For our members have found that supervisors and contract employes unfortunately to a very minor degree tend to view safety rules as rules which they may or may not follow, depending upon their independent judgment at that particular moment. We recognize that this is contrary to all of the principles established through safety engineering; but there seems to be no ready solution for this minority group except, perhaps, to make all matters of safety mandatory.

Ironically enough, most men recognize that the man who lights a match in a room filled with dynamite, is automatically in violation of safety rules. Yet, there are those who believe that other rules affecting safety can, like a coat, be put on or worn when it suits their convenience. This, we believe, is not proper.

In order to shore up the safety program in so far as the local union is concerned, the local union members have on some several occasions brought violators of safety rules before the executive board at which time considerable stress and discussion took place (stress on the need to follow safety rules) and, we have found from experience, that this has been a very effective and potent help in providing better conformance with the safety rules.

The Joint Safety Board is composed of three members from management, and three members of the local union, and the program sets out the duties of the joint board. One of their duties is to report on the progress and the activities of board semi-annually and one such report shall be submitted at an annual meeting of the representatives of management and the officers executive board members of the union.

Certain other facets involved are to promote cooperation of everyone concerned with making the safety program successful.

They review and make recommendations concerning safety suggestions which may have been appealed by an employe. They review the conduct and effectiveness of safety meetings. They review and discuss provisions and effectiveness of the standard safe working practices manual. They discuss the effectiveness of various aspects of the safety program, functions of safety representatives, safety statistics and other related matters.

This program also provides for the election, or appointment, as necessary, of the safety representative. They have functions spelled out in the program and a safety representative normally is elected by the employes in a work group.

In case of failure to do this, the safety representative is an appointive job. They are given a reasonable time off from work in order to make the necessary preparations for the conduct of a successful monthly meeting.

The function of the elected safety representative is to act as chairman in the conduct of the monthly safety meeting, and there is a supervisor appointed who will monitor, guide and assist the chairman when it is necessary or when it is desirable. There is also a group of safety advisors composed of supervisors as well as the elected safety representatives.

The program sets out the way in which the safety meetings are to be scheduled. There is a safety meeting conducted each morning by the supervisor in addition to the program that we talked about just a minute or two ago. There is a training program incorporated in the agreement and it provides for the elected safety representatives to get training in the fundamentals that will enable him to do an effective job. This program also provides for the attendance of union stewards at some of these training sessions.

All accidents are reviewed by the company and union members and the elected safety representative participates in the review. With regard to statistics and accident reporting, the American Standards Association standards are followed by the company and the recording and measuring of work injury experience is based on standards set by the American Standards Association.

There is also provision in the event there is a question as to whether or not an accident has been properly reported. This question would be addressed to the American Standards Association and their opinion would be obtained.

In the event that an employe submits a safety suggestion, and he believes the answer he receives is not a satisfactory one, he then has recourse to appeal. The union members upon appeal, will send the appeal to the local union office and the local union office then forwards it to the chairman of the joint safety board.

Certain reports are sent to the union office. All of the reports are sent to the Joint Safety Board, and certain of the reports are sent to the elected safety representative.

A SUCCESSFUL SAFETY PROGRAM

By G. V. WILLIAMSON
Vice Pres. Operations Executive, Union Electric Co., St. Louis, Mo.

As those who work in safety know, safety is a crusade. A crusade primarily against a weakness known as indifference. Like any crusade against any evil, to keep it going we have to work as hard as we can, on as many fronts as we know how. This takes lots of work and a lively imagination.

In fact Safety depends on the hardest of all kinds of work—creative effort. Creative in ideas, in avenues of approach, and in ways of appeal. In all this there is a great redeeming help—the very fine people dedicated to the same campaign, working just as hard as you are and willing at all

times to help. As in so many crusades there is the winning force of so many working for the same cause.

Let's take a look at how one company, an electric utility, has gone about it. Not because we have been outstandingly successful. We have made good progress, but obviously have to make a great deal more. But because our campaign illustrates once more the old crusading principle, hit 'em hard, hit 'em everywhere, hit 'em all together."

We have concentrated on three roads to safety. One is on *equipment*, the tools, machines, and materials with which we work. Here constant effort with highly competent technology is devoted to eliminating the hard-to-control hazards from the job. Another area are the human elements of *alertness, attitude, training* and *skill*. And finally we depend on *cooperation* because this campaign needs everybody and we mean everybody, from the man at the gate to the superintendent, and to the top executives working together.

A few examples of equipment problems and solutions illustrate the first approach.

An analysis of accidents in transmission and distribution showed that 3 per cent were caused by "electric shock." Take as an example an electric modern "blacksmith." A high frequency induction coil is used to heat metal. If the transparent protective plastic cover is accidentally lifted, the electric circuit is broken.

"Slips and Falls" account for 25 per cent of the injuries. For example, as a substitute for ladders, mechanics work on a ceiling hoist from a scaffold mounted on a truck top.

"Struck by or striking against" account for 60 per cent of the accidents. On a new bending brake it was found that rack and pinion were exposed. A guard was devised. A truck up on a hoist maybe prevented from falling off by proper support adapters.

Studies showed that in 1963, 89 per cent of the injuries involved an "unsafe act." Here then we are in the great field of training for skill and care, the physiological problem of alertness and attitude. Here are three aspects of our program in this area:

First of all we consider the "tailgate" safety discussion between foreman and crew to be a key in training *and* alertness. Each Monday morning for 15 minutes such conferences are scheduled for each overhead construction crew. These talks succeed pretty largely on the basis of skill and conviction of the foreman-leader and through participation by the crew. They are poorest when they are canned talks; they are best when there is a free interchange by all in ideas, questions, and observations of actual experiences.

More elaborately and more fully prepared are monthly one-hour safety meetings with presentations, movies, or illustrated talks, and with practice, for example on resuscitation with Resusci-Anne. Here the elected Safety representative of the Union is a key man, for this is a joint union-management meeting. Plans for the meeting are worked out in advance with members of the Safety department offering prepared material and suggestions, and with the safety representative and supervisor in joint cooperation. That key theme "cooperation" will be discussed again.

All safety efforts are "awarded" of course with just one thing—the limb or life of those working. But a so-called award dinner, really a recognition event, is organized for an evening of good food and companionship for work groups successful in roughly one year of working without a lost time accident. Here is recognized one great fundamental of safety. It involves *everyone*; the group in full bloom of mutual care and respect. Each and all responsible for the safety of all and each. These are good dinners; there is a minimum of speech making; frequently something is added in the way of a discussion of company affairs—a top official talking and answering questions about some company activity in which the men are interested, and would rather hear from one of us than a neighbor outside the company.

When such a work group wins four consecutive "recognition" dinners, in addition to the dinner a gift certificate catalog is sent to his (or her) home, from which the family can choose a tangible "present." This brings the family, the group really most interested in safety, into the act of safe work. We have another program for home safety that also does that; and that is a subject worth a talk in itself.

But now we come to cooperation. Here indeed is where safety is created, sustained, and made really workable, and where the

fullest cooperation between union management, union members and company management is the keystone. This relationship has been recognized with two unions by a safety stipulation, a formal document worked out between these two groups for the purpose of stating just how safety cooperation can be worked out. And the foundation of this stipulation is the joint safety board. It resolves agreements in work practices, safety methods, safety suggestions, and report directly to a company Vice President, Executive, to assist in resolving disputed points. This joint safety board, a true working example of safety cooperation, may be regarded as at the heart of the spirit and organization by which safety is made real and workable.

Here, too, we have had the excellent support of Union representation. The work they do brings safety directly from and back to the field workers. A similar arrangement also receiving fine support from union leaders is a safety suggestion plan with organized follow-up. Nothing is more discouraging than a 'lost" or seemingly ignored safety suggestion.

Finally, we hope to continue to receive good Union support in the quality of elected safety representatives. Groups with the best safety record are typically groups with the best representatives, representatives who understand the true safety story, a story not of eliminating a job, but of teaching the alertness, the skill, and the care to avoid accidents—those 89 per cent caused by an unsafe act.

This campaign at Union Electric has won results. But we have to be keenly aware that new ideas and new approaches are needed. We have under discussion a plan for drawing the Work Practices Manual into the Monday morning "tail gate" conferences, as well as to the monthly safety meetings. A sound tape and slide presentation is being worked out for each section of this several hundred page document. Few people read as well or as thoroughly as they should. This presentation may win readers, as well as develop a better understanding of agreed to safe work practices.

The trading stamp approach may be tried. A considerable block of stamps would be handed to an individual of random choice whose turn comes up if he is wearing the protective equipment he should.

The safety calendar in the home, with limerick contest, has been used for several years.

One event that wins considerable response is an all-day Annual Safety Conference held in the roof garden of a prominent hotel. Showmanship is the key here. It must be a day of awards and review, of displays and instruction, but also of fun. Safety cannot be won with boredom.

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Ordinarily, no fire hazard will exist if the solvent vapor concentration in air is kept below 1%. This figure is rather empirical however—there is only one solvent in the above list which is below 1% by volume. This is turpentine. The amount of ventilation required in various sizes of tanks to keep the concentration below this limit is shown in Table V.

2. Since the solvent vapors are heavier than air, they have a tendency to concentrate in the lower portions of a tank or closed structure. Therefore, the suction blowers should be operated in such a way as to prevent pockets of solvent vapor being concentrated in the lower portions of enclosed spaces. This can ordinarily be accomplished by sucking the air from the bottom of the tank so that the circulation is from the top manholes or openings down through the tank and up through the blowers. In this way the solvents are swept down and immediately sucked away from the bottom portion of the tank, eliminating any pockets of solvent vapor which might be above the explosion limit.

3. Maintain ventilation in the coated tank until the coating is sufficiently dry so that any remaining solvents cannot build up to the explosive limit. See Table IV.

4. The fourth precaution to be observed is the use of spark proof and explosion proof equipment. Electrical equipment and lights should be explosion proof; tools and shoes shall be spark proof. The use of such equipment has been common practice in the application of synthetic coatings for a number of years.

5. All smoking, matches, fire, flames, or torches shall be prohibited within 50 feet of the area where coatings are being applied.

6. All men working in enclosed areas should wear compressed air type masks to supply them with a flow of clean air at all times.

7. Where epoxies, epoxy coal tar, coal tar or phenolic resins are applied, protective clothing should be worn to eliminate contact with the liquid coating.

If these simple rules are followed during the application of any coating to enclosed spaces, the hazard from fire, inhalation of fumes or contact with the liquid should be maintained at a level which will provide maximum safety to the individual workman.

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VENTILATION FOR HEALTH HAZARDS CONTROL IN THE CONSTRUCTION AND REPAIR OF SHIPS

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Shipyard ventilation prior to World War II was usually limited to locations where the heat stress upon men due to the high ambient temperatures and additional radiant heat could interfere with their productivity. During and subsequent to the war, however,

developments in welding, surface preparation and coating of ships extended the requirements for ventilation.

A national conference on safety and health in shipyards holding contracts with the United States Navy and Maritime Commission was conducted in Chicago on December 7 and 8, 1942. As a result of that conference, unanimous agreement was reached on certain minimum standards for safety and industrial health which were later approved by the Navy on January 20, 1943, and by the Maritime Commission in February, 1943.

Section H (14) of those standards had to do with ventilation. Subsection 14.1 stated, "Ventilation is required to control temperature and to remove air impurities, as from welding and paint spraying." Section 14.4 referred to the type of equipment needed, "In ship construction, two types of ventilation are used—local exhaust as for removal of welding fumes at the point of origin and general ventilation, to supply fresh air to confined working spaces."

Another section recommended that local exhaust be used for control of welding fumes. In those cases where it was not possible to furnish a local exhaust system to a welder, it specified that a minimum of 400 cubic feet of air per minute per welder be supplied to a work space such as a deep tank where general ventilation was used alone.

In the spring of 1943, a number of workers engaged in new ship construction complained of respiratory symptoms. According to Public Health Bulletin #298, "Health of Arc Welders in Ship Construction," most of these complaints seemed to arise from arc welders who performed their work in inner bottoms or in other confined spaces of vessels under construction. This symptom complex was commonly referred to by the shipyard workers as "shipyard cough," "welder's wheeze," or "welder's bronchitis."

As a result of these complaints, the Maritime Commission in August of 1943 requested the United States Public Health Service to cooperate in a survey of shipbuilding yards to evaluate the severity of these complaints and to determine the etiology from extensive field studies.

The result of this study were published in 1947 and have particular significance to shipbuilders and ship personnel. One of the prime findings of this survey was as follows, "It has been found most satisfactory to use general ventilation as far as possible. Local exhaust ventilation requires the welder to cooperate in its use; and since this cooperation is frequently not forthcoming, the ventilation suffers accordingly."

The final paragraph of Public Health Bulletin #298 stated, "Based on the observations of this study it may be concluded that gases and fumes generated by welding of mild steel as practiced in Maritime and certain Navy-contract shipyards induces an upper respiratory symptom complex and other possibly related changes such as arc-welder's siderosis and a slightly lowered blood pressure. It would seem that these alterations as demonstrated statistically are of clinical importance so far as temporary disability, differential diagnosis, treatment and prognosis are concerned; the observations, however, indicate that these changes have not led to permanent disabling residual effects. Safety measures in the form of eye and skin protection and ventilating practices have undoubtedly aided materially in keeping all industrially related clinical findings at low levels of significance."

The next publication of interest for ventilation for welding was that of Committee Z-49 of the American Standards Association which was sponsored by the American Welding Society. Their first publication was Z-49. 1-1950. Section 8 of that publication, entitled "Ventilation and Health Protection," emphasizes the problems of welding on lead, cadmium, mercury-bearing or mercury-coated material, or zinc-coated material, and also of using fluoride-bearing fluxes.

In each of those cases, air supplied respirators were specified for use by the welders. Additional requirements and/or limitations, were stated in Section 8.41. "Mechanical ventilation shall be provided when welding or cutting is done on metals previously not covered when : a) in a space less than 10,000 cubic feet per welder; b) in a room having a ceiling height of less than 16 feet; c) in confined spaces or where the welding space contains partitions, balconies or other structural barriers to the extent that they significantly obstruct cross ventilation."

Section 8.42 states, "Such ventilation shall be at the minimum rate of 2,000 cubic feet

per minute per welder or four air changes per hour, whichever is the greater, except where local exhaust hoods and booths as per Rule 8.5 or air-line respirators approved by the U. S. Bureau of Mines for such purposes are provided. Natural ventilation is considered sufficient for welding or cutting operations where the space restrictions listed in (a), (b) and (c) above are not present."

The subsequent revision of this publication in 1958 changed nothing with regard to ventilation requirements but did take cognizance of the fact that more exotic metals and materials were being used both in rods and coatings. Where these materials were being used, the use of Bureau of Mines approved air-line respirators was required.

In Bethlehem Steel Company, responsibility for the health and safety of the individual employe is the responsibility of his immediate supervisor; hence our company slogan, "Production with safety." At all levels of supervision, staff services are provided to advise, train, and otherwise assist the line supervisor, but his is the ultimate responsibility for health, safety, as well as production.

The shipbuilding division, in the late 1950's, requested the Industrial Relations Section to assist it in preparing a manual of recommended practices for ventilation of burning and welding operations. A committee representing the disciplines of ventilation, welding, safety, and production wrote the manual.

The manual, four by six inches in size, is a convenient one for supervisors to carry in their pockets. It is twenty-six pages with the scope being covered under A) production; B) responsibility; C) personnel planning procedures; D) ventilation requirements; E) equipment and installation; and F) special problems which might be faced by the immediate supervisor.

Section (D) on ventilation requirements is divided into a discussion of fundamentals, principles of air flow, fans, blowers, and lastly, the ventilation required for welding and burning. Under Section (E) on equipment and installation, the general types and characteristics, fan and duct selection, and how to place equipment aboard ship are covered. The ventilation requirements as set forth in this manual were those that had been established by the American Standards Association.

The acceptance of this manual has been excellent, and it has been one means of providing for uniform ventilation for welding and burning operations in the shipbuilding and repair yards of Bethlehem Steel Company.

Although the large-scale introduction of welding in shipbuilding and repair required ventilation to a much greater degree than had been previously practiced in shipyards, it was the forerunner in the ventilation for preparing and coating of surfaces.

Many factors were involved in the changeover from the application of "paints" to ships by means of brushes to the now almost universal practice of spraying of "coatings." Two of the major items influencing the changeover from brush to spray were the increasing cost of labor and the advances in paint technology.

Painting and coating manufacturers developed materials that would give proper adherence, film thicknesses, and subsequent over-all life when applied by means of a spray gun. However, since the scope of this paper precludes further elaboration on the reasons for the changeover of brush to spray painting, it shall suffice to say that this transition created a major ventilation problem.

The spraying of coatings in the early stages of its development with regard to ship applications was not entirely satisfactory as far as the length of coating life. Subsequently, research by manufacturers, applicators, and owners found that the preparation of the surface prior to the application of the coatings was extremely important.

This meant that the specifications for these coatings jobs generally required that the surfaces be blast-cleaned prior to the application of the coating systems. Due to its effectiveness and low cost, the commonly-used abrasive for the blasting was silica sand, which created a potentially severe industrial health hazard.

In the Baltimore yards of Bethlehem Steel Company, it became obvious that much of our coating work would require the blasting of surfaces prior to coating. Together with the production personnel, the Industrial Health Engineering section began to investigated substitute materials for sand. After a number of trials of various materials, we were able to find a competitive product which

contained less than 1 per cent free silica, and in which the lead and zinc content was also below hygienically significant amounts.

The material that we used also met all of the requirements of the line production personnel. We have used several different substitutes equally satisfactorily in the Baltimore area both in ship building and in ship repair work. As a result, the amount of sand that is used for abrasive blasting in the Baltimore area of the Bethlehem ship building division is negligible.

The next problem that arose from the new spray coating systems was the solvents that were necessary to give the rapid drying time required for spray operations. Where formerly, turpentine, mineral spirits, and other much less rapidly drying materials were satisfactory for brush coating operations, we now ran into materials that were much more volatile and, of even more importance to industrial health personnel, had quite significant health aspects in many cases.

In April, 1951, Dr. Allen Brandt presented a paper to the marine section of the National Safety Council at the Greater New York Safety Conference in which he discussed the safe use of solvents in shipyards. This paper was probably the first in which cognizance was taken of the rapid changes in shipyard use of solvents. I should like to quote at this time one paragraph of Dr. Brandt's paper which will set the tone for the remainder of my article.

"Before getting into the meat of this paper, I should like to mention briefly one other point of misinterpretation or lack of knowledge which frequently leads to erroneous conclusions. This is the misconception of so many people in fire prevention work that if the atmospheric concentration of a flammable vapor is kept below the lower explosive limit (or 20 per cent of it as is common procedure) no health hazard exists.

"Nothing could be farther from fact. Gasoline is a relatively harmless solvent—its safe concentration being 500 ppm (parts of gasoline per million parts of air) as compared to 25 ppm for benzol, and it is an extremely flammable one. Yet 20 per cent of its lower explosive limit is 0.26 per cent or 2600 ppm which is more than five times its safe limit from a health viewpoint.

"Consequently, it can be seen that the truth is the exact reverse, namely, if the atmospheric concentration of a volatile solvent is kept below the safe level from the health standpoint, it will be much below the lower explosive limit."

One of our first interior spray coating jobs using the then so-called new or exotic coatings was performed in the Baltimore Yard in the summer of 1950. The owners of this Victory-type ship specified that the No. 4 Hold deep tanks were to be sand-blasted and sprayed. The tank dimensions were: 1) port forward 45 feet by 25 feet by 11 feet for a total of 12,300 cubic feet; 2) port aft 36 feet by 18 feet by 11 feet for a total of 7,100 cubic feet; 3) starboard forward 45 feet by 23 feet by 11 feet for a total of 11,400 cubic feet; and 4) starboard aft 36 feet by 16 feet by 11 feet for a total of 6,300 cubic feet. The tank hatches were 14½ feet by 18½ feet; trimming hatches were 4 feet by 4 feet. The necessary scaffolding was erected in each tank for the blasters.

Each of the foreward deep tanks was ventilated by two vane-axial fans, each of which had a capacity of 5,000 cubic feet per minute and 3 inches of water static pressure. These were U. S. Navy standards size 8-6-D-1-W-5 which were driven by 5 HP direct drive motors.

The fans were installed on planks placed over the hatch openings so that they would exhaust the tanks. The remainder of the hatch opening was covered with tarps and boards to make the hatch as air tight as possible in order to eliminate bypassing of the air. Trimming hatches were left open in order to provide access to the tanks and to allow air to be supplied to the tanks exhausting. Canvas exhaust ducts, 24 inches in diameter, were connected to the fan discharge and these were extended to the weather deck hatch coaming. The inlets to the fans had metal ducts installed with the intakes at different levels to eliminate stratification of the air.

Use of the fans as exhausters rather than suppliers gave two important safeguards. The first was that the access ladder was being swept at all times by uncontaminated air. The second was that by carrying the exhaust above the weather deck hatch coaming, recirculation and buildup of dirt and dust during blasting were avoided, and during the coating operation between deck spaces

and lower holds were not contaminated with solvent vapors.

This arrangement of ventilation was checked during the blasting operations, and the distribution in the tanks was found to be excellent due to the high velocities of air through the trimming hatch and the location of the exhaust inlets. Air volumes being handled by each fan were in the range of 10,000 cubic feet per minute which gave a velocity of 12,000 feet per minute of air entering the tanks through the trimming hatches.

When coating work was begun, the area around the No. 4 Hold was posted with signs forbidding hot work and smoking. A fireman was assigned to enforce these prohibitions. All matches and lighters were removed from men working in the area. Workmen's shoes were examined for protruding nails, and rubbers were provided to those men whose shoes could provide a spark. Lighting was provided by explosion-proof, portable lamps with connection boxes installed on the main deck. Suitable hoses with fog nozzles and applicators were connected and placed on the main deck; fire extinguishers were on hand.

From the ventilation measurements made during the blasting cycle, it was determined that sufficient ventilation could not be provided to the tank to eliminate the possible toxic hazard of the solvent fumes. These fumes were methyl isobutyl ketone and toluene and were typical of the vinyl coatings being applied.

Since the ventilation as determined by the measurements was practical only to the extent of control of the explosive hazard, all painters were supplied with airline respirators. Foremen, chemists, and other personnel who were required to enter the tanks were furnished chemical cartridge respirators. All respirators used by the Bethlehem Steel Company are approved by the U. S. Bureau of Mines for the specific application.

As a further safeguard on the measurements and calculations made with regard to the coating system, a chemist certified by the American Bureau of Shipping was retained to make constant readings of the explosive content of the air. A sample of the coatings has been furnished to him in order that he might calibrate his instrument for the appropriate explosive range.

The testing procedure used was to start one painter spraying in a tank and to take readings on the explosimeter in his vicinity. Typical readings were as follows: 1) average reading near sprayer—20 to 30 per cent of the lower explosive limit, 2) six feet beyond the sprayer—negligible—2 to 3 per cent of the lower explosive limit, 3) discharge from the canvas duct—negligible.

A second man was then started spraying in the same tank. When the sprayers were in opposite portions of the tank, the readings were comparable to those cited; but when they came close together in the cycle of work, the readings rose to over 50 per cent of the lower explosive limit in the direct exhaust. After this check, only one painter was used in each tank.

The required four coatings were applied to all tanks routinely with production rates being five gallons per sprayer per hour for the first and second coats and seven gallons per sprayer per hour for the third and fourth coats. These rates are similar to those given by spray gun manufacturers, but are misleading for ventilation calculations because these are average rates. Therefore, they include times for shifting lighting, moving around scaffolding and other painting tasks. However, the ventilation furnished was advantageous in that no time was needed between paint coatings for curing. This made it possible to complete the job in less than the estimated time.

A recent survey of five different manufacturers' primers showed that they contain as volatile solvents: 1) methyl ethyl ketone with a small amount of xylene, 2) toluene and xylene, 3) toluene and xylene, 4) toluene and methyl isobutyl ketone, and 5) methyl ethyl ketone, methyl isobutyl ketone, and xylene. These are similar to those encountered in the 1950 work. These coating systems have met with rapid acceptance among ship owners as considerably greater size tanks have been and are in the process daily of being coated with a veritable witch's brew of materials.

In recent years, an additional control of the environment has been required by the coating manufacturers because of the narrow range of specified temperatures and humidities during the coating application and curing. This has required the development of a push-pull type of general ventila-

tion in which the makeup air, which had been merely the ambient air in the case described, now must be controlled within these specified limits of temperature and humidity. The expense of tempering makeup air makes it economically infeasible to attempt to control the health exposure exclusively by means of ventilation.

Several years after the preparation of the company's manual on welding and burning and its acceptance and use by the line supervisors, the shipbuilding division requested personnel from industrial relations to assist in the preparation of a ventilation manual for the preparation and coating of surfaces. A similar manual to that for welding and burning was prepared with headings of an appropriate nature.

In the section under ventilation requirements, the portion on fundamentals was repeated from the previous manual. The section on local exhaust ventilation was eliminated and several typical cases were listed which had been controlled by general ventilation.

A simple formula for determining the general ventilation required when spraying in a confined space in order to control the fire and explosion hazard was given:

$$Q = \frac{8000\,(s)}{(x)\,(y)}$$

where Q = ventilation rate in cubic feet per minute

s = coating consumption in pounds per 8 hour day

x = molecular weight of coating (or primary solvent in coating)

y = lower explosive limit of coating in per cent (or of primary solvent coating).

Rates established by the above formula will give adequate control of fire and explosion hazard with proper circulation of the air in the confined space. However, higher rates may be justified from the production standpoint in order to minimize fogging and improve visibility. Additional production benefits may be obtained from more rapid drying of the coating. This manual has been part of the training facilities made available for line supervisors in our company.

The Sparrows Point yard, which is primarily a new ship construction yard, has minimized its ventilation requirements by the installation of a facility which blasts scale from plates by steel shot and then sprays the prime coat utilizing an electro-statically charged paint spray. This is an automated line with complete fire and explosion protection and safeguards.

In addition, whenever possible, subassemblies are blasted and coated on the ground fabrication tables prior to being assembled on the ways.

In summary, with regard to spray coating, this method of application has caused serious potential problems from the safety and health standpoint for the following reasons: 1) the increase of the application rate of the coating; 2) the increase of the solvent content of the coating due to the need for less viscous materials for spraying; and 3) the increase in inherent toxicity of the solvents due to the development of the various plastic-type coatings which require more complex chemicals as a solvent material.

The control of these coating applications requires individual respiratory protection for men when they are working in confined areas. They require ventilation rates of sufficient quantity so that 20 per cent of the lower-explosive limit of the applicable solvent is not exceeded.

The safe and healthful application of coatings depends upon the cooperation of the owner, vendor, and the yard. As to the owner, he must select the coatings in time so that proper precautions for applying the coating may be taken. From the vendor's standpoint, he must supply sufficient information with regard to the composition of the coating so that the yard may take the necessary precautions with the coating. The yard's responsibility is to assemble the information and furnish the equipment and personnel required to perform a safe, healthful and technically excellent job.

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METALS INDUSTRIES

NATIONAL SAFETY COUNCIL
425 N. Michigan Avenue
Chicago, Illinois 60611

1964 National Safety Congress

WHERE DO YOU GO FOR THE ANSWERS?

By W. E. SEBESTA
Chief Industrial Hygienist, Republic Steel Corporation, Cleveland, Ohio

This question has probably arisen many times for innumerable organizations whose employes have become concerned with the conditions under which they work. Of course, there may be reasons, other than those which may irritate an employe's physical health, which may generate a criticism from the employe or group of employes, in which one's health is questioned. However, since we are concerned here with industrial health, let us delve into the various paths of investigating an industrial health problem.

There are several air sampling procedures which are recommended by various individuals and organizations. Some prefer taking air samples by a midget or micro method, such as, evaluating the dust concentrations in areas, using the midget impinger system. Others prefer using a sampling method which is related to the breathing rate of an employe engaged in moderate labor.

Basic air sampling procedure must consider the type of contaminant, the method of sampling, the possible interferences, and the degree of hazard of the exposure to the contaminant.

One must first consider whether the problem is a dust, fume, mist or gaseous contaminant. If it is a dust problem, the contaminant should be collected in distilled water; if it is insoluble. If the dust may be water soluble, a non-dissolving liquid is recommended.

Dusts have also been captured during air sampling by electrostatic precipitation, by filter paper sampling, and thermal precipitation. Once the dust has been collected, it is counted as soon as possible (if it has been collected in a solution). If the dust has been captured in the dry state, the dust is redispersed in a suitable liquid in the laboratory for counting.

Sometimes, dusts are analyzed in other ways; various microscopic procedures, by change in color of the filtration medium or by gravimetric means. After counting, the dusts may be analyzed for particle size distribution or analyzed chemically for other reasons.

A fume, which is a contaminant resulting from the condensation of a volatilized material, may have to be captured using a sampling procedure capable of collecting the particles in that particular size range. Some fumes have to be sampled by use of the electrostatic precipitator.

Sampling for gases may be performed using (1) indicator tubes (if available), (2) use of a scrubbing liquid, or (3) capture a quantity of the workroom atmosphere by means of a vacuum system. The indicator tubes are susceptible to interferences, which are listed by the respective manufacturers. Scrubbing mediums can sometimes be devised to capture the suspected gaseous contaminant, this medium being analyzed in the laboratory for the specific gas.

The vacuum system refers to the capture of a sufficient quantity of the workroom atmosphere in a bottle or other container. This container was originally evacuated in the laboratory and the air sample secured in the field by opening the cylinder closure and permitting the workroom atmosphere to be drawn into the previously evacuated cylinder.

There are also other sampling methods for dusts (most of which involve filtration): a) Owens Automatic Air Filter—a paper tape device which filters the dust from a definite volume of air through a small area of white filter paper tape; b) the *Konio gravimeter*; c) the paper thimble method; d) the bag test, which is similar to method (c) above; e) the sugar tube method; and f) salicylic acid filter, which like the sugar tube, uses a crystal mass to retain the dusts.

There have been several methods developed for the capture of dust aside from the methods mentioned earlier. They are: Koniometer, Minnesota Dust Counter, Owens Jet Dust Counter, the modified impinger and cascade impactor. These are modifications of the general impingement method; the variance providing the separation of the dust into fractions which can then be observed separately.

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MINING

NATIONAL SAFETY COUNCIL
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cies, information and aid are supplied the unit-by-the Department of Safety and Technical Employment Office in Salt Lake. The pit safety program is aimed at providing safe conditions and getting as much information as possible to the equipment operators, teaching them the safe way to operate their particular equipment under all conditions and situations and seeing that safety instructions are carried out.

The Mine Superintendent has the direct responsibility for pit safety and in turn, each Pit Supervisor is responsible for the Safety of his men. It is up to him to see that they get the information, learn the safe operation procedures and to see that the safety orders are followed. The Safety Department helps him by supplying information, planning training, holding safety meetings, making inspections and keeping records.

The Mission has recorded a respectable safety record in the past, but everyone is always trying to make it better. New suggestions and ideas are welcomed and searched out in the attempt to have an accident-free operation.

REACHING THE MINER WITH SAFETY EDUCATION

By HERBERT A. WENDEL
Chairman, Bureau of Safety, The Anaconda Company, Butte, Mont.

Reaching the miner with safety education is the ultimate goal and main objective of every safety program in the mining industry. If we can get safety education to every worker and it is properly learned, enforced and obeyed, we should eliminate at least 85 per cent of all potential accidents. We should have very few accidents as a result of unsafe behavior. Then we could concentrate most of our future efforts on preventing the type of accidents which are caused by faulty or defective machinery, equipment, tools and materials.

An uninformed or uninitiated person would think that it should be a rather simple process to reach the miner with a safety education. Theoretically he would be right because here we get involved in a matter of semantics. When we say "reaching the miner with safety education" we actually mean that this education must also be accepted and learned by the miner; we intend to mean that safety must be observed and followed at all times. But in order to realize our complete meaning of the phrase, we must overcome or find the solution for a number of problems and obstacles which are all too well known by management and safety personnel.

Probably the greatest deterrents we face in properly reaching the miner with safety education are the far too numerous faulty mental reactions which are usually referred to as unsafe attitudes; these, coupled with superstitious or fatalistic beliefs common in the minds of the type of workers who follow mining as an occupation, complicate our corrective efforts.

A summary of the more common problems we are confronted with in reaching the miner with safety education would include: 1) employee resistance or reluctance to new safety ideas, programs, innovations or devices; 2) long standing, undetected or unobserved unsafe work habits; 3) improper attitudes including fatalistic beliefs and the philosophy that life itself is a gamble; 4) inherent desire to take short-cuts or chances; 5) reluctance to obey orders or safety rules that seem to involve additional work; 6) objection to the use of required personal protective equipment; 7) resistance to safety because it seems to restrict freedom of action; 8) feelings of personal immunity to accident or injury.

Miners and other employees resist safety mainly because they feel that it restricts their actions, seems to cause more work, interferes with their freedom of action or slows them down. This is probably not, in their minds, a disregard for orders or a disrespect for safety. Some men believe they know more about the job than anyone else,

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COMMERCIAL DRIVING SCHOOLS

By H. B. VINSON

President, National Professional Driver Education Association, Inc. and Texas Driving School, Dallas, Tex.

When we hear the term "driving school," the general impression seems to be that all such schools are classified as being the same. Nothing could be further from the truth. In reality, we have two distinct classifications of such schools

First, we have the *commercial driving school.* Here we find school teachers, policemen, auto clubs, auto dealers and department stores offering driving lessons to the public. Needless to say, these people offer such instructions as a sideline to their regular job or business operation. It has been our experience in the past that these people consistently oppose legislation designed to improve and upgrade the driving school profession. Inasmuch as this group uses driver training as a device to promote sales or raise a little additional money to supplement their regular salary, they should truly be classified as commercial driving schools.

Next we have the *professional driving schools.* You might ask the question: "What is a professional driving school?" In essence, these are people who have continued to study and educate themselves and work constantly to improve their programs. In the tradition of any professional person, they willingly share their knowledge with others engaged in the same type of work. They consider driver education and driver training as their chosen profession.

In many instances, these people could make more money in some other type of work. Professional school owners are proud of their business and take pride in their programs. They became the recipients of ridicule in many areas throughout the nation as the result of the activities of the commercial operators. They, like other professionals, realize the need for strong laws controlling their activities and are constantly working to improve the instruction and services they offer to the public.

To participate in a profession with no restrictions or qualifying factors is hardly worthy of consideration for any conscientious or intelligent person. However, we find many states that have NO laws controlling driving schools. Consequently, school owners continue to operate without any rules or regulation. To us, this seems utterly ridiculous.

Driving schools first became an established business in 1909. They have continued to grow and prosper as the years go by. At the present time, they are training more drivers than any other group—about 1½ to 2 million people a year. Yet driving schools are ignored by other safety organizations who profess to be working for traffic safety.

The most common comment we hear is the remark that we are doing this work for money or compensation. This seems rather odd since few people engage in any work unless there is a salary connected with the job. Next, we hear the comment that our instructors are not college graduates, but industrial psychologists advise us that this is not necessary, and, indeed, our own experience has indicated to us that people without college degrees generally can become better in-the-car teachers of driving.

As members of the National Professional Driver Education Association, we do not claim to have all the answers. We realize our shortcomings, and probably all the lies you have heard about us are true. However, being the world's largest single source of driver training, we feel an obligation to make known our views, our opinions and the truths which our experience has indicated.

1) We believe the age limit for obtaining a driver's license should be raised to 18.

2) We believe new drivers should have the choice of receiving training in either the high schools or in professional driving schools.

3) We believe that no program will ever reach the peak of maximum performance without the element of competition.

4) We feel that many programs are obsolete and totally inadequate with the changing times.

5) We feel that too many programs are nothing more than a short cut to a driver's license.

6) We believe that there is no place in our high schools for adult programs at the taxpayers' expense, especially in view of the weaknesses in many teenage programs.

7) We are convinced that road tests for drivers' licenses should be greatly improved.

8) And finally, we believe that there should be some semblance of uniformity between all groups offering driver training to the public. Consequently, we should work closely with all groups interested in improving their respective programs.

We have asked for support from many safety organizations, insurance groups, automobile manufacturers, and others, to help promote and pass laws controlling driving schools in various states. In very few states have we received any help whatsoever. On the contrary, we find in many states, especially during the past legislative session, automobile clubs as well as insurance companies appearing in the legislative chambers and opposing our bills. In short, they sometimes profess an interest and concern for traffic safety but at other times their *actions* do not bear this out. It seems incredible to us that anyone who claims to be interested in traffic safety would not only turn his back on the nation's *largest sources* of new drivers but would also frustrate our efforts to upgrade and improve our driver training programs. Is it any wonder that a few of our members are in agreement with some of the thoughts conveyed in the book *The Highway Jungle?*

Keep in mind that we are not asking for free automobiles. We're not asking for any donations. We are financially able to support ourselves.

As men of honor and good judgment, and in the interest of the entire, nationwide, driver education program, we ask your support for more rigid laws and regulations controlling the driving schools throughout the nation, and we pledge that we will work with any group that is truly interested in improving our national highway safety program. During the past years, we have enjoyed some very pleasant relationships with members of the teaching profession from colleges, universities, high schools and other safety organizations throughout the country.

We hope that this will continue. Our members are happy to work with you in your state or in your community, in any way possible to help improve our safety program.

During the past legislative sessions, we found some members of the driving school profession opposing members of high schools and other groups in the legislative chambers. This could easily be avoided by having meetings prior to the introduction of a bill wherein the two groups could get together and agree in principle on the terms of a proposed bill. Many times, driving school owners are accused of opposing high school driver education when in essence they are doing nothing more than fighting for their right to survive and conduct their businesses as businessmen working under our principle of free enterprise.

Such was the case in New Jersey this past year. Therefore, as the president of the National Professional Driver Education Association, I pledge that we are willing to meet and to discuss legislation with any group proposing bills relating to the training of new drivers. However, we will oppose any bill designed to raise the age limit for obtaining a driver's license unless professional schools are included in all training requirements of such proposed laws.

If driving schools in your state are in a deplorable condition, then you must assume a portion of the credit for this situation. Through your lack of interest in helping us obtain laws and regulations, you are displaying a lack of sincere interest in a national highway safety program.

It is not the objective of our association to ridicule or degrade other programs. However, we will not remain silent while laws are being passed, designed for the extinction of our professional schools.

There will always be a need for driving schools. The demand of the public will make this inevitable. They are essential to those wanting to learn to drive quickly. They are necessary to those who are considered problem students. They are pre-

ferred by those desiring individual instruction. And last of all, they are needed to complete the training of thousands of teenage drivers who have been partially trained in high school programs. This list continues to grow year after year.

SELLING SAFETY PROGRAMS

By JOHN A. FORD
Vice President, Public Relations, Chrysler Corp., Detroit

The automobile industry has several good reasons for promoting traffic safety, even apart from the obvious need to save lives. *Safety is good business for us.* We believe that the confidence of the American consumer in our industry, in the safety of our product, and in our ability to provide safe, pleasurable motoring, has a lot to do with the rate at which he will buy our cars in the years ahead. So we have a stake in safety for business reasons—as well as for humanitarian reasons.

We at Chrysler are proud of our work in advancing the cause of safety—the efforts of our safety specialists, our designers and production men, and our dealers. We think this is important work, and we intend to keep at it.

However, the business of public persuasion is another, more difficult matter. There are always special problems in trying to sell highway safety programs. I want to touch on some of the problems, some of the practices which seem to me ineffective, and then talk a little about how I believe a safety program can be sold.

What I just said seems to imply that selling safety *programs* is a process quite different from selling safe driving. We all know this is not true. I want to talk about the two kinds of safety selling in terms of *one* kind of communication: the kind that has some chance to persuade.

The first problem for the communicator always is to get people to pay attention. The human animal has a remarkable ability to ignore messages which are boring or apt to be unpleasant. We do not have to avert our eyes or close our ears; psychologists have demonstrated many times that we can turn things off in our heads.

Most communications about the need for safe driving, or for safety programs, require the listener or reader to assume that he's about to have an accident. This is not only an unpleasant idea to all of us; it also seems a remote one. Psychologically accidents are something that happen to somebody else. None of us really escapes that unconscious conviction except under unusual circumstances. Safety *messages* are for somebody else.

I'm sure that everybody who has had any connection with safety campaigns is very much aware of this quirk in the human psyche. Obviously, it is necessary to break through that deliberate indifference, to make people realize that this is *their* business, that you're talking about *them*. And the tactic which seems to occur to many practitioners first is shock. Grab them by the throat and yell; that will get their attention.

We've all seen thousands of examples of this approach. There are those commercials which begin with the happy suburban family on their way to the country, with the fast cut to the crumpled cars and attendants carrying stretchers. Then there are the mangled wrecks placed at dangerous intersections, with appropriate signs; the phony skeletons and mock graves; and a thousand other gimmicks, some of them admittedly forceful (as a matter of fact, some alongside the road have been so striking that they've had to be removed—as traffic hazards).

But the shock technique, even though it may have some temporary impact, really doesn't work very well. There are a couple of reasons for this.

In the first place, it has been demonstrated many times that such effects wear off quick-

ly; we develop psychological callouses in a hurry. This generally seems to inspire an effort to produce an even greater shock, and when that one begins to attenuate, another greater yet. The logical end of this approach is perpetual hysteria.

It never goes this far, of course, because of the second of those reasons. A classic study was made about fifteen years ago of what psychologist Carl Hovland called "fear-arousing communications." He concluded—and later studies confirmed—what our common sense would lead us to believe in the first place: that when the attempt to induce a sense of horror goes too far, we react sharply in the other direction. We not only turn off the message in our heads; we flatly reject it. Anybody who was in military service and saw some of those old-fashioned gutsy films about VD knows exactly what I mean.

It seems to me that whatever gain was to be realized from trying to frighten people in safety campaigns has long since been used up. Yet it still remains one of the more common approaches. One of the most familiar is the standard story on the eve of every major holiday predicting the number of bodies by the time it's over.

At the risk of seeming a rude guest, I must admit that the apparent conviction that this is an effective attack on the problem baffles me. The theory, I suppose, is that the holidaying motorist reads this melancholy advance story, blanches, and says to himself "Good heavens! I must drive safely, so I won't be one of them." And the community leader says "I must join something to prevent it."

Even assuming that the first reaction does affect driving for the better—which I doubt, for reasons which I want to touch upon later—it seems highly improbable that this standardized set-piece works that way for anybody anymore. Everything we know about communication would lead us to believe that the man who has to drive on Labor Day will, instead, simply skip the story; and the community leader will reflect that he has too many commitments already, and move on to "Li'l Abner."

In the same genre is the familiar billboard with the changeable numbers, the running tally kept by the wire services, and those bleak little boxes on the front page which show this year's total to date compared with last year's. This is news, maybe, but nothing leads me to believe that it does anything for the cause.

It probably has occurred to you by this time that we've been talking about how *not* to sell highway safety programs, which is hardly the announced topic. I suggested in the beginning that there are no arcane secrets that can solve all our problems. If there were, I'm certain that they already would be in use; it takes only a quick glance at the safety promotion field to conclude that practically every possible idea has been tried.

Nevertheless there are certain fundamentals that—if properly followed—give the safety selling message, or any message which tries to move people to action, a better chance of getting through. I'd like to introduce these with an anecdote which happens to be true.

About three weeks ago I was on a twin-engine jet going home from Chicago, and we lost an engine just after take-off. A member of the flight crew assured us as we headed back to the airport, that there was no danger and that it would be a normal landing. It worked out that way, and the landing was routine—but the experience was still a little unsettling, with emergency trucks racing to meet us and the runway cleared.

We huddled together for about an hour waiting for another airplane to be brought up, with everybody being a little self-consciously blasé about the whole business, and then took off again. The voice on the P.A. made a particular effort to reassure us during the flight with occasional little jokes and comments on the scenery and the moonlight. Then, when we started to let down for Detroit, he came on again.

He said something like this: "We're now approaching the most dangerous part of the trip." There was a sudden silence while that soaked in. Then he went on: "I'm not referring to the flight. I'm referring to the fact that in about ten minutes we'll be on the ground, and you'll be getting into automobiles and driving home. *That's* the dangereous part.

"Now, every one of you back there has your seat belt fastened. The sign told you to do it, and the girls go along the aisle to make certain. Most of you folks also have seat belts in those cars you'll be getting into,

but there won't be any sign or anybody to come around and make you use them. Try to remember, will you? We'd like to have you as a passenger on this airline again."

That, I'm quite sure, was one of the most effective safety messages ever uttered. If he'd added "and write your congressman about a seat belt law," the airport newsstand would have sold out its ball-point pens.

One of the factors in its effectiveness, admittedly, was special to that unusual occasion. The timing was right. You never saw a clientele so interested in a discussion of safety. This matter of hitting the audience when the mood is right can be an important part of obtaining impact, but unfortunately there's little that can be done about the environment of the safety message—at least until somebody invents a tape recorder that comes on automatically every time we have a close call. It might be possible to arrange for somebody to play "chicken" with the chairman of the appropriations committee when he's on his way to the statehouse for the vote on increasing the highway patrol, but that seems a little drastic.

In terms of the safe driving message aimed at individuals, it's easier to point out conditions which are unhelpful than to suggest better alternatives. The citizen dozing in front of his television set probably gets nothing at all from the safety filler dropped into the late movie—and I doubt if its print equivalent says much to the average householder pawing through the polychrome vastness of the paper on Sunday morning.

So far as I know, there has been no real study of such messages on radio during peak driving hours—but, offhand, this would seem to be a more promising situation. Most of us drive with the radio on, and we're at least occupied with the subject when the word comes.

There was a more important characteristic of that pilot's message, however, which *can* be calculated and controlled in any safety selling situation. It applies equally well to both the safe driving message and to the wider problem of developing public support for full-fledged programs.

Make sure you fasten your seat belts, the man said. In other words, here is something specific which you can *do*. It is a discrete, positive action, simple to perform, and after you do it you'll be better off than before.

When you're trying to move people to action, this is the kind of message that works. It is the stock in trade of the professional persuaders: "vote for Smith." "Buy one and get another one free." "Sign here and your family's future is assured."

A great part of most safety promotion is of a quite different sort. It is vague, or essentially negative, or both. When we're trying to make people into safer drivers, we often deal with what sound like moral preachments. "Drive safely! The life you save may be your own" is one of the most familiar phrases of our time—but it hardly suggests a concrete plan of action. "Don't be a statistic" and "make it a safe holiday" and a thousand other such slogans come close to meaning nothing. Does the slogan "insist on strict law enforcement" suggest that I really ought to go up to the cop on the corner and tell him to do his job better?

When it comes to persuading the public, or public bodies, to support safety programs with attention and money, there's been a tendency toward the same kind of irrational approach. It could be summed up as a kind of collective repetition of something like "look at all this blood! Give money!"

Drive safely—by doing what, precisely? Give money, or your time—for what, precisely? If, in selling safety, it is possible to outline a course of action which can be carried out now with a reasonable prospect of success, the chances of action are much improved. Long ago most of the insurance companies stopped concentrating on such ideas as "wouldn't it be awful if something happened to you?" For that vague and negative threat, they've substituted, in effect, those two words I mentioned a moment ago: "sign here." The insurance business is better than ever.

The seat belt campaign has been a happy example of this positive, here's-something-you-can-do-now approach. Not only are increasing numbers of people using belts, but, significantly enough, this has been sold as a *program*: witness the states and municipalities which now require their employes to *use* the seat belts in all official vehicles.

It seems to me that there are other specifics which could take advantage of the same kind of treatment. We at Chrysler have a program in cooperation with Champion Spark Plug which sends famous racing

drivers around to talk to high school students about safe driving. These are men talking about a craft at which they are expert; there's no obvious attempt at evangelizing or lecturing. They are concerned with teaching young drivers how to do the safe things and avoid the dangerous ones. Our program of providing cars free of charge for use in high school driver education is designed to do the same thing.

This might be classified more as education than as persuasion—but, then, persuasion is simply education taking hold. The fundamental assumption of these programs is that it's more important to teach specific skills than try to cultivate a state of mind. This kind of approach seems to be restricted largely to learners, for some curious reason; most adult campaigns seem to be concerned largely with developing fear. This strikes me, as an outsider, as somewhat curious. I have no idea how many accidents result from skids on icy roads (although I'm sure some of you know)—but I do know that I've never seen a television spot which instructs a driver on the proper way to get out of a skid.

If the emotional, fear-arousing approach is somewhat suspect in affecting road behavior for the individual, think how much less is going for it when we come to selling broad-gauge safety programs. Here both the need to talk specifics, and the chance to do so, are infinitely greater. Legislatures are not going to greatly increase enforcement facilities and driver education programs, industry is not going to put down more cash, the public is not going to accept a larger role in planned safety progress, on the simple basis of collective fright. Corporate and public decision making is a complicated process, but of one thing we can be sure: the fundamental case has to rest upon solid information.

This implies, among other things, a lot of hard work—beginning with research. I don't mean research in persuasion. I mean research devoted to measurement of the effectiveness of safety activity. The Cornell work on crashes, and particularly on seat belts, is a classic example—but it is only a very narrow slice of a very wide spectrum. More careful evaluation of such things as driver education programs, of highway design and construction and maintenance, or of driver psychology, are necessary to provide the ammunition for the sell that will get acceptance. That ammunition must come first.

With it in hand, we will then be able to sell safety programs on the basis that they produce results. The history of the growth of the financing of medical research provides an interesting corollary. It is still difficult to get money, particularly public money, to support something as broad as medical education. But medical research—that's something quite different. Thirty years ago it was difficult to get money to support basic medical research—but now this kind of activity has become associated in the public mind with the idea that "we're on the way to a cure." The cures have come, of course, and every time one does, it generates a new wave of support for more research.

It seems highly improbable that anybody is ever going to come up with a sure-fire preventive for the automobile accident. But progress can be made through research—and highway safety programs can be sold, not on a basis of acting in self-defense because you might be next, but because research pays off. As a driver, I am more impressed by the information that the rebanking of a curve over which I drive daily has cut accidents by a few percentage points than by a photograph of the latest pile-up. And, incidentally, as a driver I seldom get that kind of information—at least in a form in which I take notice of it. The rest stops on modern super-highways generally have a few bulletin boards on them, filled with bits of local history, maps, and an admonition to drive safely. People always seem to be reading these things. Has anybody ever thought of putting on them a description, in non-technical terms, of how the road is designed, and why it's done that way?

In a sense, of course, the preparation of such ammunition and the building of a better case for support of safety programs through both money and public involvement represent the hard way to do it. It's easier to think up catchy slogans or have one more crack at the horror story. But the evidence is accumulating in an increasingly depressing way that the familiar methods—whatever we might charitably assume they once accomplished—are less effective all the time. This audience does not need to be told that the fatality *rate* is now going up. We're revers-

ing a long-time trend during which the gross increases in fatalities could be explained in terms of more cars and more drivers, while the actual rate either diminished or remained steady.

This means that not only professional safety people but all of us who drive are looking the tiger in the eye. The selling of safety programs, and of safety itself, is at a critical phase. Perhaps "selling" is a bad word; it implies the striking, the catchy, the touch of blarney. Our needs now are for the rational, not the emotional; the specific direction, not moral preachments; the giving to people of things to do, rather than nightmares.

If those who are professionally charged with the administration of safety promotion do these things, they will be better persuaders. If those of us on the outside accept our responsibilities, we'll be somewhat better receivers. And if all of us work a little harder in both roles, we may live longer and enjoy our automobiles more.

JOINT SESSION WITH CHEMICAL SECTION

SAFETY PITFALLS IN AUTOMATION

By DONALD W. RICHMOND
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It is frequently said that most accidents are preventable. While the accident rate in processing operations due to equipment failures appears to be fairly modest, occasionally a malfunctioning control system can lead to serious accidents resulting in deaths and a heavy destruction of property.

Efforts successfully have been made to shut down portions of an operation in a safe manner when instrument break-downs occur. Conscientious engineers have made great contributions towards reducing safety hazards in their designs.

Certain pitfalls in instrumentation which can lead to difficulties seem to appear all too frequently, however. Of course the mistake is always unintentional, but what's worse, these pitfalls invariably exist undetected—until something happens one day.

My purpose is to briefly present the most commonly overlooked safety hazards in automation. It is hoped that a study of the principles involved in the following discussions will enable the reader to improve his safety "batting average," whether his concern is design of new facilities or upgrading of existing ones.

Location of Equipment. The problem of location of controls is often put off until it is too late to effect changes. Sometimes the decision of location is left to someone who is not familiar with instruments. The complicated control loops may have been satisfactorily worked out on paper, but is it possible for maintenance personnel to remove the control valve safely? It is advisible to allow for complete drainage of liquids away from the control valve to permit safe removal. This is especially important when hazardous fluids are involved.

These same considerations should be given to the location of all field mounted transmitters, primary elements such as thermocouples and orifice plates and final control operators. Many chemical burns to personnel have been recorded as a direct result of such design oversights.

Unfortunately these accidents sometimes occur as much as a year or more after installation and the designer never knows about it. Unless an awareness of location hazards is developed, a repetition is likely.

Self-Acting Pressure Regulator. There are two basic types of pressure regulators. One is the type with the integral downstream pressure tap and the other has the external downstream pressure tap.

The first valve is a single seated valve which normally is used either with small flows and small valve sizes or on those applications involving small pressure drops. The other valve is double seated generally because of large flows or large pressure drops. Usually double seating begins at the 1½ inch size.

In both cases, however, the action of the spring is opposed to the pressure that is placed upon the diaphragm. The purpose of the regulator is to reduce a fluid pressure to a smaller value. Rupture of the diaphragm is the commonest cause of failure in both types of self-acting regulators. Should the diaphragm fail for any reason, the action of the spring will be to return the valve to the wide open position.

Because of its design, therefore, pressure regulators fail in the unsafe position, i.e., open. Upon such a failure full upstream line pressure can exist on the downstream side of the valve. This brings up the first rule about pressure regulators—they always fail unsafe.

Because of this inherent weakness, it is customary to find pressure relieving devices or safety discs installed downstream of self-acting pressure regulators to safeguard equipment from over pressure.

Pressure Relieving Devices. There are two commonly used pressure relieving devices. One valve differs from the other in

that the action of the valve plug is reversed and the diaphragm pressure connection is made on the upstream side of the plug instead of the downstream side. It is used for regulating purposes because of the throttling characteristics of the plug and spring. This valve is available in single or double seated bodies depending upon the pressure drop unbalance at the plug.

It is possible for tight shut off in the single seated design, but the double seated valve should never be considered for tight shut off service. As in the case of the downstream pressure regulator, a ruptured diaphragm is the commonest failure. Such a failure will result in a closure of the valve.

Because of this weakness, consideration should be given to a positive means of pressure release on the upstream side of the regulator in order to prevent equipment over-pressures.

The relief valve performs a similar service as the spring-diaphragm relieving regulator, but there are important differences. The upstream pressure at the relief valve is exerted on the plug only and all of the downward spring force is exerted on the plug.

To prevent valve chattering, a special plug design which presents effectively a larger cross section to the fluid after the valve opens, causes the valve to open more fully and remain open until the upstream pressure has dropped to a lower pressure than the initial opening pressure.

This valve is normally closed and opens only under emergency conditions in order to prevent the system pressure from exceeding a specified value. These valves are always single seated, are always designed for tight shut off and can be used on gases, vapors or liquids.

A common cause of failure is a blockage of the inlet. This occurs in many services involving condensation and freezing of vapors and in many chemical services. In some instances, the problem can be solved by mounting the valve closer to the vessel where freezing could be eliminated.

In other situations, particularly where corrosion is involved, the installation of a rupture disc between the vessel and relief valve will effectively protect the relief valve. In this case, the rupture disc is designed for the specified relieving pressure and the relief valve is set at a somewhat lower pressure.

One of the commonest mistakes involving relief valves however, deals with its location and the piping configuration upstream and downstream of it. Undersizing of either the upstream or downstream piping will cause chattering when the valve relieves. All too often the exhaust pipe is vertical with an open end. Any water which falls through this pipe lodges at the closed valve.

In subfreezing areas the resulting ice if it forms will prevent the valve from opening. Appropriate caps or a downturned pipe will prevent rain from entering the pipe. A reasonable alternate solution is the provision of a drain at the bottom of the exhaust pipe or the lowest section in the valve. Many valves are sold with plugged drain connections in the valve body. It is necessary only to replace the pipe plug with a downturned street ell.

Frequently, relief valves or rupture discs are installed for the mistaken purpose of protecting a system from the pressures of an explosion. This is a misapplication of these devices. An explosion disc is often used for this service.

The rate of pressure rise in any explosion is so rapid that it is very doubtful, at best, that a relief valve or small rupture disc could possibly prevent pressures from exceeding safe limits. The control of explosions is beyond the scope of this booklet.

Temperature Regulators. The actuator of a self-acting temperature regulator is a bellows motor in which the vapor of a fluid in a temperature sensitive bulb exerts its pressure. The bulb contains a liquid such as ether or alcohol. The temperature sensitive bulb is located in a tank or vessel which is to be temperature controlled.

The heating medium for the vessel passes through the automatic valve as the fluid pressure inside of the bulb increases because of an increased temperature. The pressure in the bellows motor will gradually close off the valve.

This action reduces the rate of heat input to the system and in that way the temperature is regulated. As in the case of the pressure regulator, a failure of the thermal system will cause the valve to fail in the wide open position because of the action of the spring.

These regulators with valve plugs on top of the valve seats are used on heating service. This brings up the same rule with regard to pressure regulators—all self-acting temperature regulators on heating service fail in the open position which is generally the unsafe position.

For cooling service, the same instrument is used by reversing the action of the valve. The plug is on the underneath side of the seat instead of the top side. A failure of the thermal system will cause the spring to close the valve, in which case the coolant is shut off. Therefore, self-acting temperature regulators for cooling service fail in the unsafe position.

Because of the inherent weakness of self-acting temperature regulators, some external temperature switch is required in order to protect vessels from overheating.

Single seated temperature regulators can be made to shut off tightly while double seated regulators cannot be relied upon for tight shut-off service. As in the case of spring-diaphragm pressure regulators, temperature regulators will throttle over a range of from 5F° to 20F°.

Closed Tube Temperature Control. The closed tube system temperature controller employs a temperature sensing bulb as in the case of temperature regulators. Close temperature control is available because proportional and proportional-reset control mechanisms can be added to the instrument.

The final control valve is usually an air operated diaphragm motor valve. The action of the controller is always reverse, but the choice of valve action is determined by the service. On heating applications, the normally closed valve is used and on cooling applications, the normally open valve is used. In either case the valve fails in a safe position upon a loss of the air supply.

This control system is not necessarily safe however. A failure of the thermal system will cause the measuring pen or pointer to fall hard against the zero end of the scale. The action of the controller, regardless of the set point position, is to move the valve to overheat the system. This disadvantage can be overcome by the use of a special bulb system.

Using mercury in the bulb system and a carefully selected piece of invar inside the bulb the pressure of the mercury drops upon a rise in temperature due to the differences in the coefficient of expansion of the invar, mercury and the stainless steel sheath.

Upon a failure of this closed tube system, the pen or pointer falls hard against the high end of the scale. The action of the controller, regardless of set point position, is to move the valve to cool the system off. This applies to heating and cooling systems as well.

Electronic Balance Instruments in Control Loops. Whenever a thermocouple or resistance bulb is used as the primary temperature measuring element, its voltage or resistance is almost always measured by an electrically operated potentiometer or bridge circuit. Upon a failure of the primary element, a choice of upscale or downscale movement of the pen or pointer is available. This choice allows the final control valve to move to a fail safe position in the event an open circuit appears at the primary element.

If there is a failure of the power supply, the pen or pointer will stop in its last position at the time of power failure. Whenever on-off control or throttling control employing automatic reset response is used, the final control valve will be either fully open or fully closed.

The failure position depends upon which side of the control point the measurement was at the instant of power failure. Statistically then only 50 per cent of the power failures at the measuring loop will result in a fail safe valve position.

There are many ways to overcome this difficulty in potentiometer or wheatstone bridge circuits. One way is to use electronic controls instead of pneumatic control. Since the electronic output derives its power from the same power supply, a failure of the power will return the output to zero.

If pneumatic control is employed, a solenoid valve in the pneumatic controller output line can solve the problem if care is taken to supply the power to the solenoid valve from the same circuit as that which supplies the potentiometer or wheatstone bridge. Upon a power failure the control valve can remain:

a) in its last position by using a tight shut off 2-way solenoid.

b) at one extreme position by using a 3-way solenoid with a vented third port.

c) at the other extreme position by using a 3-way solenoid with a specified pressure connected to the third port.

Quite often, an electrical to pneumatic temperature transmitter is used in order to employ an all pneumatic control scheme. Standard transmitters of this type result in a zero output pressure upon a power failure.

If a solenoid is not employed in the controller output signal, it is advisable to determine the safe output pressure upon power failure. On most temperature applications it is recommended to feature full output pressure on power failure. In this way, the controller will cause the control valve to fail in the safe position. If a high temperature alarm on heating applications or a low temperature alarm on cooling applications is built into the control loop, there will be an instant "abnormal temperature" warning whenever the electrical power supply fails.

Mass Transfer. In the transfer of liquids from one vessel to another, questions of liquid level in each tank become important considerations. Many means of level measurement are currently available. The transfer of liquid from one or more vessels to one or more vessels also raises questions of operating errors. One of the most prevalent operational errors is believing a valve is closed when it is open. This problem can be serious if there is a fire hazard.

If level alarms or switches are connected to each tank, a measure of safety has been built in to prevent spills. If the fluid does not readily permit weight or level measurement, some measures of safety can be built in by connecting limit switches to each drain or fill valve. The switches are electrically arranged so that only two valves can be opened at one time.

If a third valve is accidentally opened, the automatic feed valve shuts off. This arrangement requires that each valve is mechanically connected to a gang of switches in an enclosure. All switches are closed except one. There are as many switches as valves.

In practice, the solenoid is replaced by a relay which performs other functions including alarms. Other similar arrangements can be likewise worked out for other piping control schemes.

Electric Motor Failure. Electric motors have become the very pulse of modern processing industries. They provide the muscles to move gases, liquids, solids and heavy equipment. Upon a motor failure, production is usually shut down. Motor failure alarms are therefore very common in the design of interlock and annunciator systems.

Several safety pitfalls occur in motor interlocks. For example, if it is desired to protect a stirred pot reactor from loss of agitation, the method often used is the auxiliary contact on the motor starter. This procedure overlooks fractures of the agitator shaft. If the shaft breaks, the motor continues to run, and the system therefore is not protected against loss of agitation.

One way to overcome this problem is to use a current sensitive switch on the motor current. The reduction in current upon a shaft breakage is the signal to use.

Another example of an unsatisfactory interlock is the use of an auxiliary contact of a pump motor starter as the initiating device to represent a loss of flow through the pump. The flow through a centrifugal pump or blower would be zero if a block valve in the line is closed. The motor would continue to run, yet there is no interlock action. One way to resolve this problem is to use a switch directly from a flow sensitive or measuring device, since it is the loss in flow that must be guarded against. If the fluid is difficult to measure, a pressure switch is often satisfactorily used since pressure is an indirect result of flow.

In most cases, motor failure alarms are perfectly appropriate, but before deciding upon a procedure to provide safety, consideration should be given to the following:

1. Define the system requirements.
2. Make a list of probable and possible failures together with the consequences.
3. Make a list of methods to solve the problems in step 2 above.
4. Ask yourself if there are any ways in which the suggested methods in step 3 would fail to function.

High Voltage. Much reliable information on the dangers of high voltage is so commonly available that it seems as if nothing

more can be said on the subject. Perhaps this argument would be acceptable were it not for the continuing records of accidents involving electrical shocks. Suggested for serious considerations are the following list of do's and don'ts:

1. Don't use voltages over 115 volts on instrument interlocks and switches or on instrument panel boards.
2. Do take care to enclose wiring behind instrument panels.
3. Don't use exposed terminals in instrument cabinets or panels if terminals carry 115 volts.
4. Do take care to identify areas of high voltage such as using appropriate color paint and the appropriate warning signs.
5. Use 3 wire power connections to panel instruments and use the third wire to ground the case. This is especially important if the panel is non-metallic or ungrounded.
6. Make simple provisions to remove power from instruments to facilitate maintenance.

Conclusions. The safety pitfalls described herein represent those most commonly encountered in the process industries. While the devices illustrated and described were deliberately simplified for the sake of clarity, it should be emphasized that the principles involved in the unseen hazard constitute the underlying purpose of this booklet. The reason for the emphasis of these principles lies in the countless repetition of the same principle designed into so many apparently different control loops.

SAFE ELECTRICAL EQUIPMENT IN OUTSIDE AREAS HANDLING FLAMMABLE LIQUIDS & GASES

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Many years ago, in the far off city of Baghdad, there lived three blind brothers. Now it came to pass one day that a merchant of India visited Baghdad with an elephant. And the blind men who were curious about the elephant asked to touch it. The first blind man felt the elephant's leg and said, "Verily, an elephant is like a trunk of a tree." Then the second blind man felt the elephant's trunk and said, "Nay, brother, you are wrong, an elephant is akin to a snake." And finally, the third blind man felt the elephant's ear and said, "Nay, brethren, you are both wrong, an elephant is like a huge palm leaf." And all the assembled peoples laughed because the blind men could not agree on what the elephant was like.

While this parable dates back many thousands of years to ancient Persia, it has meaning for us here today in the supposed controversy between the petroleum and chemical industries on the subject of safe electrical equipment for hazardous areas. Just as each of the blind men judged the elephant by his own narrow viewpoint, or shall we say, feelpoint, so each of the industries has approached the problem exclusively in terms of its own experience, operations and needs.

The chemical industry with its many batch processes and much of its equipment and operations still indoors, has favored electrical equipment suitable for the highest degree of hazard. The petroleum industry on the other hand, with its continuous processes, closed systems and its outside plants has been an advocate of electrical equipment suitable for a considerably lesser hazard. The controversy, however, has about run its course, for as the chemical industry goes more and more to continuous processes and to outdoor plants, it will, for economic and technical reasons, have to take an approach not unlike that of the petroleum industry.

Just what such an approach should be and how it would provide adequate protection against fire and explosion in outside plants

processing flammable liquids and gases, is our subject for today.

Article 500, the section of the National Electrical Code which deals specifically with hazardous locations, tells us that locations where explosive concentrations of vapors or gases may develop are called Class I locations and that Class I locations are divided into Class I, Division 1 locations and into Class I, Division 2 locations. Division 1 locations are locations where hazardous concentratons of flammable vapors or gases exist continuously, intermittently or periodically under *normal* conditions of operation, maintenance and leakage. Division 2 locations are 3 types; 1) locations adjacent to Division 1 locations which may occasionally be reached by hazardous concentrations; 2) locations where flammable volatile liquids or gases are handled, processed or used but where hazardous concentrations are *not normally* present due to confinement of the materials in closed systems; and 3) locations where hazardous concentrations are normally prevented by positive pressure ventilation. These locations become hazardous only in the event of accidental rupture of vessels or piping or breakdown of ventilation.

Division 1 locations then are locations where we can *normally* expect explosive concentrations for extended periods of time and Division 2 locations are locations where explosive concentrations occur only under *abnormal* conditions and thus only occasionally and for relatively short periods of time.

Since in outside chemical plants, materials are handled in closed systems; open air ventilation prevents accumulations of vapors; and explosive concentrations occur only under abnormal circumstances, most areas of an outside plant are legitimate Division 2 locations under the National Electrical Code. There is therefore no reason why Division 1 explosionproof equipment should be used throughout an outside plant as was so often done in the past. On the other hand, there are a number of very cogent reasons why explosionproof equipment should not be used indiscriminately. Let us take a look at some of them.

One of the basic principles of explosionproof technology is that entry of vapors into unpressurized electrical equipment cannot be prevented even with the tightest of gaskets. Given enough time in an explosive atmosphere, the equipment will breathe-in that atmosphere and an explosion may occur.

Electrical equipment for Division 1 locations, where we can normally expect explosive concentrations for extended periods of time, must therefore be designed *"explosionproof."* This means that the equipment is enclosed in a case which is strong enough to withstand an internal explosion of a specified vapor. It must also by proper design of all joints and seals, prevent the ignition of the specified vapors surrounding the enclosure by heat and flame from within. Finally, the equipment must operate at an external temperature such that the specified vapors will not be ignited by it.

Note that we have several times indicated that the equipment is satisfactory for a specified gas or vapor. As explosionproof motor enclosure for example which can withstand an internal explosion of a gasoline-air mixture cannot necessarily withstand an explosion of a hydrogen-air or acetylene-air or even an ether-air mixture since these mixtures develop considerably higher explosion pressures. The National Electrical Code and the Underwriters' Laboratories which lists approved electrical equipment, take cognizance of this by grouping materials on the basis of their hazardous characteristics.

Class I, Group A equipment is satisfactory for atmospheres containing acetylene.

Class I, Group B equipment is satisfactory for atmospheres containing hydrogen and gases of equivalent hazard such as manufactured gas which has a high percentage of hydrogen.

Class I, Group C equipment is satisfactory for atmospheres containing ethyl ether, ethylene and cyclopropane.

Class I, Group D equipment is satisfactory for atmospheres containing gasoline, hexane, naphtha, benzine, butane, propane, alcohol, aceone, benzol, lacquer solvents and natural gas.

Unfortunately, many of the chemicals with which we are concerned in present day chemical manufacturing, are not to be found listed in the groupings. For example, such common modern day chemicals as ethylene oxide, acetaldehyde and hydrogen sulfide to name only three which are quite troublesome are not listed. And sometimes when the chemicals are listed there is only a limited

amount of approved explosionproof electrical equipment available. For example, there are no approved explosionproof motors for acetylene and hydrogen.

It is *not* permissible to select electrical equipment on the basis of an analogy drawn between an unlisted chemical atmosphere and other listed chemical atmospheres. It is also *not* permissible to use Class I Group D equipment for Group A, B, or C atmospheres on the basis that Class I Group D equipment is the best available. True, such a procedure has been followed for years—when in doubt use Class I, Group D. However, the use of Class I, Group D equipment in unlisted atmospheres is a violation of the National Electrical Code and may lead to a disastrous explosion since the Class I Group D equipment may not be able to withstand the pressure of an internal explosion of the unlisted material or prevent the propagation of flame therough the joints and seals of the equipment to the surrounding atmosphere.

Why, if this is so, have we not had more explosions due to the use of improper explosionproof electrical equipment? The answer probably lies in the fact that there are so few true Division I areas in the sense that an explosive mixture exists continuously throughout an entire area. The ventilation, which is necessary to allow employees to work in an area, tends to limit the concentrations of vapors and gases and confine the explosive mixtures to the immediate vicinity of the vapor or gas source. And since the allowable concentrations for indusrial health are usually far lower than the lower explosive limits, there is a built in safeguard in almost all atmospheres in which people must work.

For example, the lower explosive limit for ethyl ether is 1.9 per cent vapor concentration in air and a concentration as low as .2 per cent causes acute intoxication after several hours of exposure. Similarly, the lower explosive limit for benzene is 1.4 per cent and a concentration of .75 per cent is dangerous after one half hour of exposure. If you wish to consider the MAC value as the top concentration in any area, then the margin of safety is even greater. Thus, in most cases, if people are working in an atmosphere, there is little immediate danger from a fire or explosion. Essentially then what we have done in the past is to use Division 1 explosionproof equipment in Divison 2 areas and while this is legal and unlikely to get us into trouble, it is costly and unnecessary.

For the true Division 1 locations, the limited number of tested materials and the limited amount of approved explosionproof equipment for Groups A&B are serious technical handicaps to designing a plant with fully explosionproof electrical equipment.

Maintenance is also a difficulty with explosionproof equipment. Although it is likely to require maintenance less frequently than ordinary equipment, once repair is necessary, it must be done by a thoroughly trained man with loving and exacting care, otherwise the reassembled equipment may no longer be explosionproof.

Finally, explosionproof equipment is very expensive. I know of one $3,000,000 outside chemical plant where the increased cost for a fully explosionproof installation amounted to seven per cent of the entire project and because of the materials being handled, the use of explosionproof equipment did not improve the safety of the plant.

To recapitulate, then, the full explosionproof equipment approach and certainly the classic Class I, Group D approach is neither desirable nor economically and technically feasible for most outside chemical plants.

We cannot, however, write off explosionproof equipment because in every outside chemical plant, there are some Division 1 areas. Among these are—

1. Open below-grade areas such as pits, sumps and trenches and all above-ground areas within dike walls where vapors may accumulate. Electrical equipment should be kept out of such areas or should be Division 1 with proper seals to prevent vapors from communicating to otherwise safe locations.

2. Pumphouse and compressor houses with restricted ventilation which handle flammable liquids, vapors and gases. Because of the continuous nature of most outside chemical plants, shutdown for repair is not always immediately possible and explosive concentrations may build up suddenly from leakage around packing and bearings. Where solvent pumps are located outside, Division 2 motors are permissible.

3. Locations where equipment must be opened regularly and frequently for repair

or for the addition of materials to the process and where the release of large volumes of flammable vapors cannot be avoided.

4. Locations where a failure of process, storage or other equipment will cause an electrical system failure simultaneously with the release of flammable liquids, vapors or gases.

5. Areas immediately around flammable liquid loading and unloading racks, drum filling buildings with restricted ventilation, and areas immediately around storage and process tank breather vents.

All these locations, in my opinion, should be considered Division 1 areas. If the materials being handled are listed, then we can use approved explosionproof equipment but what do we do in these Division 1 areas when the chemicals being handled are not listed and we have no approved explosionproof equipment? Well, we can use any equipment which is approved for all 4 Class I Groups—A, B, C&D. It is most unlikely that there would be any gases or vapors that are worse than the combined bad properties of acetylene, hydrogen and ethyl ether.

While this is not strictly according to Hoyle or, shall we say, the National Electrical Code, taking this small liberty is absolutely essential if we are to be able to place any electrical equipment in a Division 1 area where unlisted materials are handled. We cannot possibly eliminate all electrical equipment from every Division 1 location and this approach gives us such necessary general explosionproof equipment as conduit fittings and boxes, lighting fixtures and fittings, snap switches and motor controller push-button stations. Beyond this equipment, we must take a different tack to solve the problem.

Intrinsically safe equipment is one possibility. By definition, intrinsically safe equipment and wiring is incapable of releasing sufficient electrical energy under normal or abnormal conditions to cause ignition of a specific hazardous atmosphere. Again, you will note we are talking of a "specific" atmosphere. A piece of equipment which is intrinsically safe for one atmosphere is not necessarily so for every atmosphere. Each gas and vapor has a minimum ignition energy which must not be exceeded in normal or abnormal operation of a piece of equipment, otherwise an explosion may result. Intrinsically safe equipment can be used advantageously for instrumentation, for control circuits and for communication equipment but it is not a solution to the overall problem.

Remote location of electrical equipment is another approach. It is often possible by the exercise of a little ingenuity to locate some of the electrical equipment in less hazardous Division 2 areas, or in nonhazardous areas. Transformers, switchgear and starter panels can often be located in nonhazardous areas so that ordinary equipment can be used. Remote location, while it has wide application, is also not a complete answer to the overall problem since some electrical equipment such as pump motors, lights and switches must necessarily be in the hazardous area.

A third approach is purged and pressurized equipment, cases, enclosures, rooms and buildings. The provision of an air pressurized control house for an outside chemical plant is rapidly becoming a standard practice. As much of the electrical equipment as possible is put into the control buildings: instruments, control devices, switchgear, circuit breakers, starter buttons and even the instrument and process air compressors and motors. Since the building is kept under positive pressure at all times and vapors cannot enter, the electrical equipment can all be nonexplosionproof. It is essential, however, that the air for pressurization be drawn from a location where it cannot become contaminated with either toxic or flammable vapors. It is also necessary to provide an alarm to warn of loss of pressurization so that the electrical equipment can be shut off if a hazardous situation is developing.

Pressurized motors are very valuable tools and are approved by the Code for Division 1 locations as an alternate to explosionproof motors. For hydrogen and unlisted materials for which there are no approved explosionproof motors, pressurized motors are the only solution. A totally enclosed motor is provided with positive pressure ventilation from a source of clean air or inert gas and is so arranged that it cannot be energized until it has been thoroughly purged. It is

also so arranged that it will automatically deenergize if the pressurizing supply fails. These totally enclosed motors must also have safeguarded external surface temperatures so that they will not cause ignition of the vapors in the area.

Pressurized cases and enclosures for instruments and control equipment have similar safeguards against high temperature and loss of pressurization and in addition should be designed so that the power must be cut off before a case can be opened.

The final way to solve the problem is also suggested by the Code. You will recall that a Division 2 location is a location where flammable liquids, vapors or gases ar handled, processed or used but where they are normally confined in closed systems or where hazardous concentrations are normally prevent by positive mechanical ventilation. Therefore, if we can upgrade Division 1 areas to Division 2 areas by proper ventilation and/or by closed systems, we can use Division 2 electrical equipment just as we will use Division 2 equipment in the greater part of our outside plant. Just what is Division 2 electrical equipment and what degree of safety can we expect from it? Division 2 equipment is essentially ordinary, low temperature electrical equipment which is nonsparking or which has its make or break contacts immersed in oil or contained in hermetically sealed chambers. Explosionproof equipment is used when nonsparking devices are unavailable.

In order to have an explosion from this type of equipment, it is necessary to have an explosive concentration for an extended period of time and to have a simultaneous failure of a piece of electrical equipment which results in a spark. In a true Division 1 area, such equipment might under adverse conditions cause an explosion. In a true Division 2 area, where explosive concentrtions exist only under abnormal conditions and therefore only very rarely and for relatively short periods of time, Division 2 equipment is more than satisfactory and gives adequate protection against fire and explosion.

Ideally, when designing electrical equipment for an outside chemical plant, any and all of the methods that we have outlined should be investigated and possibly used. While we have listed intrinsic safety, remote location of equipment and purged and pressurized equipment as alternates for Division 1 locations, they work equally well for Division 2 locations and may be less expensive. Flexibility should therefore be the keynote in specifying electrical equipment for outside chemical plants. That flexibility will not only produce the most economical installation, it will in the long run produce the best protection against fire and explosion.

EXPLOSION VENTING OF BUILDINGS AND TANKS

By WILLIAM H. DOYLE
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I want to discuss the explosion venting which will permit a combustion explosion, originating at atmospheric pressure, to take place inside a building or tank and, because of the venting devices or system, cause minimum damage to the building or tank, minimum injury to personnel, and, in the case of the tank, result in retaining most of the liquid even though it may be burning.

Explosions involving explosives are not being considered here. They are a subject for study in discussing barricades rather than vents.

Detonations of combustible mixtures are likewise a subject of barricades. To distinguish between detonations and explosions in this sense: detonations progress at a speed exceeding that of sound while the speed of flame in uncompressed mixtures of gases or vapors with air is only some 2 to 10 feet per second. The speed of flame travel increases rapidly as pressure builds up

and that is one reason for choosing to neglect explosions originating at pressures other than atmospheric.

In 1933, two bench mark papers were published. The first, by the Department of Agriculture, covered venting of explosions in grain dust and starch dust, both in air. This paper was the result of continuing work since the first report on dust explosions by the U.S. Department of Agriculture to the National Fire Prevention Association in 1922. The second, by the Bureau of Mines, discussed experimental work done cooperatively with the Western Electric Company on venting explosions of acetone vapor in air. The Department of Agriculture work reported on the pressures that could build up with various dust concentrations in a closed bomb and in structures with open vents. The Bureau of Mines work reported similarly on pressures in a closed bomb and a bomb with open vents but then continued on to investigate the different situation that existed when the vents were closed with diaphragms made of various thicknesses of aluminum, tin and lead.

The above two papers, both now old enough to vote on November 3, 1964, give adequate background and formulae to permit safe design of buildings and tanks to resist explosion when the protection is by means of open vents. This is not, however, a practical approach in most cases, although N.F.P.A. Standard No. 652 on magnesium powder plants, suggests that two walls of any pulverizer room be constructed of doors that may be kept open during operations, and modern design of chemical plants and some dust-producing plants emphasizes weather-proofing of equipment and its installation in the open to bypass the problems of explosion venting.

Until 1950, it was general practice, although the limitations of the procedure were well recognized, to use pressures reached by explosion tests in equipment having open vents as a design basis for venting buildings using weak walls, glass areas, hinged sash and doors and similar closed vents. Eventually, however, the effect of vent closures on resultant pressure for dust explosions was investigated by the Bureau of Mines and the results were published in 1946.

Up to this point, I have intentionally omitted specific figures on cencentrations, pressures, etc. Let us now consider some actual results from these papers. What open vent ratio is needed for example, to keep the resultant pressure from exceeding 2 lbs./sq. in.? The answers are:

For a "mild" dust explosion 1 sq. ft. of vent for each 65 to 70 cu. ft.

For a "severe" dust explosion 1 sq. ft. of vent for each 16 to 18 cu. ft.

For an optimum acetone mixture 1 sq. ft. of vent for each 6 to 7 cu. ft.

Why did I select 2 lbs./sq. in.? Because that is 288 lbs./sq. ft. and the resistance of typical structural walls to lateral pressure (10′ x 10′ panels), determined by the dead load method of the Bureau of Standards, is about as follows:

8″ thick high strength brick	125	p.s.f.
8″ thick medium strength brick	48	"
8″ thick medium strength brick (best workmanship)	60	"
8″ thick clay tile	40 to 64	"
8″ thick concrete block	35	"
3 7/8″ thick glass block	91	"
3″ thick vermiculite between sheet steel panels	227	"
10″ thick 2-4″ concrete block with 2″ air space	50	"
8 1/2″ thick reinforced brick with tile backing	203	"
Wood frame	273	"
10″ thick reinforced concrete panels	430	"

This means to me that venting must, except in the case of reinforced concrete or specially designed structures, be adequate to keep the explosion pressure below 2 lbs./sq. in. In fact, for most 8″ masonry structures, it should be kept below 1 lb./sq. inch.

Why am I not more precise and why do I not recommend venting to limit the pressure to a certain fixed per cent of the wall test pressure? Now we are getting into the area where venting becomes more of an art than a science. At this point, I will only point out that the Bureau of Standards' test applies a dead weight while explosion loading is a transient where inertia plays a considerable part so that a mathematically correct expression would involve functions of the dead weight wall resistance, the maximum possible pressure in a closed bomb test, the maximum rate of pressure rise, the ratio of vent area to volume and the ratio (possibly weighted) of the inertia of the vent closure to the inertia of the fixed section of the wall. Adequate research on this complex interrelationship has not been

done. However, there are other factors of great practical importance.

First, let us consider the factor of concentration. In the Bureau of Mines Report on acetone, it was indicated that an open vent ratio of 1 to 6 or 7 was needed to keep the resultant pressure below 2 p.s.f.g. However, this was for a mixture of 5.5 per cent acetone vapor by volume in air. The lower explosive limit for upward propagation of an acetone explosion with spark ignition is about 2.15 per cent. A 3 per cent mixture gives a good explosion but a vent ratio of 1 to 52 held the pressure to 2 p.s.f.g. This means, practically, that it is not necessary to consider the worst possible situation when designing explosion venting because the worst possible situation is difficult to obtain when trying to test for it under laboratory conditions and is practically impossible to obtain under field conditions. Certainly the overpowering order of acetone at even 1/2 of its lower explosive limit would have prompted workers to open windows and doors, turn on fans and wash down spills long before an entire work room could be filled with even a lower limit mixture. At any rate, such a supposition is necessary to justify the thinking that vent ratios of from 1 to 35 to 1 to 60 are adequate for most flammable liquid exposures. This, of course, although the fact is sometimes overlooked, means that automated operations require either a more stringent approach to explosion venting or mechanical devices, such as flammable vapor indicators, to substitute for the absent workmen as detectors of incipient hazardous conditions. Such mechanical devices can start ventilating fans or sound alarms as conditions may indicate.

The factor of concentration with respect to dusts is somewhat different. Dust clouds have no detectable upper explosive limit, but usually the cloud that is ignited is near the lower limit. This produces a mild, easily-vented explosion but also stirs up any dust lying on the floor or shakes down that on overhead surfaces. An explosion in this secondary dust cloud or in a similarly formed tertiary cloud is usually much more severe because the cloud is larger. However, the first explosion will have displaced vent closures so subsequent explosions occur with open vents. Incidentally, the Bureau of Mines points out that when vent closures are of the type that swing shut after relieving pressure, the rapid cooling of the hot combustion gases remaining in the building may cause an external pressure of as much as 800 p.s.f.g. For this reason, as well as to have open vents to relieve a secondary explosion, venting devices, such as doors, hinged windows and swinging panels, require stops to hold them open whenever they operate.

At this point, it seems in order to take up the matter of increase in pressure caused by vent closures. The Bureau of Mines' report on acetone explosions is not pertinent, in this case, because the tests were designed to examine the venting of heavy equipment and pressures examined were in the 5 to 70 per square inch gauge range.

The 1946 Bureau of Mines report on relief vents, as related to dust explosions, is good, but the authoritative report is one made in 1950, again by the Bureau of Mines, titled "Pressure-Relieving Capacities of Diaphragms and Other Devices for Venting Dust Explosions." The data and conclusions in that report are equally applicable to vapor explosions. This material is published in N.F.P.A. Standard No. 68 and I have included the table and charts which, cover, as you will note, only frangible materials or materials which will blow completely out of a vent. Use of vent closures of either of these types does away with the problem of keeping the vents open to avoid secondary damage because of the vacuum effect. There is, however, the disadvantage that the entire closure, or fragments of it, may become dangerous projectiles. This is more of a problem with materials such as glass, rigid paper laminates and metals, and less serious with materials that are flexible or which tear in place. A piece of cardboard can be scaled quite a distance but a piece of paper must be folded into an airplane shape before it can be thrown very far.

One common vent sealer is, of course single strength window glass. However, because of projectile danger, its use is less frequent than it used to be. Where it can be used with reasonable safety, as where windows face toward an embankment or a blank wall, scoring the glass diagonally will reduce the pressure at which it will relieve. When this is done, it must be remembered that the effect is a function of the sharpness of the V at the bottom of the scratch and that the

silicates in glass are just sufficiently soluble so that continued wetting with rain and dew will cause the scratch to heal, that is, assume a U shape, so that over a period of five to ten years scored glass will regain most of its original strength.

Implicit in the above remarks concerning frangible and blow-out vent closures is the assumption that each individual device closes only a relatively small opening. Individually large closures are almost invariably of the blow-out panel or swinging panel (or door) design. With small closures, the consideration of designing them to remain closed during high winds (explosions should operate them but winds should not) is a relatively small problem. However, as vents increase in size the need to design them for an internal load of 25 to 30 lbs. per square foot without opening, pretty well eliminates the possibility of using paper and flexible plastics. Vent closures thus become large and rigid and operate by moving as units rather than by rupture or by pulling away from their fastenings as they stretch. With closures of this type, the inertia of the unit tends to become the most important measure of its effectiveness. Vents of this nature which have a relatively high mass, and therefore a high inertia, can be used only when the explosion to be vented is one that has a relatively low rate of pressure rise. My physics professor, some 37 years ago, forced me to learn that F equals M x A (force equals mass times acceleration) and promised that if I would remember it, all problems would be clear to me. For vents of this nature he was entirely correct. The next time anyone tries to talk you into a counterweighted hinged vent, remember inertia, F=MA; smile in a superior fashion, say "no" and mean it.

With respect to safety, large vents that move as a unit are probably better than the small frangible closures such as glass. Because of their greater mass, they will travel farther, particularly if they plane, but they are very much fewer in number.

Another point about explosion venting that has been investigated is the effect of relative location of the vents. English work at the Fire Research Station, Boreham Woods, Hertshire, reported in 1959 under the title "Reliefs for Gaseous and Vapour Explosions" indicates that pressures and flame speeds may be up to 50 times greater when the ignition source is remote from the vent than when it is less than three hydraulic diameters away. This effect was reported previously by the Bureau of Mines as a qualitative matter but the equation and the mathematics first appeared in the English work. Recognition of this effect has resulted in requirements in several N.F.P.A. Standards. For example, No. 656 on "Spice Grinding Plants" requires that no part of a grinding room be farther from a vent than 1.1 times the least horizontal dimension of the room.

In a rather rambling fashion, I have now covered background information with respect to strength of structures, explosion pressures, relieving capacity of vents and factors affecting vent selection and location. Now I would like to give a few specific instances illustrating modern practice in design of explosion relief facilities for buildings. In the publication "Occupational Hazards" for June 1961, there was a report of a hydrocarbon vapor explosion in a development laboratory of the Dow Chemical Company at Midland, Michigan. The area was "surrounded," vent ratio unspecified, by panels of foamed "self-extinguishing" polystyrene. Ten to 12 panels blew out and others melted in the subsequent fire. Explosion damage was nil.

Use of foamed plastic for such a purpose is relatively new. The panels are light weight so have low inertia; they are good for thermal insulation and they have low mass so they do not fly far and what they hit, they hit gently.

When Parke, Davis & Company built a new plant in Holland, Michigan, in 1961, exterior walls were designed to give explosion relief venting in ratios varying from 1 to 30 to 1 to 80. Walls consist of concrete grids with openings about 1', 1" by 1', 7". The openings are closed with 1/16" thick cellulose butyrate plastic bowed with the convex surface toward the exterior and caulked in place. The bowing affords good wind resistance. This seems like an excellent design but I know of no field experience with it. Incidentally, this was reported, with pictures, in the January 22, 1962, issue of "Chemical Engineering."

The Eastman Kodak Company uses an insulated metal wall for explosion relief in

areas where temperature and sweating must be controlled. The panels are mounted in metal frames and held in place by bolts or pins of such design and number that the panels will blow out at an internal pressure of about 30 p.s.f.g. The top of each panel is connected to the building structure by a chain having considerable slack. This last feature is, of course, to minimize the chance of personal injury.

The Manufacturing Chemists' Association publishes, as you probably know, case histories of accidents, reported by members. Case History No. 994 reported successful operation of explosion venting. When I asked for more details, I was told that the explosion relief construction consisted of 1/2" thick corrugated asbestos cement panels 4' x 8' attached to the steel beams of the building using "Top Seal" explosion relief bolts 3" long x 3/16" diameter with 3/8" heads, 3/4" neoprene coated aluminum washers. Under stress, the washers gave and, in this case, the siding fell off intact. This particular fastening system is made by the Fabricated Products Division of the Townsend Company, West Newton, Pennsylvania.

The job assigned me back last spring was to discuss explosion venting of buildings and tanks. With respect to tanks, there is little I can say. The previously mentioned Bureau of Mines Report on acetone vapor explosions and work done by Cousins and Cotton in the Factory Mutual Engineering Department Laboratories in 1950 and reported by them to the American Society of Mechanical Engineers in 1951 as Paper No. 51-PR1-2 both indicate that tank rupture can be avoided only by making the tank strong enough to contain an explosion, which means designing it to contain about 100 p.s.i.g., or by making the entire end of the tank an explosion vent or by some intermediate combination of the two. Design to contain is used in rare cases where the cheaper approach of keeping the vapor space inert is not practical. When containment is used, the design must be such as to keep the hydraulic radius of the vapor space as near unity as possible with respect to container length. The reason is that ignition of a combustible mixture at one end of a pipe will cause compression of the unignited mixture further along the pipe. When the heat of compression causes ignition of this compressed mixture, pressures of up to 700 to 800 p.s.i.g. can readily result. Therefore, the tank designed to contain an explosion must look as little like a pipe as possible.

When it comes to making the entire end of the tank an explosion vent, this is certainly not advised for horizontal tanks. Not only would the burning contents be discharged violently but the tank body would have a tendency to rocket. With vertical tanks, however, use of a cone roof with a weak seam where the roof joins the shell will provide satisfactory explosion relief, provided that the tank is so located that neighbors will not some day call up and ask that the strange tank roof on their property be retrieved by its rightful owner. In this respect, construction of a cone roof tank in accordance with the standard of the American Petroleum Institute will automatically result in a tank with a weak roof to shell seam. Where dome roof tanks are concerned, satisfactory results have been obtained by grinding down the top peripheral weld.

In summary, most of the basic work on explosion venting was done in the 1930's and 1940's.

Best current thinking with respect to building venting results in use of:

1. Concrete grids sealed with blow-out sheets of plastic.
2. Structural frames sealed with foamed plastic.
3. Insulated or uninsulated panels attached to structural frames by specially designed fastenings.
4. For tanks, design to contain or use an A.P.I. cone roof tank.

gallons of compartment volume. The time lost by a multi-compartmented truck can be kept to a minimum by loading the first compartment educted while educting the others.

Aluminum trailers are almost standard equipment for haulers and are becoming more common for delivery service. Unfortunately, the alloy used for construction cannot withstand exposure to fire without loss of structural strength. After about one minute of uncooled exposure to a ground fire, an aluminum trailer will fail and its contents will be added to the fire. Further, an internal explosion that a steel trailer will normally contain will split an aluminum trailer.

These characteristics of aluminum trailers drastically affect the demands on loading rack fire protection. If ignition occurs inside an aluminum compartment, the compartment will split and its burning contents will pour on the ground. Even if the other compartments aren't split by the initial explosion, the ground fire will cause them to in about one minute. Unless any other trucks in the area are removed or cooled rapidly, their contents will soon be added to the ground fire.

One minute is too short a time for a loader, who sees or hears the explosion, to shut the rack down, run to the nearest fire hose, and bring the hose into action. Certainly one minute is too short a time for help from outside the loading area to come into action. Therefore, a rack that does not have some sort of automatic fire protection system, such as heat-actuated sprinklers, risks a large ground fire. When we say large, we are thinking of over 10,000 gallons at even a small rack.

Precautions which will minimize the damages and injuries in the event of a rack fire are:

1. Keep men out of the cabs and, to the extent possible, off the trucks during loading. Even a few feet can mean the difference between a serious injury and no injury.

2. Keep as many hatches as possible closed during loading. This prevents a hatch fire from spreading into other compartments.

3. Install sprinklers to protect trailer bottoms.

4. Grade rack areas to control flow of liquid in the event of a spill.

5. Install fusible links in the loading line to cut off the flow of a product in the event of a fire.

Conclusion

We still do not know why, after years of safe operation, two fires occurred on the same rack within less than 48 hours. Theories abound, but data on the conditions which existed just prior to many loading rack fires are unavailable. By unavailable, I mean the responsible officials in many companies will not release the data they have collected, nor will they permit investigation by outsiders. Investigation of accidents is one of the best means of getting the information required to prevent a repetition of the accident. Secrecy about loading accidents can only lengthen the time required for finding a solution to this serious problem.

Therefore, I urge each of the readers of this article to do everything in his power to make information on loading accidents available to groups studying the problem. This can be each individual's contribution to loading rack safety.

TRANSPORT TRUCK LEGISLATION

By JOHN A. AINLAY
Committee on Public Affairs, American Petroleum Institute, Chicago

My talk on the subject "Transport Truck Legislation," gives me an opportunity not only to discuss regulations which are peculiar to the transportation of flammable liquids, but also to sound a word of warning lest our industry be saddled with many additional, unnecessary and, sometimes, inimical regulations under the guise of safety.

To lay the foundation for this talk on tank vehicles, I shall say that in my work I am constantly appearing before city councils and other regulatory groups, and sometimes even in the courtroom, defending the petroleum trucker against *unreasonable* regulations. From this experience, I have come to know why many of these regulations are proposed and promulgated.

These proposed regulations, promoted under the guise of safety, can actually be placed in about four general classifications:

The first classification includes restrictions promoted by competing forms of transportation. This type of regulation is not encountered as much as it was in the past.

The second classification includes regulatory measures promoted by persons who may have an honest but erroneous idea as to what is necessary to achieve safety. These men are usually public officials and they are generally heard from immediately after an accident or near-accident. These so-called "experts" are most apt to propose that unloading at night be *prohibited*—or, sometimes, the exact opposite—that night deliveries be *required*. One of their favorite gimmicks is to propose restrictions on the size of the vehicle or the number of gallons that may be hauled. This may be accompanied by suggestions for unreasonable speed regulations. These men are often led into erroneous thinking by inaccurate news reporting of accidents.

I regret to say that the third classification consists of restrictions promoted by people within our own industry who seek a competitive advantage by prohibiting direct delivery to service stations by transport trucks. These individuals are usually local citizens with considerable influence with their local city council and fire chief. I'm talking about proposals which would limit the size of a truck for service station delivery, but would place no limit on its size when delivering to a bulk plant. Fortunately, this is becoming less of a problem every year. I will talk more on this subject later.

Then there is the last classification which includes the informed and realistic approach to safety. Regulations of this fourth type are generally developed and endorsed by career fire chiefs who have a good working knowledge of National Codes, such as those published by National Fire Protection Association and National Board of Fire Underwriters. These proposals usually put more emphasis on safe structural design and maintenance of equipment, conduct of the operator and, sometimes, in cooperation with the industry, the designation of certain preferred routes for tank vehicles.

Now I want to cite some specific examples in each of the four classifications. Before doing so, however, it should be said that one of the reasons that we have unreasonable and unnecessary regulations is because the accident and fire experience within our industry is so exceptionally good! I mean just that. When you realize that the demand for petroleum in the United States equals almost one-half billion gallons a day and that most of this is hauled in a truck at least once, you must consider that the relative number of fires is phenomenally low. It is this rarity of fires which makes them so newsworthy when they *do* occur. From your own experience you know that a transport fire anywhere in the United States is front page news, accompanied by pictures all across the nation. This, plus the spectacular appearance of a petroleum fire, gives the public and public officials erroneous impressions as to the need for regulations.

Now to go into the specifics: In Chicago, in 1950, after a streetcar rammed into the side of a transport truck, an ordinance was introduced to limit the size of trucks to 3,000 gallons, and to require that deliveries had to be made between midnight and six in the morning. Industry experts were able to convince the city council that such an ordinance would increase the hazard rather than decrease it. A substitute ordinance was worked out with the cooperation of our industry. This ordinance divided the city into zones—setting up preferred routes to be used. There are three kinds of routes:

(1) Those which are to be used when passing through the city.

(2) Those to be used when driving between zones.

(3) Those to be used within the zone.

This ordinance has been on the books in Chicago for approximately 13 years and has worked very well. In fact, we have letters in our files from public officials citing this as an outstanding example of "industry-

government cooperation." However, I should point out that the fact that this ordinance works well in Chicago does not necessarily mean that a similar ordinance would work well in other cities.

One of the most recent proposals aimed at the petroleum transport came up during the last session of the Michigan legislature. Under the proposed law, petroleum trucks would have been restricted to 25 miles per hour in communities where the population density exceeds 500 persons per square mile. (How the driver was to make this determination was not explained in the bill). You can imagine the problems this would create, with little or no improvement in safety. This legislation was proposed as the result of an accident in which a truck loaded with bacon ran into a petroleum truck. Although the bacon continued to burn long after the petroleum fire was out, legislation was aimed only at the petroleum truck. I am happy to report that the legislation did not pass.

At the local level, the ordinances which have caused us the most trouble have been those which prohibit the use of a transport truck for delivery to service stations. Even though this type of ordinance is always promoted as a safety measure, its effect would be the exact opposite. It would increase the hazard rather than reduce it.

I have personally come up against this type of ordinance at least 40 or 50 times in the 11 central region states. It is safe to say that at least 75 per cent of the time it is proposed by certain segments within our own oil industry.

Here is how it is usually promoted: A local bulk plant agent hears that his supplying company is planning to make direct delivery to a certain service station. In the past, gasoline has been delivered to his bulk plant by transport truck. He, in turn, has been re-loading it in small amounts and delivering it to the service station. Now if a company is going to deliver directly to a service station, the bulk plant agent is fearful that he may lose the commission. To protect his own commission, he calls upon his local councilman and convinces him that delivery by transport to a service station is very dangerous. The councilman then asks the agent about the size of his own truck. The agent has a 1,300 gallon truck. So the ordinance is written prohibiting the delivery of gasoline to a service station in a truck with more than a 1,300 gallon capacity.

Of course, the retailer is usually a friend of the local agent and has been told that if he does not support the proposal he will have all of his money tied up in a big gasoline inventory. So he is normally persuaded to lend his support to the proposal.

There is another source of local support for this type of restriction. I'm referring to the rumor that a company which does not have a local bulk plant is planning to open a new service station in town. With this threat of more competition, it is no problem at all to get the local retailers and bulk agents to back this restriction for, if the outside company cannot deliver by transport, they are not apt to open a new station.

There are many reasons why this type of ordinance increases the hazards. I am sure that you are familiar with them. It is good to report that except for a few far western states there are only a handful of these ordinances still remaining on the books.

For many years, the industry put up with this type of ordinance without testing it in the courts. There were no Supreme Court decisions dealing directly with the problem and the courts are not inclined to substitute their judgment for that of the local city councils when dealing with the police powers of local government.

Our industry was afraid that an unfavorable decision would be the springboard for promoting many more of these ordinances. So, for several years, our efforts were concentrated at the city council level.

One of the first court cases came up in Sedalia, Missouri. This ordinance prohibited delivery to a service station by means of a transport truck. The lower court declared the ordinance invalid and the decision was not appealed to the higher court.

Valparaiso, Indiana, passed a similar ordinance back in 1949. About two years ago, it was challenged and was declared invalid by the lower court. Again, there was no appeal.

About a year ago, similar ordinances in Columbia, Missouri, and Ballinger, Texas, were declared invalid by their respective lower courts. The Columbia case was not appealed. However, the Ballinger case was

appealed to the Texas Court of Criminal Appeals where it was also declared invalid.

This summer a similar ordinance was challenged in Colorado Springs, Colorado, and a ruling from the Court is expected any day now.

At the present time, there is another court test under way in Tomah, Wisconsin. If it can be won, it will leave Denver, and one or two other Colorado cities as the only cities where this ordinance is a serious problem in the Midwestern states. There are three or four small towns where it is still on the books.

In every one of these cases, expert witnesses testified to the effect that a gallonage restriction on deliveries to service stations actually increases the hazard.

At this point I would like to add a word of warning.

I am afraid that we are going to be faced with a new rash of unnecessary, misguided proposals to regulate transports as a result of our increasing use of aluminum tanks. You and I know that these aluminum tanks are not going to explode. We also know that when it is involved in a fire, the aluminum tank will open up as the metal melts above the liquid level. Some of our best safety authorities say that this is an added safety factor because it gives additional protection against a pressure rupture of the tank. But from a public relations standpoint, it has already and will continue to create problems. To the public and to news reporters every tank that opens up in a fire is an explosion. We have spent years convincing firemen and the public that a tank truck is designed to contain the product even when involved in a major fire. Now, somehow, we are going to have to convince these people that when a tank melts down it is also doing what it is designed to do.

Let me cite some examples:

Here is a dandy. To my knowledge, this is the first time we have made the paper in color, and is a classic example of what I am talking about. The *Minneapolis Tribune* reported a fire in Minneapolis and on the front page picture is a headline: "Gas Truck Overturns and Explodes." In the accompanying news story they refer to the "explosion" many times:

"In the series of explosions at the intersection. . . ."

"As the explosion spewed burning gasoline through the intersection. . . ."

"Explosion rocked area. . . ."

Apparently, they tired of the word "explosion" and for the next two references used the word "blast" and then, of course, in this small map there is an "X" where the "explosion" occurred. When you see the pictures of the truck you will notice that the aluminum tank has melted away leaving only a part of the shell and the running gears. The public must assume that this was a "blast" that spewed gasoline over the area.

This particular edition was printed for out-of-state delivery. A local representative for the petroleum industry called upon the newspaper about midnight and convinced the editor that the paper was doing a disservice by reporting an explosion when an explosion had not occurred. In the middle of the night, the paper pulled apart its front page and re-worded the story. This is a copy of the morning city edition:

"Gas Truck Overturns, Ignites," and in each place where the word "explosion" had previously been used, they used "burning" or "flaming gasoline" and they even added a paragraph which reads "the explosions presumably were caused by the truck's tires."

As a result of this accident, an ordinance was introduced in the Minneapolis Council which would have limited tank trucks to a 4,000-gallon capacity. It would have required special transport permits, and would have placed a 20-mile per hour speed limit on gasoline trucks and would have required deliveries to be made between the hours of 10 p.m. and 6 a.m. Fortunately, the ordinance did not pass.

There have been many other instances, but I will cite only one more. It occurred in Superior, Wisconsin, just about three months ago. A news item describing a truck accident uses the word "explosion" four different times. One paragraph reads: "Explosion ripped a hole about 3 feet in diameter in the front end of the tank and the force of the blast threw the truck's engine about 20 feet."

In this instance, the fire department was certain that the truck had exploded and

even the owner of the truck thought it had exploded because there was a big gaping hole about 3 by 5 feet in the front of the tank. I will spare you the details, but we were able to show the fire department and the owner that this was not an explosion and that the opening was caused by the melting of the metal in the empty compartment. The report of the engine being moved by the blast was purely the reporter's imagination.

As the chief fire inspector of Superior was taking me to see where this fire occurred, he said, "You don't realize until something like this happens how many of these trucks are running on our streets without any regulation."

So I issue this warning to you—even though an aluminum tank may be just as safe as a steel tank, those of you who are operating them must be prepared to defend them against adverse publicity which they are going to receive when involved in an accident.

It was mentioned earlier that our industry is sometimes the victim of erroneous news reportings of an accident. Perhaps this is partially our own fault. There seems to be a tendency on the part of people who have had an accident or a near-accident to "clam up," apparently with the hope that there will be little or no publicity. I believe that this attitude is wrong. If a reporter must operate in the dark then you must expect bad, misleading and erroneous publicity.

Now for a closing word of advice. If you will examine your own files on gasoline fires involving the unloading of trucks, you will find that in most of the fires where there was extensive damage the report will show that the driver did not remain with the truck while unloading. Fire chiefs have told me that this is often true.

Now I know that you are going to say that you instruct your drivers that they must remain at the truck. . . . I have never known a company which did not. Every state code and many city ordinances require it. Yet a large percentage of our fires are caused by the fact that the driver did *not* remain with his truck while unloading. I believe that almost one-half of the fires involving unloading operation would have been prevented, or would have been comparatively small, had the driver been present to detect a leak, an overflow, or a broken coupling.

Certainly any extra effort on your part to see that this rule is obeyed will show up as a definite improvement in our fire loss experience, and this in turn will result in a better understanding of our industry on the part of the public with less demand for unreasonable regulations of our transports.

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MANAGEMENT HAS A RESPONSIBILITY FOR SAFETY

By JOE S. STONE
Vice Pres., Southern Bell Telephone & Telegraph Co., Atlanta, Ga.

Our nation, engaged as it is in the battle against Communist domination, must preserve every economic and human resource. To each of us citizens, whether in industry or elsewhere, falls a critical share of the responsibility for conserving these resources.

So to you who fight this cunning enemy, not with the traditional sword and shield, but with the keener lance of knowledge born of experience, wisdom and understanding, I congratulate you on your conquests and am proud to be among you.

Into the ever-widening and deepening stream of the work force of our Nation flows, generation after generation, those hazards to life and limb which, if undirected, cause misery, loss of life, disability and costly consequences.

Because of carelessness, lack of knowledge, hurry, lack of supervision and forgetfulness, there flows from what ought to be a great, ever-widening, quiet and peaceful stream, an ever-increasing stream of broken bodies, wheel chair patients, amputees and funeral processions called the River of Blood.

Management has a responsibility for this, not the whole responsibility, but a responsibility, not to build bridges to merely cross this stream and let it go on to ever increasing flow, but to build dams that will arrest the flow, retard its evil progress, eliminate the rapids and cause it to become a quiet, peaceful ever enlarging stream again.

What are some of the dams which might be erected?

Since good management is cost-conscious, it needs to recognize that the casualty lists are lengthening and that the cost to America is now running the staggering total of almost 100,000 lives lost and more than 16 billion dollars annually.

What amazing totals! Only one national expenditure is greater than the cost of accidents—national defense. Last year accidents cost us more than the combined federal budget for labor and welfare, commerce and housing, international expenses, national resources and the maintenance of general government.

In human misery, accidents cost us more than we can possibly comprehend. How much is one life worth? How much does it cost when a husband and father meets an untimely death? How much are your eyes worth?

Management has a responsibility for building a dam of *economics* and they will do this only when they recognize that accident prevention and safety precautions do not cost—they actually pay dividends.

Another responsibility that management has for safety is in the field of *education and training. It is through education and* training that the free enterprise system has grown and flourished. It is through education and training that attitudes are made and changed. In my opinion a large part of safety and accident prevention depends on the right kind of attitudes.

Evidence of this is shown in our business during periods of extreme hazards such as sleet storms, hurricanes, fires, floods and tornadoes. Do workers get hurt then? No, they do not. They recognize the hazards, their attitude is one of carefulness, they work rapidly but cautiously.

On the other hand the accident rate goes up on their regular day-to-day assignments —routine jobs. They feel safe and they fail to take the necessary precautions—Attitude! Attitude! "Nothing is going to happen to me—I can take just a little chance." Many of us are guilty of such.

Management has a responsibility for developing this kind of attitude and needs to recognize that education in accident prevention does not stop at any age or any time but, like any education, must be programmed from the table to the grave.

When management has realized its responsibility for education in the field of

safety, it must follow up by seeing that new and improved methods and safeguards are *engineered* into all new machinery, tools, plants and modernizations.

It is just as important, perhaps more so, in this age of mechanization and automation, to build into new facilities the latest in safety know-how as it is to improve by experience what we now have.

This is where management must use the safety engineer to the maximum of his ability, and here is where, if you do not have a safety specialist, you will wish that you did. His advice would be invaluable when his real worth shines through.

Properly engineered highway grades and curves are just as important as are proper control signs and a non-slick road surface.

Another area where management has a responsibility for safety that is often overlooked lies in its *encouragement* of the right kind of laws.

The federal, state and local governments are constantly passing and changing laws pertaining to safety and some of the laws enacted have become burdensome to management, possibly largely because, when the hearings were held, management did not take time to discuss them with the committees, or thought that they would not be affected by their enactment.

Workman compensation laws were developed from the humanitarian aspect and insure that the workman will be treated fairly. Many lives have undoubtedly been saved and many benefits have been paid that would never have been otherwise.

Cities have ordinances covering safety items, building codes, inspectors, fire regulations and police forces, all of which set standards which must be followed by management. The price of complying and the cost of these services on behalf of safety is staggering and is defrayed either by increased taxes, special license or franchise taxes.

Still further consideration by management is necessary to avoid costly civil suits or litigation that arise from motor vehicle accidents or careless behavior on the part of its employees.

All of these have an effect upon how a person can manage his business and, therefore, management should take direct action in the encouragement of the right kind of laws.

Thus far I have mentioned four "E's" of management's responsibility for safety:

Economics
Education
Engineering
Encouragement

These are four dams that might impede the flow of the river of blood, four dams that, if properly constructed and maintained, would change the characteristics of the ever-widening stream.

Three more dams are in need of construction and the first and foremost is the dam of *enthusiasm*.

Who has ever conquered without enthusiasm? It was enthusiasm that led our forebears through the trackless wilderness, it was enthusiasm that has forever raised our colors in battle, it is enthusiasm that wins ball games, and it is enthusiasm that makes a good safety record.

It is the responsibility of management to keep the *esprit de corps* high—to hold high the morale of the organization—to keep employees interested in their work and their work interesting.

Show me a group where the morale is high and I'll show you a group which has a good safety record.

This is an extremely important part of any employee endeavor.

In spite of all that can be said and done, in spite of all the efforts of management to keep morale high, there are times when a workman continues repeatedly to ignore known safety practices.

Despite his supervisor's repeated instructions and admonitions, he persists in his disobedience.

When such is the case it is time to build the sixth dam of *enforcement*. Management just cannot ignore such a potential hazard and must take disciplinary action, either in the form of short suspension, repeated suspensions or in ultimate layoff.

How else can management uphold the hand of its safety supervisor? If he does not get the support he needs, he becomes ineffective, ill-adjusted, discouraged, morale becomes low and the effectiveness of his work

is lost in the complexity of inadequate follow-through and lack of support of the program which management itself instigated.

So I would suggest to you who are experts in this field that when your feel that management is not rendering the support which you and your program of safety deserve, you yell to high heaven and keep on yelling until your cry is heard above the roar and din of the complexities of the moment. Your program is of necessity a continuing one, and the difficulties of the moment should not long be allowed to interfere.

It must be the dream of everyone who is interested in safety, that some day, somehow, sometime they can walk through the Elysian fields of No Accidents for a week, a month, a year or even 5 years.

In order to ever nearly approach this ideal, there must first be inculcated into the mind of every individual his own responsibility for his own personal safety.

Safety and safety habits must become as much a part of the natural man as are his other desires and wants.

This habit could then well be called the *embodiment* of safety in the individual.

Management has a responsibility here to see that the effect of its every act, word and deed are such that this influence on the individual makes *him* realize that his own personal, selfish interests will be best served by his accepting this responsibility which is his and which he alone can discharge.

The action of management should never be such as to detract in any way from his discharging this most important responsibility.

These are the seven "E's" of management's responsibility for safety: Economics, Education, Engineering, Encouragement, Enthuisasm, Enforcement, Embodiment; these are the seven dams that should be built to effectively harness the current — to decrease and impede the flow of the river of blood.

If and when these dams are effectively constructed and properly maintained, the mighty and ever-increasing stream of workmen will continue to move majestically onward, clearly, beautifully and peacefully, without the unwanted and undesirable companionship of today's river of blood.

ASSOCIATIONS HAVE A RESPONSIBILITY FOR SAFETY

By C. S. STACKPOLE
Managing Director, American Gas Association, New York City

What can a national association do to improve an industry's safety record?

The experience of the gas industry demonstrates that such an association can make a substantial contribution to solving the problems of accident prevention. One of the American Gas Association's major responsibilities is the formulation and implementation of an industry-wide safety program carried out through its members.

A.G.A. is a professional, technical and trade association formed by investor-owned companies and individuals in the gas industry. Its purpose is to pursue common interests at the national level more effectively and economically than could be done by members themselves, working individually or in separate smaller groups.

With a staff of 400, the American Gas Association ranks among the ten largest national associations in the United States. It serves nearly 400 straight gas and combination gas and electric company members, which, in turn, serve 9 out of 10 of the nation's gas utility customers.

The membership consists of gas utility, pipeline, manufacturing, holding, service, and other associate companies, such as advertising agencies, banks, and producers, and nearly 7,000 individuals.

A.G.A.'s safety program is an outgrowth of the gas industry's accident experience in the years following World War II.

Each year the National Safety Council ranks the forty major industries by their accident frequency and severity rates. Back in 1930 the gas industry was in eighteenth place, and from 1930 to 1945 it fluctuated up and down until, in 1945, it was in twentieth place.

The year 1945 was significant in that it was the year that the industry really began to grow. It was the advent of natural gas on a national scale. Pipelines came in and distribution systems started to expand. As the years rolled by and expansion continued, it became evident that the accident prevention efforts of the industry were not keeping pace with its growth.

In 1946 the gas industry was in twenty-seventh place among the forty major industries. In 1947 it was in thirtieth place and the industry properly, although somewhat Johnny-come-lately, became concerned about its accident experience. Insurance premiums reflected the poor experience, and in many instances, insurance was difficult to obtain because of this steady increase in accidents.

The industry ranked thirty-fourth among the 40 major industries in 1948, and that year saw the first step in exercising responsibility for employee safety on an industry-wide basis. The first corrective action was to increase the activity of the American Gas Association's accident prevention committee. Other steps followed. As a result, by 1963 the industry had moved up to 17th place.

Important as employee safety is, the area of public safety is no less important. In this area, the gas industry's safety image is determined. Progress or retrogression in local markets is determined largely by the goodness or the badness of that image in the public eye. The industry has come a long, long way on the road to greater public safety.

In 1951 the industry formed an executive safety committee at A.G.A., made up of chief executives, to demonstrate top management interest and obtain the impetus and motivation which always result when presidents and chairmen speak their pieces loudly and firmly in support of employee safety efforts.

Because industry leaders firmly believe associations have a definite responsibility in the areas of public and employee safety, A.G.A. now has a very active, expertly-staffed professional safety department. It functions under the association's top level general management section, with assists from all other interested departments.

It dates back to 1952 when the association added a manager of the safety department to the staff. His principal job is to disseminate to the industry information from the executive safety committee and data on the work the accident prevention committee had been doing. In addition, he gathers information and statistics to help determine the cost and to guide the expansion of the employee accident prevention program. In 1962 an assistant manager was added to pay particular attention to matters concerning disabling injury analyses.

From the beginning, the accident prevention committee has effectively promoted the "idea-swapping" concept. Its entire program is centered around keeping the industry constantly aware of what is happening in the field of accident prevention and what individual companies are doing to correct and control their accident experience.

Today, the committee has 42 members, representing every segment of our industry's operations, a representative from the National Safety Council, from two insurance companies, and one from service companies. The scope of the committee is the study of accident causes, preparation of manuals and data sheets, recommending corrective measures, and the dissemination of information to the industry that would be helpful in the reduction of employee injuries, motor vehicle accidents, and accidents involving the public.

The committee, one of the most active and productive in the association, has 13 subcommittees.

One outstanding activity is the annual Accident Prevention Conference the committee sponsors each year, usually held in an area that has an accident frequency rate worse than the industry average. During the two-day conference delegates from some 100 companies (in more than 30 states and Canada) usually attend.

Delegates have an opportunity to attend workshops on pertinent topics where ideas and experiences are exchanged. Also, as part of the conference every other year, a material and idea exchange display is organized. Last year more than 30 gas utility and pipeline companies showed some of the materials, manuals and programs which they had developed or used successfully in their accident prevention programs.

A safety publication subcommittee prepares and publishes 3 quarterly reports, called, "How Injuries To Gas Men Might Be Avoided." They are analyses of significant accidents gas companies have experienced and the corrective action taken or needed to prevent similar accidents. Another quarterly publication, "Safety Siftings," is a digest of the best available articles relating to safety, culled from the safety literature and house organs of the gas companies, and made available to all members. The third quarterly, "Tailboard Topics," is edited by Don Buckley, safety director of the East Ohio Gas Company.

An especially successful activity has been a two-day supervisory training course, started in 1954, entitled, "Accident Prevention Through Informed Supervision." The course has been conducted 112 times, in 32 states and Canada, by A.G.A. safety manager R. N. Papich, assistant safety manager, Harry Becker, and members of the accident prevention committee. More than 3,200 superintendents and supervisors from more than 200 companies attended.

The companies testify that the course has been of real help. It has had the additional, valuable effect of getting the association and its know-how out to companies, which for years were members, but never had any direct contact or tangible evidence of what the association could do for them.

Only about one-fourth of A.G.A.'s member companies are large enough to employ safety specialists or establish safety departments. The association clearly must accept the responsibility for formulating an effective, industry-wide safety program.

In this context, the action program entitled "Nix the Six" was especially helpful. It was prepared, developed and produced by the association's accident prevention committee and staff in 1963. Member companies participated enthusiastically. The program is based upon the committee's analysis of more than 2,000 disabling injury reports submitted voluntarily by gas companies during the preceding three years.

Analysis revealed that there are six most common types of accidents accounting for more than 75 per cent of all disabling injuries reported. They are: fall to different level, overexertion, struck against, fall to same level, struck by object, and bodily reaction. In its first mailing to the industry, the committee urged that the prevention of these six particular accidents should be given top priority.

The most comprehensive selection of accident prevention audio-visual materials A.G.A. had ever prepared was made available to the industry to assist in controlling those six most common types.

As all association executives know, any activity must have the support of its top executives to be successful. It is particularly true in the prevention of accidents. Here, the executive safety committee, mentioned earlier, plays a vital role. Composed of chief executives of outstanding member companies and normally chaired by the association's second vice president, it is the accident prevention committee's "pipeline" to every chief executive in the industry. It has been invaluable in helping to keep top management informed of our industry's problems in the field of accident prevention and the progress being made in solving them. Even more important, however, is having informed, dedicated, hardworking, enthusiastic and talented safety men from member companies working so untiringly on the safety problem.

What has the industry achieved since its association faced its safety responsibilities, largely through these men and their predecessors? The industry started to do something about its employee accident control problem in 1948. Since then, it has shown consistent improvement in its disabling injury frequency rate, establishing the longest unbroken reduction in frequency rate in U.S. industrial safety history. That's sixteen consecutive years *of disabling injury rate reduction* by an entire industry.

The industry has reduced the number of disabling injuries from more than 6,200 in 1947, to less than 2,500 in 1963, a decrease of 60 per cent. It is now 17th in the standing

among the 40 major industries mentioned above.

What might have been the facts had the industry maintained its 1947 disabling injury frequency rate of 21.86? It would have increased its disabling injuries to more than 8,700 in 1963. A.G.A. believes that, over a sixteen-year span, at least 65,500 disabling injuries have been prevented. Estimated savings in the "wages only" cost of the disabling injuries prevented are more than $47,650,000.

How much has it cost the industry through the association's accident prevention department? Actual budgeting for accident prevention activities began in 1951 with a modest $7,900. Total out-of-pocket costs for the past sixteen years were $424,750. For a mere $30,340 average per year as an association, A.G.A. has helped save its companies more than an estimated $47,650,000 in "wages only" cost for injuries prevented.

A.G.A. is pleased with its progress in employee safety—*but not satisfied.* The gas industry is still above the all-industry average in its disabling injury frequency rate, but it is definitely heading in the right direction. It is probably unique in the measures it has taken to help assure the safety of its appliances and the piping and mains that are used to supply convenient gas service. The American Gas Association spends millions of dollars each year for research activities and on its testing laboratories in Cleveland and Los Angeles, which have been at work since 1925. Their Blue Star seal of approval on gas appliances is a familiar symbol, an assurance that the appliance—whether it be a kitchen range, a water heater, clothes dryer, air conditioning plant, refrigerator, garbage incinerator, furnace, or even one of the new gas lights—has passed their rigorous testing procedures. Tests are designed to help insure safety, serviceability and durability—in short, safe and superior performance for the user.

Testing appliances is only the first step in a continuing process that doesn't stop until it reaches the 35 million homes of our nation's gas customers. Not only do the A.G.A. laboratories in Cleveland and Los Angeles carry on their valuable testing, they also collaborate with the American Standards Association in setting up new standards for materials and construction. This same type of activity is carried right down to the local level where companies cooperate with local and state authorities to encourage the setting up of gas equipment safety codes.

This means that A.G.A. is constantly engaged in researching and developing new materials and methods for piping, purifying, controlling and handling the gas that serves the public so well. Often, at the laboratories, brand new appliance ideas come out of work that started as a safety check. Eventually, home-owners everywhere benefit.

The standard tests used in A.G.A. laboratories are set up and supervised by a 275-man approval requirements committee of the American Gas Association. The size of the group gives some idea of the size and scope of the industry's continuing effort in this branch of public safety.

The committee is made up of representatives from gas utilities, gas appliance manufacturers, the National Board of Fire Underwriters, the U.S. Public Health Service and the American Institute of Architects, among others. Safety and comfort of gas users is their No. 1 interest.

The laboratories test more than 6,000 gas appliances and accessories each year, and, in 1963, there were 245 A.G.A. employees and $1,500,000 devoted to the work. Each year, as new scientific discoveries are made through the association's national research program, the laboratories' testing standards are raised even higher. Today, for example, no domestic gas range can earn the Blue Star seal unless all burners light automatically, including those on the top of the range, and the oven and broiler.

No other major industry has anything quite like the industry's Blue Star testing program. It is unique. Thanks to it, appliances bearing its approval seal are among the safest, most convenient and easy to use.

A.G.A., of course, engages in competitive safety programs among member companies, and the certificates and plaques for records accomplished are avidly sought after. Staff managers and their assistants are called upon to conduct week-long safety audits on company premises with the help of those in charge. Many times the audits result in the boss giving more attention to safety, and perhaps setting aside more money in the

budget to help the safety director do a more "profitable" job for his company.

The industry is a great and expanding one—not yet old, except in birthdays. It celebrates its 150th in 1966. Its past growth is but a down-payment on the years to come. With the kind of management, operating, accounting, selling and accident prevention people who are in it today, present levels can be considered mere road signs to future heights far beyond today's fondest hopes and dreams.

LIVING WITH ACCIDENT PREVENTION

By RICHARD K. AYERS
Managing Director, Metropolitan Safety Council, Denver, Colorado

Serious consideration might lead one to wonder if perhaps it is the very living with accident prevention that might partially frustrate attempts to look at the broader necessity of getting others, too, to live with accident prevention. For any realistic appraisal tells us we still are having far too many accidents—too much misery—too much loss. Is it perhaps a challenge we face to improve our techniques in spreading the word—effectively?

I suggest that if we are to hope to have others concerned with this living with accident prevention we might well ask "Who cares—really?" Well, we know that in addition to normal human consideration, management cares about the economics of the thing, supervision cares about the productivity, and employes care about the loss and the suffering too—but usually have some difficulty in relating themselves to personal accident experiences. Actually, we may be only at the starting point to this whole thing—far too few really know enough to care very greatly! That gives us a whale of a job to be done—right?

It possibly challenges us to ask a few more questions such as "What are we saying?" even "Who's listening?" or "What's happening?" and the answers to each of these questions and others like them can only come, I believe, from a better understanding of communications techniques. We have to get the message through—effectively!

It may be possible that one of the most serious impediments to successful accident prevention comes from the natural assumption that sensible people will react sensibly from a store of factual information. Awareness is important but we must know it takes far more. It takes acceptance—even appreciation. We can gain awareness by presenting facts in a comprehensible way. We can gain acceptance with the addition of stimulation. We can only gain appreciation when this is all appealing to the one we are approaching. To spread our living with accident prevention it must be proven to the advantage of the receiver of our message.

And, if we are to compete successfully with the steady drone of noise in today's world, we need be a bit expert in our abilities to communicate.

It should be understood that the communication process is a highly complex one involving many variables in both the disseminating and receiving relationships. It would be foolish to hold that accomplishments in this field can be either simple or easily developed. But, the hope worth holding is that we may draw from others in our organizations who specialize in this field as well as call upon the specialists from outside to aid and assist.

In the meantime, it might be appropriate to consider some of the basics in the communication process. We might ask ourselves some questions such as:

What are we saying? To find the right message information must be gathered, evaluated, made usable, and then disseminated—not filed away in some drawer.

To whom are we talking? We have to define the right people from top to bottom and all the way between and know who they are, what they do, what they think and how they react.

What are we talking with? To select the right tool or combination of tools we have to evaluate every medium of communication from the personal contact to the mass media. That's a pretty broad range, too.

When is the right time? We need time our message to pertinency.

Who says so? The source needs be creditable and respected. Example is often one of our greatest problems as well as one of our greatest potentials.

And, is anybody listening? Our message needs to provide information, gain understanding, improve performance, and assist toward our goals. The feedback process is seldom as automatic as one would suppose. In fact, feedback, to be effective, must be nurtured, planned and structured. And it may be the most important step in the entire process of communications.

Really, we have been throwing out a lot of rules in almost a random fashion. One could go on for days in this manner. One could make a whole presentation from exploration of any one of them. Yet—I suggest the greatest challenge facing the accident prevention people today is to bring their knowledge of accidents and what causes them, along with their ability to determine what needs being done to avoid them, into a much improved practice of the communications techniques.

I contend that only as we learn to take our own living with accident prevention into the lives and actions of those about us can we expect to accomplish our job of solving accident problems. As we can not only gain awareness, but stimulate acceptance and appeal to appreciation, will we be able to measure our accomplishments. In short—we have to communicate—effectively!

And this, I believe, from all I can see and hear, is just what accident prevention people are addressing themselves to today in increasing degrees. As they are living with accident prevention they are doing an ever improved job of getting others to live with accident prevention by getting the right message to the right people in the right way at the right time—or they are coming closer to it day by day!

BE WELL GROUNDED

By B. J. LORENZ
Manager of Safety, Northern Indiana Public Services Co., Hammond, Ind.

Lights go on—lights go off—we cut our lawn—we trim our hedges—all of us do one or more of these every day—some of these many times a day. Generally, we don't give it a thought. We just take it as a matter of course.

But nearly any day we can pick up a paper and read where a man was killed by an electrical shock while looking for a water leak under his house with an extension cord, or perhaps we can read where a wife or mother was electrocuted while washing in her basement.

These people were killed by exposure to low voltage and most of us ask ourselves—"How in the world could that happen?"

I would like to try and explain what happens to the human body when it comes in contact with electricity, what values of electricity it takes to get us into trouble and of course, what precautions we should take to avoid these accidents.

1. In order to be sure we are all speaking the same language, with apologies to those already familiar with electrical terms, I will define the terminology I will use. This of course, is simplified, but for the practical purpose to which this knowledge can be applied, it is adequate.

The movement of electricity depends on three factors.

Voltage—Current—Resistance

a. Voltage—Pressure—just as in water—a pump produces so many pounds pressure—so here the pressure of force is expressed in *volts*.

b. Current—Is the amount of electricity

flowing. Just as you have so many gallons of water flowing, so the amount of electricity flowing is expressed in amperes or amps.

c. Resistance—Just as your hose produces a friction to slow the flow of water, so the type of conductor produces a resistance which is measured in ohms.

d. Volts=amps x ohms.

Difference in Potential

e. When we speak of high voltage we are talking about any value of pressure over 300 volts. Low voltage applies to any pressure 300 volts or below.

C. Low Voltage

1. Let's take a look at low voltage, the type of electrical circuit all of us are so familiar with, the one which we all take so much for granted, the one which is in practically every home and the one which you probably are concerned with the most. Let's look at this from the standpoint of what this voltage range, 300 and below, can do to the average guy. I wish to stress at this point, that the values used are averages and various authorities will differ to a minor degree on these values.

Your body is a good conductor of electricity. It will offer some resistance, but by and large, recalling our definition, it does not offer enough resistance to cut down the current flow below the danger point. Remember it is the current flow or amount of current which does the damage. The path of the current also has an effect, especially on the vital areas, the head, heart, and lungs.

The points of contact, from an energized wire or piece of equipment to ground, have a definite bearing on the outcome. Hand-to-hand contact; hand-to-foot; foot-to-foot. A test meter is used to measure amperes, the amount of current. In one type of meter the scale goes from zero to .20. This represents not even one ampere, but only goes to ⅕ of an ampere.

Each of the small divisions represents 2-one/thousandths of an ampere. A thousandth of an ampere is called a milliampere or a mill.

The scale of a demonstration meter might be divided into four areas, green, yellow, orange, and red. Each area represents a given effect which the flow of current will produce in the body.

The green area might cover currents in the range from zero to 8 mills or up to 1/125 of an amp. In this range you will feel a tingling sensation of shock, but it wouldn't be painful and you could let go.

The yellow area would represent currents between 8 and 15 mills or up to 1/66 of an amp. You will get a painful shock, but in all probability you could still let go.

The orange area represents currents between 15 and 50 mills or 1/20 amp. Here you will not only get a painful shock, but will lose control of your muscles. Your muscles will contract and you may have difficulty breathing. Rather revolting situation if someone isn't near to help you.

Currents in the red area are the most treacherous of all. This range between 1/20 of an amp to ⅕ of an amp affects the heart in a way that smaller or *larger* currents will not. It produces *ventricular fibrillation.* Under this condition the heart ceases to act as a pump and its muscle fibers just sort of quiver. Results are fatal.

Currents beyond 200 mills or ⅕ of an amp are unpredictable. Severe burns usually result. Muscular contraction sets in, often the heart or breathing stops or both. In these cases, prompt application of artificial resuscitation can save the life of the person involved.

To illustrate the effects of the currents on a man, let us use the same meter but the voltage used is only 6 volts D.C., which produces currents low enough to be harmless to the man involved. The meter is adjusted to produce the same readings as if the man contacted a normal 120 volt service in the average home.

The man makes contact with his hands, that were wet with water, and a current of 22 mills or 1/50 of an amp is flowing.

After this he dried his hands thoroughly and produced a condition of sweaty hands. The result is 60 mills or about three times as much as before.

Our two readings are water 22, sweat 60. Wet hands from water would produce a painful shock, and loss of muscular control. The victim CANNOT let go and he is in serious trouble unless he gets help.

The sweaty condition produces not only shock and loss of muscular control, but also produces *ventricular fibrillation* of the heart.

With dry clothes there is no current flow on contact—but moisten the right elbow and chest with water and we find 25 mills or 1/40 of an amp flowing.

Moisten with sweat and we find 55 mills or 1/20 of an amp.

Here again the same results—the orange and red areas.

2. Due to the low voltage used on these illustrations, one important factor was not included and that was the length of time of contact. The biggest single item of resistance offered by our body is our skin. Once a breakthrough is effected, the resistance is greatly diminished resulting in an increased current flow. On contact with a 120 volt circuit, blisters will form after three seconds. Once that occurs and contact is maintained, you are immediately in the area that could produce ventricular fibrillation.

The factors which determine the outcome of contact with low voltage are:

1. Amount of the current.
2. Path of the current.
3. Type of current—A.C. or D.C.
4. Duration of contact.

D. *Preventive Measures*

1. I am sure that you have noticed that the current values which can cause death are well below any values that are needed to blow the ordinary fuse or circuit breaker. So you cannot depend on those protective devices, but must produce your own.

2. How do tools become energized?

a. Cords—enter body.

b. Defective switch or wire attachment.

c. (1) Brush holders—outside of drill body—insulation chipped by screwdriver.

(2) Windings break down or short out.

d. Contact with external energized equipment.

3. Combat these exposures by:

a. Good maintenance and inspection

b. Best way is to ground tool, either with 3-wire system or by an adapter plug with grounding attachment. In the proper sequence:

(1) Grounding clamp attached to ground first.

(2) Ground plug adapter should be plugged in receptacle.

(3) Plug of portable tool plugged in last.

Reverse procedure to break down set-up.

c. No known ground-operator should insulate himself.

d. Insulated drills are available, with plastic body and drill isolated by fiber gears.

I have not presented this picture of electrical hazards in an effort to produce in your mind the specter of a monstrous dragon ready to leap out and grab any and all. Electric power is like any other type of power whether it be water, steam, gas or atomic. Properly harnessed, controlled and handled, it is a very useful and willing servant in homes, stores, and industry.

You should be in a position to see that, within your jurisdiction, all of the necessary precautions are taken to insure that it will be a servant and not a destroyer of life or property.

DUELING WITH A THUNDERSTORM

By C. J. CROCKFORD
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Have you ever thought of the many varied safety programs in relation to the lowly weatherman? Have you ever noticed the local weather prognosticator in the elevator as he wends his way to his office? Have you noticed the contemptuous looks, in fact, some of pure hate cast his way by the other passengers, if the current weather does not happen to suit their mood at the moment? It is not enough to forecast the weather

correctly (and we goof on this one every now and then), but the forecaster is held responsible by a large segment of the public for weather conditions that are out of step with their desires at the moment.

So here we have a frustrated friendless psychological accident victim in the making. A man who unthinkingly could step off the curb into the path of traffic, or perhaps stumble down elevator shafts. Can you picture this chap taking out his frustration at the wheel of his car in freeway traffic? I hope before this Congress adjourns we will see a sub-committee formed for the express purpose of assisting unfortunate weather forecasters back into the path of safety righteousness.

And now let us talk about the weather as it affects the Detroit Edison Company.

As you all know, the subject of weather is a universal topic with all of us. In fact, it is the first topic of the morning for most of us with the decision attending our clothing selection for the day. It is also a vital ingredient of our fishing trip or weekend of golf.

Of course, Mother Nature being unpredictable, goes into a tantrum every now and then, and the weather becomes a serious problem to electric utilities. They know from past experience that wires will come down, circuits will lock out and serious interruptions to service will occur. Under conditions such as these, utilities are seriously concerned and strive to remove hazards and restore service to the public in the shortest possible time. Under these conditions, weather becomes a formidable enemy indeed, and we must plan to engage it as such. We must constantly be aware of weather conditions that cause storms to develop, locate and track them as they move through our system, and draw up our army of linemen, technicians and equipment to do effective battle with this challenging opponent.

This paper describes how we at the Detroit Edison engage our enemy, the summer thunderstorm, the most spectacular of the various types of inclement weather common to our location.

The Detroit Edison Company serves over 1.3 million customers living in an area of 7,600 square miles comprising the southeastern portion of the State of Michigan. Our overhead lines department is divided geographically into five field divisions. Each division operates independently and is responsible for all wood pole line construction, maintenance, and operation in its respective area. Department operations involving steel tower transmission lines are the responsibility of a centralized Tower Group based in Detroit.

WEATHER POSES A PROBLEM. The Detroit Edison Company in common with other electrical utilities faces the same problem in coping with the thunderstorm—that is to have enough personnel and equipment at the scene of trouble as soon as possible when trouble occurs. This problem takes on serious proportions with us after normal working hours and particularly during the weekends. The summer months only aggravate this situation by the exodus of our people to recreation areas.

It would seem that if a reasonably accurate storm forecasting system could be developed, we would have enough time to gather our working forces together or in the case of weekends, to put them "on call" so that we could be assured of their availability. We must all agree that it is better to have a working force ready for storm duty and not need them, than to have a storm catch us unprepared. Of course, in using a plan such as this, we must work with a reasonable margin of error because storms that develop quickly in our own system reduce the available time necessary to marshal our forces.

Our problem then, resolves itself into the following listed conditions:

1. To have adequate personnel available when trouble occurs.

2. To dismiss this personnel when storm trouble is over.

3. To allocate personnel over a prolonged adverse weather condition.

In essence, what we are doing at Detroit Edison is simply this—we are viewing weather forecasting and storm tracking as an important and separate operation instead of a minor duty of our dispatch board.

We presently are operating a full time Weather Center that acts as a collection agency for weather information and reports. Here, incoming weather information is analyzed as to its effect on our system and storms are tracked by radar during periods

of adverse weather. All of this information is passed on to concerned company divisions and departments. During storm periods, this function becomes a continuous operation. We make full use of professional weather information as supplied by the Detroit Office of the United States Weather Bureau, plus some instrumentation of our own.

In addition, we receive reports of adverse weather from Consumers Power Company that serves Michigan to the west of our system, with additional information being supplied by our own people in outlying areas of our suburban divisions. Current factual data is the life blood of weather forecasting and it has been our experience that all the weather information that we can obtain is never enough.

Our own weather instruments are all read at our Weather Center, located adjacent to the Detroit Division Line Board, which is headquarters of that particular division and also the nerve center of our entire Overhead Lines System.

This facility is manned around the clock in contrast to our suburban districts that operate only normal daytime hours, except, of course, during emergencies caused by adverse weather, etc.

A list of weather instruments and equipment that we presently use follows:

(1) Recording Barometer

(2) Recording Wind Direction Indicator and Anemometer

(3) Recording Thermometer and Dew Point Indicator

(4) General Service U.S. Weather Bureau Teletype (Telco).

This teletype is a service of the local office of the U.S. Weather Bureau and prints a running resume of weather forecasts and information embracing the areas of Michigan and the northern portions of Illinois, Indiana and Ohio.

(5) Service 7060 U.S. Weather Bureau Teletype (RAWARC).

This is a special service of the U.S. Weather Bureau giving nationwide weather information and radar bearings from all of the mid-western Weather Bureau radar installations.

(6) Recording Static Meter

A recording voltmeter that indicates the audio output of a radio receiver tuned to 189 K.C. is located in Detroit and picks up lightning disturbances, which are recorded on a chart. This recorder is an important factor to us in alerting our dispatch personnel of the presence of lightning or static disturbances due to air turbulence. Inasmuch as a weighting circuit is installed ahead of the recorder, the indicated trace is a function of both the amplitude and frequency of the static disturbances.

(7) Airways Weather Receiver

This device is a radio receiver located at one of our sub-stations in the vicinity of the Detroit Metropolitan Airport, which incidentally is the headquarters of the Detroit Office of the U.S. Weather Bureau.

This receiver is tuned to a frequency of 388 K.C. used by the Federal Aviation Agency to transmit Weather Bureau information to aircraft. The audio output of this receiver is sent by telephone line to our Weather Center in Detroit.

OUR WEATHER PLAN IN OPERATION. The weather problem posed by the threat of a thunderstorm to our own system or to any electric utility resolves itself into three major points as follows:

1. When and where will the storm strike?

2. What is the intensity of the storm?

3. Is the storm over?

These simple questions become of major importance to us in deciding how many men and how much equipment are needed to meet the challenge of adverse weather. So, let us take a look at the first part of the weather problem:

1. When and where will the storm strike?

It has been our experience that to wait until we have evidence that the storm is entering our system is probably the greatest mistake that can be made weatherwise. One must be alerted and ready before that critical time is reached. To obtain a safe margin of time, we have found that weather must be studied and evaluated daily. At Detroit Edison, weather watching is a continuous operation and we are forever alert for the appearance of conditions that may indicate the formation of a thunderstorm. We well know that conditions of high humidity and high temperature associated with movements of warm and cold air masses establish conditions for the breeding of a thunderstorm.

So we study the weather maps day by day so as to follow the movements of the warm and cold fronts as they pass through Michigan. We continuously study our instruments and teletypes and any and all information that might be helpful in predicting the future weather pattern.

Watching a thunderstorm develop is both interesting and awe inspiring, and something that has been going on from the beginning of time. So let us peer a little closer into the make-up of our adversary. Frontal air systems such as a large mass of cold air moving in and pushing under warm moist air or a warm moist air front moving into and rising over a cold air mass causes the phenomenon known as the thunderstorm.

In both of these cases, the warm moist air is cooled as it rises; and as it reaches its dew point temperature, condensation takes place and clouds are formed. As these cloud formations gain in size and altitude, precipitation takes place and rain and ice crystals start to fall through the cloud formation and the thunderstorm is born. Cloud formations of this type during thunderstorms often reach altitudes of 40 to 60 thousand feet, and we are able to gauge intensity by determining the altitude of these cloud formations. This measurement is made by radar as will be described later. The presence of hail is another factor used in our storm evaluation—the size of the hailstones being a function of intensity. Hail is caused by water droplets moving up and down inside of a cloud formation, until they become heavy with ice, and gravity is able to overcome the cloud's thermal forces and the hail falls to earth. Meanwhile, lightning caused by electrostatic charges developing in the cloud formation, is being measured by our static meters and evaluated.

At Detroit Edison, during the thunderstorm season which usually takes place in the months of April through September, and when conditions of high humidity and temperature are present as mentioned before, we increase our vigilance. In our particular location in Michigan, the greater portion of our adverse weather comes out of the west. So we watch our instruments, plot radar bearings, read the teletypes as they are sent to us from the Weather Bureau and try to seek out the storm at the earliest moment in order to allow ourselves the widest margin of time possible so that we may assemble men and equipment.

As soon as we have the first evidence that a storm is moving in on our system, the game of "weather chess" begins. The barometer is steadily falling, and the readings on our static meters are rising. The radar teletype is showing echoes to the west and the General Service Weather Bureau teletype is sending us storm confirmation. At this point, all divisions of our system are warned.

Then the next part of our duel with the storm begins, as we plot its course and attempt to ascertain its intensity. This operation is carried out on a Plexiglass covered plotting board consisting of a map of all the area in a 300-mile radius from Detroit. This area corresponds to the area under radar surveillance.

We operate the plotting board by marking the echo positions, as received by teletype, on the Flexiglass sheet with a grease marking pencil. As the storm progresses, later radar information is marked on the board in this same fashion by using various colored grease pencils so that the progress of the storm is clearly displayed. With accurate radar bearings, the location and movement of storm cells becomes a relatively accurate procedure. This phase of the operation becomes a navigational tracking problem with corrections being made as additional radar bearing information is received by teletype.

Combinations of these bearing points are used to designate lines or areas of storm echoes with individual strong storm cells also indicated. In addition to "bearing" information, the altitude of the echo is ascertained by radar.

Now that we know where the storm is located and its probable course, the second part of the weather problem must be pursued:

2. What is the intensity of the storm?

In our operation, we rate adverse weather in the following categories as a function of their severity.

1. *The Weather Alert.* The alert is the first order of warning of expected adverse weather. This warning gives the alerted divisions time to notify key personnel and perhaps arrange work so that a shift to storm operation may be implemented smoothly.

2. *Scattered Storm Alert.* These are storms of small cell structure causing minor damage. During alerts of this type, those on call should be especially conscious of the weather. It may be necessary to add to the work force when only on-call crews are on duty.

3. *Moderate Storm Alert.* Storms classed as moderate will contain adverse weather that will cause minor to serious damage to the system. Consideration should be given to mobilizing from one-quarter to one-half of the working forces.

4. *Severe Storm Alert.* Storm activity classed as severe will contain large areas of damaging storms. Divisions thus alerted should fully mobilize work forces in order to be prepared for an extensive amount of emergency work.

Storms of severe intensity may involve sending personnel from other divisions into damaged areas. We must know the movement of the storm to do this wisely.

In attempting to determine the storm's severity, every item of information is used and integrated into the weather picture. Storm reports from previously mentioned sources are probed as soon as they are received regarding the presence of hail, wind, lightning and possible tornado activity. Many of these calls come from our own people in outlying areas as the storm passes through our system. In all fairness, it must be said that this is not a "cut and dried" procedure, and storm experience is of tremendous assistance to the person or persons assigned to make storm intensity decisions. After our own experience these last three years, we believe we will be able to do this job with a reasonable degree of accuracy.

All the information regarding the storm, as previously described, is transmitted to our field divisions continuously, keeping them fully informed as to the probable time of the storm's arrival to the time when the storm alert is declared over.

This brings us to the third part of the weather problem:

3. Is the storm over?

Two things help us to determine that the threat of further storm activity is ended. One, of course, is the radar. As the storm moves through our system on its way eastward, storm cell echoes disappear from the screen and temperatures drop indicating that cool air is taking the place of the warm moist air mass that spawned the storm. So we watch our radar information, and plot temperature gradients throughout the system using information supplied by our airways weather radio receiver. The determination is then made, and as the storm moves through our system, each division judged in the clear is notified of its termination. We have found that this point can be determined with a great deal of accuracy.

To date, our experience has been very gratifying indeed. Since we have been using the weather system just described, we have been forewarned on every thunderstorm that has invaded our system. Sometimes we call out men that are not needed, but this is a calculated risk as there are many variables in the weather picture over which we mere mortals have no control. This is particularly true in the Michigan area, due to the stabilizing effect of the large bodies of water comprising the Great Lakes. This costs us some money, of course, but it is on the right side of the ledger as far as customer interruptions and hazards are concerned.

Meanwhile, our weather plan goes forward with us peering into the next twenty-four hours, day after day, because we have learned that this is the only way our storm problem can be handled effectively.

The measures I have described are, of course, applied to other types of adverse weather such as wind, snow, sleet and rain, but this is another story in our year round weather operation.

I sincerely express my gratitude to Mr. J. Ballard in charge of the Detroit Office of the U.S. Weather Bureau and his staff for their gracious help and assistance in our weather program. This measure of cooperation is a vital ingredient of our weather program.

And so, day after day, week after week and month after month, we are now maintaining a weather watch because we believe we have indeed learned how to effectively duel with a thunderstorm.

Public Utilities

SEVEN YEARS SAFETY EXPERIENCE AT SHIPPINGPORT ATOMIC POWER STATION

By G. M. OLDHAM
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The reactor at Shippingport is of the pressurized water type, using light water for moderation and cooling. The project was authorized in July of 1953 and actual plant construction started in March, 1955. The plant achieved initial criticality on December 2, 1957, the generator was synchronized with the Duquesne Light Company's transmission system on December 18, 1957 and was operating at full power of 60 megawatts (electrical) on December 23, 1957.

The reactor portion of the Shippingport plant was designed and developed by the Bettis Atomic Power Laboratory under the direction of and in technical cooperation with the Naval Reactors Group of the U. S. Atomic Energy Commission's Division of Reactor Development. The Bettis Laboratory is operated for the Commission by the Westinghouse Electric Corporation.

The Duquesne Light Company, which owns and operates the turbo-generator facility of the plant, is under contract to the U. S. Atomic Energy Commission to supervise, operate and maintain the entire plant and purchase the steam produced by the operation of the atomic reactor.

The Shippingport project, therefore, represents a joint endeavor of the government, a public utility and an industrial concern. If you think this adds complications from an administrative point of view, you are correct. However, there is one area in which all parties concerned have always been and continue to be vitally interested, and that is safety.

When talking about safety at the Shippingport Atomic Power Station, one naturally thinks of three areas: safety of personnel in the reactor plant, safety of personnel in the turbo-generator plant, and safety of the general public. For today's discussion I will limit my remarks essentially to safety in the reactor plant and touch only briefly on the other two areas mentioned.

From the inception of Shippingport, personnel safety was and still is uppermost in the mind of the designer and the operator. While working with radiation was not exactly new, it was far from being "old hat" to most people at the time Shippingport was becoming a reality. The designer of the reactor portion of the plant had to keep asking: Is the shielding sufficient to protect the worker; will the materials used safely operate under high radiation levels; can equipment be worked on safely?

Our experience over the years has shown that the designer did a creditable job. The operator, on the other hand, had to keep constantly in mind the safety of all personnel; where he could permit operators to go; how to protect them from over-exposure to radiation; when maintenance work could be performed safely in all cases; problems associated with safety during refueling and a myriad of other safety problems. Here again, our experience has been good.

For the purpose of this paper, I think we will have to accept the design of the plant as now fixed and that built into the plant are all the safety requirements delineated by most of the safety codes, laws, directives and suggestions pertaining to a nuclear power station. It then is up to the operator to carry on the work of operating the plant in such a manner as to provide for the utmost in personnel safety. Let us see what we at Shippingport have done in this respect.

In 1957, when we were starting to man the station, it was decided that to as large a degree as possible plant personnel would be recruited from within the Duquesne Light Company. One advantage of this arrangement was that we would be able to start out with people trained in safety, not necessarily nuclear safety it's true, but safety common to the electric power industry.

Our effort met with success to the point that only one person, a health physicist, was recruited from outside the company. Since

most of the personnel were not familiar with radiation safety, a rather extensive indoctrination course was established, consisting of several hours of classroom lectures, including pertinent moving pictures and slides.

Experience has shown us that the lecture type of indoctrination is valuable for new employees and that a lecture period of approximately one hour is sufficient to provide them with the basic knowledge they need to start working safely. Subjects covered in these indoctrination lectures include: what radiation signs mean and how to proceed when one is encountered; the difference between radiation and contamination; an introduction to use of anti-contamination clothing; radiation clearance and permit procedures; and an explanation of the application of time, distance and shielding as protection from radiation.

Two tools that we have found to be of great help in the safe performance of work involving radiation are the radiation clearance and the radiation work permit.

The radiation clearance form is used when it is necessary for personnel to enter an exclusion area only for operation, inspection and observation purposes. At Shippingport an exclusion area is an area that is barricaded and labeled with the appropriate radiation warning signs. No one is permitted entry unless arrangements have been made in accordance with approved procedures.

If it is necessary to perform maintenance, construction or testing, a radiation work permit is required in addition to the radiation clearance.

The radiation work permit provides a detailed account of the radiation exposure related to a particular project and aids in future planning. The use of these two permits, which we insist on being executed according to approved procedures for each job involving radiation, have prevented many cases of unnecessary radiation exposure and possible over-exposure.

It should be borne in mind that these radiation permits are used in addition to our normal Duquesne Light Company Equipment Clearance Permit which is used to authorize the performance of maintenance work on either electrical or mechanical equipment. This particular clearance procedure has been used very successfully throughout the Duquesne Light Company for many years.

It is realized that no matter how elaborate a safety program may be, there is always the chance that an accident may happen. Prudent pre-accident planning, then, would include a method of taking immediate action to minimize the effect of an accident on the person or persons involved.

At Shippingport we have an emergency squad available around the clock, 7 days per week. This squad is trained to handle any emergency, including fire and/or accident, in which either the nuclear or conventional portion of the station is involved. The squad consists of a squad chief, a squad captain, a reactor attendant, a pump attendant, a radiation technician and a chemist.

The squad chief is the station operating engineer on duty and the squad captain is a station operator with the balance of the squad being assigned on a day-to-day basis at the beginning of each shift.

In the event of an accident or fire, the discoverer immediately reports the incident to the control room. By use of an appropriate alarm, the emergency squad is summoned and immediately proceeds to the trouble spot. On the squad are at least two persons trained to administer first aid. Frequent training exercises are scheduled in which fire problems, injuries, new equipment and general plant emergencies are discussed. These serve to maintain emergency squad proficiency and alertness.

Since the injured may be contaminated with radioactive substances, provisions have been made to either decontaminate him and then transport him to the local hospital; or if he is injured severely enough that valuable time might be lost during the decontamination, he is wrapped in a polyethylene film and moved directly to the hospital.

Realizing the problem that might arise as a result of handling an injured person contaminated with radioactive substances in a hospital, we worked out a plan with the local hospital staff whereby we stocked the hospital with the essential supplies such as blotting paper, polyethylene film and so forth. The hospital in turn has made a room available, that can readily be washed down, where the patient can be given emergency treatment and decontaminated. We give periodic lectures to all the nurses and hospital staff members on the basic principles associated with radiation and radioactive contamination

including the best methods of decontaminating a person.

Our emergency squad has been credited with the saving of one life. In this case (no contamination involved) the employee was found unconscious in the washroom having lost a large amount of blood from a ruptured ulcer. The squad was summoned and got him to the hospital just in time. The attending physician said that five minutes more and it would have been too late to save his life. A trained, well equipped emergency squad is, we believe, a necessary adjunct to a good safety program.

A safety plan, or any other plan, no matter how well developed and detailed it may be, is not worth the paper it is written on if it is simply neatly bound and put in a good safe place only to be pulled out when someone asks if such a plan is available.

At Shippingport we have the kind of safety plan which we believe is well developed, detailed and reduced to procedure form; and we do practice using it. We have drills involving the emergency squad each ten days on the two back shifts alternating between a fire drill and personnel casualty. On a more infrequent basis, we practice moving a simulated contaminated injured person to the hospital. This drill we make as realistic as possible and involve the local hospital staff. I am happy to report that, as of this date, we have never had to put this plan into actual use and I hope we never have to go through such an experience.

The maintenance and operation of a nuclear power station requires periodic decontamination and cleaning with various types of chemical agents. At Shippingport a clean-up procedure, to be used on components that would have intimate contact with the primary coolant, specified acetone as the cleaning agent. A survey revealed that a great deal of acetone was being used on the site. The traffic in acetone was found to be great enough to warrant purchasing and dispensing of the acetone in and directly from 55 gallon drums. The survey further indicated that the exposure to this insidious explosion hazard must be reduced or, if possible, eliminated.

A review of the actual job application of acetone as a cleaning agent was made and it was determined that ethyl-alcohol could be substituted for acetone. An industrial grade denatured ethyl-alcohol was found to be acceptable. This substitution resulted in raising the flash point from 0° F for acetone to 53° F for the denatured ethyl-alcohol. However, despite the improvement in flash point, we were still using a material which required safe handling methods.

Bulk shipments of flammable solvents were stored in a "Flammable Liquids" storage building which was isolated from the main portion of the plant. The 55-gallon drums of solvent were moved into convenient locations within the reactor plant as needed and the solvents dispensed directly from the drums into various types of containers. This system resulted in the accumulation of larger quantities of flammable solvents in and adjacent to work areas than could be considered safe. This problem was solved by the establishment of a Solvent Distribution Station for the reactor plant.

A limited supply of solvent, in drums, is placed on a raised concrete pad outside the degreasing room. A drum of solvent is hooked up to an inclined feed pipe which penetrates the building and terminates at the distribution station inside the building and inside the reactor plant control area. The outside drums are grounded to the grating over the trough, on which the containers set while being filled. In addition to the above, alligator clip grounding straps are used from the pump nozzle to the can.

A manual pump is used to move the solvent into an approved type transfer can or work container. Any solvent which remains in the transfer hose drains back into the supply drum. A fire screen, which is located under the grating shown at the bottom of the slide, serves as a flame arrestor to secure any solvent spillage accumulation in the trough. The solvent vapors which result are exhausted by an explosion-proof fan through the duct work at the right side of the collection trough.

Since part of our survey indicated that the work and transport containers being used at the time were not suitable for solvent work, an adequate supply of approved equipment was obtained. These containers have been engineered with flame arrestors, fusible links and pressure vents. Our policy is for the workman to draw off a minimum quantity of solvent for the job at hand. The solvent is then transported to the job in an ap-

proved safety container. The work can, which must have a flame arrestor or quick closing fusible link lid, is filled from the transport container. All residual solvent in safety or work cans must be stored at the end of the work day in NFPA (National Fire Protection Association) code approved explosion-proof storage cabinets.

As another aid to safety, we have developed a housekeeping committee, consisting of three station staff members or their agents, that makes a weekly inspection of the station, noting any areas that need attention from a good housekeeping point of view. They also determine which group of workers is responsible for creating any undesirable condition, who is responsible for correcting the condition, and determine the date on which corrective action will be taken. A formal report is prepared and signed by the station superintendent who forwards the report to the general superintendent of the department for his information and action, if any is necessary. We are firm believers in the adage which states "Good Housekeeping and Safety Go Hand in Hand."

As I mentioned earlier, we have an obligation to safeguard the general public as well as personnel on site from the release of radioactive material to the environs. The *PWR Hazards Summary Report* dated September 1957 states that "no plausible sequence of events could cause a release of hazardous quantities of fission products beyond the site boundary."

Continued operation of Shippingport has reaffirmed this statement and, therefore, one could conclude that with regard to any plausible accident there is really no need for an emergency plan for Shippingport. However, it is not considered prudent to be unprepared for handling an emergency should some unforeseen situation arise which might involve persons or property outside the plant.

For this reason, an emergency plan has been prepared. This plan has been developed in cooperation with the U. S. Atomic Energy Commission and the Westinghouse Bettis Atomic Power Laboratory. It is a very comprehensive emergency procedure. It spells out in detail what steps are to be taken in the most unlikely event of either a major or minor release of radioactivity to the river or the atmosphere.

Practice drills have been performed many times to familiarize site personnel with their duties and the manner in which off-site personnel, such as the U. S. Atomic Energy Commission, Westinghouse Bettis Atomic Power Laboratory, Pennsylvania Department of Health, state and local police and civil defense, will be used should the need arise.

After each drill, a critique is held in which all aspects of the drill are discussed and changes in the procedure are made if necessary. A schedule of drills has been prepared and will be carried out during the coming years at approximately six month intervals.

This then, in a general way, is our approach to the problem of safety. A most logical question then might be—What has been accomplished? Let us look at the record.

Since the day the Shippingport reactor achieved criticality for the first time, December 2, 1957, 2,904,239 manhours have been worked by Duquesne Light Company personnel to June 30, 1964. During this time the average radiation dosage for all employees has been 1,108 mrem/man-year which is below that permitted by the federal regulation by a factor of 4. The maximum average radiation exposure for any one employee has been 3,256 mrem/man-year. We feel that this is a good record and we plan to do as well, if not better, in the future.

Shippingport has not escaped scot-free from lost time accidents, however. Since 1957, we have had five lost time accidents. In 1958—nine days lost time from a knee injury due to slipping on a patch of ice; one in 1959—twelve days lost time from a back injury due to an awkward-lifting situation; one in 1960—one day lost time from a back injury due to a pushing situation; and one in 1963—66 days lost time from a back injury due to pulling weeds on a hillside. Our last lost time accident occurred on June 17, 1964. This man fractured his ankle when he tripped descending some steep stairs.

As you can see, none of these cases had anything to do with radiation. To date we have never had a man lose time due to radiation injury. In fact, we have never had any type of an injury because of radiation exposure.

In cases of cuts, abrasions, or other minor injuries causedoby contact with contaminated equipment, the injured area is surveyed and decontaminated prior to the application of

any antiseptic or other treatment. If it cannot be decontaminated successfully at the site, the injured is taken to the local hospital where the contaminated area is surveyed again and treatment is taken over by the doctor in attendance. We have had one such case to date that required some minor surgery to remove radioactive contamination.

A graph representing a record of the radiation exposure history at Shippingport is divided into four categories: Operations, maintenance, modification (contractors), and a fourth group called "others" which accounts for miscellaneous personnel such as clerical, guards, supervisory personnel ... etc.

The maintenance work group incurs most of the radiation exposure and, in fact, most of the operations and contractor exposure was received in connection with maintenance operations. This is logical when it is realized that access to the operating reactor is not permitted because of high radiation intensities; but when the reactor is shut down to permit maintenance work, a much lower but still significant residual radiation field from activated corrosion products is encountered throughout the reactor system. The intensity of this shutdown radiation averages about 50 milliroentgens per hour in work areas. This may not appear to be a serious radiation problem, but the need to perform many man-hours of necessary work with its resultant radiation exposure generates the statistics on this graph.

It is significant to point out that the radioactive corrosion products did not appear all at once but have been building up over the operating years. As a result 1958, our first year of experience, realized a much lower total exposure than the succeeding years. Careful job planning and close attention to radiation exposure rates have been successful in enabling us to perform our work more expeditiously. The rising radiation level in our Reactor Plant has not resulted in a steadily rising radiation exposure average; however, the radiation exposure has been very important in our refueling program.

Each refueling represents the largest maintenance job on station and incurs the major portion of the radiation exposure. Since the third refueling was carried out late in 1962 and the fourth did not start until early 1964, the year 1963 shows a much lower total exposure than the previous years.

The sizeable radiation exposure incurred by subcontractor personnel in years 1960 and 1961 resulted from modification work on the reactor plant coolant pumps and associated piping. It has been necessary to subcontract this work in the past because the practical time for scheduling work of this nature is when the reactor plant was shut down for a refueling. During the refueling periods, all available Duquesne Light Company maintenance personnel were needed for refueling duties.

The radioactive corrosion products which were mentioned as being the source of most of the external radiation exposure are contained within a closed system. When the system is cut into and opened up to the atmosphere, stringent radioactive contamination and personnel protective measures are required. The possibility of ingestion or inhalation of radioactive materials is another of the hazards that are considered insidious in nature and require pre-planning.

Normally, this contamination is kept confined to the job area where the men involved wear appropriate protective equipment, but during the last refueling (1964) an airborne contamination problem developed. After removal of instrumentation from the reactor head, contamination which had been loosened during a "pre-refueling" decontamination of the coolant system became airborne to a much greater extent than during previous refuelings. Personnel were protected with respiratory devices throughout this phase of the refueling, but a bothersome area-contamination problem resulted. The contamination settled on all areas in the fuel handling building.

It was found to be impractical to attempt to restore "clean" conditions on the walkways because of the contaminated dust being dislodged by air currents and vibrations from crane operation. A small scale absolute filter exhaust system was tried and found to be inadequate. Subsequently, a large scale air cleaning system capable of filtering 50,000 cubic feet per minute through absolute filters was installed. Subsequently, airborne radioactive contamination problems have been minor and housekeeping problems on walkways and in work areas are those normally expected.

After the airborne contamination occurrence and before the air cleaning system was completed, additional precautions were taken on items removed from the reactor. Basically, this action consisted of withdrawing all components directly into polyethylene bags.

The largest single item removed was the reactor vessel head. For this operation, a polyethylene tube 24 feet in diameter and 80 feet long was obtained. This was pulled down over the reactor head far enough so that the ends could be tape sealed to the reactor vessel bolt flanges.

As the head was removed, the tubing maintained a contamination barrier system which was then separated into two sealed systems by bunching and tying the tubing in two places. After cutting the polyethylene bag in between the tied off points, the neatly packaged reactor vessel head was then withdrawn.

During all the years that we have had people exposed to radiation, there have been only a few cases in which an employee exceeded 3 REM/quarter by 10 per cent. Only two cases have occurred within the past three years. Both of these cases happened during the most recent refueling operation where the men in question were working along with 150 other people doing very similar work. In one of these cases, the quarterly radiation exposure was 3,260 MREM and was due to a clerical error in addition when accumulated dosage was being calculated.

In the other case of exposure over 3 REM/calendar quarter (actually 3,120 MREM) there was some question of why the film badge reading was high; but after extensive investigation, it is believed to be due to the radiation reaching the badge at an angle. It has been found by testing that such a condition can result in a film reading 40 per cent higher than the actual radiation exposure dosage.

When one considers that most of our personnel some seven years ago knew practically nothing about radiation or the problems associated with radiation safety, I think that our accomplisliment has been excellent. Much of the credit for our good record must be given to our health physics organization and their continual vigilance.

We must not overlook the fact, also, that the workers themselves have done a good job in conscientiously following the rules, regulations and procedures formulated for their safety.

Last, but not least, recognition must be given to the management of the Duquesne Light Company and the U.S. Atomic Energy Commission for the wholehearted backing of our entire safety program. Without management backing it is most difficult, if not impossible, to make any safety program a success.

In fact, it was the cooperation of all the Shippingport personnel and other interested parties in the Duquesne Light Company and the U.S. Atomic Energy Commission that made it possible for us to receive an award from the Edison Electric Institute in August 1962 for having worked one million manhours without a disabling injury and an Award of Merit from the U.S. Atomic Energy Commission in April 1963 for having worked 1,320,153 manhours without a disabling injury.

The latest annual lost-time accident frequency rate available for the Electric Utility Industry is 5.77 (lost-time accidents per 1,000,000 manhours worked). The Duquesne Light Company has a frequency rate average of 2.72 for the past five years (excluding coal operations). At Shippingport the five year average is only 1.36. The five year frequency rate average for all industries is 6.12.

Safety is for us, as it is for everyone, a continuing challenge. It is our desire to make each year, each day, each hour safer than the preceding one. Toward this goal we will continue to strive.

Acknowledgments

Staff who have participated in the preparation of this report include W. F. Wirth, Health Physicist; W. G. Ficks, Senior Engineer; and R. G. Gollas, Safety Supervisor. Their assistance is greatly appreciated.

Reference

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ORGANIZATION OF WATER UTILITY SAFETY PROGRAMS

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Organizing and operating a safety program for a water utility is simplicity itself. The first requirement is that the manager be completely sold on the program. With his backing and continuous support a safety program can be established and has been found to succeed.

Without the help and continuous backing of the manager, the job of establishing a safety program is practically impossible. Therefore, to start and maintain a program requires the constant support of the manager. Thus, the first job in activating a safety program is to sell the manager on its benefits. We must find out who pays for accidents. Here we see that:

1. The employer pays by:
   (a) Increased insurance rates.
   (b) Damaged tools.
   (c) Ruined materials.
   (d) Lower production and poorer quality; lower profits.
   (e) Damage to equipment.
2. The employe pays by:
   (a) Loss of income.
   (b) Personal injury.
   (c) Job loss.
3. The customer is affected by:
   (a) Interrupted work schedules.
   (b) Increased cost.
   (c) Possible property damage.

By this analysis of who pays for accidents we can intelligently say to the manager that there are three benefits derived from a safety program:

1. The employer saves money.
2. Prevention of personal injuries to employes.
3. There is a promotion of good public relations.

Therefore, it is evident that the benefits to be derived from a safety program are worthwhile and the manager will be successful on the safety band wagon.

In 1959, I attended the National Safety Congress in Chicago, where Raymond Faust, secretary of the American Water Works Association, spoke at this Public Utilities Section meeting commenting that not to establish a safety program could stamp the manager as being non-progressive or even incompetent. This is harsh language, but none-the-less factual.

Now that the manager is sold on safety, what is his next action? Again, the course of action is quite simple. Before launching a program, he should become familiar with the contents of the *American Water Works Association Safety Manual*, particularly Parts 1 and 2. Part 1 relates to the "Need for Safety Programs" and Part 2 to "Starting and Maintaining Programs," and the 5th Edition of *Accident Prevention Manual for Industrial Operations* published by the National Safety Council. This is probably the most authoritative and complete work existing on the subject of safe practices for industry. I would recommend affiliation with the National Safety Council which is a federally chartered, non-profit association that distributes information on the causes of accidents and ways to prevent them. More than 7,000 business firms encompassing 28,000 plants and operating locations are council members relying on the council for facts, ideas, and training materials for their safety programs.

These manuals are sound. They explain the need for a program and state the specific benefits derived from it. In my opinion, whether a utility has five employees or hundreds, the job of preventing accidents entails these basic, common-sense rules:

1. Have good hiring procedures.
2. Pre-employment physicals.
3. Have a permanent work force with good wage and salary administration.
4. Employe and employer communication.

5. Initiate and maintain interest in safety.
6. Keep an injury record.
7. Locate and correct hazards.
8. Make equipment, plant arrangements, and working methods safe.
9. Control work habits.

The principle behind these steps remains the same: Ideas proved successful in large operations will work in small ones. But, there is one basic difference in the two. In the larger organizations, preventing accidents belongs to the foremen and supervisors. Establishing work procedures, instructing workers to use safeguards, and supervising them to see that they do so is the foreman's responsibility.

You might question this duty, but let me say that preventing accidents is tied in with many of the important duties which foremen have always had, even when there are no formal safety programs.

Some of the typical foreman's duties are to:

1. Maintain orderly conditions.
2. Keep work on schedule.
3. Maintain equipment.
4. Establish work methods.
5. Supervise and instruct workers.
6. Maintain a full day's work.
5. Control costs and quality.
8. Good communication.

Safety instruction and supervision are the foreman's duty; therefore, he cannot surrender them to the safety director or to a safety committee without surrendering a large part of his job as foreman.

In the typical small system employing half a dozen men or less, the safety-minded manager must be the safety director along with many other functions he performs. He trains each individual employe in ways of eliminating accidents and he is also the one who must eliminate unsafe working conditions.

For medium to large utilities it is advisable to have a full or part-time safety director to achieve best results. His responsibility and authority should be fully defined and his function as safety director, safety engineer or safety inspector should be made known to all. The man charged with safety must have the backing of a safety-minded manager when he advises or instructs employes about unsafe conditions or acts or when he is recommending safety equipment. (It is *most important* for the manager to act promptly on the safety director's recommendations for building safety into the job).

Initiating and maintaining interest in safety is a broad subject and can be discussed for hours. Therefore, let's consider this problem in its simplest form: initiating and maintaining interest in safety is primarily a selling job.

Selling safety is no different than selling any tangible product, so far as selling principles are concerned. Too often we think that selling "intangibles" is more difficult than selling televisions or lawnmowers or air conditioners or cameras. Actually, the principles are the same. All we need to do is change the product name from "cameras" to "safety."

Before you can sell any product, you must know that product thoroughly. Since I was the person selected to direct the safety program in our organization, it was my job to find a practical way of indoctrinating the employes. After talking with many safety people, we decided to sell the supervisors and foremen first.

As we really wanted to sell safety, and keep it sold, we felt we had to find an outstanding sales manual. We purchased the *Supervisors' Safety Manual* published by the National Safety Council and written by staff engineers of the council's industrial department.

The manual is a 367-page text prepared expressly for supervisors and foremen, designed to show them the relationship between safety and production and help teach them basic accident prevention and human relation techniques. There are 12 chapters, some called, "Safety and the Foreman;" "Know Your Accident Problem;" "The Human Element;" "Personal Protective Equipment;" and "Materials Handling and Storage." We covered one chapter per week in a two-hour session until all 12 chapters were completed.

Nineteen supervisory personnel attended the sessions. In order to stimulate interest, we asked various ones to conduct a chapter of their choice. This type of involvement proved satisfactory because it made more than one person think about safety. As

an aid in presenting the material, we used the N.S.C. Manual *Instructor's Guide* which explains how to organize the class; what size it should be; the equipment needed, such as a blackboard, tables, projector, etc. and the job as an instructor. Also, visual aids, appropriate films, moving pictures, and safety graphs are indicated for use with the various chapters of the manual.

In addition, other aids, such as protective equipment, guards, charts, and models may be used to good advantage. Included in guide is a quiz designed to cover material presented in each chapter. These quizzes certainly stimulated everyone's thinking and in fact some good, warm-to-hot discussions came out of the many questions asked.

After the supervisors' course was going full swing, we started reaping early returns. Foremen were bringing up the need for corrective action on many unsafe acts and conditions (which had undoubtedly existed in some instances for many years). Here lay the real test. Would management spend money to buy safety equipment, correct unsafe conditions, and do something to correct unsafe acts? Yes, they would! Many hundreds of dollars were spent on replacing worn tools and purchasing additional equipment.

In addition to the many safety devices purchased, we felt there was a need for a safety shoe program. We recommended a safety shoe program to our water district board and on February 2, 1960 the water district board voted to pay 1/3 of the cost of 1 pair of safety shoes per employe per year.

Also, in January of 1961, a safety contest was accepted. Briefly, the rules for this contest are as follows: A contest will consist of each two-month period in which there is no lost-time accident or chargeable automobile accident. At the close of each contest, a $25.00 U.S. Savings Bond is awarded. In determining the winner, the names of all eligible employes are placed in a box and *one* name is drawn. The drawing is done by an impartial person not connected with the district.

Each week a five to ten minute safety talk is conducted. The subject material is first covered in the weekly foremen's meeting held at 11:00 a.m. each Friday and are known as "Safety Talk Topics." Then it is given by each foreman to his respective crew. The talk topic is taken from the N.S.C. "Talk Topic" booklet.

We purchase the books and then pass out a "Talk Topic" each week at the foremen's meeting. Along with this topic a follow-up sheet is handed out which the foremen must fill out and return through line organization to the safety director. The follow-up sheet asks questions related to the particular material covered. It also asks standard questions every week, such as:

1. Number of employes under your immediate supervision not wearing safety shoes.
2. I am aware of the following unsafe conditions:

_____Meter installation—location: _____

_____

_____Bad dog—location: _____

_____

_____Poison ivy—location: _____

_____

I am convinced that we cannot relax or rest on laurels achieved, but instead we must try to keep improving our program wherever possible. We have found by experience that this weekly talk arouses interest and leads to more discussion among the employes than if the meetings are conducted in a mass meeting each time. Various subjects are selected and assigned at these meetings.

We find this weekly meeting to be very helpful to the new employes. The subforeman or foreman usually outlines the hazards of our particular type of work to the new employe and explains the necessity of following rules of safety which will protect him against injury, as well as his fellow employes.

Through the cooperation of the insurance companies, industrial plants, the National Safety Council, and other safety-minded people in our area, we have been quite successful in obtaining films, some speakers, and other appropriate programs for the general safety meetings for all employes. These meetings are held monthly. We find that this type of program appeals most to our employes, particularly if the films and/or speakers are identified in one way or another with our type of work.

As further challenge and incentive, the water district has been entered in the water-works division of the public utilities safety contest since January 1, 1960. This contest is sponsored by the National Safety Council and approximately 400 contestants are entered. In our group, which is Group "B," consisting of water utilities averaging between 5,000 and 20,000 man-hours per month, the water district ranked 29th out of 30 in 1960 with a frequency rate of 49.42; in 1961 we ranked 2nd out of 30 with a frequency rate of 0. In 1962 we ranked 3rd out of 31 with a frequency rate of 0. In 1963 we ranked 20th out of 37 with a frequency rate of 11.24. Thus far this year we are approximately 3rd out of 34 with a frequency rate of 0.

Naturally, management and the employes of Water District No. 1 are somewhat proud of the record established with the exception of 1963 when we did suffer two lost-time injuries and this, we feel, can be attributed to the fact that we did not have regular weekly safety meetings.

One of the best ways of locating hazards is to make a physical inspection with the man on the job or with the supervisors. So many injuries are caused by little things—slippery floors, cluttered work areas, defective tools or exposed moving parts. Often risks may be substantially reduced by simple good housekeeping. An excellent way of correcting hazards is to have management back up safety recommendations. In our organization, safety recommendations come from department heads and employes, as a result of the weekly safety inspections by the various departments.

The original and duplicate recommendations are forwarded to the safety director who checks them out and approves them. If the recommendation is of such a nature that there is a policy involved or a large outlay of money, then the manager also reviews the recommendation and makes a decision. After recommendations are approved, they are forwarded to the proper department for completion. After the unsafe condition has be corrected, a report showing that the work has been completed is returned to the safety director.

Record keeping is so fundamental with all of us that it should be no surprise that this is required in a safety program. Without records there would be no way of comparing the accident experiences from year to year, month to month, or even discussing the experiences.

An "Injury Report" is the first record the water district makes. Here concrete facts can be determined through extensive investigations and questioning of all injuries.

Let me say that the investigation of accidents is *not* for the purpose of placing blame, but a fact-finding operation to gather information needed to determine reasonable and practical action for the solution to the problem. In this connection, it is not only the individual or individuals involved in the particular accident that we are concerned about, but all other employes who may be exposed to personal injuries. Therefore, by piecing together all the factors which caused an injury, the safety program can function objectively.

Another form used in record keeping is the "Physician's Progress Report." This form is used for each visit by the employe to the district's doctor for all on-the-job injuries. The attending doctor lists the nature of the injury and also any instructions to the employes. He states whether the injured is released for full duty or limited duty.

If limited duty is permitted, the doctor states the conditions. One copy of the report is kept by the doctor and one copy is returned immediately to the district office. This report was the result of a few employes disobeying the doctor's instructions. I have not discussed all of our record keeping, but have mentioned the most important ones.

The best way to make equipment and working methods safe is to integrate safety into all jobs. This fact is highlighted in the *Safety Practices Manual for Water Utilities.* I want to give you these procedures that management should carry out:

1. Integrate safety into the contract specifications for buildings and equipment by requiring that the contractor or vendor meet all state and local safety requirements. This approach provides a safe environment from the beginning.
2. Provide good lighting and proper ventilation.

3. Supply safety clothing, gloves, goggles, protective footwear, gas masks, and dust masks, as required.
4. Remove all obstacles and impediments to the safe movement of men, trucks or machines.
5. Repair damaged floors, broken steps, broken glass, and cracked walls and ceilings.
6. Replace worn or damaged tools.
7. Provide proper equipment for the hoisting and movement of heavy objects.
8. Install non-slip floors and stairs, particularly in pumping and treatment plants.
9. Provide strong and completely protective stair and guard rails around pits, open tanks or elevated platforms.
10. Install guards for moving parts of machinery.
11. Remove debris, waste matter and obsolete or useless equipment.
12. Provide storage facilities of proper construction and design for all types of supplies, tools, and materials kept on hand.
13. Provide adequate sheathing and bracing materials for water main service line construction and repair work.
14. Provide first-aid facilities, including transportation within convenient reach of all workers.
15. Maintain sanitary lockers and washrooms.

Regardless of the amount of safety built into a job there will be human error, so we must give thought and effort to controlling work habits.

Wherever possible, right and wrong ways of doing jobs should be conducted—always accompanied by explanations of the reason for one work habit versus another.

Safety education starts when a new employe comes to work. He needs to learn about the safety policy of the organization and be willing to accept it. Good job instruction is necessary for production and also for safety. Men who break in on a job by trial and error can never be trusted to do the job right and safely. This is why instruction is always a part of our job assignment even for experienced men. Also, corrective instruction is a must, not as fault-finding or condemnation, but as teaching and coaching; correcting small errors as soon as they are noticed makes for a good, safe employe.

Good indoctrination and job training will do four things for a new employe:

1. He will feel that the work has value when he is told how his job fits into the overall picture.
2. He will know his work is appreciated when he receives praise with good reason. (Praise in public—reprimand in private.)
3. He will have a sense of security by knowing exactly what the job is and how to do it.
4. He will belong to the work group when he learns how to work safely with others.

I would like to emphasize that a safety program is a very important part of a utility operation, regardless of the size, and we as utility people are charged with a real responsibility in protecting our employes, the public, and ourselves. It's not just what we *want* to do—it's also what we *have* to do and with the wholehearted backing of management, a safety program is bound to succeed.

RECORD KEEPING AND ACCIDENT INVESTIGATION

By JOHN T. CAPPIO
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RECORD KEEPING

Records of accidents are essential to efficient and successful safety work just as records of production, costs, sales, profits and losses are essential to efficient and successful operation of a business. Records supply the information necessary to transform haphazard, costly, ineffective safety work into a planned safety program which permits full use of all the proven techniques to effect control over the specific conditions and acts which cause accidents. Records are the foundation of a scientific approach to accident prevention.

When kept in accordance with the recognized A.S.A.-Z.16.1, Standard Method of Recording and Measuring Work Injury Experience, records provide an objective evaluation of a safety program, identify high-rate plants or departments, and give information needed to remove the accident causes which contribute most to the high rates. More specifically, the records may be used to:—

a. Create interest in safety among supervisors by furnishing them with information about the accident experience of their departments.

b. Determine the principal accident sources so that efforts may be concentrated where the largest reductions in accidents can be effected.

c. Provide information about the most frequently unsafe practices and unsafe conditions to supervisors and safety committees so that they can utilize their time and efforts to the greatest advantage.

d. Judge the effectiveness of the safety program by showing whether the accident experience is getting better or worse, and by providing comparisons with the experience of similar organizations.

Nearly all states require that reports be prepared for work injuries; the types of reports vary, depending on the rulings in the different states. It must be emphasized, however, that to accomplish best results in the prevention of injuries, the information indicated in the above listing should be developed in addition to any records or reports required by state law, unless the required reports include all data needed for a complete analysis program.

Formula for Keeping Records

There are five important steps in developing adequate information about accident experience:

a. Obtain a report on every injury, including disabling injuries, medical treatment, and first-aid cases.

b. Classify and record each injury according to the American Standard Method of Recording and Measuring Work Injury Experience.

c. Prepare a monthly or other periodic summary report showing injury rates and the circumstances and causes of the accidents which resulted in the injuries.

d. Analyze periodically the circumstances and causes of the accidents.

e. Make an annual report for management and supervision.

f. Send a copy to the National Safety Council for comparison with the records of similar organizations.

Since the completeness and accuracy of the entire accident record system depend on the information transmitted in the individual accident reports, simple forms, which contain all essential information, must be used. Two types of report forms are recommended:

(a) the supervisor's (or investigator's) report form to be completed following each injury.

(b) the first-aid report for minor injuries treated on the job.

Supervisor's Report

It is recommended that the line supervisor make a detailed report about each injury severe enough to require a doctor's attention or other recognized medical personnel, for one or more treatments.

The completed report provides valuable information for the safety engineer or safety

committee and also requires a statement of the supervisor's corrective action. Its purpose and the method of filling it out should be fully explained to every supervisor, perhaps in the course of supervisory training.

Copies of the supervisor's accident report should be sent to the safety engineer, safety committee chairman, and other designated persons.

Because of the importance of the personal factor in accidents, much may be learned about accident causes from these employee injury records. If certain employees have frequent injuries, a study of these persons may reveal more than a study of accident locations, agencies, or other factors.

First-Aid Report

It is recommended that records be kept of minor injuries, for use if injury requires doctor's care and evaluation of the complete accident experience picture.

Analyzing Causes of Accidents

The principal question to be answered is: What was wrong and how can it be corrected?

A method of analysis and classification developed to fit directly into the technique of accident investigation, for the purpose of providing a statistical method of recording the accident facts, is essential in accident prevention work. The analysis restricts factors recognized as being most closely related to the accident, and of the most value in practical accident prevention work. Rules for analysis and selection of accident factors provide a large degree of uniformity in statistical presentation.

Casual Factors of Accidents

This classification provides a statistical method of recording the essential facts of accident occurrence, from which can be compiled information essential for accident prevention. Provision is made for the recording of only such factors as are closely related to the accident, and of most value in practical prevention work.

Each essential point of information about an accident is referred to in the classification as an accident factor and factors are grouped into these major classifications:

(1) the agency (i.e., defective object or substance most closely related to the injury)

(2) the agency part

(3) the unsafe mechanical or physical condition

(4) the accident type

(5) the unsafe act

(6) the unsafe personal factor

Definitions of Accident Factors

The agency is the object or substance which is most closely associated with the injury and which in general could have been properly guarded or corrected.

The agency part is the particular part of the selected agency which is most closely associated with the injury and which in general could have been properly guarded or corrected.

The unsafe mechanical or physical condition is the condition of the selected agency which could have been guarded or corrected.

The accident type is the manner of contact of the injured person with an object or substance, or the exposure, or the movement of the injured person which resulted in the injury.

The unsafe act is that violation of a commonly accepted safe procedure which resulted in the selected accident type.

The unsafe personal factor is the mental or bodily characteristic which permitted or occasioned the selected unsafe act.

Classification of Accident Factors

The lists of accident factors given here are major classification groups, omitting detail, for all factors except accident type. (Detailed classifications are given in A.S.A. Z.16.2, Part II, Detailed Classification of Accident Factors.) The purpose of listing the major groups here is:

(1) to indicate the general scope of the classification, and

(2) to permit a selection of the degree of detail which may be adequate to meet specific needs. To facilitate the use of the major classifications, some of the items falling into each are shown in parenthesis, indicating the scope of the particular classification item. The method of classification proposed here is both elastic and flexible. The following list shows the scope of the classification of accident factors in general groupings.

Agency Associated With Injury

Machines (lathe, punch press, saw, drill press, buffer, stamper, etc.)

Prime movers and pumps (engine, pump, compressor, fan and blower, etc.)

Elevators (passenger or freight, electric, steam, hydraulic, hand operated, etc.)

Hoisting apparatus (crane, derrick, dredge, etc.)

Conveyors (belt, sprocket, chain, and other types)

Boilers and pressure vessels (steam boiler, super heater, condenser, digesters, pressure piping, etc.)

Vehicles (motor, animal, railway, water, aircraft, etc.)

Animals (domestic animal, insect, snake, wild animal, fish, etc.)

Mechanical power transmission apparatus (main shaft, counter shaft, bearings, pulleys, etc.)

Electric apparatus (motor, generator, conductor, rheostat, lamp, etc.)

Hand Tools (axe, cleaver, chisel, crowbar, file, mallet, knife, etc.)

Chemicals (explosives, vapor, fume, corrosives, poisonous vegetation, etc.)

Miscellaneous agencies (ladder, floor opening, window, tank, can, box, etc.)

Agency Part

Agency parts are not itemized in this simple classification because the parts for the agencies listed above differ greatly. (A detailed list of agency parts is given in A.S.A.-Z.16.2 Part II). Even without referring to a list, however, the accident investigator will ordinarily be able to select the agency part, once he has determined the agency.

Unsafe Mechanical or Physical Condition

Defective agencies (rough, slippery, sharp, inferior composition, etc.)

Hazardous arrangement, procedure, etc. in, on, or around the selected agency (unsafely stored, congestion, overloading, etc.)

Improper illumination (insufficient light, glare, etc.)

Improper ventilation (insufficient air change, impure air source, etc.)

Unsafe dress or apparel (absence of or defective gloves, aprons, shoes, respirators, eye protection, hard hats, loose clothing, etc.)

Accident Type

Striking against (refers generally to contacts with sharp or rough objects, resulting in cuts, slivers, punctures, etc. due to striking against, kneeling on, or slipping on objects)

Struck by (falling, flying, sliding or moving objects)

Caught in, on, or between

Fall on same level

Fall to different level

Slip (not fall) or overexertion (resulting in strain, hernia, etc.)

Exposure to temperature extremes (resulting in burning, scalding, freezing, heat exhaustion, sunstroke, frostbite, etc.)

Inhalation, absorption, ingestion (asphyxiation, poisoning, drowning, etc., but excluding contact with temperature extremes)

Contact with electric current (such as results in electrocution, shock, etc.)

Accident type not elsewhere classified; unclassified; insufficient data

Unsafe Act

Operating without authority, failure to secure or warn

Operating or working at unsafe speed (too slow, too fast, throwing materials, etc.)

Making safety devices inoperative (removing, misadjusting, disconnecting, etc.)

Using unsafe equipment, hands instead of equipment, or equipment unsafely

Unsafe loading, placing, mixing, combining, etc.

Taking unsafe position or posture (under suspended loads, lifting with bent back, etc.)

Working on moving or dangerous equipment (cleaning, adjusting, oiling, etc.)

Distracting, teasing, abusing, startling, etc. (quarreling, horseplay, etc.)

Failure to use safe attire or personal protective devices (goggles, etc.)

Unsafe Personal Factor

Improper attitude (disregard of instructions, failure to understand instructions, nervous, excitable, etc.)

Lack of knowledge or skill (unaware of safe practice, unskilled, etc.)

Bodily defects (defective eyesight or hearing, fatigue, intoxication, existing hernia, weak heart, etc.)

Unsafe personal factor not elsewhere classified; unclassified; insufficient data; no unsafe personal factor

Publish Reports

A supervisor is interested primarily in his own department and workmen. One of the most effective ways to create and maintain the interest of supervisors and foremen in accident prevention is to keep them informed about the accident experience of their departments. Departmental injury rates for sufficient amounts of exposure reflect the effectiveness of the supervisor's safety activities.

Since interest increases with knowledge, bulletins containing analyses of the principal causes of injuries in each department not only will maintain the supervisors' interest at a high level, but will provide the supervisor with the type of information which will help them to effect further reductions in injuries.

The data on which injury rates are based make good topics for discussion at employee safety meetings. The number and severity of injuries, hours worked without a disabling injury, and the details about individual accidents can be used as a basis for interesting discussions. The department's or plant's standing in a safety contest is often used to emphasize individual responsibility for prevention of injuries.

Bulletin Board Publicity

Posting a variety of materials on bulletin boards is one of the best ways to maintain the interest of employees in safety. Many items, such as the following, can be found in accident records or prepared from them:

No-injury records

Unusual accidents

Charts showing reductions in accidents

Simple tables comparing departmental records

Standings in Contests

Frequent causes of accidents

Measuring Stick

Reports to Management

Management is increasingly interested in the accident experience of its companies. Therefore, monthly and other periodic summary reports, which show the results of the safety program, should be furnished to the responsible executive. Such reports need contain no details or technical language and may be supplemented by simple charts or graphs to show the recent accident experience in relation to that of the preceding period and that of similar companies.

In a large company, departmental data help the executive visualize accident experience in various plant operations and provide a yardstick for better evaluation of progress made in the elimination of accidents. If cost figures are obtained, comparisons of such figures for different periods are of particular interest.

Safety Performance is Relative

Only when a company compares its injury experience with that of similar companies, or with that of the entire industry of which it is a part, or with its own previous experience can it obtain a meaningful evaluation of its safety accomplishments.

To make such comparisons, a method of measurement is needed which will adjust for the effects of certain variables contributing to differences in injury experience. For two reasons, injury totals alone cannot be used.

First, a company with many employees may be expected to have more injuries than a company with few employees.

Second, if the records of one company include all the injuries, and are counted in the rates, while the records of a similar company include only injuries serious enough to cause lost time, obviously the first total will be larger than the second.

American Standard Z.16.1

What is it and how is it used?

This is the accepted method of compiling industrial injury rates approved by the

American Standards Association in 1945. The work on this Standard dates back to Bulletin 276 of the U.S. Bureau of Labor Statistics, published in 1920. Although developed by a body representing governmental statistical agencies, the rate provisions of this bulletin were widely followed in whole or in part by private agencies. At a national conference on industrial accident prevention, called by the U.S. Secretary of Labor in Washington in 1926, a resolution was adopted in favor of a revision of Bulletin 276 by a sectional committee set up under the procedures of the American Standards Association. As a result of the work of the committee, the first edition of the Standard was completed and approved in 1937.

Work was started in 1942 on a revision of the standard; it was completed, and the revision was approved in 1945. Shortly after the 1945 revision, the International Association of Industrial Accident Boards and Commissions and the National Council on Compensation Insurance withdrew as sponsors of the project, and the Accident Prevention Department of the Association of Casualty and Surety Companies assumed joint sponsorship with the National Safety Council.

Since 1945, the Standard has been twice reviewed, in 1954 and in 1959. It is now being reviewed again. The 1945 revision provided for an interpretations committee to handle questionable cases that had been presented during the past years. The cases had indicated the need for further revision, particularly in order to clarify which should be included or excluded from the rates. The revision changed the basis for severity rates from 1,000 hours of exposure to 1,000,000 hours, thereby placing it on the same basis as frequency rates.

Realizing that questions may still arise from time to time concerning interpretations of the Standard, provisions have again been made for an interpretations committee, to assure a uniform handling of questionable cases. It is recommended that anyone using the standard and desiring an interpretation of a questionable case communicate with the American Standards Association in accordance with paragraph 5.19 of the Standard.

The purpose of the Standard is to provide a practical and uniform method for recording and measuring work injury experience. Injury rates compiled in accordance with it may be used to evaluate:

(a) the relative need for accident prevention activities in different departments of an establishment

(b) the seriousness of the accident problem in an establishment or industry

(c) the effectiveness of safety activities in establishments with comparable hazards

(d) the progress made in accident prevention within an establishment or industry

The fact that the employee or employer did not have control over the cause of a work injury shall not be a criterion for excluding the work injury from application of the provisions of the Standard.

The methods outlined in the Standard for classifying work injuries are independent of workmen's compensation laws and rulings of workmen's compensation agencies.

Note: Permission was granted A.W.W.A. to reproduce this Standard. It appears in the 1962 November Issue of the A.W.W.A. Journal.

Computing Accident Rates

Frequency Rates

The disabling injury frequency rate is based on the total number of deaths, permanent total, permanent partial, and temporary total disabilities which occur (see p. 11) during the period covered by the rate. The rate relates these injuries to the hours worked during the period and expresses them in terms of a million-hour unit by use of the following formula:

$$\text{Disabling injury frequency rate} = \frac{\text{Number of disabling injuries} \times 1{,}000{,}000}{\text{Employee-hours of exposure}}$$

Severity Rate

The disabling injury severity rate is based on the total scheduled charges for all deaths, permanent total, and permanent partial disabilities, and the total days of disability from all temporary total injuries which occur during the period coverel by the rate. The rate relates these days charged to the hours worked during the period and expresses the loss in terms of a million-hour unit, by use of the following formula:

$$\text{Disabling injury severity rate} = \frac{\text{Total days charged} \times 1{,}000{,}000}{\text{Employee-hours of exposure}}$$

**—These rates are based on a calendar year—

Calculating Employee Man-hours

The number of employee-hours used in calculating injury rates is the total number of hours worked by all employees, including those of operating, production, maintenance, transportation, clerical, administrative, sales, and other departments.

Employee-hours should be calculated from the payroll or time clock records. If this method cannot be used, they may be estimated by multiplying the total number of employee-days worked for the period covered by the number of hours worked per day.

Disabling Injury

To standardize the types of injuries to be included in the rates, certain minimum requirements have had to be established. Generally, only those injuries are included which result in death or permanent impairment or which are sufficiently serious that the injured employee is unable to work within 24 hours of the end of the shift on which he was injured. These injuries are referred to as disabling injuries and are of four classes, as follows:

a. Death is any fatality resulting from a work injury, regardless of the time intervening between injury and death.

b. Permanent total disability is any injury other than death which permanently and totally incapacitates an employee from following any gainful occupation, or which results in the loss of or the complete loss of use of any of the following in one accident:

(a) both eyes;

(b) one eye and one hand, or arm, or foot, or leg;

(c) any two of the following not on the same limb: hand, arm, foot, or leg.

c. Permanent partial disability is any injury other than death or permanent total disability which results in the complete loss or loss of use of any member or part of a member of the body, or any permanent impairment of functions of the body or part thereof, regardless of any pre-existing disability of the injured member or impaired body function.

d. Temporary total disability is any injury which does not result in death or permanent impairment but which renders the injured person unable to perform a regularly established job which is open and available to him during the entire time interval corresponding to the hours of his regular shift on any one or more days (including Sundays, days off, or days when the plant is shut down) subsequent to the date of the injury.

Temporary total disability—key points. Of the four classes of disabling injuries used in calculating standard injury rates, temporary total disability is the most difficult to interpret uniformly. Key points in the definition are:

a. The injury must be serious enough that the injured worker is unable to work at all on any day following the day of injury. The injured worker need not report for work at the beginning of the shift on the next day—he may report at any time during his shift—but when he does report, he must be able to work.

b. If the worker is not scheduled to work the next day, it must be determined whether or not he would have been able to work if he had been scheduled. This opinion should be obtained from the physician who is authorized to treat the injury. If the physician is of the opinion that the injured worker would not have been able to work the next day, the injury would be classified as a temporary total disability, even though the worker was able to return to work during his next scheduled work time.

Medical Treatment Injury

The medical treatment injury is an injury which does not result in death, permanent impairment, or temporary total disability, but which requires medical treatment.

First-Aid Case

The first-aid case is an injury which does not require medical treatment, and treatment is received on the job.

Although these nondisabling injuries are not included in the standard injury rates, they should be given consideration and at-

tention. It does well to keep totals of them, and note their frequency, the departments in which they occur, what types of injuries they are, and the relationship between them and disabling injuries.

Listed below are accident rate comparisons as published by the National Safety Council:

	Frequency Rates	Severity Rates	Three Year Rates	Frequency	Severity
1956	15.58	413	(54-56)	16.10	673
1957	15.83	995	(55-57)	15.60	732
1958	17.69	1009	(56-58)	15.51	858
1959	14.43	534	(57-59)	16.06	855
1960	14.44	738	(58-60)	15.46	767
1961	12.93	659	(59-61)	13.96	657
1962	13.73	573	(60-62)	13.77	660
1963	13.02	638	(61-63)	13.24	622

ACCIDENT INVESTIGATION

Successful accident prevention requires a minimum of four fundamental activities:

a. A study of all working areas to detect and eliminate or control physical hazards which contribute to accidents.

b. A study of all operating methods and practices.

c. Education, instruction, training, and discipline to minimize human factors which contribute to accidents.

d. For cause analyses, a thorough investigation of at least every accident which results in a disabling injury to determine contributing circumstances.

Purpose of Investigation

Accident investigation is of such prime importance in the safety program that both top management and whoever is responsible for the safety program must guard its soundness as a device for preventing accidents. Investigations must be kept objective, factual, and free from the "punishment" motive. Otherwise, they may do more harm than good.

This is not to say that responsibility may not be fixed where personal failure has caused injury, or that such persons should be excused from the consequences. However, the investigation itself is concerned only with the facts, and the investigating individual or group is best kept free from involvement with the consequences.

The principal purposes of an accident investigation therefore are:

a. To learn accident causes so that similar accidents may be prevented by mechanical improvement, better supervision, or employee instruction.

b. To publicize the particular hazard among employees and their supervisors, and to direct attention to accident prevention in general.

c. To determine facts bearing on legal liability. An investigation undertaken solely for this purpose, though, will seldom give enough information for accident prevention purposes. On the other hand, an investigation for preventive purposes may disclose facts which are important in determining liability.

Each investigation should be made as soon after the accident as possible. A delay of only a few hours may permit important evidence to be destroyed or removed, intentionally or unintentionally. Also, the results of the inquiry should be made known quickly, inasmuch as their publicity value in the safety education of employees and supervisors is greatly increased by promptness.

Analysis of the circumstances of accidents according to the recommended standard method can produce these results:

a. Identify and locate the principal sources of accidents by determining, from actual experience, the materials, machines, and tools most frequently involved in accidents, and the jobs most likely to produce injuries.

b. Disclose the nature and size of the accident problem in departments and among occupations.

c. Indicate the need for engineering revision by identifying the principal unsafe conditions of various types of equipment and materials.

d. Disclose inefficiencies in operating processes and procedures where poor layout, for example, contributes to accidents, or where outdated methods or procedures which overtax the physical capacities of the workers can be avoided, as by using mechanical handling methods.

e. Disclose the unsafe practices which need special attention in the training of employees.

f. Disclose improper placement of personnel in instances in which inabilities or physical handicaps contribute to accidents.

g. Enable supervisors to use the time available for safety work to the greatest advantage by providing them with information about the principal hazards and unsafe practices in their departments.

h. Permit an objective evaluation of the progress of a safety program by noting in continuing analyses the effect of different safety measures, educational techniques, and other methods adopted to prevent injuries.

Accident Reports

Learning (a) who, (b) when, (c) where, (d) how, and (e) why an accident occurred means a great deal in learning how to prevent them. The accident report, therefore, should answer these questions:

(a) Who?—Injured Employee
(b) When?—Date and Time
(c) Where?—Location
(d) How?—Description
(e) Why?—Cause

Analyzing Key Facts

The first step in analyzing an injury or accident report consists of selecting from the report the answers to the following questions:

a. Nature of injury. What was the injury?

b. Part of body. What part of the body was affected by the injury?

c. Source of injury. What object, substance, exposure, or bodily motion inflicted the injury?

d. Accident type. How did the injured person come in contact with the object, substance, or exposure, or during what personal movement did the bodily motion occur?

e. Hazardous condition. What hazardous physical or environmental condition or circumstance caused or permitted the occurrence of the event?

f. Agency of accident. In what object, substance, or part of the premises did the hazardous physical or environmental condition exist?

g. Agency of accident part. In what specific part of the agency of accident did the hazardous condition exist?

h. Unsafe act. What unsafe act of a person caused or permitted the occurrence of the event?

The following examples show how to identify the key facts in an injury:—

Case #1.

The operator of a circular saw reached over the running saw to pick up a piece of scrap. His hand touched the blade, which was not covered, and his thumb was severely lacerated.

Analysis

a. Nature of injury—laceration.
b. Part of body—thumb.
c. Source of injury—circular saw.
d. Accident type—struck against.
e. Hazardous condition—unguarded.
f. Agency of accident—circular saw.
g. Agency of accident part—blade.
h. Unsafe act—cleaning moving machine.

Case #2.

A truck driver jumped from the rear of a truck to the ground instead of using the steps. As he landed, he sprained his ankle.

Analysis

a. Nature of injury—sprain.
b. Part of body—ankle.
c. Source of injury—ground.
d. Accident type—fall from elevation.
e. Hazardous condition—none indicated.
f. Agency of accident—none indicated.
g. Agency of accident part—none indicated.
h. Unsafe act—jumping from elevation.

Case #3.

A laborer working in a trench was suffocated under a mass of earth when the unshored wall of the trench caved in.

Analysis

a. Nature of injury—asphyxiation
b. Part of body—respiratory system.
c. Source of injury—earth.

d. Accident type—caught under.

e. Hazardous condition—lack of shoring.

f. Agency of accident—trench.

g. Agency of accident part—none.

h. Unsafe act—failure to use shoring.

Accident Costs

Accidents to employees are costly, not only to the employer, but also to the injured employee, his family and society as a whole.

It is customary to refer to compensation payments and medical expense as direct cost. All other accident costs are spoken of as indirect costs.

Careful analysis shows that on the average the indirect cost (to the employer) of a disabling injury, is at least four times the direct cost.

What is the indirect cost? The indirect cost of industrial accidents is detailed by Heinrich as follows:

I. Cost of lost time of injured employee (wages).

II. Cost of time lost by other employees who stop work:

a. Out of curiosity.

b. Out of sympathy.

c. To assist injured employee.

d. For other reasons.

III. Cost of time lost by foreman, supervisors, or other executives as follows:

a. Assisting injured employee.

b. Investigating the cause of the accident.

c. Arranging for the injured employee's production to be continued by some other worker.

d. Selecting, training, or breaking in someone to replace the injured employee.

e. Preparing accident reports, or attending hearings concerning the accident.

IV. Cost of time spent on the case by first-aid attendant and hospital department staff, when not paid for by the insurance carrier.

V. Cost due to damage of machines, tools, other property, or spoilage of material.

VI. Incidental cost due to interference with production, failure to fill orders on time, payment of forfeits, and other similar causes.

VII. Cost to employer under employee welfare and benefit systems.

VIII. Cost to employer in continuing the wages of the injured worker in full, after his return—even though the services of the worker (who is not yet fully recovered) may for a time be worth only about half of their normal value.

IX. Cost because of the loss of profit on the injured worker's productivity and on idle machines, or equipment.

X. Cost of subsequent injuries that occur in consequence of the excitement or weakened morale due to the original accident.

XI. Overhead cost per injured worker—the expense of light, heat, rent and other such items, which continue while the injured employee is a nonproducer.

It should be emphasized here that many of the details of Indirect Accident Cost will not be brought out by the usual cost system. This is particularly true of time loss by fellow employees, executives, and supervisors, and may apply to material spoilage, machine and equipment damage, and production loss as well.

Cost to injured workers

Injured workers themselves, however, are the heaviest losers. Their actual losses in money may not be so great as the employer's losses, but workers are less able to afford their share of the financial burden, and, in addition, it is they who must bear the physical pain and suffering that accompany every injury. If injured while on the job, the worker of course does not have to pay his own hospital and doctor bills, he does receive some income in the form of workmen's compensation if he is under a compensation act or covered by insurance. But if injured while off the job, he not only loses his pay during the time he is unable to work, but, in addition, must pay his own bills for medical and hospital attention. Accordingly, his expenses pile up while his income and savings dwindle.

Cost to Society

Industrial accidents also place a heavy burden upon society in general. Even though the employer pays compensation for on-the-

job accidents, injured workers and their families frequently require financial help or support from such social agencies as hospital associations and other relief organizations. Much of this financial burden is borne by agencies that are supported entirely by taxes.

In summary it is established, therefore, that a standard recording system is essential to good accident prevention. It affords and provides information:

1. Concerning accidents
2. Principal cause of accidents
3. Facts concerning accidents
4. Means of creating interest and awareness
5. Accident rates, frequency and severity
6. Accident costs
7. Measurement of performance—Similar organizations and National Safety Council

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BUILDING SAFETY CONSCIOUSNESS AMONG EMPLOYEES

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The size of the water utility must be a consideration in developing safety consciousness among waterworks personnel. Sixty-seven per cent or 485 of the 723 municipalities in Iowa having public water supplies are in a population group of 1,000 or less, yet this 67 per cent group of municipalities represents only 14 per cent of the urban population.

Thirty per cent or 218 of the 723 public water supplies in Iowa are in a population group of 1,000 to 15,000. This group represents 34 per cent of the urban population of the state. There are only 20 municipalities in Iowa having public water supplies that are in a population group of over 15,000. This last group of 3 per cent represents 52 per cent of the total urban population of the state.

These figures are based on the 1960 census compiled by the Division of Public Health Engineering, Iowa State Department of Health. The aforementioned figures are presented to this audience to show that 86 per cent of our urban population is served by 33 per cent of the municipalities having public water supplies.

A safety program suitable for a small town in the Middle West would not effect the same results in New York. Adapting the safety program to the size of the water utility cannot be ignored. The attitudes and convictions of the small plant are more easily corrected. This accomplishment can be controlled through the ordinary supervisory methods.

A representative list of accident causes that apply to this type of plant includes material handling, housekeeping, hand and machine tools, electrical equipment and work practices. The accidents fall into the two well known major categories; namely, failure on the part of the worker, or unsafe conditions. After the planning and developing of a safety program, the plant puts this program to work. Active direction and interest is necessary. Management must accept this responsibility.

The cooperation of management is necessary to attain the right attitude toward safety. The elected officials are concerned with the safety of the public in the community they serve; but, at times, fail to recognize the need of a good safety program among the municipal employees.

The limited budgets do not permit a large expenditure for personal protective equipment. Modest expenditures over a given period of years is usually sufficient to provide ample protection. The men find that the very best of protective equipment is obtained for them. Much study goes into the selection of this equipment.

The small water utility's attitude or conviction usually indicates that safety and accident prevention programs are not applicable. The feeling that, due to its size, it is not exposed to the hazards as compared with larger municipalities, is incorrect.

The water utility's employee must be familiar with a wide variety of hand tools, thus he is a mechanic. He is constantly around electrical equipment—ranging from large pump motors to small delicate recording instruments. In many cases this involves the exposure to electrical hazards. He is the maintenance man on the grounds, working with a power mower or even on a ladder or scaffold, washing the water plant windows. We find him a heavy equipment operator or laying pipe in the bottom of a ditch, not to mention servicing and reading of meters. This and a host of various other duties expose this man far more than his superiors realize.

The safety supervisor generalizes on all safety topics that affect these men on and off the job. The wide variety of subjects that can be covered for the small plant operator by and large serve to remind and teach these men.

The key to the development and building of safety consciousness among employees rests with the foreman or supervisor. His

close daily contact with the employees places him in a position to supervise the individual duties safely. The foreman or supervisor can effectively bring about the proper feeling and attitude of safety. To quote Oliver Summers, of the Indianapolis Water Company at the Annual Conference of the AWWA in Kansas City in May of 1963:

"There is a monetary savings to be had; however, this saving is not nearly as important as the need to prevent suffering and to save lives. At times, perhaps, people lose their sense of values. They can replace the dollars, but they cannot replace the life."

The supervisor or foreman does not want to see his employees suffer. He is interested in them as individuals, recognizing that as an individual each man receives personal attention. The foreman or supervisor recognizes the individual, acknowledges his work, gives credit when due, lends an ear to the employee's likes and dislikes, provides an air of security to the employee, and points out the importance of job safety.

I believe the smaller water utility can be reached easily to develop safety consciousness. The employee of a smaller group feels that someone cares for him. The close contact between the supervisor and employee is the liaison necessary to reach the worker.

All information related to injury reports is used. The facts of an accident are analyzed and the conclusions serve to prevent recurrences.

Each man realizes, for the first time that the head, eye, finger, trunk, leg, foot, toe and back injuries are his. He realizes now that his co-worker's welfare depends on him. He begins to participate in discussions and assists in interpretation and analysis of accidents.

His suggestions are sought. They are carefully weighed for practicability and soundness, and they are generally accepted. The safety incentive is present. Continued reminders in the form of meetings, films, posters, etc. are used. Continued effort and cooperation between foreman and supervisor must be maintained.

Safety consciousness among employees is incorporated in that familiar word "attitude." It is a way of life—it is catching. The good example displayed by you and your supervisory personnel will provide the sound foundation in the building of safety consciousness among employees.

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EDUCATION: KEY TO ACCIDENT PREVENTION

By JOHN F. NASH,
Senior Vice President, New York Central System, New York City

More than one million lives have been saved since the birth of the National Safety Council in 1912. This is an outstanding record, and we should be proud of it.

But unfortunately, we cannot become complacent about safety. We cannot take it for granted.

Accidents injure 45 million people and cost nearly 15 billion dollars every year. On the average, 85 people are injured every minute. That means that before I finish my talk 1,275 more people will be on the injured list across the country.

Thus, in human terms, the toll is staggering. And it's equally staggering in terms of dollars, too. Accidents cost the American people $28,500 every minute. During the 15 minutes of my talk today, another $427,500 will be added to the cost of accidents. How fine it would be if we could use that money in conquering cancer or paying off the national debt! How fine it would be if all the injured remained healthy and on the job!

To determine the cause and to devise a cure for accidents is a task that will require our very best efforts. We have made headway. But we still have far to go. First of all, I believe, we should realize that accidents happen to people. Wherever there is human activity, there is likely to be an accident, sooner or later.

Now, why do I stress a fact that is so simple and obvious? I do so because I think we tend to forget that there is always a human factor in every accident. In this age of scientific marvels, we tend to rely too much upon technology. Yet, with all our amazing machines, we still pay a very high price for accidents. For example, we have the best automobiles in the world. They are equipped with powerful brakes, durable tires, the best metals, yet the human toll on the highways goes up every year.

Certainly, it cannot be denied that some accidents are caused by mechanical failure. But, hidden somewhere in the cause of every accident is the factor of human failure. The most dangerous part of every car is the "nut" that holds the steering wheel. Our machines are safe. But our human beings sometimes are not. As the Safety Council has long recognized, the cause of most accidents does not lie in the machine—it lies in the man.

Therefore, I believe the cure for accidents lies in the realm of psychology more than in that of technology. Let me give you an example of how important human psychology is in the field of accident prevention.

Years ago, the New York Central relied upon safety supervisors who were based in New York City. They traveled around the system preaching safety. After a while, we noticed that whenever one of these supervisors held a meeting with a group of employees, the trainmasters and superintendents were generally absent. Yet, the trainmasters and superintendents were the day-to-day bosses for the people who were doing the work—and who were having the accidents.

Any good management realizes that the attitude of employees is largely determined by the attitude and actions of their supervisors. In this case, the men said to themselves: "Obviously, the boss thinks this safety stuff is a lot of hooey. Otherwise, he'd be here at this meeting." The men listened patiently. And then they went right out and did their work in the same old way. If safety wasn't important to the boss, then of course it wasn't going to be important to the employees.

Thus, we lost the chance to change the men's attitude toward accident prevention; and this is a crucial factor in human psychology. If you want a man to do something differently, you must change his attitude. We also realized that teaching would be more effective than preaching. Telling a man what to do is only half the job. The other half is to show him how to do it. We gave the men goals to work for, but we failed to give them the methods to accomplish these goals.

So we reorganized our safety department. We put an educator in charge of our safety program, and we made all first-line supervisors directly responsible for safety. In addition, we put our safety supervisors out in the districts, on the general managers' staffs.

By doing all this, we made our people feel that safety was important. And we taught them how to be safe. From that time on, the New York Central's safety record has improved continuously.

Railroad accidents, however, are less than two per cent of the national total. Unfortunately, it's a very difficult task to make the general public conscious of the need for safe conduct.

Consider the question of railroad grade crossings. Not long ago, one of our safety supervisors was riding the locomotive of a train in Michigan. The view ahead was very good. Suddenly, as the train approached one of the many crossings in the area, an old car pulled onto the tracks. The engineer blew the whistle and began to use his brakes. At the very last moment, the car pulled off the tracks. It was loaded with teenagers, who thumbed their noses as the locomotive roared past.

These young people were playing the exciting game of "chicken". This case is not a typical one, but it illustrates the attitude held by many drivers. You would almost believe that some of the public are deliberately trying to destroy themselves. In 1963, 25 per cent of all grade crossing accidents during the day involved cars hitting the side of a passing train. That means they ran into the train! During the night, 51 per cent of all accidents at grade crossings involved hitting the side of trains.

It is obvious from these figures that railroads can no longer be held solely responsible for grade crossing protection. Despite warning lights, bells, and barriers, people still insist on trying to beat the train to the crossing. Too often they lose that race—and their lives. Government at all levels has recognized that the problem of grade crossing protection is of public interest. Working together, the industry and government are making real progress.

But, even in areas where every protective device is used, there are still too many accidents. Over 70 per cent of 560 grade crossing violations in Ohio last year occurred despite flashing signal lights, gates, watchmen, or flagmen. It is obvious that the problem cannot be solved completely at the grade crossing. It must be solved elsewhere, primarily through education and re-education of everyone in the nation.

The New York Central, through education, changed the attitude of its employees toward accident prevention. Now, our schools, clubs, communities, and homes must join the effort to prevent grade crossing accidents.

A five-alarm fire broke out in an apartment house in New York City last winter. A small girl ran out in sub-zero weather at night and turned in the alarm. The building burned down, but no tenant lost his life. Asked how she knew what to do, she replied: "They taught us in school."

What better proof do we need for the value of safety education?

The cause and the cure for accidents lies within the individual human being. All the safety devices in the world cannot insure us against accidents. Our fine police forces have fought long and efficiently to protect us from harming ourselves. But we do not have enough policemen to watch every individual all day long.

In the final analysis, then, we must rely upon ourselves for the protection of our own safety and security. After all, isn't self-reliance the basis of our American traditions? The principle of individual responsibility applies directly to the effort to prevent accidents.

Through education we can help more people to realize that they are responsible for their own security. This is precisely what the National Safety Council has been doing for the last 52 years, with such great success.

It is up to each of us to carry that fine work on, to make it more and more effective in every area of life today.

RELATIONSHIP BETWEEN OPERATING RULES AND SAFETY PRACTICES

By R. C. LINDQUIST
Supt. Rules, Safety & Fire Prevention Dept., Northern Pacific Railway Co.,
St. Paul, Minn.

Over 100 years ago, right-of-way between two opposing trains was determined by which engineer was the best fighter. The loser had to back up to the last siding.

I've been told that one early rule book from a railroad in the South contained a rule, "If you see a man with a chicken, you will assume he stole it and take the chicken away from him." From the examples of early operating rules, you can see they were often crude, but they no doubt seemed like good common sense in those days.

You have all heard the saying, "Safety is common sense." I have heard common sense is necessary for a happy marriage. Common sense would avert many divorces: as a matter of fact, it would avert many marriages.

Operating rules developed over many years because of serious accidents. When an accident occurred, the investigation which followed developed the need for a rule which, if understood and followed, would prevent the same accident from occurring again.

As the rule book grew in size, accidents still occurred. Investigations developed the fact, that even though the book contained a rule which should have prevented the accident, the men hadn't bothered to open the book, to read, and learn the rule.

It was apparent examinations must be held to ascertain all men understood the rules. Examining boards were made up of division officers and employes who were told to examine every man on the operating rules.

Accidents still occurred and investigations developed the fact that the examiners themselves had many different ideas as to the proper interpretation and procedure to be followed under a given rule.

Finally, a rules department was set up. This department was charged with writing, interpreting and training all the examiners so all had the same interpretation of each rule. This worked pretty well except as crews operated on foreign railroads, they were expected to know the operating rules of these lines as well as their own. Many rules were the same, but many had different interpretation between the properties.

Pressure from unions and state legislatures brought about consolidation of rules books between railroads that had joint operation. Committees from interested lines met and agreed, sometimes after many arguments, as to which interpretation would be used for each rule.

This has, in many cases, modernized our operating practices. However, it also has served to continue antiquated practices which do not conform to our present day operations. Men on these committees must accept the challenge of looking forward to the future, writing new rules rather than being satisfied with, "it's been working for fifty years, let's leave it alone."

History is an especially meaningful word around the Northern Pacific these days. I'm sure you all have been made aware that Northern Pacific marked its charter centennial July 2 of this year. It was 100 years on that date since President Lincoln signed into law the act of Congress which created our railroad.

In our company magazine, *The Telltale*, we have been running a historical series. In one installment, it was pointed out that Lewis and Clark, 160 years ago, made their long and arduous journey without having lost a single life to an accident. In fact, only one death was recorded over the two-year span of the expedition—one of the men fell victum to an attack of acute appendicitis shortly after the expedition got underway. How's that for a safety record?

Think of it. We weren't a particularly civilized nation yet, especially out in the Northwest, where Lewis and Clark and their crew blazed a trail that was followed, ultimately, by the Northern Pacific. How do you suppose they managed to bring it off as they did?

Well, first of all, they left nothing to chance, from President Jefferson, who devised the project, on down through Lewis and Clark to the lowliest private who accompanied the expedition, each and every man knew there would be dangers, both foreseeable and unforeseeable, and plans were made accordingly. It may surprise you, but students of the early American scene tell us this is a fact.

Our daring, fearless, intrepid pioneers were the most safety-conscious Americans of all time. Neither Lewis nor Clark, nor our Daniel Boones, Davy Crocketts or Jim Bowies ever went into the wilderness without long and intensive preparation. Every possible contingency was considered; every known hazard was weighed; and plans were made to avoid or minimize each danger. In short, precautionary measures were a way of life, or more bluntly, the way of staying alive. And to top it all off, they used safety slogans just as you do today. Some of them have come down to us through history, although their significance may be a bit obscure.

The ladies, for example, might think there was some special feminine meaning attached to the reminder, "Keep your powder dry!" In the days of Lewis and Clark, this was a safety first slogan of the highest order. Wet gunpowder in the wilderness could have tragic consequences for the hunter, Indian fighter or explorer.

The pioneers' rule—on the trail, in camp, on the hunt—was preparedness. A pioneer who blundered recklessly into the wilderness invited disaster and even death. Being prepared was not simply a clever motto which boys learned to win a tenderfoot badge.

Operating rules on our property—and I expect yours, had an earlier beginning than our safety rule book. However, operating rules in reality, are safety rules when we analyze them. In most cases, however, they primarily protect against damaging trains and equipment and by this means protect against injuries that may follow.

Operating rules are in most cases readily followed and enforced—much more so than the average safety rule.

Haven't we as safety men missed a chance to train our operating employes by adding training rules to our preliminary operating rules examination? Our employes and supervisors know operating rules are enforced and therefore have a healthy respect for them.

I believe a close working relationship between the safety and rules department will bear fruit to both departments. We have found it desirable to use safety department equipment in our rules classes for two reasons: First, we have a captive audience, second, the employes welcome safety movies and 35MM slides to break the monotony of these examinations and thus are receptive to safety talks.

Last year on the Northern Pacific, the safety and rules departments were operated as two separate departments. It became apparent the men were duplicating work in certain areas with much dead time between trains. Feeling shorthanded in the safety department led to a gradual integration of rules, safety and fire prevention work, so that now we have smaller territories, but each man is responsible for all phases of our department. We now have established six territories where before we had but four.

Naturally there were problems learning the work of the other department—two of our safety men had practically no experience in rules work and our rules men knew little about safety work. Both groups found the new work challenging and were very interested in learning the new work.

Each man is now responsible for developing his own 35MM slide program within his district. This is in addition to overall system material we furnish from headquarters. They have found it desirable to integrate safety, fire and rules work so that we have achieved not only a less costly operation to the company as far as salaries are concerned, but in addition, have an efficient operation within the department. Each man is able to schedule all phases of his work at a terminal on a given day, thus allowing more time to be spent at trouble spots, which we all have.

They have found their jobs more interesting and it has been noted employes and supervisors are more receptive to accident prevention work than in the past. From our experience, which has been highly successful, I can only advocate increased cooperation between rules and safety departments.

Most of us have been looking for the key to open not only the employes' minds but the supervisors' minds to safe work practices.

Our pioneers had safety in mind because it meant life or death.

Our supervisors have a healthy respect for operating rules not only to prevent accidents but also because of the biennial examination they must pass.

Why then, not use these examinations as the key to open our supervisors' minds to accident prevention? I think we can and have started slowly in this direction by teaching safe working habits as a part of our preliminary rules examination required of all new operating employes. We intend to expand this to all newly promoted officers and re-examinations. In time, accident prevention work will become as important as strict operating rules observance.

WORKSHOP—HOW TO STOP RAILROAD ACCIDENTS

Presiding: G. R. Huntoon, Superintendent, Rules and Safety, Chicago, Rock Island and Pacific Railroad Co., Chicago, Ill.

OPERATING DEPARTMENT

Moderator—B. L. Schoech, Superintendent, Rock Island Division, Chicago, Rock Island and Pacific Railroad Co., Rock Island, Ill.

MECHANICAL DEPARTMENT

Moderator—I. H. Irwin, Supervisor, Safety and Fire Prevention, Chesapeake & Ohio Railway Co., Ashland, Ky.

MAINTENANCE-OF-WAY

Moderator—B. J. Gordon, District Engineer, New York Central System, Cleveland, Ohio.

The audience was divided into three groups in random fashion without regard to individuals or particular line of work, under these three headings: Operating, Mechanical, and Maintenance-of-Way.

After assembling at the designated places, each group was further divided into smaller discussion groups of six to eight. Each discussion group selected a chairman to guide discussion within the group.

Each moderator presented the same three questions for discussion:

(1) "What is the most common cause of injuries in the department?"

(2) "What have you done in the past to prevent this type of injury?"

(3) "What do you plan to do in the future to prevent them?"

After each question was asked, a period of five to ten minutes was allowed for discussion within each smaller group, each participant writing his individual answer on a card. At the end of the discussion time, each group agreed upon a common answer, and the chairman of each group, in turn, stated the answer of the group. These group answers were recorded.

The same process was then followed with the second and third questions. After that the entire audience reassembled and the moderators each summarized the conclusions reached.

Following are the summaries of the group answers to the questions, and tabulations of all the individual answers, taken from the individual answer cards.

SUMMARY OF GROUP ANSWERS
OPERATING DEPARTMENT

QUESTION NO. 1

All groups: slips and falls in getting on and off equipment!

QUESTION NO. 2

Group 1: Educate employee; training and personal contact.

Group 2: Constant field education.

Group 3: Formal investigation of all violations of safety rules.

Group 4: Claimed but not admitted.

Group 5: Good housekeeping.

Group 6: Record of employees classed as "repeaters" and handle with employee for correction.

QUESTION NO. 3

Group 1: Retain and step up education program.

Group 2: Continue and elaborate on field education.

Group 3: Change work habits.

Group 4: Display posters.

Group 5: Get wives and families in on the act.

Group 6: Continue to maintain record of repeaters.

MECHANICAL DEPARTMENT

QUESTION NO. 1

Group 1: Slips and Falls.

Group 2: Struck by objects.

Group 3: Slips and falls.

Group 4: Improper use of tools and improper tools for the job.

Group 5: Improper use of tools and improper tools for the job.

QUESTION NO. 2

Group 1: Good housekeeping; proper footwear; education.

Group 2: Educate, instruct and supervise.

Group 3: (Slips and falls)—Education and housekeeping.

Group 4: Inspection, instruction and enforcement.

Group 5: (Improper tools and use)—Supervision over tools and use.

QUESTION NO. 3

Group 1: (Slips and falls)—Continued stress on good housekeeping and inspection of footwear. Pressure on supervision.

Group 2: (Struck by objects)—Increase education and expand use of protective equipment.

Group 3: (Slips and falls)—Increase supervisor activity.

Group 4: (Improper use of tools and improper tools)—Intensive supervision and use of educational data.

Group 5: (Improper use of tools and improper tools)—Continue the training and reemphasis on supervision.

MAINTENANCE-OF-WAY

QUESTION NO. 1

Group 1: Sprains brought about by careless materials handling.

Group 2: Injuries caused by being caught in or between while handling ties, rails, small machines.

Group 3: Material handling due to being struck by falling, or swinging objects.

QUESTION NO. 2

Group 1: Proper supervision.

Group 2: Safety education—visual aids, personal contact, protective equipment.

Group 3: Safer methods combined with mechanization.

Group 4: Same as A, B, and C.

QUESTION NO. 3

Group 1: Educate and motivate supervisors to supervise for safety.

Group 2: Increase mechanization—intensify educational activities.

Group 3: Better job methods—investigating methods.

Group 4: Same as 1 and 2 and more thorough investigation of accidents.

TABULATION OF INDIVIDUAL ANSWERS

Questions:

1. What is the most common cause of injuries in the {Operating / Mechanical / Maintenance-of-way} Department?

2. What have you done in the past to prevent this type of injury?

3. What do you plan to do in the future to prevent them?

OPERATING

QUESTION 1

Getting on and off cars	12
Tripping hazards along tracks	10
Foreign body in eyes	4
Falls, Miscellaneous	3
Carelessness—negligence	2
Throwing switches—sprains	1

QUESTION 2

Employee training	21
Stressed good housekeeping	11
Safety meetings	7

Personal contacts	5
Investigation	5
Observation & correction of rule violations	4
Supervisor training	3
Encourage proper footwear including safety shoes	3
Paint grab irons	2
Encourage suggestions	1

QUESTION 3

Intensify education of employees and supervisors	27
Intensify good housekeeping	5
Concentrate on accident repeaters	3
Closer supervision	2
More personal contacts	2
Intensify proper footwear program	2
Better maintenance of safety appliances on locomotives	2
Investigations of rule violations	1
Better illumination in yards	1
Control speed	1
Full use of lanterns, signals, etc.	1
Stress family safety	1

MECHANICAL

QUESTION 1

Slipping, tripping, falling	20
Improper use of tools	11
Carelessness	9
Struck by falling object, striking against, caught between	6
Poor housekeeping	3
Handling material	3
No protective equipment	1

QUESTION 2

Instructed workers	14
Stressed good housekeeping	14
Education in safety meetings	11
Stressed supervisors' responsibility	9
Instruction on proper use of tools	6
Investigated accidents	5
Stressed safe footwear, hard hats	5
Discuss rule violations with offenders	2
Use absorbent for oil	1
Overhead reels for servicing	1
Proper ladders and staging	1
Enforce blue signal rules	1

QUESTION 3

More pressure on supervisors	18
Intensify worker education	16
Intensify good housekeeping programs	6
Intensify effort thru safety meetings	3
Intensify effort on footwear and protective equipment	3
Revise rules	1
Stress proper use of tools	1
Investigate repeaters	1

MAINTENANCE-OF-WAY

QUESTION 1

Handling material	22
Slips, trips, falls	4
Sprains & strains	2

QUESTION 2

Employe education	8
Supervisor responsibility	7
Employe education in safety meetings	5
Mechanization	4
Use films	2
Emphasize protective equipment	1
Furnish tie tongs	1
Use younger men for heavy lifting	1

QUESTION 3

More education of employes (including safety meetings)	13
More mechanization	11
More supervisor education	8
Improve job procedures	2
More protective equipment	1

COOPERATIVE EFFORT IN THE PREVENTION OF HIGHWAY-RAILROAD ACCIDENTS

By DOUGLAS M. FERGUSSON
Dir. of Safety, Personal Lines, Nationwide Insurance Co., Columbus, Ohio

My employer is a large casualty insurance company, and at work we're naturally concerned with helping people who *have had* accidents. But we are *at least equally interested* in helping people avoid accidents—and the loss of life, limb, and property that goes hand-in-hand with accidents.

Most of our accident-prevention activities are planned and executed in conjunction with other agencies, both private and public. Thus, my employer—a mutual insurance company—joins with other privately owned companies, with semi-public organizations, and with law enforcement officials to promote safety effectively in everyday living.

In combating accidents (wherever they occur), we even forget the whitehot competition that exists between insurance companies; we work cooperatively for safety with some of our most rabid competitors, striving through cooperation to stop the senseless waste of human and material resources. Consequently, I approach the problem of grade crossings with the same desire for cooperative objectivity.

I believe our mission—yours and mine—is one of fact-finding, not fault-finding. To this end, I believe that all of us—highway users and railroad interests—*really want to stop* grade-crossing accidents. To this end, also, I believe that only through cooperation will we be able to make vehicle-train crashes a thing of the past.

Here are several personal experiences which tend to illustrate the importance of cooperation in safety activities.

About three years ago, a woman employee of our companies called me with a plaintive plea for help. She was an advisor to a local 4-H club whose members had undertaken a project to improve a grade crossing in their small rural community. The topography of the crossing involved was such that a motorist had to begin moving across the tracks before he could determine whether it was safe to proceed. If a small rise at the point of the intersection could be reduced and adjacent brush removed, this hazard could be eliminated and motorists would have an unobstructed view of the tracks from a safe vantage point. The interest of the 4-H club was intense, but its efforts had been futile. It had contacted state highway authorities, the department of highway safety, township trustees, county commissioners, and officials of the railroad. Each, in turn, had said that corrective work was the responsibility of the others. The young members of the 4-H Club were demoralized by the apparently hopeless situation.

Shortly after entering the picture, I arranged through the department of highway safety to have representatives of all the aforementioned agencies to meet together to discuss this grade-crossing problem. The result was amazing and significant. Each agreed to supply something to get the job done—one the trucks, one the manpower, one the bulldozer, one the resurfacing of the road, etc.

This was cooperation at work!

Here's another example—not long ago, while I was working on an activity of the grade crossing committee, the thought struck me that many exhortations of the safety professionals may be falling on deaf ears. I reflected, "how can we interest others in this urgent problem?" And suddenly, a solution began to take form. Within a few months, I knew, the Ohio Department of Education would hold its annual school bus supervisors' seminar. Here would be an opportunity to get someone else to tell our story. A telephone call to the Ohio director of pupil transportation set the plan in motion. Although the agenda for the seminar was tentatively set, he was impressed sufficiently with the idea I had to adjust the program.

We would arrange to have a school bus supervisor ride the head end of a crack passenger train. The director of pupil transportation would select the supervisor, with the requisite that he be a capable public

speaker who could impart an effective message at the seminar. Moreover, the director agreed to reimburse the supervisor, in the form of an honorarium, for his first class train ticket. The rest was relatively easy, thanks to the efforts of your good associate, Ed Bleur, and the management of his line.

What we got for our effort was exactly what we need more of—someone telling our story from a veiwpoint which had previously been completely foreign to him.

This is cooperation at work!

Generally, then I think the most urgent task in obtaining safer grade crossings is the job of generating complete trust and understanding on the part of all parties concerned with the problem. A genuine display of desire to bring about improvement is mandatory. We all stand to gain by this willingness to cooperate.

I would like to leave several ideas on how we here today might work to this end.

In a paper prepared for presentation to this group last year, Joseph H. Hayes of The Association of Western Railways had this to say:

"The practical answer lies in both the areas of better observance and enforcement of regulations governing driver behavior and in the construction or installation of more grade separations and protective devices."

I believe there is more practical wisdom in these words than a listener may first realize. From the standpoint of observance, it should be noted that all traffic safety efforts have one common theme-the voluntary obedience of drivers to motor vehicle laws. If drivers can be persuaded to obey laws voluntarily and also to follow the dictates of ordinary common sense, the grade-crossing problem would be greatly minimized. Therefore, it appears that more laws are not needed; what we must have is an understanding, and uniformity of existing laws, coupled with an appreciation of the hazards that exist at any location where trains and vehicles cross at common grade.

We need to explain thoroughly the grade-crossing problem to the public—and to explain in language that is unmistakable, that every layman will understand.

Whether you believe it or not, railroading is a dramatic and romantic occupation. It has its own language, regulations and peculiarities. In themselves, these characteristics are not exclusive with the railroad industry, but I believe that they are not generally understood or appreciated—and that they confuse the public and make our job more difficult.

To illustrate the lack of understanding that exists for railroad words, rules, and foibles, I cite the story that is told of one motorist telling another how he determines whether a train is approaching. He points out that train signals are spaced every one-fourth mile—so if the nearest signal is red a train has just passed, and no more trains can be expected for some time. While you and I know this to be patently false, it is easy to understand how the uninitiated might believe it to be true.

Therefore, I urge all of you, individually and collectively, to undertake a vigorous safety-oriented public relations campaign. Accept every opportunity that is presented to you to make the motoring public aware of the hazards of vehicular movement at grade crossings. Educate the laymen! And create opportunities to get your story told by taking aggressive action to speak before civic groups, PTA's, motor fleet supervisors, law enforcement organizations, and others who have an interest in traffic safety. Only by pursuing such a course can we hope to cultivate the common ground on which we must meet if we are going to achieve measurable success.

As for enforcement, I suggest that in far too many instances this term evokes a picture of badge, gun, and traffic ticket where more is really involved. Commercial and semi-commercial vehicular operations (together with individual motorists) can be subjected to other facets of enforcement, i.e., education, re-training, disciplinary action, or suspension of the driver. The most effective enforcement tool so far seems to be the "near-miss reporting" program. To date, near-miss through National Safety Council reporting has been fantastically successful. Since its inception in January, 1963, eleven carriers have made reports involving operations in 24 states. As you can see, this only scratches the surface—both in the number of carriers reporting and in the number of states receiving reports. Yet, ironically, all letters received to date from recipients of

these reports have been not only highly complimentary, but have also included a plea for more and more reports. This reaction suggests the question, "why aren't *All* carriers in *All* states actively participating in the near-miss reporting program?" It's a good question; I wish I had the answer!

Now I know that many carriers are handling these reports directly with the companies involved in the violations. This approach has some advantages, but I submit that there is more promise for remedial action when the report is received from a third party—say, from the National Safety Council.

Therefore, I challenge each and every one of you—as well as any colleagues absent today—to determine whether your employers are cooperating in this well accepted effort. And if they are not, dedicate yourself to correcting that deficiency. Such a procedure just might lead you to establish a reporting program similar to the Ohio plan (with which you are all familiar) in your operating territory. To this end, we would then achieve not only selective enforcement but selective education as well.

Finally, I would like to make a few remarks about grade separations and automatic protection. It is obvious that if we could eliminate all intersections at common grade, we could eliminate all collisions between trains and motor vehicles. It is equally obvious, however, that not only is the cost of eliminating some 225,000 such intersections prohibitive but highly unrealistic. As for automatic protective devices, I am not sure they are the deterrent to collisions that they are purported to be. I firmly believe these devices do make a genuine contribution to a reduction in the frequency and severity of grade-crossing accidents, but they cannot be relied upon to provide the total solution to the problem. I was amazed to learn, while reading a recent recap of the Ohio plan, that the large majority of violations and near-misses involve a disregard of automatic protective devices.

I am convinced that improved cooperative educational efforts, combined with expanded near-miss reporting programs, offer the greatest opportunity for early favorable results.

I hope that the thoughts I have voiced here today will arouse you—that you, in turn, will arouse your neighbors and the people of your communities—and, finally, that all of the citizens and officials of our nation will be awakened to take cooperative, corrective action.

Active leadership is needed *now*! Progress is not automatic. The world grows better—not because people wish that it would—but because they know that it can, and pitch in and take steps so it will be made better.

The time has come for all of us to push together if we are going to reduce the incidence of collisions at railroad-highway grade crossings. Let's delay no longer: Let's work together and get the job done.

EARTHQUAKE!

By J. C. MacKENZIE
Superintendent of Safety, The Alaska Railroad, Anchorage, Alaska

First, I wish to correct any implication that the title of my assignment may have inferred. I am *not* an authority on earthquakes, and hope that I do not leave anyone here with the thought that I consider myself one. The few references I make in regard to technical information come from the geological survey who *are* experts and authorities on the subject.

Before talking about The Alaska Railroad, I wish to spend a few minutes on the Alaska earthquakes in general. I say "earthquakes" because in the three days following the first and greatest shake, some 52 aftershocks were recorded. Eleven of these aftershocks were of a magnitude of more than 6, and one was recorded at 6.7. Ten of the aftershocks occurred within 24 hours after the initial shocks.

The first and greatest of the earthquakes began at 5:36 p.m. on Good Friday, March 27, 1964. This earthquake started much like previous Alaskan earthquakes. However, it turned out to be much different—it kept increasing in momentum and violence until it reached its greatest magnitude and subsided somewhat faster than it had increased. It was recorded with a Richter magnitude of 8.6 and it released at least twice as much energy as the earthquake which did so much damage to San Francisco in 1906. The first shocks lasted up to four minutes in some areas and were felt on land over an area of half a million square miles. This earthquake generated the most disastrous of the tidal waves which followed, and, together with the tidal waves, accounted for the loss of more than *100 lives* and property damage of *half a billion dollars.*

The epicenter of the March 27 earthquake was in northern Prince William Sound, about 80 miles east of Anchorage, in a region of high rugged mountains with many glaciers, the mountains rising from the shore line of fjords. The small cities of Valdez and Cordova are 40 and 70 miles, respectively, east of the epicenter. The port of Whittier is 40 miles to the southwest and the port of Seward is approximately 100 miles to the southwest.

The land to the west and southwest of the epicenter and subsequent epicenters generally subsided—in some areas as much as 10 feet. East of the epicenter the land uplifted. One island 80 miles in length and 20 miles in width, was uplifted 35 feet in some places.

The shocks triggered avalanches and rock slides throughout the southwest Alaska mountains and the submarine landslides triggered and generated the great tidal waves which struck all along the Alaskan coast, from Kodiak Island to Cape St. Elias. The big wave raced south and hit the coasts of Oregon and northern California.

The seismic waves varied greatly in height and in force. One surge of water entered Valdez Arm and deposited debris at a mine 170 feet above sea level. Normal tides along the Alaska Coast in Prince William Sound run as high as 14 feet. (Kodiak, Seward, Whittier, Valdez, and Cordova are the larger communities in this area.) The first high seismic wave hit at low tide throughout this area. Had it hit at high tide, it is believed that more lives would have been lost, and there certainly would have been greater property damage. When subsequent seismic waves hit on higher tides, people had moved to safe elevations.

It is fortunate that no tidal waves occurred on Cook's Inlet, because the tide level at 5:36 p.m., on March 27, was at the 30-foot mark at Anchorage. Some tides rise to 33 feet in this location.

The Alaska Railroad was extensively damaged by the earthquake. Damage was caused by;

1. Seismic shocks
2. Land slides
3. Tidal waves
4. Subsidence
5. Fractures through right of way, bridges and buildings
6. Fire

7. Inundation and wave action on subsided areas during high tides.

The Alaska Railroad's headquarters, mechancial shops, B & B shops, supply department, and main yards are located at Anchorage. Power failed in Anchorage with the first shock, which probably accounts for the fact that there was not one fire in the Greater-Anchorage area during the first three days.

All personnel whose homes were not too badly damaged, and who could work their way through debris, fissures and other obstacles, reported to their job locations within a few hours. Telephone communications were dead. We were able to reach two trains north of Anchorage by radio and "tie them up," and also one train south of Anchorage, which, fortunately was stopped at a station when the quake hit, because it could not have moved in either direction anyway.

All other means of travel being impossible, surveys were started by air early the next morning. By using helicopters and small airplanes, we got our first knowledge of the extensive damage to the railroad outside of Anchorage.

In Anchorage, the railroad was damaged by land slides, tracks warped out of line, and subsided ground in the yards. A few buildings were damaged to the extent that they had to be removed. All buildings were damaged to some extent, as were service lines.

In our supply department, bins and racks were emptied and then scrambled. Part of the material yard was covered by thousands of tons of muddy clay from the land slides. File cabinets everywhere were overturned and emptied. You can imagine the resulting mess.

The railroad immediately went on 7 days a week, and long days for almost everyone. Hundreds of new employees were hired and new track and bridge gangs were activated. Hiring continued throughout the summer and fall.

Railroad power and water cars were utilized for emergency power and sanitation purposes. Until the telephone system was back in service, radio played a major part in the railroad's operations.

Our communication lines were in extremely bad condition. We started men out north from Anchorage to clean up the open wire circuits. The men spent days taking wraps out of the open wire. Their work was complicated when new wraps were thrown into the lines by the subsequent earth shocks. By Sunday night, March 29, they had the microwave system in operation to Portage, south of Anchorage. This, despite the fact that two high towers had been badly damaged. All microwave stations were damaged to some extent.

The Alaska Railroad southern terminal is located at Seward, Alaska. The earthquake was strongly felt in Seward but ground motion was minor compared to the massive destruction inflicted by submarine landslides and seismic waves. Large fuel tanks were ruptured and ignited. The burning fuel was spread by the tidal waves along the waterfront. More than 4,000 feet of railroad yards along the waterfront disappeared into Resurrection Bay, taking with them the docks, warehouses, and many fuel storage tanks belonging to oil companies. Two docks disappeared completely, as did the small boat harbor. Most of the fishing and pleasure craft berthed here were demolished. The few boats which were not completely shattered were carried inland, some as much as a mile, and deposited there when the water receded.

The railroad's marginal docks and transit sheds were destroyed. Two gantry cranes, a big stiff-leg derrick, six straddle carriers, and other dock equipment toppled to the bottom of the bay. The railroad yards were destroyed as was most of the rolling stock in the yards at the time. Locomotives were rolled like tank cars.

Our sea train terminal is located at the port of Whittier. The seismic shocks did a considerable amount of damage to the railroad docks and slip towers; oil tanks were ruptured and an oil dock and an older army dock disappeared. Fire completed the destruction of many oil tanks, a lumber mill and some frame buildings.

The tide at Whittier was at the 1-foot level. About two minutes after the first shock, water in the bay rose quietly about 26 feet. This water carried no debris, and receded to about normal. Approximately one minute later a wave came in. This wave was about 35 feet high and carried much debris when it hit the area of the railroad

depot. Within a few minutes another wave of about the same height occurred. A barnacle covered boulder of 4 cubic yards was deposited on the tracks near the depot.

Track north of Anchorage was damaged in places by subsidence, landslides and by being thrown out of alignment by the shakes. South of Anchorage the damage was tremendous. One slide, a few miles south of Anchorage, took out more than 1,400 feet of track and grade.

The railroad follows the north shore of Turnagain Arm of Cook's Inlet from Potter to Portage, south of Anchorage. The mountains along this section rise abruptly to an elevation of more than 5,000 feet. Track and grade sustained extensive damage in the fill areas. The land subsided from 4 to 9 feet in places, and most of the track and grade in the fill areas looked as if the track had been laid on rolling ground. The high tides of April 13 and 14, augmented by strong winds, washed out many sections of grade before tracks could be raised to the desired elevation and rip-rapped. These April tides moved in ice floes which also did much damage to the bridges.

The Whittier Line branches off at Portage. There are two tunnels on this branch, one about two and one half miles long and the other one mile long. It is interesting that no damage was done to any of the tunnels, with the exception of a small amount of fallen rock. The tunnel portals are 4 feet lower than before the earthquake. The entire mountains through which these tunnels pass must have subsided. We have hauled and placed a million and a half cubic yards of gravel and rock for rip-rap. It will take twice that amount more to raise the grade to the desired elevation.

The railroad from Seward to Portage also suffered extensive damage, especially in the low elevation sections. In one place, a landslide moved a section of grade and track into Kenai Lake.

The railroad bridges took a terrific beating. A great many were totally impassable. The ground movement generally relieved itself at the water courses or ravines, compressing the bridges and laterally displacing the grade as much as 8 feet. Piers and abutments were displaced both laterally and horizontally. Most of the span-to foundation connections were sheared with anchor bolts failing mainly in shear. However, some failed in tension where the pedestals rotated. Bridges were temporarily repaired to the point where we could operate. The new permanent structure program is now getting under way.

On April 5 the first train was run north from Anchorage to Fairbanks. On April 20 the first train was run from Anchorage to Whittier. Since that time regular service has continued.

Until the slip was rebuilt, a huge floating crane was used for loading and unloading at Whittier. The first train to Seward was run on September 13. As there are no dock facilities at Seward, service to that city will be intermittent until the new dock and yards are ready which will be late in 1965.

I would like to conclude my talk with a few words about Anchorage—Alaska's largest city.

I leave it to your imagination, and let you picture in your minds, a city of some 80,000 people smashed to its knees and surrounded by devastation. All utilities were immediately knocked out. Miles of water, sewer, electrical, and communication lines were heavily damaged. Streets were torn and buckled. Many buildings in the city were completely destroyed, others badly damaged. Several entire blocks in the heart of the business district sank as the ground underneath started to slide. There was damage everywhere. Anchorage's exclusive residential area, "Turnagain by the Sea," did not escape. Seventy-nine beautiful homes there were destroyed as the ground crumbled, some sliding seaward as much as a quarter of a mile. The individual homes in this area are valued at $40,000. to $100,000.

There was absolutely no panic. I can say to you without reservation that when the need arises we may continue to have complete confidence in our fellowman. All people of Alaska joined hands and set about doing what had to be done. Neighbor helped neighbor, and stranger aided stranger.

A superhuman task was accomplished when electrical power was restored to large areas by Sunday afternoon. Temporary restoration of water and telephones followed closely, as well as sanitation facilities. The seemingly impossible was accomplished in record time.

Then began the task of "digging out." This has been accomplished in a large measure, and we are still on our feet.

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