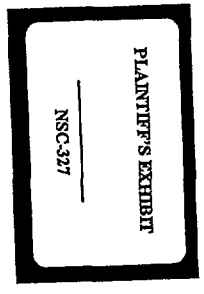
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Papers Delivered in the Marine Sessions

Economic and Insurance Impact on Recent Safety Trends ..... *Paul M. Poliak* 3

Safety on Offshore Pipelaying Equipment ..... *E. B. Touchberry* 8

The Impact of an Alcoholism Program on Safety ... *John J. Hennessey* 13

Longshoring Safety and OSHA ..... *Bernard Samers* 17

Container Operation Safety ..... *Raymond L. Cunan* 18

Hazards & Safety Problems Involved with the Cleaning of Tank Barges ..... *Thomas A. Wolfe* 26

Polyurethane Chemicals, Foam and Solvents for the Barge Industry ..... *William J. Purosky* 29

National River Academy's Role in Safety Training ..... *William F. Fassler* 36

Care, Use and Inspection of Hoists ..... *J. T. Wilson* 41

The Hoisting Triangle ..... *Robert DeBenedictis* 45

Public Relations and Safety Does Work ..... *James E. Feeny* 55

Forty Years of Safety Communications on the Great Lakes by Means of Radio ..... *J. D. Cain* 58

Marine Fire Safety Training at Texas A & M University ..... *Albert G. Stirling* 67

Safer Tank Entry ..... *Hugh M. Stephens* 70

Ro/Ro—the Van Ship Stowage for Safety ..... *Capt. R. J. Murray* 76

Waterfront Facility Safety ..... *Cmdr. John L. Patterson* 80

A Safety Analysis of the Foreign Tanker Boarding Program ..... *Cmdr. William J. Ecker* 84

Improved Marine Safety Through License Examination Modernization ..... *Lcdr. William G. Wohlfarth* 91

Officers of the Marine Section—1977-78 99

Dates for 1978 National Safety Congress & Exposition 103

Other Volumes and Order Blank for NSCTransactions ..... Back Cover

78 2053

Marine Sessions

ECONOMIC AND INSURANCE IMPACT ON RECENT SAFETY TRENDS

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For the past 20 years or more, numerous organizations, committees, investigations, surveys, and reports were involved in the complex problem of fish boat safety and its related insurance matters, and from all these activities, while some safety features did develop, nothing on a concerted, organized, nationwide approach to the problems occurred.

In the past four or five years, however, somewhat more of a crisis has developed, which has awakened the industry to realize that no longer can they simply "study" the problems and hope that they would then simply go away. First, let's briefly review the nature of the fishing industry in the field of safety and insurance.

Ownership

To a great extent, the fishing industry is still a rugged individualistic type free enterprise system. A high percentage of the vessels are owned and operated by a sole proprietorship, or at most, small fleets may be owned by companies specializing in a particular field and area. It is not an industry with numerous government owned and operated vessels as in some countries, nor, as in other countries, is all or the bulk of the fleet owned by one or several large corporations. The problems that exist, the costs involved, and the steps required to resolve such problems is at the grass roots level with the individual owners.

Payment for Injuries and/or Illness

The fishing industry is, as our Merchant Marine in general is, free of compensation-type statutes covering injuries and illness such as the Longshoremen-Harbor Worker Act or state compensation acts. Liability of the owner to his crew is still based on general maritime law and Jones Act principles.

The general maritime law sets forth rights and/or obligations. First, maintenance, cure, and unearned wages rights and, second, the crews' right to a seaworthy vessel.

Insofar as maintenance, cure, and unearned wages, this concept dates back to ancient history, and in fact was probably one of the first if not the first compensation type rights to employees. Simply stated, when a crew member becomes injured or ill while in service of a vessel, he is entitled to maintenance at about $8.00 to $10.00 a day. This is paid to him while he is an outpatient and is to compensate him for the lodging which he is losing while not aboard the vessel.

Cure simply means that the owner is obligated to furnish medical attention to the man should he become ill or injured while in the service of the vessel. In many areas, Public Health Service is available for this treatment, and this lessens the burden of the owner.

The unearned wage concept means that once a crew member becomes ill or injured, he is entitled to his wages to the end of the voyage, which in the fishing industry the courts have interpreted to mean is to the end of his employment period, generally meaning to the end of the fishing season. This in some areas, such as in the Alaska crabbing industry, can be substantial, meaning that if a man

breaks a wrist or a finger and requires several or more months of outpatient care, he is entitled to his lost wages during that period, which can be considerable sums should the catch be successful during that period. On some boats this could amount to as much as $8,000 to $10,000 per month.

These rights of maintenance, cure, and unearned wages are an absolute right. There is no need to prove negligence or unseaworthiness—it's a liability without fault. The vessel owner must pay and, in fact, is penalized should the condition become aggravated due to his refusal to make such payments.

And still, under the general maritime law, the crew member has a right to a seaworthy vessel. Here again, regardless of how careful the vessel owner is, if in fact the vessel is judged to be unseaworthy and this was the proximate cause of the injury, the owner is liable regardless of how careful or prudent he was preparing the vessel for its voyage. Liability with respect to unseaworthiness gives rise to compensatory damages over and above the maintenance, cure, and unearned wages discussed above; that is, the crew member would be entitled to compensatory payments for pain and suffering, future lost earnings, any permanent injury consequences, loss of consortium, etc.

The Jones Act likewise provides a crew member rights to compensatory damages similar to those available under the general maritime unseaworthiness doctrine. Under the Jones Act, liability is based upon negligence, while under the Longshoremen and Harbor Worker Act, when a man is injured there is no dispute as to his rights to full payment as provided under the Act. There is a set schedule for temporary total disability and scheduled awards for permanent partial disability. He need not prove fault; these rights are automatic.

A seaman, on the other hand, under the general maritime law, likewise has an absolute right to maintenance, cure, and unearned wages (that is, generally speaking, because there are a few very limited defenses to maintenance and cure), but to get the larger amounts covering future lost earnings, pain and suffering, permanent partial disability losses, etc. he must prove unseaworthiness under the general maritime law or negligence under the Jones Act.

Regulatory Bodies

A fishing vessel is not subject to United States Coast Guard inspection or to related inspection laws. This is a concession to the industry by Congress, so, generally speaking, a fishing vessel is not subject to inspection and not required to meet the inspection standards as promulgated by the Coast Guard regulations. Likewise, a fishing vessel is not subject to load line. Here, again, is a specific Congressional exemption to the industry.

In the area of manning, there likewise are certain exemptions and concessions to the fishing industry. Under 46 USC 222, etc. the government granted the Coast Guard authority to set minimum requirements for the number of officers and crew aboard vessels. This law, for example, sets out that all inspected vessels must have a licensed master, and it further sets out for different size vessels the number of licensed personnel. However, here again, keep in mind that all of these requirements and all of the authority given the Coast Guard deals with inspected vessels. A fishing vessel is not subject to Coast Guard inspection and so is not subject to these manning requirements.

Of course, the Officers Competency Certificates Convention, which was incorporated in our law by 46 USC 224(a), does require all vessels on high seas to have a qualified officer if over 200 gross tons. So if a fishing vessel is over 200 gross tons, then she, of course, must have a licensed master.

Speaking in very broad, general terms, if in fact the fishing boat inspection exemption is taken away, we would have to turn to the numerous complex Code

sections dealing with various size vessels for inspection and manning requirements. We should keep in mind, though, that the Coast Guard does have special regulations and inspection laws for vessels under 200 tons that are not fishing vessels and that deal to a great extent with small passenger boats. It is argued that this would be the type of law that should be tailored for fishing vessels should it be desirable to put fishing vessels under Coast Guard inspection.

Lastly, in reviewing the nature of the fish boat owner and fishing industry with respect to safety and insurance, we must keep in mind that the fishing vessel owner is a business man and, like any other business man, he hopes to make a profit. To make a profit, he has to be sure that the outflow, representing the cost, is less than the inflow, representing the fish catch revenues. Unlike other business men, we must remember that insofar as expenditures relative to safety and training are concerned, the immediate beneficiaries of the program may be the owner himself, his immediate family or friends; therefore it adds an extra burden in his decision making process when it comes to expenditures in the realm of safety and training.

Recent Developments

What is all the fuss about at this time and what is happening in connection with fish boat safety and insurance?

A few years ago, boat owners in the tuna fleet of Southern California and in the various New England fishing fleets found themselves lacking in what they considered an acceptable P&I market from a cost-wise approach as well as not having a market readily available. This development arose from a number of reasons which we will not go into, but resulted in the owners, as so often happens, particularly in recent times, turning to the federal government for assistance and guidance. Rightly so, the National Marine Fishery Service called a two or three day conference in Washington D.C. to discuss the alleged problems. After several days or more of such sessions, an ad hoc committee was formed, of which I had the privilege of being a member. For several years, meetings were held in different parts of the country as well as Washington, D.C. to study the problem. From these meetings it was obvious that the insurance industry was ready and willing to serve the fishing industry. They in effect said, "You tell us what type of protection you wish and we will give it to you, keeping in mind that we are a free enterprise-orientated industry, and for every dollar we collect we must keep something out for profits." So in effect, there wasn't an insurance problem, it was a cost problem.

It was also obvious from the meetings and generally accepted that there was an ample opportunity to reduce the risk element and in turn the accidents which cause the injuries to fishermen and damages to vessels and which greatly affect the cost of the insurance. These risks could be reduced through a sound, effective safety program to which the industry seemed to be receptive; in fact, it was disclosed that in parts of the country, particularly in Alaska, New England, and the tuna industry, programs were moving along.

It was also obvious that there were really no overall meaningful statistics or data available to determine that the loss rate in the fishing industry was worse or better than any other industries. It was also apparent that though the condition of the fishing vessels was a contributing cause to losses, the lack of applied knowledge and know-how of crew members was also a principal cause. This would tend to dictate a need for a training program.

Another important point that the industry was considering was whether or not the present compensatory type of system for injuries and illness was the most efficient and economical one to serve the industry. That is, one based on the need to prove unseaworthiness and negligence in order to collect amounts

over and above the maintenance, cure, and unearned wages. For some time there were strong advocates for the industry to sponsor legislation, and in fact a bill was introduced in Congress by Congressman Downing of Virginia, whereby generally the general maritime law and Jones Act rights would be eliminated in exchange for a compensation type act similar to the Longshoremen and Harbor Workers Act. However, after studying the statistics and the results of the 1972 amendments to the Longshoremen and Harbor Workers Act, it was found that now it took sky high premiums to obtain longshoremen and harbor workers coverage and, in fact, costs of the longshoremen and harbor workers coverage has threatened to drive small business out of the industry and/or forced them to operate on a strictly uninsured basis. For such reasons, at least at this time, the consensus appears to be that from an economics point of view the retention of the general maritime law and Jones Act system is in order.

The industry also began to realize that not only were there immediate safety problems involved, but that long range problems were arising. With the advent of OSHA, Congress in effect mandated to OSHA that in any area where there were no Federal standards covering the safety and working conditions of employees, OSHA was to affirmatively set such standards. As discussed above, the fishing fleet at the present time is not subject to Coast Guard inspection, and herein lies a wide open field for some action to be taken. The same is true with respect to uninspected tugs.

The Coast Guard at various meetings, and rightfully so, advocated that if in fact safety standards or inspections are necessary in the fishing fleet, that traditionally the Coast Guard has been in the maritime field and has the knowledge and capacity within reason to undertake such tasks.

It was further obvious, with such a trend, that if the fishing industry itself did not take affirmative action in setting up safety inspection and training programs that they very likely would be faced with government regulations and standards to which the industry itself would not necessarily agree.

In talking to knowledgeable marine consultants in the Pacific Northwest, I asked what problems they forewaw should fish boat inspection laws be passed. In broad terms they replied that probably a more detailed stability test involving extra costs and time could run anywere from $2,000 to $5,000 for that project. They also could foresee the need for extra stability such as smaller tanks, more bulk heads, heavier hull structure, additional framing requirements, etc.

A former Coast Guard OCMI, now a consultant in the Pacific Northwest, made an off-the-cuff opinion that, depending if the vessel was old or new, wood or steel, etc. and involving tonnage up to 300 tons, to comply with existing inspection laws could run between $30,000 to $150,000 and then, of course, it would have to be kept up to regulation from thereon. However, he did further indicate that if it involved a new construction of a fishing vessel, that the relative costs to put her under existing inspection requirements would be considerably less than trying to put an older existing vessel under inspection.

Keeping in mind the immediate and past problems of safety and insurance and considering the potential new legislation and regulatory mandates that may be forthcoming, the fishing industry, not only on a national level but on local levels, is moving to set forth its own voluntary fishing vessel safety standards, training, and inspection.

On a national level, there is being organized the National Council of Commercial Vessels Safety and Insurance, whose designated purposes will include: to promote safety standards in commercial fishing vessel construction, maintenance, and operation; to promote training programs on safety; to provide to commercial fishing industry and its related services up-to-date information on safety developments; to create an information system for reporting, evaluating, and distributing statistics and analyses on safety, accidents, and related topics; to provide technical assistance as may be appropriate in safety and insurance matters; to act as an intermediary in dealing with government agencies involved in matters of vessel safety and insurance and a number of other such goals or purposes, including to seek funding, both from private as well as government sources for implementing any of the functions described herein.

Likewise, in many areas at this time, underwriters have taken steps to be more thorough insofar as their underwriting techniques are concerned. Previously, the marine surveyor's condition and valuation survey would be sufficient for underwriting a risk. Today, particularly in the crabbing industry in the Pacific Northwest, stability tests and reports are required prior to attachment of any policy.

In the New England areas, boards and safety committees have been set up and, we understand, are taking steps for inspection and setting standards.

In Alaska, independent of the National Council, AFSAC (Alaska Fishery Safety Advisory Council) has been organized and has invoked many safety innovations already, including seminars on the use of equipment. They have already heard testimony from surviving crew members on vessels that have been lost. Were it not for survival suits, which were advocated by AFSAC safety committees, these crewmen would not have survived the sinking.

Although subject to criticism for a number of reasons, particularly the exclusive arrangements of administering the underwriting program (that is, giving rights to only one broker, thereby making the safety program less accessible to vessel owners with broker or fleet preference) AFSAC has developed a connection between their program and some underwriters. To date, we are unable to state if or how successful the program is; however, regardless of the success of that particular program, this is evidence that should the fishing industry come up with a sound, workable, voluntary safety program including inspection and training of personnel, the insurance industry can't help but respond with either lower premiums or broader, more readily available insurance markets.

There is room and a need for these programs to expand, both on the national and local levels. The consensus appears to be that, as between OSHA and Coast Guard, it is more logical to involve the Coast Guard with the voluntary, industry-wide, sponsored safety program. The problem, of course, is to approach the problem on industry-developed, sound economic principles and not simply to expand and create larger bureaucratic regulatory bodies.

The challenge to the fishing industry to take steps in its own behalf to reduce the number of accidents in return for economic gain is not only here but is necessary to save the industry as we now know it.

SAFETY ON OFFSHORE PIPELAYING EQUIPMENT

By E. B. TOUCHBERRY
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Contrary to popular belief, safety requirements for each different phase of industry do not have to be a completely different concept, or unique or complicated set of standards, regardless of the category in which the project or work may fall. When properly applied, the basic principles of safety will, probably over 90 per cent of the time, fit or coincide with any job assignment.

It has often been said that it is most difficult, or near impossible, to implement an adequate safety program on offshore pipelaying equipment. Actually, the implementation of a safety program on offshore equipment is no different from setting up a safety program on any land based operation. Except for a few unique or unusual circumstances, the basic principals of safety apply on all ofshore equipment. That is, on offshore pipelaying equipment we have to deal with use of personal protective equipment, rigging, flammable liquids, firefighting equipment, ladders and scaffolding, heavy equipment, noise control, entry into enclosed areas, shop equipment, lock and tag out of electrical switches and valves, etc. This list could go on and on, and would almost be identical to any land based operation. As an example, on any land based operation, when making a lift with a crane, the use of tag lines is essential for safely maneuvering or positioning the load. By applying the same basic safety principals of using tag lines on all lifts, loads handled on offshore pipelaying equipment can be maneuvered or positioned safely.

Another good example or comparison of offshore and land based safety is eye protection. On offshore pipelaying equipment there is almost continuous use of portable grinders and bench grinders. Again, by applying the basic safety principals of proper eye protection and tool inspection and maintenance, an employee on offshore equipment can work just as safely as an employee on any land operation.

On offshore pipelaying equipment there is continuous welding for 24 hours a day, seven days a week. Again, by applying the basic safety principals for welding operations, the welders on offshore pipelaying equipment work in as safe an atmosphere as any welder on land.

Through these few examples, it is easy to see how closely related safety requirements are for both offshore and onshore job assignments.

We have various sizes of offshore pipelaying equipment which are of two basic hull designs: conventional, which has a flat bottom hull, and the semisubmersible, which has columns supported by twin hulls. This equipment is not self-propelled. It is towed to location and, when set up, it is positioned or maneuvered by its anchors.

The deck size of Santa Fe pipelaying equipment (barges) ranges from 160 feet in length and 65 feet in width to 400 feet in length and 106 feet in width. Most of the pipelaying equipment is equipped with a deck crawler crane and a revolving derrick crane with capacities ranging from 400 to 600 tons slewing to 500 to 1,000 tons fixed over the stern. Depending on the size of the equipment, living quarters are provided for from 40 to 230 employees.

The most common method of laying pipe offshore is welding joint by joint, and the configuration of the barge deck, or deck layout, is such that the pipe ramp is located along one side of the deck or down the middle. Those with the pipe ramp down the middle are referred to as "center lay" barges.

Another method of laying pipe is the reel method. Santa Fe is the only company with this capability. At the present time the reel method is limited to small diameter pipe up to 12-inch o.d. The reel barge is designed to lay steel pipe at rates up to 10,000 feet per hour. The reel barge is equipped with a 79-foot diameter reel. Pipe is spooled onto the reel at the pipeline bases, then the barge is towed to location and the pipe is unspooled. The pipe reel has a capacity of approximately 20,000 feet of 12-inch o.d. pipe and 240,000 feet of 4-inch pipe.

As mentioned earlier, offshore pipelaying barges are of various sizes, but they all have one thing in common; limited space. The deck of the larger Santa Fe pipelaying barges is 106 feet wide. When you consider that in this 106 feet of space there is the pipe ramp, running the length of the barge, storage areas for the 40-foot pipe sections and other materials, and that space must be provided for a crawler crane, and in some cases a forklift to operate on deck, you can readily see that everything has to be kept in its proper place.

You are all aware of the important role orderliness (housekeeping) plays in any safety program; on offshore pipelaying equipment, orderliness is a must. Not only is there limited space in each area on the equipment, or for each operation that might be performed, due to the movement of the equipment caused by wind and sea conditions, there is the added necessity for securing materials or equipment which would be considered secure and stable on a land operation.

You need no imagination to realize that offshore pipelaying equipment is continually in motion. This continuous motion definitely increases the hazards involved in various operations aboard the equipment. For example, when rigging for a lift, not only does it require good balance on the part of the employee, he is confronted by movement of the slings, trying to attach shackles when the object he is rigging is moving with the roll of the equipment. He has to be alert and prepared when the lift is made from the deck or storage rack because most assuredly as soon as the object is lifted, it will swing; how far and which way depends upon the roll of the equipment at the time of the lift.

Another hazard, ever present, is transferring employees to and from offshore equipment. According to the equipment, this is accomplished by-climbing to or from vessel and crew boat, riding Bill Pugh nets (personnel baskets), or helicopter. The hazard involved in transferring personnel is directly related to wind and sea conditions. In many cases transfer cannot be accomplished. Transferring of personnel must only be accomplished under the close supervision of a senior supervisor on the equipment.

Although offshore pipelaying equipment is equipped with handrails, the possibility of an employee falling overboard cannot be overlooked. In situations when an employee is required to work over unguarded water or is being transferred to or from the equipment, it is imperative that he is equipped with and is wearing a life work vest.

Probably the greatest potential hazard on offshore pipelaying equipment is morale. Due to the number of employees and length of time spent in such a confined area, offshift recreation is vital in order to maintain good morale so that safety performance does not suffer.

During the past three years the most frequent injuries have occurred to fingers, feet, and legs. The most frequent causes have been material handling and falls. This includes both minor and lost time injuries.

Most safety programs are devoted primarily to the physical side of safety. We at Santa Fe emphasize what we call TSI: Total Safety Involvement. That is, our safety program is directed at both divisions of safety: the physical and the mental. The physical side of safety we can

combat fairly easily because it is something we can see; maybe an employee using a grinder and not wearing eye protection, or an employee working from an incomplete scaffold and not tied off with a safety belt.

However, the mental or abstract side of safety poses one hell of a problem. Supervisors are not mind readers. Unless they know each employee exceptionally well, it is difficult to know what each employee might be thinking at any given time. Due to the number of accidents which occur as a result of body in one place and mind in another, it is imperative to develop good safety attitudes and safety awareness. It is imperative that this development begins with top management and filters down through project management and supervision to each employee. If top management has a sincere attitude and understands the need for and gives wholehearted support and involvement to the safety program, there can only be continuous improvement. However, if top management says it wants a good safety program but fails to get involved and give support, you have not only lost the battle, you have lost the war. The success or failure of a safety program, whether onshore or offshore, hinges on the attitude and involvement of top management. When top management has a good safety attitude, field supervision will be made accountable for directing the work of employees under their supervision in a safe manner and for the safe condition of equipment and facilities.

In order to combat the mental side of safety, it is imperative that each member of supervision know and understand each employee. As mentioned earlier, members of supervision are not mind readers. However, by knowing their employees well there are many times when they can pick up signs from the employee that his thoughts might be someplace else. It may be a tone of voice or a mood which is unusual for a particular employee which should be a signal to supervision that something is bothering a particular employee.

Employees should be informed to let supervision know when they have a problem or are bothered by something off the job. There are many things which could affect or distract an employee, such as financial problems, sickness in the family, an upcoming vacation, etc. Each employee should also be informed that he need not tell his supervisor what his problem might be, unless he wants to, but he should let him know that he does have a problem.

When a supervisor is aware an employee has a problem, he can place him on a job that day which will be less dangerous or less hazardous, thereby greatly reducing the possibility of an accident.

When a supervisor is aware an employee has a problem, he can place him on a job that day which will be less dangerous or less hazardous, thereby greatly reducing the possibility of an accident.

Employee safety awareness can only be developed if management and supervision have a good safety attitude and set the proper example. Unless the supervisor shows concern and is sincere in his safety attitude, employees are reluctant to inform the supervisor of a problem they may have and probably won't. In order to cope with the mental or abstract side of safety, employees must feel free to approach their supervisor with any problem they may have. Employees must be continually reminded that an outside distraction affects not only them, but also their fellow employees.

On the physical side of safety it is imperative that only adequate and proper tools and equipment are purchased. Before any tools or equipment are put in use they must be inspected to ascertain if any safeguards must be added or any changes made to ensure the safety of employees, such as installing additional guards, removing trigger locks from power tools, etc. It should be noted here that a tool or piece of equipment can only be used or operated by those employees who are qualified in its use or operation.

In our efforts to promote total safety involvement, we at Santa Fe use the following safety tools.

Safety—the prevention of accidents—must start when and where and by the same means that any phase of the work starts: at the planning stage. No work has ever been accomplished without some degree of planning; the more thorough the planning, the better the result. Thus, the people responsible for planning (the craft superintendent, the engineers, the department heads, and other supervision) will secure a degree of accident prevention in their work in proportion to the thoroughness with which they participate in initiating and executing planning for safe work. We at Santa Fe require all work to be pre-planned prior to the beginning of each phase of each project. By so doing we know who, does what, when, why and how before the work begins.

Our next safety tool is the safety orientation. Each new hire is given an orientation to familiarize him or her with the company's safety program and explain their role in the overall safety program. Equally as important is the safety orientation for supervision. All of a sudden, the employee promoted to supervisor is not receiving the safety instruction, he is now giving safety instruction. It is essential that he be oriented as to his safety responsibilities as a supervisor.

As with any safety program, there are many procedures or guidelines used to assist employees and supervision in their safety responsibilities. It is no different in our offshore pipelaying operations. Besides the federal government regulations, numerous foreign country regulations, our procedures are in the form of employees safety handbook and company safety manual. Many of the items I have previously mentioned are covered in the safety manual, with additional procedures for weekly safety meetings, fire drills, abandon ship drills, and the like. It is our policy to have one basic set of procedures which are used throughout the work. As previously mentioned, we do have to abide by governing agencies in many countries.

Another safety tool which we feel is of prime importance is job placement and safety instructions. It is most important that each employee is assigned on a daily basis to a job that matches his capabilities and it is equally important that each foreman or supervisor gives safety instructions with every job assignment everyday. We feel that safety instruction is the most important safety tool we have. By giving the employee safety instruction with each job, he is well aware of and prepared for hazards that may exist when the job begins.

Regardless of the number of procedures, regulations, or government requirements that we are required to comply with, they are useless unless supervision accepts their safety responsibility to follow up in the field or on the job and enforce employees to comply with regulations. This follow-up and enforcement cannot be done in a haphazard way or when supervision may take a notion. It is vital to the safety program that follow-up by supervision is done on a day-to-day basis.

The last safety tool is training. Training has always been an important part of any well established safety program. Today, due to the stringent requirements imposed on employers by the Occupational Safety & Health Administration for enforcement of employee safety, training is no longer "important," it is a *necessity*. The day has gone when supervision instructs an employee and forgets about it. As mentioned earlier, supervision follows up and instructs on a day-to-day basis. In order to assist the employer in safety compliance, safety training must be utilized to ascertain that employees understand what is expected of them. We must all remember, an informed employee is an efficient employee.

During the past three years, our safety performance on offshore pipelaying equipment has steadily improved. We have continued to reduce lost time injuries and finish each year with a fre-

quency rate not only lower than our leading competitor, but also much better than the construction industry.

In summarizing, I would like to reemphasize that, basically, safety on offshore pipelaying equipment is no different from safety on any land based operation. Whether onshore or offshore, a safety program can only be successful if the program is supported by and has management involvement. Every effort must be made to continuously create the safety awareness with safety responsibility accepted on a job-by-job, day-by-day basis, and we have to face it: whatever we might be involved with is either safe or unsafe. There is no "almost safe." Whether it be supervision or craftsmen who try to take the short cut in safety, trying to get by without following safety requirements, they are fooling no one but themselves. Every employee on the job must remember that safety involves everything, everybody, all the time, under all circumstances.

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THE IMPACT OF AN ALCOHOLISM PROGRAM ON SAFETY

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The Random House dictionary defines "safety" as: "Freedom from the occurrence of risk or injury or loss."

To rely solely on statistical information in relation to the impact of an alcoholism program upon safety, solely as it pertains to accidents, does not tell the whole story of an alcoholism program's impact upon safety in the sense defined above.

To illustrate, let's take the definition quoted—"Freedom from the occurrence of risk or injury or loss." We could include, just to name a few things, the following:

1. Under "risk" and "injury": bodily accident affecting self or others; death for self or others; early death or severe handicap due to debilitating physiological side-effects of alcohol; early retirement due to debilitating psychological or physiological effects of alcohol.

2. Under "loss": loss of job; loss of family; loss of financial security; loss of job management ability; loss of self esteem; loss of happiness; loss of potency.

To me, the above seems to have enormous import in relation to an alcoholism program.

Besides the obvious connotations "safety" has, it covers a vast territory affecting the individual, his fellow workmen and family, production, demands upon insurance plans, and the company health care system.

Another interesting consideration of "safety" which is not usually emphasized is the carry-over impact of an alcoholism program on off-duty safety. To illustrate, the Illinois Bell Telephone Company, Chicago, Illinois, accumulated data on 402 clients of its alcoholism program from 1951 to 1972. The results in relation to off-duty accidents were:

	5 Years Before	*5 Years After*
Women	32	6
Men	43	22
Total	75	28

The number of on-duty accidents were:

	5 Years Before	*5 Years After*
Women	4	1
Men	32	10
Total	57	11

The above is cited mostly to emphasize that alcohol program impact affects the individual rehabilitated. The rehabilitation is carried over into his behavior and relationships in the social situation.

There is another facet of safety which affects all of us in terms of tax dollars and health-medical services. It is a risk and injury facet which the alcoholism program can and is having an impact on. How extensive that risk and injury area is can be illustrated by the following statistics.

In 1971, the U.S. Dept. of Health, Education and Welfare released a second special report to the U.S. Congress on alcohol and health. The report concentrated on six areas where estimates had been arrived at of the costs of alcohol misuse in the U.S.: The cost assigned to lost business-industrial production was $9.35 billion; to traffic accidents, $6.44 billion; to health-medical services, $8.29 billion; to the criminal justice system, $0.51 billion; to the social welfare system, $0.14 billion; and to alcohol-related programs and research, $0.64 billion—a total of $25.37 billion.

The American Medical Association in 1956 identified alcoholism as a disease which is complex and serious. The alcoholism program that attempts to deal with the disease is moving into an area of medicine in which the questions still outnumber the answers. Despite extensive research, nobody really knows why some drinkers become alcoholics and others faced with the same circumstances do not; why both an alcoholic family background and a completely "dry" background increase the likelihood of alcoholism; why some alcoholics spontaneously cure themselves; why, although alcoholism is a progressive disease that usually develops over many years, a small number of drinkers can drink heavily all their lives without becoming alcoholics, while an even smaller number become almost instant alcoholics.

Alcoholism is a major problem for both labor and management. Currently there are over five million employed men and women who are suffering from the early, middle, or late stages of alcoholism. Most of this group are successful in concealing their illness, since their appearance and manner, and the fact that they are holding a job, does not fit the stereotype notion of the alcoholic as a skid-row bum.

It is difficult to estimate the hidden hazards of this group in terms of safety management and control. The increased probability for on- and off-the-job accidents and the risks involved through the thousands of employees in this group engaged in hazardous occupations are a major concern to safety engineering and safety maintenance professionals. Promise of a national contribution to the reduction of this problem is inherent in a new and rapidly growing movement marking a significant departure from the normal adversary relationship between labor and management. They are getting together as equal and fully cooperating partners in a program focusing on prevention, early detection, and motivation to accept treatment for employees suffering from alcoholism.

Alcoholism is a treatable illness. The alcoholic is a sick person and can be helped to a successful recovery. A forthright, treatment-oriented approach to the problem drinker which helps the employee face his illness and guides him to professional and experienced lay-groups is far more effective than the historical warnings, reprimands, or summary discharge.

With respect to an employee having alcoholism, the combination of unsatisfactory performance, accidents, excessive costs, and the almost certain progressive deterioration of the individual to the point of unemployability if the illness goes unchecked creates a situation which conscientious management and labor should neither tolerate nor ignore.

Recurrent poor job performance due to the use of alcohol becomes a simple, direct, and clear definition of alcoholism. Alcoholism is simply repeated poor work because of the way the employee uses alcohol. The old erroneous assumption that the alcoholic was readily identifiable by the foreman through observing the physical and behavioral symptoms associated with the popular stereotype, such as bloodshot eyes, shaking hands, alcohol breath, loud and obnoxious conduct, and lack of cleanliness and personal grooming, or that any employee not having such readily identifiable signs could not be an alcoholic, have proved useless in identifying the alcoholic.

Behavior is the key. Behavior, not alcoholism, is the keyword from the beginning. Taxing an alcoholic with alcoholism simply starts an argument. Confronting him with the results of his alcoholism—job performance—and the possibility of job loss frequently motivates him into treatment. Job security is the alcoholic's over-riding concern. The alcoholic's health or his wife and children are secondary.

Thus, industry's ability to deal with the problem is genuinely unique. Alcoholics can be reached more effectively through their jobs than through any other aspect

of their lives.

Somewhere, today, the driver of a forklift truck will be involved in a serious accident, not because he is drunk on the job but rather because he is hung over from the night before—because he feels the need for a drink and because his mind and body are preoccupied. Workmen's compensation insurance may be involved as a result of this injury, and the chances are good that he may use some hospitilization insurance coverage.

Another employee will enter the hospital for "stomach trouble," "upper respiratory infection," or some similar socially acceptable diagnosis. Following a short period of hospitalization, he will return to work and receive the usual sympathetic concern from his fellow workers. Nothing unusual will be thought about this period of hospitalization. His wife, however, and perhaps his doctor, will know differently. They will be aware that hospitalization was needed because of the results arising from heavy and chronic ingestion of ethyl alcohol.

Insurance coverages are called upon thousands of times daily to help absorb the chronic and repetitive costs resulting from the illness of alcoholism. This should not be surprising, however, when we consider the magnitude of an illness which affects the lives of so many people in this country. There are few types of insurance coverage that can claim to be immune from the consequences of alcoholism.

The I.L.A. Alcoholism Program is a union-based program being operated under an agreement between the I.L.A. and the New York Shipping Association.

The New York Shipping Association and the I.L.A. have published a joint policy statement regarding the Alcoholism Program. It reads as follows:

1. The N.Y.S.A.-I.L.A. recognizes alcoholism as a disease which is treatable.
2. The N.Y.S.A.-I.L.A. is not concerned with a person's personal decision to drink or not to drink. Our concern is only with the effect alcohol has on the employee's health and, in the case of an eligible dependent, the effect alcohol is having on family life.
3. All medical records will be maintained in strict confidence.
4. Shop stewards, working in cooperation with pier superintendents, will make referrals to the program director and his staff. These referrals will be based upon job performance only. Diagnosis of the problem will be made by the professional staff assigned to the program, located at the N.Y.S.A.-I.L.A. Medical Center in New York.
5. Nothing in this policy statement supersedes already existing negotiated agreements between the N.Y.S.A. and the I.L.A.
6. This policy is to be implemented in a way that will lead to the maintenance of a member's job, health, and home life.
7. Members requesting time off to visit the clinic shall be granted this time as they are for any other job-related health problems that necessitate a clinic appointment.

The key to the job performance referral to the Program is the union shop steward on the pier. In cooperation with the pier superintendent and the foreman, he acts as the liaison between the employee and the Program.

I have visited with shop stewards in all crafts in the Port, asking for their help in implementing the Program. After the initial visit with the steward, I have consulted the company representatives describing their responsibility in the referral process. This was done initially on a one-to-one basis. For the Program to be a success, we had to eliminate any appearance of "finking." The men had to understand what was being done and why it had to be done. The complete confidentiality of the employee or his dependent in

treatment was guaranteed.

Formal training, consisting of lectures and films, has been instituted. All shop stewards and key management personnel are involved on a rotating basis.

78 2056

LONGSHORING SAFETY AND O.S.H.A.

By BERNARD SAMERS
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This study was aimed at assessing the effectiveness of OSHA in longshoring and at identifying some of the fundamental causes for the very high accident rate in the industry. The research, which took place from July 1974 to July 1975, consisted of interviews with OSHA field personnel, maritime trade association personnel, union representatives, managers of longshoring establishments, and longshoremen themselves, as well as the collection of accident statistics and manhour data, almost 7,000 accident reports, and miscellaneous other extant data, studies, and statistics.

This study is the first real estimate of the accident rate in longshoring since 1971. The accident rate in longshoring has not changed very much since 1969. OSHA's effectiveness, judged by this statistic alone, would be in serious doubt.

However, the industry itself has a number of unique and special problems, which make OSHA's task almoust insurmountable. The industry's difficulties and special characteristics are not the often-quoted "special material handling gear, casual labor, and highly hazardous and changing work place." The special problems in this industry are its well documented, inordinately poor industrial relations, complicating effective supervision of work; a long, in-bred tradition of doing things unsafely and accepting it; a serious problem of alcoholism; and a number of economic incentive factors which mitigate against improvement in safety.

There are a number of things OSHA can do to improve its immediate compliance posture, including improvements in the organization and staffing of area offices and changes in policy to achieve more uniform application of the standards, as well as more extensive standards covering new technology, marine terminals, and longshoring procedures. We do not believe, however, that inspection and compliance activities can have a serious effect on the accident rate, given the nature of the industry's problems, without inordinate expenditure of resources and extremely repressive enforcement.

Real improvements in safety, in the past, have been made primarily as a result of changes in the technology of material-handling gear, and these differences between establishments are still demonstrable. Thus it seems that OSHA's best chance of affecting the accident rate will come from aiding and abetting technology through research, promulgation of the positive incentives available in safety and productivity from technology changes, and through long range changes in standards to eliminate relatively hazardous technology.

We also think OSHA needs to do research on the control of alcoholism in industrial situations. Such research should not center on the root causes or prevention of alcoholism, but should center on developing effective methods of preventing alcoholics from maiming themselves and their fellow workers in industrial situations.

Ultimately, the longshoring industry's problems will only be solved when the industry, its unions, and even OSHA, stop projecting the blame for safety problems on other parties and begin to seriously cooperate in hazard reduction. The most likely area for such increased cooperation is in improving the quality, attitudes, and skills of first-line supervisors as a means of reducing the proliferation of unsafe procedures contributing to accidents.

 78 2057

CONTAINER OPERATION SAFETY

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The Pacific Maritime Association Voluntary Container Accident Prevention Program was developed in 1969 and 1970 as the result of meetings with employers, employees, Department of Labor, state, and Coast Guard personnel. The need for such a program was evident. Accident experience in container yards was increasing our knowledge of hazards peculiar to these operations, and the plans for building more and larger container handling docks and ships were well underway.

Rough drafts of the Voluntary Program were written by the Southern California Area Accident Prevention Committee located in Los Angeles-Long Beach, and by the Northern California Area Accident Prevention Committee serving San Francisco-Oakland. The process was somewhat time consuming. The language of each segment had to provide maximum employee safety and be flexible to cover a variety of operations and equipment types. An example of this variety is found in the types of container handling facilities at West Coast ports. Some container yards are designed for straddle truck operations where containers stored in rows from one wide and two or three high are common. Other yards with large transtainers hovering over rows of containers four or five wide and three or four high are used. A third variety is when chassis storage is utilized, with all containers parked on the chassis, using semi-tractors. Each of these have differing equipment and physical layout requirements with unique hazards.

Writing a voluntary program that would be useful in preventing accidents and allow for the versatility of these differing methods of operations required an atmosphere of negotiation during the meeting sessions. The final product is one which can be applied to any type of container operation found on the Pacific Coast. Its application will help identify and prevent accidents recognized as possibilities in these operations.

After the Voluntary Container Accident Prevention Program was written and typed in final draft form, one additional question needed to be resolved about its language, and that question couldn't be answered by the safety representatives and operating personnel who wrote the program. It was a question about legal responsibility and liability that was forwarded to attorneys for an answer.

Specifically, two problems bothered the authors of the Voluntary Container Program in view of the longshoring industries' experience with personal injury lawsuits and claim handling procedures at that time. First, would the adoption of such a program increase liability for accidents; and secondly, would the adoption of such a program cause liability to shift from one group of Pacific Maritime Association members, such as ship operators, to another group of members such as stevedore or terminal operators?

The answer provided by the attorneys to each question was affirmative. Conceivably, the provisions of a voluntary container accident prevention program could become the basis of a court decision as to the scope of the warranty of workmanlike performance that is imposed on stevedores in regard to their third party obligations and also may be of significance in determining whether or not the stevedore or terminal or other person responsible was engaged in "serious or willful misconduct."

However, the Voluntary Container Accident Prevention Program was implemented, in view of the additional comments by counsel and the basic desire among all members of PMA to reduce accidents. The additional comments from counsel pointed out that the failure to have a voluntary program and live up to it may lead to government-imposed safety requirements or standards developed by case law which may or may not be based on practical or effective accident prevention procedures.

It was determined that the original purpose of developing a voluntary container accident prevention program which would reduce injuries greatly overshadowed the negative possibilities of the program being used against the employer in court. The program was then approved for distribution for PMA membership as a voluntary program. Voluntary because it was written without being required by a government agency, and voluntary because individual companies could utilize it in whole or in part as determined by the company.

In the seven years of the program's existence, it has not been used in an attempt to demonstrate increased liability nor caused any liability shift, to the best of my knowledge and available resources. On the positive side, the ingredients of this program have contributed to a reduction in the frequency of container yard injuries.

The Voluntary Container Accident Prevention Program consists of a stevedore segment and terminal segment. The stevedore segment applies to the ship and dock operation and equipment utilized in the handling of containers. The terminal segment pertains particularly to the physical environment, traffic control, and layout of a container yard. These two segments were written to intentionally delineate responsibilities between a stevedore and a terminal, since at some West Coast Ports a separate employer was responsible for the terminal operation of receiving and delivery of containers to the land mode. The terminal operator most likely would have control and responsibility for the terminal physical environment on a full time basis, while the stevedore employer may be present only during the ship operation.

In many container operations, the terminal and stevedoring functions are carried out by the same employer. In these cases, the same employer would be responsible for both the stevedore and terminal segments of the Voluntary Container Accident Prevention Program. This presentation will take you through the various requirements of the stevedore and terminal segments of the Voluntary Container Accident Prevention Program and slides showing types of operations and methods of compliance will be presented.

Container facility types. There are three principal types of shoreside container handling methods. Many yards may be a combination of several methods.

1. The straddle truck picks up the container from under the container crane and transports it to long storage rows where it is placed one, two, or three high. It is again transported to a truck chassis or rail car for inland movement.

2. The travel crane or transtainer method uses semi-tractors to transport the container on a chassis from the container crane to the storage location. The travel crane then places the container in storage rows as large as four wide and four high. The semi-tractor returns to the container crane for the next container.

3. The transfer truck or semi-tractor operation has the container crane landing the container on a chassis and then the chassis is parked in the yard with the container still on it. The semi-tractor disconnects and then hooks up to an empty chassis and repeats the process.

The first section in the stevedore segment deals with container cranes, the key piece of equipment in the efficient movement of containers in each type of operation. Generally, the program requires compliance with all applicable regulations and safety rules that address themselves to these types of cranes.

Specifically, some of the items covered that pertain directly to employee safety are as follows:

1. Means of access and walkways on cranes. Some manufacturers' designs are surprisingly not in compliance with existing standards regarding ladder clearances, cages, and hand rails. Modifications have been made to assure safety of employee operators climbing or descending from cabs. If you have ever climbed one of these large cranes, you will appreciate all of the protection from falling that is available—it is a long way down!

2. Hoisting personnel and equipment. A safe place for employees to ride the lifting beam, protected from falls and turning machinery, is required when employees are to be hoisted aloft using the container crane. Also, a method of preventing cones and bridge clamps from falling when they are hoisted on the beam is necessary.

3. Wheel guards. On rail trucks of the gantry legs wheel guards are considered important in preventing the possibility of employee injury when the crane is traveling. A means of deflecting personnel and preventing contact with the wheel is provided.

4. Communications. Radio or telephone are useful in assuring an efficient and safe operation, depending on the type of operation and equipment used. Crane operators are able to operate only on clearly understood instruction.

5. Emergency shut off devices, clearly marked and readily accessible, are provided for ground personnel. A Stokes basket and first aid box should be available.

6. Warning signs and markings with high visibility colors are used when needed to prevent employee exposure to overhead loads and assist operators of equipment in judging locations.

In addition to the cranes, emphasis on the safety of the containers being hoisted assures that the hazard of dropped loads due to structural failure is reduced. Outbound containers with visible defects are not to be hoisted. Inbound damaged containers that must be offloaded are handled only in a safe manner, which may be by discharging the cargo first or using special lifting precautions. Container operations involve the inspection of the container for damage. Some yards do this at the entry gate, others during the storage or routinely in maintenance cycles. Regulations prohibit the hoisting of containers with visible structural damage which would render unsafe their handling and stowage.

Federal law requires that an actual gross weight, determined by weighing the container and its contents at most container facilities, be provided with loaded containers so that personnel in charge of loading can determine the hoisted weight. In addition, containers must be marked with the weight of the container when empty, the maximum weight the container is intended and designed by its manufacturer to carry, and the sum of these two weights.

Ladders are an essential device in container operations. Both fixed ladders and portable ladders are utilized, and the Voluntary Container Program specifies ladder safety for each. Crane access ladders must provide a safe means of access and egress for the operation and maintenance personnel. Persons are protected by cage and railing where required.

Portable ladders for use in lashing containers are also widely used. These ladders must extend 36 inches above the upper landing platform and be positively secured against shifting or slipping. Of course, ladders must be of adequate strength and in good condition.

Fixed ladders are also found on vessels' decks for access to cell lids and stowed containers. These must be in good condition and free of grease or oil. Access to the ladders must be free of lashing materials and cones.

Hazardous cargo is handled in container operations with special care. All cargoes are labeled and placarded in accordance with DOT regulations. Prior

to the start of operations, employees handling hazardous cargo are advised of the nature of the hazard and of the precautions to be taken in the event of any leaks or spills. The stowage requirements for hazardous cargoes are complicated but necessary. Often the plans for this aspect of hazardous cargo handling are determined with the aid of computers to assure proper stowage and compatability with the other cargoes.

The documentation requirements of hazardous cargo containers are similar to the requirements for such cargo shipped by conventional packaging methods. The vessel officers, in conjunction with the stevedore and terminal operator, maintain an accurate Dangerous Cargo Manifest which must be kept in a designated holder on or near the vessel bridge.

Illumination is important in both dock and shipboard operation. Efficiency and safety are enhanced by proper lighting. The avoidance of glare and contrast is equally important to illumination levels. The maintenance of existing light sources and attention to detail in planning new yards and facilities has been a key factor in assuring adequate illumination.

Qualification of machinery operators. The Voluntary Container Accident Prevention Program requires only those employees considered by the employer to be competent by reason of training or experience be permitted to operate cranes and power operated vehicles. Some member companies hire and train their own operators from the union hall, while others employ men trained in PMA Joint Training Programs. In recent years, container crane operators, straddle truck operators, and semi-tractor drivers have been trained in major West Coast ports.

Safety rules for stevedore employees are covered in this segment. The language was written to emphasize employee duties and specify procedures for compliance. All safety rules applicable to container operation must be complied with. Employer representatives must set a good example by abiding by the rules and properly instructing each employee on the job in the proper method to be utilized in performing that employee's assigned task.

Contract provisions regarding health and safety are referenced in the voluntary program. All safety rules of the Pacific Marine Safety Code which have application to container operations are to be complied with. This code was originally written in 1929, and has been included in the longshore contract since 1946. Many of its general work rules and safety duties of employees are useful in preventing injuries in modern-day container handling situations.

Additionally, there is a provision in the longshore contract for any employee to refuse to work under conditions which immediately endanger his health or safety. This provision is subject to the contract grievance machinery and is to be used only in good faith for bona fide health and safety issues. In addition to all applicable rules found in the Pacific Coast Marine Safety Code and recognized safe procedures, which are included by reference, the Voluntary Container Accident Prevention Program specifically requires items considered mandatory in container operations.

The first of these is the wearing of hard hats. This requirement of the Voluntary Container Accident Prevention Program was included in its original draft in 1970. This was more than two years before the present OSHA standard requiring hard hats became effective. This requirement in the Voluntary Program was worded to assure employees working aboard full container ships would be provided with hard hats and required to wear them. At that time, the hats were issued on the job to be returned and cleaned at the end of each shift. Subsequent to the OSHA standard promulgated in 1972, hard hats were issued to all Pacific Maritime Employees and procedures for payroll deduction purchase of replacement hats were developed in each port. These hats are now required in all phases of container operations, except where not en-

forced by OSHA.

A major cause of injuries during longshoring operations can be reduced through good housekeeping. Requirements for both employees and employers for effective housekeeping procedures to be enforced are provided. All lashing gear is to be stowed so as to provide a clear working area and clear walkways; lashing devices are to be lowered to deck level and not dropped.

In addition to the wearing of hard hats and good housekeeping, the third set of safety rules covers hazards involving the use of vehicles in the container yard. The container program includes specific rules for straddle truck operation and semi-tractor operation which are intended to reduce injuries occurring from these types of equipment. Straddle trucks are required to have access ladders in compliance with fixed ladder standards and maintained in safe condition. Brakes on the straddle trucks must be equivalent to the requirements specified by the design manufacturer, and they must be maintained in good order. Sprockets and chains that permit employee exposure to the possibility of being caught when they are moving are required to be guarded.

Straddle trucks operating within the container yard are required to have lights providing adequate illumination. Proper mirrors or other equipment are required to be installed so as to provide adequate visibility for the operator, based on design of the equipment.

Operating rules for straddle trucks include requirements that no unauthorized riders are permitted, drivers are required to use proper means of access to and from the equipment, drivers shall not drive equipment under loads being handled by hoisting equipment, and the operators are required to use all the warning devices installed in the vehicle and shall not tamper with such equipment.

The speed of all straddle trucks shall be regulated with the port traffic provisions by means of plainly marked and designated speed zones, lined roadways, and restricted pedestrian walkways in all congested areas.

Warning devices are required on a straddle truck in order that an audible warning for 400 feet from the front and the rear of the truck may be heard by an employee.

Previously mentioned housekeeping requirements which apply aboard a vessel are also applicable in dock operations in that all working areas where persons are engaged in work shall be kept free from litter and passage ways shall be kept open.

Semi-tractors used in container operations are required to be maintained in safe operating condition, with adequate means of access for the operators provided and platforms as necessary existing on the tractor frame for the operator to make airbrake hose connections. Lights and mirrors must be maintained in safe condition. All controls and instruments are required to be maintained in proper working order.

Operators of semi-tractors are instructed to check for a positive fifth wheel pin lock when engaging the tractor to a chassis and to hook up both air hoses when the tractor is hooking to a chassis equipped with brakes. The operator is required to raise the fifth wheel to a safe driving level, depending on the conditions to be encountered in the container yard. Semi-tractor operators operating under container cranes are instructed not to drive away from under the crane until clearance is indicated by dockmen working on the ground. This is in order that the driver will not drive the unit without the container being properly secured to the chassis. Drivers must set parking brakes before leaving semi-tractors unattended. All vehicles, including straddle trucks and semi-tractors operating in a dock container yard, are required to be equipped with adequate warning lights. The use of rotating beacons on all stevedore vehicles is recognized as an effective warning method. This is in order that other operators in the yard are aware of the equipment operating in the

Truck Tractor Trlrs

vicinity.

Thus far we have discussed the stevedoring segment of the Voluntary Container Accident Prevention Program. Primarily those portions of the operation aboard ship and those types of equipment which are normally operated by stevedore employees have been covered. As mentioned earlier in the presentation, when this document was originally written, there was concern that in certain operations the terminal operator in a container yard may be a different employer from the stevedore contractor. For this reason, the terminal segment was written as a separate portion of the document, and for those companies whose employees provided both the terminal and stevedoring services, compliance for them could be based on adherence to the combined package of the stevedoring and terminal segment.

Generally speaking, the terminal operations are required to meet all standards prescribed by the state in which it is located, OSHA, and the Pacific Coast longshore contract.

Working surfaces, such as permanent floors and platforms, shall be reasonably free of dangerous projections or obstructions and shall be maintained in good repair and reasonably free from oil, grease, or water. When the type of operation necessitates working on any slippery floor area, such surfaces are to be protected against slipping.

Permanent roadways, walkways, and storage areas in the yards must be maintained and reasonably free of dangerous depressions or obstructions and debris. Floors and platforms are to be constructed and maintained as to support safely the loads to which they are subjected.

Aisles and passageways are to be kept reasonably clear and in good repair. Where, due to a lack of proper definition, such aisles and passageways become hazardous, they are to be clearly defined by painted lines, curbings, or other means of markings. Where the nature of the work is such that aisleways and passageways become slippery, high friction surfaces, cleats, coverings, or other equivalent protection against slipping is required.

The topic of pedestrians in the container yard is one which presents one of the most persistent problems in container operations. This is a serious problem, since it can result in a vehicle-pedestrian accident, and these types of accidents are often very serious or fatal to the pedestrian. For this reason, the Voluntary Container Accident Prevention Program was strongly worded to minimize pedestrian exposure whenever possible. The program states that authorized pedestrians in the container handling area will be kept at an absolute minimum, and that unauthorized pedestrians will not be allowed in the container yard at all. The program recommends the use of two-way radio communication between clerks and employees handling containers and the marking of containers in large numbers so that clerks may be kept out of the container handling yard. Clerks who must still enter the container handling area should be restricted to marked walkways or should be provided with an adequate vehicle. It was agreed that high visibility vests, used both day and night by all pedestrian employees in the container handling area, are an effective accident prevention tool. Pedestrian walkways are used by pedestrians in container handling areas, and these walkways should be designed to reduce the exposure of these pedestrians to container handling equipment. Areas where pedestrian and vehicle paths must cross are to be properly controlled.

Most large facility container yards on the West Coast use a shuttle bus service where necessary to transport employees from the yard gate entrance to the vessel or other visitors who are required to travel within the container yard. Signs informing vessel crew members, often required to be printed in foreign languages, have been used to inform departing crew members of the proper

procedures to be used.

Also noted in the stevedoring segment, but of equal importance in the terminal operations, is the requirement that night operations must be adequately illuminated. Proper lighting is important in container handling yards, since heavy equipment is in constant use during night shifts and often during poor weather conditions.

Areas of high contrast between bright lights and darkness and the location of lighting sources to eliminate glare are important in assuring adequate lighting in a container yard. Container yard traffic patterns are to be planned and properly publicized to assure that patterns for the delivery and receipt of containers are efficient and that the overall flow of traffic within the yard does not create safety problems. Painted yard markings showing the traffic pattern to be used or handouts at the entrance of the container yard to each driver are methods of indicating traffic patterns. The importance of adhering to indicated aisle markings cannot be over-stressed. It is tempting to an equipment operator to cut through an empty container row to shorten the distance of his journey. However, serious injuries have occurred when the operators of the other vehicles within the yard are not anticipating a short cut in an unauthorized traffic pattern. Once established, the traffic pattern should be enforced and the markings adequately maintained to assure compliance by all vehicle operators.

Although not a part of the original Voluntary Container Accident Prevention Program, some port practices have developed since this original draft which are utilized in container freight stations. These operations have grown to become a part of the overall container terminal picture in recent years. Not unlike the conventional terminal shed receiving and delivering cargo, container freight stations are required to provide for the safe handling of cargo in and out of containers using forklifts and conventional cargo handling methods.

Adequate dock plates are required which will allow forklifts to enter and exit containers on chassis. These containers on chassis must be blocked to prevent accidental movement, and the front of the chassis must be supported to assure that the weight of the forklift and cargo will not collapse the landing gear. Adequate ventilation is required in the container, as well as adequate illumination for the operation at hand.

Procedures previously mentioned for handling hazardous cargoes are applied to container freight station operations, as well as all general safety rules pertaining to the hand-handling or mechanical handling of cargo.

As you have probably determined, many of the ingredients of the Voluntary Container Accident Prevention Program were not new. They have been around for many years and applied to the conventional cargo handling methods. On the other hand, some of the hazards of container operations, particularly those derived from the uses of large equipment and pedestrian control features required that a tailor-made program be developed for the use of all container operations in a given port area. The result of this need was the Voluntary Container Accident Prevention Program. Keep in mind that this program was initiated in 1970, at a time when the impact of container handling on the Pacific Coast Ports was beginning to be realized as a major cargo handling method. Today, the impact of containerization has been greater than was ever anticipated in 1970, with a growth in container tonnage from 8,800,000 tons in 1970 to 23,000,000 tons in 1976.

During this same period, the number of container terminals and container operators has increased as well. For the purposes of this presentation, a special review of our West Coast injury statistics was done in order that those companies that were operating in 1970 could be compared then and now. A disabling injury frequency figure average for this group of companies at the year end 1970 was 59.5 disabling injuries per million man hours worked. A comparison of the same companies operating at the year end 1976 shows a disabling injury frequency figure of 48.8 disabling injuries per million man hours worked. This figure represents an 18 per cent reduction in the disabling injury frequency for these companies during this seven-year period. By comparison, the combined total injury experience for all PMA West Coast operations suffered a 19 per cent increase during the same period. In view of the increase in containers handled and the decrease in container operation injury frequency, it can be concluded that the Voluntary Container Accident Prevention Program has been useful in reducing disabling injuries in container operations, and we feel that it has contributed significantly to the efficiency of West Coast container operations.

78 2258

HAZARDS AND SAFETY PROBLEMS INVOLVED WITH THE CLEANING OF TANK BARGES

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In many respects, safety precautions while cleaning and gas freeing are similar to safety precautions taken in any industrial process. There are some points, however, that make necessary a more intensified safety program in barge cleaning operations. To my knowledge, there is no other industrial process similar to this one from an overall hazardous point of view. In many other processes, the system or the equipment may at some stage of the process present a hazard, but in gas freeing the very nature of the job is hazardous from the moment the barge is tied off at the cleaning area until the job is finished. If there was ever a job that required eternal vigilance on the part of the personnel, it certainly is gas freeing tank barges.

Anyone in the marine industry knows the pressures applied to reduce the down time on the barge, and it is only natural for the owner and owner's representative to press for the fastest job possible. Certainly, speed in accomplishing the cleaning is important, but the cleaning plant personnel must always remember that one of the greatest threats to safety is haste. It is necessary, then, that the supervisor be forever vigilant to prevent action taken in haste without proper regard for safety.

It might be well at this point to briefly describe the nature of the company that I am associated with so that a better understanding may be had of the organization that is necessary to safely and efficiently clean and gas free barges in today's market. Port Allen Marine Service, Inc. is a subsidiary of Midland Enterprises, who operate one of the largest inland water fleets in the nation. Our fleet of tow boats move hundreds of tank and dry cargo barges throughout the Mississippi, Ohio, and Illinois rivers and across the Gulf of Mexico. Our barge cleaning plant is located at Baton Rouge, Louisiana in the very heart of the petrochemical center of the United States. In all modesty, I can say our plant is one of the safest, most efficient, and modern in the industry. As many as 100 barges move through this plant each month. Our personnel are highly trained, safety oriented, and well equipped.

In order that everyone be in a better position to understand and appreciate the hazards of barge cleaning, it is essential that they have a working knowledge of the construction and operation of tank barges. Although barges differ somewhat depending on the purpose for which they were intended, they essentially all handle petroleum chemicals in a similar manner. Different products require different types of tanks or vessels. For all overall purposes, there are three main types of tank barges: single skin, double skin, and cylindrical tank. Then, you can split off into single bottom, double side, cofferdams, double bottom single side, box bow or end piece, internal coiled, external coiled, hot oil system, deep well pump, deck pump, internal piping, deck piping, split cargo piping and piping, etc.

Each barge, even with the same characteristic, presents a different cleaning problem. The last barge or the previous loading sequence can present a different hazard. No two barges or, for that matter, the same barge the second time, are the same from a safety point of view.

A barge arriving at a cleaning plant must be treated as a bomb. Most of the time that is exactly what they are. There are a number of basic hazards inherent to gas freeing, the most dangerous and common one being the risk of explosion. The normal process of gas freeing creates a mixture of explosive vapors with the proper amount of oxygen; then all that is necessary is ignition from static or friction and you have an extremely severe explosion. As we all know, take away any one of the three ingredients and you can not have the explosion. We spend a great deal of money and time trying to eliminate the ignition leg from the fire triangle; that is the only leg we can hope to control.

All personnel involved in cleaning and gas freeing are required to wear special clothing, and all equipment is certified for hazardous areas. The workmen wear special conductive shoes and boots to drain off any static charge before it builds up. All blowers, pumps, hoses, and washing machines are mechanically grounded. No nylon rain wear or clothing is permitted in the gas freeing area. Each new employee is assigned to an experienced employee for at least 30 days. During that time, he is thoroughly coached in the hazards of the job and the safety procedures he is expected to follow. As much as possible, we use the "buddy system," with each man watching out for his buddy as well as himself.

When a typical single skin barge arrives at the dock, it is immediately grounded with a bombing cable to eliminate the possibility of a static build-up that could result in a spark. The barge is then checked with an explosive meter, and as soon as the cargo system has been flushed, all Butterworth hatches are removed and all compartments are ventilated to bring the atmosphere down below 30 per cent of the explosive range. All free liquid is stripped from the compartments, and after further ventilation to bring the atmosphere down to 10 per cent LEL, the men can enter the compartment equipped with fresh air breathing masks and protective clothing. Forced ventilation is maintained at all times to compensate for the possibility of the residue of product and scale releasing fumes as it is handled. All equipment used is of a non-sparking material, and all blowers and other equipment of static-producing nature have ground cables to attach to the body of the barge.

While men are in the compartment with fresh air masks, at least one tender is on deck at all times. The tender has available a mask to be used in case of emergency. The tender maintains periodic contact with the men in the tanks. The atmosphere is checked each hour and a record maintained. In case of a build-up of gas, the workmen are removed from the tanks and steps taken to correct the problem.

I have only touched on the high spots of cleaning. There are many more steps and problems, such as trying to comply with EPA, OSHA, Air Control, and several other federal and state organizations.

If barge owners and builders would sit down with the people who clean barges, a lot of the safety problems could be eliminated by some very basic changes in construction, such as the hatches in every compartment, effective location of Butterworth hatches, and location of cargo piping suctions, not only for cleaning, but for better stripping of tanks at discharge. One gets the impression that the people who design barges have never been exposed to the problems of cleaning, inspecting, and pumping the barge. One wonders what the logic is in routing steam through the heating coils from the top of the compartment to end up at the suction bell as luke warm water when the suction is where the heat is most needed. Also, why place the wing wall hatch at the end of the compartment that will be the most elevated when the barge is empty and compel the cleaning people to crawl the length of the wing wall to clean or strip the compartment? With the new regulations on toxicity, the job of having to work in unnecessary cramped spaces will only prolong the time necessary to

clean the barge, and as time is money the price increases.

I have been in this business longer than I like to admit, and I get carried away when I think how much safer and cheaper barge cleaning would be if more thought went into design.

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POLYURETHANE CHEMICALS, FOAM, AND SOLVENTS FOR THE BARGE INDUSTRY

By WILLIAM J. PUROSKY
Project Leader, Polyurethane Division, Mobay Chemical Corporation, Pittsburgh, PA

Most of the workers we deal with in the barge industry are welders and/or cutters who are well aware of the hazards associated with that industry. For example, the intense light from an electric arc used in welding can be detrimental to good eyesight if precautions are not taken. The gases produced by arc welding rod flux can cause respiratory problems. The intense heat used in arc welding or acetylene cutting can be detrimental to your well being if the correct clothing is not used. The handling of gas cylinders, the use of acetylene, the movement of large heavy pieces of steel, the necessity of working on or near water, and many more activities that are done daily in the barge industry are potential health hazards. However, most workers (whether they realize it or not) have learned how to handle these jobs with relative ease and safety. In this discussion, we will bring to your attention some of the potential health hazards associated with polyurethane chemicals, solvents, and foam as applied to a particular installation. First, we will discuss the liquid polyurethane chemicals; second, the foam itself; and finally, the solvent used in cleaning the system. In each of these categories, we will also give the normal precautions recommended for good safety when using these materials.

Handling of Liquid Chemicals

Many industrial chemicals are capable of producing damage to man if potential health hazards are not recognized and if means are not provided to protect those who may be exposed. Typically in polyurethane systems used for applications, two major chemicals are combined at a predetermined ratio to produce a third different chemical product. One of these chemicals is a diphenylmethane diisocyanate (often referred to as MDI), and the other is a hydroxyl rich polyol containing a refrigerant (R-11) and strong basic amine catalysts. That sounds like quite a mouthful. We call them the "A" side or isocyanate and the "B" side or polyol. Let us take a closer look at these products from a safety point of view.

The "A" Side or Isocyanate Component

Industrial experience both in the United States and abroad indicated that isocyanates may be manufactured, shipped, handled, and used without difficulties if proper precautions are followed. In brief, precautions recommended for safe handling of the "A" side or MDI isocyanate include:

1. Avoidance of spills and the use of adequate respiratory protective masks in cleaning up spills if they do occur. In humans, there is evidence that inhalation of vapors, mists, or droplets of MDI isocyanates will result in irritation of the upper respiratory system with the development of bronchitis, asthmatic breathing, and constriction of the chest. If a large spill does occur, use an absorbent sweeping or cleaning compound to absorb the liquid. If the spill is in a closed area, ventilate immediately and use an approved vapor respirator with particulate prefilters. Remove the absorbed material from the area in open drums and treat with water containing one per cent of ammonia before disposal.

2. Provision of adequate exhaust ventilation to remove vapors during the handling or usage of MDI isocyanate in

The precautions we have mentioned must be followed to limit the hazards associated with the "B" side or polyol side of the polyurethane system. Again, the general rule is that polyurethane polyol components should be handled with caution, and skin and eye contact should be avoided.

Rigid Polyurethane Foam

A considerable number of toxiocological studies have been conducted to determine physiological hazards of finished polyurethane plastic materials. These studies have shown that the products investigated are physiologically and chemically inert, produce no sensitization responses on skin contact even in highly sensitive persons, pass through the digestive system intact, and caused no malignant tumors implanted in rats for 1,050 days. These studies should not be interpreted to mean that all polyurethane products are completely safe. One of the big advantages of polyurethanes is the fact that they can be formulated many different ways. Obviously, there will be some formulations that will be hazardous to a greater degree.

There are other ways in which polyurethanes can be considered as hazardous. One of the conditions that you may get involved with as a daily occurrence and does warrant mentioning is polyurethane dust. Consistent with good industrial hygiene practices, exposure to high levels of all dust, including polyurethane dust, should be avoided. Polyurethane dust is classified as a "nuisance" dust which can cause mechanical irritation of the eyes and mucous lining of the nose and throat. We mention this in light of the fact that samples may be cut on a band saw for some physical property determination. When a large number of samples are to be cut, a dust mask which mechanically filters and prevents inhalation of the dust should be worn along with well-fitted side shield goggles.

Other ways in which polyurethane foams present a hazard are flammability and combustion. Since they are organic compounds, polyurethanes and related materials are combustible and can create a fire hazard. Recognition and avoidance of factors which can create a high degree of hazard is essential if polyurethanes are to be used safely. Primarily, we are interested in three factors concerning the application of foam in a barge.

1. *Exotherm During and After Application.* The chemical reaction between the MDI or "A" side and the polyol or "B" side generates heat, commonly called exotherm. Three important aspects of the exotherm must be considered: the quantity of heat generated; the rate at which it is generated; and retention of the heat generated. Of the three, the rate of heat generation is probably the most important. Large amounts of heat generated in a short time period can result in spontaneous combustion. It has been proven that these large heat-generated reactions can be produced by an excess of isocyanate if the reaction is off ratio or poorly mixed. This could result in a serious fire hazard. For this reason, all foam dispensing equipment should be calibrated daily so that components are kept within plus or minus two per cent of the ratio specified by the supplier.

Under no conditions should a greater amount of foam than that recommended by the supplier be applied in one shot. An increase of total material poured increases the effect of the exotherm which could cause scorching, splits, and generally poor foam properties.

2. *Polyurethanes in Place.* In barge applications, it becomes necessary to cut and weld steel after polyurethane foam has been put in place. Obviously, it is best to do as much cutting as possible before the foam is put in place. We have already discussed the fact that the foam will burn. Here we will mention procedures to limit the hazard from the burning foam. There are a number of methods that can be used to cut steel. The following methods are listed in their order of recommendation:

Mechanical cutting using various types of saws. This method is best since the cutting is not involved with an open flame or an electric arc. Drawbacks are the size and weight of the tool, making side wall and overhead cuts very difficult. Normal safety precautions should be followed for use of the reciprocating or continuous blade cutting saws. The fire hazard normally associated with polyurethane foam is still present but to the least degree of any cutting method. When cutting, if a heavy section of steel or a reinforcement attaching point is encountered, a build-up of heat can occur from the added friction of the blade. This heat can be sufficient to ignite the foam. Care should be taken to prevent this heat build-up by slowing the cutting speed when possible. A fire watcher with a dry chemical fire extinguisher and/or a high pressure fire hose should be posted at the cutting site and should be present for at least 30 minutes after completion of the job.

Electric air-arc welder with a gouging rod. This method uses a high intensity electric arc to melt the steel. Immediately upon melting, a stream of compressed air is used to blow the melt away. Using this method, a smoldering fire occurs, with an increased probability of a flaming fire continuing due to small molten pieces of steel that become embedded in the polyurethane foam. The advantages of this method are the lightness and portability of the tool making for relative ease in cutting heavy steel in overhead, vertical, and close clearance areas. The depth of foam penetration is on the order of magnitude of one to two inches. Normal precautions for the use of electric arc should be followed. This method is generally faster than the mechanical saw approach. The drawbacks are quite predictable. The polyurethane foam will be burned by this method. Again, a fire watcher with a dry chemical fire extinguisher and/or a high pressure fire hose is required at the cutting site and should be present for at least 30 minutes after completion of the job.

Acetylene/oxygen cutting torch. We firmly recommend against this method. This method is the least desirable from a fire and personnel hazard point of view. Here a high temperature open flame is used to heat the steel to slightly less than molten. At this point, an excess amount of oxygen is pressure fed to the steel to induce rapid oxidation or "burning" of the metal. The advantages of this method is the great speed at which the steel can be cut. However, the disadvantages far outweigh the advantages. Maximum damage to the urethane foam as well as the greatest fire and personnel hazard will occur with the use of an acetylene torch. The flame penetration into the polyurethane foam is usually of the magnitude of six to eight inches. The polyurethane foam will burn, with a definite fire remaining at least for a short time after cutting and in some cases for a long time after cutting. Not only is the polyurethane foam ignited under high temperature conditions, but it is then oxidized with part of the excessive oxygen not consumed by the burning steel. Again, a fire watcher is a necessity. However, we find that chemical extinguishers are of limited use and recommend a high pressure, high volume water hose be on the site and at the area to be cut. It is necessary that the hose be activated to the nozzle so that immediate action will produce a large volume of water on the cutting area. The fire watcher should remain 30 minutes after the foam has stopped smoldering or smoking.

In all of the methods mentioned, it is recommended that the cutting operator and fire watcher be equipped with an organic vapor filter mask and approved eye protection devices. Fire and smoke will definitely be caused by these cutting methods. This fact cannot be taken lightly. For these reasons, all barges that have been foamed must be marked in a conspicuous location. We are willing to work with your industry to design a plate or plaque listing the hazards associated with cutting steel to repair the barge.

The electric welding or arc welding of a foam filled barge is considered less of a problem than cutting. If the welding is

permanently fixed processing equipment such as a foam machine. This provision is usually engineered into a foam machine room in the form of high volume exhaust fans. The design of two doors in a building is also instituted to enable normal air movement to eliminate vapor presence even when the fans are not operating. In addition, the very low vapor pressure exhibited by the MDI greatly reduces the vapor hazard during handling, allowing these less complicated and more comfortable handling procedures. However, it is not an invitation to careless handling, since the effects of direct contact with isocyanates are known and best avoided.

3. Medical screening of employees should be done to prevent exposure of those known to be susceptible to allergies or asthma. It has been shown that individuals with allergies or asthma are more apt to react to isocyanates than those who are not allergic or asthmatic.

4. Sampling and analysis of the workroom or foamroom atmosphere to indicate the adequacy of control ventilation. We at Mobay make arrangements to monitor a foam house during some of the first barges shot each year. This is a typical safety precaution to insure that an installation meets all safety criteria for which it was designed when built.

5. Immediate removal and reassignment to other jobs when any worker develops symptoms due to inadequate control, accidental exposure, or pre-existing sensitivity.

These points serve as a good guideline to safely handling isocyanates of the MDI type. There are a number of other procedures that are needed to complement those already mentioned. Personnel should be informed of the following procedures:

1. When working with liquid MDI, keep in mind that it is a potentially hazardous chemical and should be treated as such. If you experience mucous membrane irritation, tightness of chest, coughing, headache, and/or shortness of breath, leave the area immediately and notify your immediate supervisor.

2. If the material splashes on your skin, wash the area with soap and water at least five minutes.

3. If the material splashes into your eyes, wash with large amounts of water for a minimum of 15 minutes. Then consult a physician.

4. If the material is taken internally, induce vomiting and consult a physician.

Of course, whenever working with chemicals, safety glasses and chemical resistant gloves should be worn. The position and use of the safety shower and eye wash should be known by each individual. If your clothes become saturated with MDI isocyanate, remove them and do not use those clothes until they have been laundered. Again, wash your skin thoroughly with soap and water before you put on clean clothes.

In short, you should recognize the MDI isocyanate as a potential health hazard. When any action becomes questionable to your own well being or the well being of your personnel, clarify this action with your supervisor. They, in turn, will ask us, the supplier, for answers to more specific problems that may arise and have not been covered here.

The "B" Side or Polyol Component

The "B" side of the system is generally a mixture or a blend of many other chemicals. Typically (as is the case in most barge foams), it consists of a base polyol, a catalyst, a blowing agent, flammability-retarding agents and/or other additives. Hazards involved in their use are the sum of the hazards listed for each of the constituents, to varying degrees. As a general rule, polyurethane polyol components should be handled with caution, and skin and eye contact should be avoided.

Polyols used in manufacturing rigid urethanes and related materials are generally one of two types or a combination of one or both types in a blend. These are polyesters or polyethers terminated by hydroxyl groups with which the isocyanate component (or MDI in this case) reacts to form the finished product.

These materials are generally classified as Class III B combustible liquids and are not considered serious fire hazards. However, they will burn if exposed to sufficient heat and oxygen. Combustion products generally consist of carbon dioxide, water, carbon (soot) and possibly carbon monoxide.

One of the other parts that make up the "B" side or polyol is called a catalyst. Catalysts are used to control and balance the polymer-forming reaction and, in foams, the gas-forming reaction responsible for foaming. The type of catalyst used in most barge formulations is called a tertiary amine. Tertiary amines are used in relatively low concentrations at about one per cent of the polyol component. They are alkaline or basic in nature and their vapors are irritating to the eyes, upper respiratory tract, and lungs. Liquid tertiary amines are readily absorbed even through the intact skin. Skin contact may lead to dermatitis and skin sensitization. Eye contact can cause severe irritation or burns. Therefore, even though there is only one per cent or less of this material in the "B" side, we recommend that skin and eye contact be avoided. Again, wash the skin thoroughly with soap and water if contact with the material took place.

Another part of the "B" side is called a blowing agent. For economic and other considerations, halocarbon blowing agents have found wide use in rigid urethane foam systems. The two most commonly used are: trichloromonofluoromethane (R-11) and dichlorodifluoromethane (R-12). High concentrations of halocarbon vapors will cause loss of feeling (anesthesia) and unconsciousness (narcosis). The concentration of the barge systems is about 20 per cent. On site, three to four per cent of R-12 is sometimes added. The vapors of these materials are heavier than air and tend to remain localized and/or diffuse slowly in the breathing zones of workers. Although these blowing agents have a relatively low order of toxicity (R-11 and R-12 TLV are accepted to be 1000 ppm), such halocarbons are metabolized to fluorides in the human system and can present a potential hazard in high concentrations.

Halocarbons are generally non-flammable, but present a physiological hazard under fire conditions. When heated to decomposition, these halocarbons generate various quantities of highly toxic carbonyl chloride (phosgene) and carbonyl fluoride. These toxic products may be generated even when halocarbons are inhaled through a lit cigarette. Therefore, smoking, open flames, or use of electric arc equipment in the vicinity during foaming operations when R-11 or R-12 vapors are present in the atmosphere should be strictly prohibited. Polyurethane components, namely "B" component, should not be exposed to heat or stored outdoors in direct sunlight. Typical storage temperatures should range between 60°F to 80°F. At 140°F, the vapor pressure of R-11 is 30 psi gauge—more than sufficient to rupture a standard gauge steel drum. At most facilities we insulate the storage of the "B" side, and for added protection a high volume cooling unit is usually included with the installation.

Finally, one of the other agents used in the "B" side is a flammability retarding agent. Flammability retarding agents incorporated into polyurethane systems are usually organic phosphates and may also contain chlorine or bromine. They may be eye and skin irritants and are related chemically to highly toxic insecticides. Typically, 10 per cent of the "B" side is made up of these agents. Exposure to organic phosphates can cause weakness, nausea, headache, constriction of the chest, wheezing, coughing, and difficulty in breathing. Skin and eye contact should be avoided. These agents are used to decrease flammability properties in polyurethanes. They have high flash points and do not constitute any significant fire hazard. Thermal decomposition of these agents can generate hazardous and corrosive fumes of phosphorous oxides and hydrochloric or hydrobromic acids.

done against steel completely backed by foam, very light fire and smoke are created with only minor damage to the urethane foam. A lap type joint covering the area to be repaired is recommended. Caution must be used in welding over an area partially filled with polyurethane foam. The possibility of dripping molten weld into or onto the foam surface is high. The result could be, under proper circumstances, a fire hazard. This possibility increases if a butt joint is used above the area. It is recommended to have a dry chemical extinguisher in the immediate area of arc welding. Acetylene welding is not permissible for those reasons mentioned in the cutting discussion.

In the event of major damage to the structure of the barge, we recommend removal of the foam from the interior of the barge whenever possible. Two methods are generally accepted for this purpose: (a) the foam can be physically dug out using a mattock or shovel. Care should be taken to correctly dispose of these pieces to prevent local pollution of the area; (b) the foam can be cut using a high pressure water stream. In this manner, larger pieces can more easily be removed and disposed of or reused in the same or a different barge.

3. *Fire Fighting Procedures.* Small fires involving polyurethanes can be extinguished by any of the conventional methods—water, carbon dioxide, foam, or dry chemical. If large quantities of urethane are involved, however, small scale extinguishing methods are ineffectual, and drenching the fire with large quantities of water from sprinklers and fire hoses is the most effective means of control. In addition to the normal protective attire—helmet, boots, gloves, and rubber clothing, personnel fighting fires involving polyurethane in quantity should be equipped with organic vapor cannister face masks or self-contained breathing apparatus. If danger of oxygen depletion exists, as in a fire burning within an enclosed area, self-contained breathing apparatus is mandatory.

Fire hazards of polyurethanes in varying degrees are common to all fires—heat, carbon monoxide, carbon dioxide, oxygen depletion, and smoke. In fires involving polyurethane rigid foams containing flammability—retarding additives (like the typical barge system), large quantities of dark smoke can be generated quickly. Combustion or thermal degradation of polyurethane foams results in a complex mixture of gases, smoke, and solid residue, the overall composition of which depends primarily upon the chemical make-up of the urethane, availability of oxygen, and temperature during exposure. This behavior is not unique to polyurethanes. It is true for any combustible material in a fire environment. For instance, burning cellulose can produce 96 compounds. (Cotton is almost pure cellulose.)

Thermal decomposition of polyurethanes at temperatures below the ignition point results in generation of isocyanate vapors and other volatile products. Since there are temperature gradients within any fire, these products may also be generated by burning urethane, particularly if the fires have limited oxygen access. Generally, the combustion products of urethane foams in a clean, hot fire with adequate oxygen availability are carbon dioxide, water vapor, and various quantities of nitrogen oxides, carbon, carbon monoxide, and traces of hydrogen cyanide. In barge systems used, corrosive, acidic vapors are also produced.

In short, the fumes and smoke produced by a foam fire should not be inhaled. If a situation arises where fumes and smoke are in your vicinity, an organic vapor cannister mask or self-contained breathing apparatus is required.

4. *Cleaning Solvent.* The solvent recommended for cleaning mixed polyurethane foam is methylene chloride. It is by far the least toxic of the four chlorinated methanes. The toxic effect is predominantly narcosis, although apparently not effective enough for good anesthesia. It does not cause significant organic injury.

The principal problem from use is the "drunkenness" that may cause inept operation, which may in turn result in injury to the man himself or others around him.

The symptoms of excessive exposure may be dizziness, nausea, tingling or numbness of the extremities, sense of fullness in the head, sense of heat, stupor or dullness, lethargy and drunkenness. Exposure to very high concentrations may lead to rapid unconsciousness. Prompt removal from exposure usually results in complete recovery.

During clean-up operations, hands should not be immersed in cleaning solvents, because these remove natural skin oils and can cause solvent dermatitis.

Summary

We have tried to bring to your attention the hazards associated with a foaming operation in its entire scope. Obviously, we could not answer all of the questions that you might have had. We, as the supplier, offer all assistance and knowledge we have to your safety department in helping you be aware of potential hazards and using correct procedures to minimize those hazards.

NATIONAL RIVER ACADEMY'S ROLE IN SAFETY TRAINING

By WILLIAM F. FASSLER
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The inland waterways industry is frequently overlooked by the general public because most waterway freight is bulk rather than final consumer goods. Except for recreation, the public has limited contact with the nation's inland waterway system, so they find it difficult to understand how significant this mode is to the nation's flow of commerce.

The barge and towing industry is impressive. It operates on 25,000 miles of navigable waterways. These waterways are used by more than 1,800 companies operating more than 4,000 towboats and tugs, 25,000 barges, and employing more than 80,000 people.

It is estimated that there are 300 billion ton-miles of traffic each year on the waterways system moving cargoes such as coal, steel, grain, petroleum, fertilizer, and chemicals. This tonnage is expected to increase 300 per cent in the next 25 years. The four main beneficial characteristics of water transportation are flexibility, high capacity, high speed, and low cost. All of this reveals that the inland waterway industry is playing a vital role in our nation's economy. As the energy crunch becomes more critical in the years to come, the industry will be playing an even more important role due to its efficient movement of large amounts of bulk cargo.

However, with new towboat construction costing two to three million dollars each and barges running $150,000 for an open hopper to $750,000 for a sophisticated liquid tank barge, the cost of doing business is growing by leaps and bounds. Management of barge companies have to find ways of cutting costs and staying competitive.

In the analysis of cost of doing business, one item previously considered very lightly was personnel costs. This area of cost has now come under much closer scrutiny especially in light of the excessive turnover being experienced, the incompetency of a growing percentage of boat personnel, and rising insurance costs resulting from the high accident frequency of the vessel personnel. The cause of these three items of cost have been traced to the methods used to hire employees for river work.

For the past 40 to 50 years, the person responsible for hiring boat employees for the barge lines depended mostly upon "walk-in" applicants to fulfill his personnel requirements in the deck force. There was no screening, very little interviewing, no orientation, and especially no training. Many deckhands were hired via the telephone with no other personal contact. Management finally concluded that this procedure was incapable of providing the manpower necessary for their present and future needs; but more important, it was not capable of providing the necessary competency of the wheelhouse personnel.

It became apparent that the industry could no longer depend on this "helter-skelter" method of hiring, training, and retaining the people necessary to man the vessels in the inland waterways. This, coupled with the great increase in government regulations and restrictions, has caused greater concern, especially in areas of pollution and occupational safety and health. This concern dictated that a more effective and structured method of personnel procedures had to be established.

Alarmed by the realization of the seriousness of the manpower situation and the shortages of competent personnel needed to man the wheelhouses of the towing vessels, a group of towing industry top executives from various barge lines banded together in mutual cooperation to bring their manpower problems under control. One important result of the meetings held by this group was the determination that what industry needed most was a formal and structured method of training. A place was needed where young people could go and receive proper training that would equip them to work in the towing industry. These meetings spawned the ideas and the enthusiasm that resulted in the birth of the National River Academy back in 1970.

The Academy's earliest development was greatly assisted by Representative Bill Alexander of the First Congressional District, State of Arkansas, who worked with the industry leaders in setting up the Academy. It was his efforts that obtained a Federal charter for the Academy and assisted in obtaining the grounds for the present site.

The Academy, which was the first and only one of its kind, was dedicated to the river industry, and it was developed with the following goals:

1. To provide facilities for entry level deckhand training in proper and safe work practices and procedures.

2. To provide technical and vocational courses for qualifying individuals in all phases of the inland waterways including tankerman, engineers, and steersmen.

3. To provide the training and instructions necessary for experienced personnel to upgrade their licenses as required by the Coast Guard.

We were organized as a privately owned non-profit group, supported by regular members who must be operating barge lines; associate members—any firms or individuals closely connected to the barge business, such as shipyards; and affiliate members, such as local businessmen and individuals interested in the progress and growth of the school. This method of organization has provided us the one characteristic of which we are the proudest: we have never received any federal or state government funds or assistance, which we think makes us rather unique.

The Academy is housed in a 16,000 sq. ft. building that provides efficient office space, functional classrooms and training area, generous living quarters for more than 75 students at any one time, a galley and dining area serving food comparable to that served on a towboat, and a student lounge equipped with TV's, pool table, ping-pong, and other amusement games.

We have just completed a $250,000 building project that included three new classrooms, a new engineering building with classroom and shop, a tow mock-up of two boats and 13 barges, and the new Lily Peter fire fighting facility which includes a smoke maze building.

Since its birth back in 1970, the Academy has sought to provide programs and courses that could provide the safest and most efficient employees, since safety is a matter of continuing and vital concern to the barge and towing industry.

Earlier, we stated that barge operations are plagued with high personnel costs as a result of the high accident frequency on the boats, coupled with the high turnover of personnel. This leaves little doubt that the personnel departments of most companies are in trouble. I doubt that there are but a few companies that can boast of no problems in this area. It has been established that the majority of the trouble can be traced to the poor hiring methods. These methods of hiring are the probable cause of high turnover, and the lack of training is the probable cause of the high loss time accidents. Our studies have indicated that deckhands suffer two-thirds of the lost time accidents, and 70 per cent of these accidents happen to "green," untrained men during their first few weeks on the job. This, I believe, is the result of the frantic hiring of just anyone when a boat calls to report a deck vacancy. There is little or no screening, interviewing, or orientation, and especially no training. The new man is sent to the boat with little consideration of the future. The indoctrination, job instruc-

tion, and training is left to chance, doubtfully to be provided by the experienced members of the crew. Most of these men know their jobs well, but they are not skilled as instructors. Even when they are capable of teaching they seldom have the time or more likely won't take the time to work with a green man and teach him his job.

This results in a sometimes sarcastic attitude on the boats among the older, regular employees toward the green, untrained employee: the attitude that, "If he doesn't hurt himself or quit in the first three months, then we'll start to teach him what he ought to know."

The Academy feels it has an answer to this justified sarcasm and the problems of industry hiring methods. We have accepted it as a challenge which can effectively be met by optimizing training results through the application of modern techniques, effective administration, unique training aids, and a combination of institutional and on-the-job training. The first step was the development of our three-week Deckhand Program, which we project will correct these problems.

To be sure we would cover everything to satisfy industry needs, our Goals and Priorities Committee met with administration officials, personnel directors, marine superintendents, and vessel personnel, including captains, mates, and engineers of all the major barge lines. From these men, knowledgeable of and responsible for the operation of the boats, some 500 items considered necessary to have a well-rounded safety and work-oriented employee were developed.

Armed with this information, the Academy staff began putting together the course outline for our Deckhand Safety Training program which would be the first of its kind to train inexperienced river employees. The staff decided that the course would have to be at least three weeks in duration and give the trainee as close to true-life picture of boat life as possible.

The first thing on Day one, the trainee is welcomed to the *M/V N.R.A.*, and the school's rules and regulations are explained. This is followed by an orientation program to acquaint the trainee with his future home, the towboat, and his new job, a deckhand. Day one and two of the program are most important because they are devoted to instructions in all safety rules and regulations through slides, movies, and video tape presentations. The trainee learns about the proper clothing to wear on job and what protective equipment he will be using. We expose the hazards he will encounter and demonstrate the procedures to be used to protect himself and his fellow employees from injury.

The Inland Waterways Safety and Health Association's "44 Rules of Safety" are covered individually in discussions and the viewing of the movies "Towboat Tips" and "Locks and Lines." This is followed by presentations such as "Proper Lifting," "Proper Carrying," "Correct Use of Ratchets and Winches," and everything else we think he should know.

During the first day of class, the trainee is issued a life jacket, called a work vest. He is instructed in the wrong and right way to wear this vest, and he will be required to wear it whenever he leaves the classroom to work on the tow mock-up, even though it is located in the middle of a soybean field. This develops a very important safety habit for the trainee, as it impresses on him the importance of wearing the work vest when he finally goes to work on the tow where he will be exposed to the danger of falling overboard. The trainees are also introduced to the "Smart Duck Club," which was developed and sponsored by the Inland Waterways Safety and Health Association and is recognized by the National Safety Council. This club promotes the wearing of work vests by awarding certificates and badges to any marine employee whose life was saved due to the fact that he was wearing a work vest when he accidentally fell or was knocked into the river.

The schedule for the first two days calls for mostly classroom instruction, but

since the main work of a deckhand on a towboat is handling rigging; i.e., wires, chain links, ratchets, and cheater bars, everything necessary to secure the barges in the tow, we get into this phase of training early. To provide the proper training in this area and yet do it the safest way, we have constructed two separate tows; one is a dry cargo tow, which has a towboat and nine hopper barges; the other a liquid tow with a towboat and four tank barges. This concrete tow mock-up is actual width size but the length has been shortened by eliminating the cargo space. It has all the same fittings as would be found on the real barges. The mock was designed so as to provide as many different and unusual couplings as would be encountered on the river. By coupling, we refer to the method used to join two barges together.

From this point on, the trainee is instructed in every phase of deckhand duties, with actual hands-on experience on the tow mock-up. At all times, the trainees are under the constant eye of the instructors who correct or modify any actions or work of the trainee that might tend to injure or lead to habits that could cause future problems.

The balance of the first week and the second week are devoted to his job, to tow work, making-up and breaking-up the barges, carrying ratchets, throwing lines, and care and maintenance of the equipment, much like they would on a real towboat.

One of the unique aspects of towboat life is the work schedule, which in most instances is a six-hour on, six-hour off routine, around the clock, seven days a week, usually for at least 30 days in a row. To acquaint the trainees with this routine, the entire second week of the course they are worked from 6:00 A.M. to 11:30 A.M. with a six-hour rest period in the afternoon. This is followed by night sessions from 6:00 P.M. to 11:30 P.M. This gives the trainee experience in working at night by the light of the moon and/or flashlights and searchlights. We also work the trainees in all types of weather so he will not be surprised when his job requires him to work in the severest elements.

The third week starts with one full day of first aid training, with each trainee receiving a Basic First Aid Certificate via the Red Cross Multi-Media Program.

The next day is devoted to marine fire fighting at our fire facility. We give 10 hours of classroom instructions on the chemistry of fire and fire fighting procedures to handle the three main classes of fires: A-solid, B-liquid, C-electrical. Details of Class D fires are covered. We stress fire prevention as the best fire protection, and conclude with instructions in search and rescue and other lifesaving and emergency procedures.

After this classroom instruction, the trainee receives eight hours of field experience fighting real fires using CO_2 hand extinguishers on strip fires and dry chemical hand extinguishers on leaking flange fires, multi-level step fires, and paint locker fires. Following this, he is instructed in the use and handling of hose and fog nozzle and then participates in the extinguishment of several large fires such as multi-level fire and 100 sq. ft. of bilge type fire, using hose and fog spray.

In the search and rescue portion of this day, the trainee is taught the correct procedures to use to search for and rescue a victim from a smoke filled area. This is followed by exposure to actual smoke filled area to acquaint them with this sometimes fatal condition.

They are instructed in the use of self-contained breathing apparatuses, and use of it in an attack on the interior Class "A" fire.

The final two days of the course are spent reviewing all the safety rules, the first aid instructions, and all fire fighting and fire prevention procedures.

After final exams, we feel we have an individual who is properly safety motivated and ready to be sent to the boats to start a career in the river industry.

As yet, it is too early to tell if the Academy's role of providing safety-

oriented training will be effective as our projections and goals, but as the months and years roll by, we are confident that our Deckhand Safety Training Course will result in a lower accident frequency and lower turnover rates for those barge companies using the trainees from our school.

78 2061

CARE, USE, AND INSPECTION OF HOISTS

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Encourage the operator to be the right hand of safety, or Mr. "I Think." Example:

"I think the brake on this hoist slips."

"I think the chain is worn, gouged-cracked."

"I think the cable is worn, broken strands, etc."

"I think the limit switch is not functioning."

"I think the hoist makes an odd sound."

We cannot wait for the weekly, monthly, or annual hoist sling inspection; we place the responsibility on the operator for daily safety and pride in his equipment to assist safety and maintenance programs. Should "Mr. I Think" state to his supervisor "The hoist may have been overloaded," the supervisor should not be critical, but rather: Investigate why possible violation took place. Instruct operator in the proper procedure. See that the overloaded unit is taken out of service. See that a safe functional unit is installed. Be sure the unit replacement is equal to the load.

Because the same lifting procedure is carried on daily, this is no assurance of safe practices. Conditions constatnly change. Examples are: lifting medium damage (hoist or sling); rated loads previously calibrated do change; change in personnel (experience); head room or layout change.

Constantly evaluate loads handled. Gain assurance hoist is equal to load demands. Evaluate the external condition of hoist or sling. Be on guard for layout possible changes. Be on guard for load character changes.

Care between employees, particularly when handling overhead loads, is vitally important. Do not carry loads over co-workers. Warn co-workers on all conditions. Do not sustain loads on sling or hoist for any period of time. Block up or rest load in safe floor or rack area.

Eighty-five per cent of hoists used in industry fail due to overloading. How can the operator determine probable overload? Hoists manufactured in the United States are designed for one man only control or operation. The effort required by an operator to raise a one-ton load on an average one-ton hand hoist is 70 lbs. On an average 10-ton hand hoist it is 100 lbs. One man can raise a one to 10-ton load. One man can determine excessive resistance, indicating a faulty load or overload exists. Should two men operate a hoist, their combined effort could raise 400 lbs. overload on any hand hoist.

Where reoccurring overloads exist, install hoist overload protection. Carefully instruct operator on proper procedures. Determine and correct reason for overloading.

Hand hoists when new are tested to 150 per cent of rated capacity. Electric hoists when new are tested to 125-150 per cent of rated capacity. This is to insure and guarantee the hoist will perform to rated capacity, not beyond. Although the manufacturer will state he designs his equipment with a factor of 5, this in no way indicates hoists can be operated beyond rated capacity.

For example, electric hoists were required to raise a 4250 pound aircraft engine up to the fuselage of a plane. Two manufacturers bid on their 5000 to 6000 lb. units. One manufacturer exaggerated his product's rating and offered 4000 lbs. Fortunately, management of the exaggerated source realized the error and voluntarily supplied all 6000 lb. units,

accepting their dollar loss. If the manufacturer indicates you can slightly overload his product, the user or operator feels he has assurance to go beyond all limits in safe loading.

Leading American hoist suppliers today provide overload protection either as a standard feature or add-on cost on all type hoists. Bear in mind that 85 per cent of all hoists on occasion are overloaded, causing fatigue or possible hidden, hard-to-detect damage to the unit. By means of overload protection we gain assurance of greater safety, due to this added protection. For example: it takes approximately 70 lbs. of human effort to raise a ton load on a one-ton hoist. When this effort increases to about 85 lbs., the hoist refuses to raise the load. The manufacturer pre-sets his protection to 25 per cent beyond capacity in order to comply with regulations. Thus when any unit is repaired, new parts installed, on a regular periodic hoist test, 125 per cent of rated load may be applied to assure the rated capacity. This overload protection feature is available from the manufacturer, not only on new hoists, but as a conversion on most presently in-use modern hoists.

Old style iron or steel hoists can readily be identified because of their bulk and excess weight over today's light-weight portable units, particularly in the 1/2-ton, two-ton capacities. Older hoists, all makes and designs, require extra care. For example, no lifetime lubricated bearings were used; non-aging gear case lubrication was not used; they are of low efficiency—extra effort is to raise loads; lower safety factors due to lack of alloy or high strength steels; chains of iron or low-carbon steel tend to have fatigue or grain growth, whereas today's lighter, stronger alloy steel load chains have no fatigue; old style units have operating parts exposed to the atmosphere and damage.

Most safety-conscious hoist users recognize the inefficiency of these hoists and bring about their replacement etc., but in doing so make no specific provision to properly discard or scrap these tired, old work horses. In many cases they are improperly stored in tool rooms or similar dangerous areas, where they are kept to be used in case of emergency. Here lies the great danger, for when an emergency takes place, these outdated hoists are called upon to raise loads not in the pattern of daily routine and create a great accident problem, for the hoist is not nearly suitable to the demand of the emergency.

Avoid storage of old style, obsolete hoists. In the event any hoist is stored for a 30-day period or longer, a trained, competent man should carefully inspect, repair, and test the unit and maintain a careful record of repair, test, and date identification. Then use care in proper storage.

Even though you carry out the same hoist application daily, this does not prove you have the suitable or proper hoist for your specific application. For example, in 1941 a six-ton hoist was installed in a pump house; this area was some distance from the main building or central supervision control. In 1966, due to a failure and fatality, I was called in to assist in an investigation. I found:

1. One man, guiding a load into a 22 foot pit under the load, was trapped, with no area of escape. He should have been above the load using guide ropes on load being lowered.

2. Because this hoist was used on only two occasions yearly, to raise and lower a pump, no preventive maintenance, repair, or test of the hoist took place on a periodic basis. The condition of the hoist was poor.

3. Due to the length of the load to be raised, the operator took the liberty of power-driving the hoist by means of a 3/8-inch slow speed electric drill. Hand hoists have no limit switches to prevent overstrain, and the shafts, gears, and brake design are not capable of the high speed of power drive. In this instance, the load chain was power driven beyond the hoist causing load drop or failure. Yet, for 25 years this load was handled the same way, until failure occurred.

Mr. Think will:

1. Use a cable or chain sling properly secured to the load.

2. Engage hoist lower break securely to sling.

3. Raise load gently and gradually to avoid impact.

4. Assure clearance for load being lifted, and that no co-workers are in the immediate danger area.

5. Not leave load unattended. He will block it up or rest the load.

Following are some suggested inspection procedures. ANSI, 30.16 is directly involved.

1. Every in-plant hoist should have a history card indicating model, capacity, type, serial number, area used in, date in, date out of service. (C. M. Hoist Division, Columbus McKinnon Corporation, directly or through their distributors provide complete suggested inspection procedures on all design of hand, and electric hoists, plus history cards, on a no charge basis.) Hoist inspection should be carried on by an in-plant, trained, qualified inspector and/or repair man.

2. Daily check: Lower hook for distortion or bent shank. Proper swivel of lower hook; in the event there is no swivel, the bearing or bushing is frozen and must be taken out of service for rework at once. Lack of swivel will not allow a twist in the hoist cable or chain to work out, and in turn force the kink or twist to jam into lower hoist body area, causing a direct failure.

Load chain—check for bearing point wear, cracks, fracture, elongation, gouged or bent links. Cable—check for wear, flat spots, broken strands. Cable or chain wear is directly related to lower break sleeve, load wheel or idler wheel related wear (proper lubrication).

Hoist main frame—check for crack in frame, see that upper/lower limit switches function properly. Underload—check accuracy of brake holding function.

Check for possible damage to hoist control.

Angular lifts are dangerous, and extreme caution should be exercised in handling loads. Raising a given load any degree from centerline of hoist suspension, causes:

1. Added stress on anchor point of hoist to carriage.

2. Angular lift places up to 90 degrees of load weight on one side of carriage or two rather than four wheel usual suspension.

3. Superstructure suspending hoists are exposed to angular stress the runway, etc., were not capable of handling in the original design.

4. A chain hoist can handle some angular lifts if care is used. Cable hoists can not, because cable overlap, kinks, and breakages occur due to friction between cable, drum, and hoist frame.

5. Last, but not least, when initially engaging an angular lift load there is a tendency to create an uncontrollable pendulum motion, where load will sway or swing, striking someone or some object, etc. We realize some angular lifts are necessary, but use extreme care in handling, especially to avoid shock loads.

Never work under suspended loads. A famous hotel in New York City has a 4000 lb. chain electric hoist. In service investigation, I learned the hoist suspends an 1800 lb. beautiful glass chandelier in the main ballroom. Three times weekly a cleaning lady comes in after hours, and by means of the hoist lowers this glittering light to floor level in order to polish the hundreds of crystals. Before sun-up she completes her task, raises the fixture to ceiling height, yet the hoist is in a ceiling completely enclosed.

This condition existed for seven years. Guests, visitors, the hotel help daily and constantly pass under this suspended load. When hearing of this condition, I approached management on the danger. They were indifferent, claiming a 4000 lb. hoist is of no concern with only an 1800 lb. load. I stressed the fact that at sometime in the future this hoist will become tired, fatigue will set in, some parts may malfunction. Contacts, brakes, cable, chain etc., over so long a period of

time cannot work in their favor. I managed to supply a safety chain; in the event of a hoist malfunction, the chain would be a secondary suspension safety.

Some years past, chain or cables were manufactured from iron or low carbon steel having less than half the strength and wear factor of today's quality alloy steel heat treated chain or cable. A blacksmith years back would judge when his coke bed or heat furnace was up to the proper heat. He'd then insert his scarfed bar stock in this heat until the bar was obviously cherry red. He would then form this stock into a link of chain and peen or lap weld the link securely. His was an exacting art or craft. He had great pride in his workmanship, but like all human elements, at the close of his work day he was tired, weary, hungry, and his guard was down. Here is where the "weak link" probably took place. Here is where we experienced failures, etc.

Today there is no weak link, for no human element is involved in the processing and manufacture of chain. It is a completely and accurately controlled process. The analysis of material is precise, the links electric "butt" welded, heat treated, and severe tests are fully automated to give you extremely high strength, long wearing chain without any fatigue and great wear resistance.

Come-a-Longs are lever-operated tools which have proved to be the most dangerous load handling tool in use. Dangerous because they are used in difficult areas, under extreme conditions where a regular hoist cannot adapt to application.

These tools are usually supplied in three-fourth, one and one-half, three, and six ton capacities with four to 10 foot lift for inching loads, short lifts, or securing loads in position. They are light in weight, of cable or chain design. The cable type is usually designated light duty, and chain as heavy duty.

The effort exerted to raise loads by the handle averages 52 to 80 lbs. effort on 3/4-ton capacity. However, workmen daily and constantly overload a 3/4-ton rather than secure a 1-1/2-ton capacity tool. Workmen are aware of overload due to the effort exerted to raise the load. In fact, they seem to joke over the fact that they use a "cheater" or a pipe to extend the handle in order to gain greater leverage, thus bypassing the tool's safety.

Experience, history, and records tell us the puller or Come-a-Long tool, though very flexible and rugged, still has the No. 1 history on record of causing accidents in load handling. Yet, most investigations prove that abuse and carelessness account for the failure of this type tool.

78 2062

THE HOISTING TRIANGLE

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Historically, material handling accidents have accounted for over 25 per cent of the fatalities and injuries in all industries. By comparison to other recognized hazards, relatively little has been done to really effectively administer protective measures to reduce these accidents.

Years ago, when boilers and pressure vessels were causing death and destruction, codes and laws were formulated to prevent reoccurrence. Today, a major effort is being aimed at the health hazards in industry, and rightfully so. However, the material handling accidents continue, and the maritime industry is no exception. The reason for this somewhat puzzles me. With advances in engineering and technology, the trend continued, so we ask ourselves: Why?

The crane is truly a marvelous machine; there appears to be no limit as to what it can do. An inventive industry continues to turn out machines that stagger the imagination. Lifts of 100, 1,000 and 3,000 tons are performed almost on a daily basis. The reach of the crane has become almost a contest for manufacturers, and the speed in which they operate is ever increasing.

Does the safety profession and others responsible for material handling really understand a material handling operation? Our experience and the statistics indicate that they do not. What, then, do we do about it? How do we keep the crane, one of man's most useful tools, from turning into one of man's most devastating weapons?

Let's make a comparison. We are all well aware of what happens when a boiler or pressure vessel has a structural failure, a failure of a safety device, or an operational failure. There is a sudden release of energy that is uncontrollable, and the results are disastrous. Thus, the reasons for the ASME Code, boiler and pressure vessel laws, required inspections, and so on—in essence, laws and procedures to control energy.

Well, a material handling operation requires energy and, like a pressure vessel, this energy must be controlled. So the name of the game is to control this energy to do safe productive work.

First, let's take a look at a typical maritime crane, or any crane, and find the energies present.

1. Static energy—the sheer weight of the machine in upright position. We are all aware when, for some reason or another, this tremendous weight tips over.

2. The wire ropes which support the load and the boom are constantly under varying degrees of tension—this tension is also an energy source.

3. There is energy present in the power sources—the diesel engine, the electric motors, the hydraulic systems.

4. And, of course, let's not forget the weight of the suspended load.

The amount of energy present is enormous. How do we control these energies to do safe, productive work?

Once again, I'd like to make a comparison. We are all familiar with the fire triangle. To have a fire, you must have a fuel, an oxidizer, and a source of ignition. These are the basic elements of a fire—remove one and you cannot have a fire.

In my opinion, there is a hoisting triangle, and it has three basic elements: the machine, the operation, and the rigging. Without these three basic elements and their considerations, you cannot have a safe hoisting operation. Let's build this triangle and talk briefly about

each element and its components.

Let's start by looking at the machine itself. What we basically are looking at in the machine is the condition of the machine. So let's look at some major considerations when we look at the condition of the machine.

Configuration

First of all, what is the configuration of the machine? To know the proper configuration of the machine, we have to derive what it is from the load rating chart that is posted on the machine, if it incorporates all that information from the operator's or instruction manual that comes with the machine. What do we look for? Does the boom that is on the machine match the corresponding load rating chart that is posted in the operator's cab? Is the counterweight configuration proper for that for which the machine is set up? Is the machine reeved properly? Not only for the auxiliary line, which is the light duty line, but the main hoist line, does it have the required parts of line for the load intended to be lifted? Is the boom hoist assembly reeved properly? Are the pendants properly installed—those which support the boom or those which support the jib? Has the application of the pendants been correct, or has one of the pendants been replaced, which automatically induces side loading to the boom? Is the gantry or extendable A-frame in the position that it should be in? Are the shorter sections that receive a high load at the base of the boom? Or in other words, is the boom itself configured properly? And, of course, is the wire rope that is on the machine adequate for what the manufacturers prescribe? Not only in breaking strength, but in construction. Does the load block, whether the main or auxiliary, have the adequate capacity for the machine in the configuration? These are just some of the things that we look at when we look at the configuration of the machine utilizing the information supplied by the manufacturer, if it is available.

Modifications

An area in which we as a crane inspection company find numerous deficiencies is that dealing with unauthorized modifications to the machine. Modifications that effect the structural integrity or the safety of unit must be sanctioned in writing by the crane manufacturers. The majority of these modifications or add-ons are found on the boom or the counterweight. Drilling holes and welding on booms without specific procedures from the manufacturer not only creates an unsafe condition but also voids any warranty. If you are contemplating modifications, it behooves the owner of cranes to contact the crane manufacturer for procedures and methods that will not effect the integrity of the unit. The OSHA requirements are very explicit in this area, including documentation of authorization.

Repairs

Another consideration that we look at under machine condition, of course, are any repairs that have been performed on the machine. Here again, have the repairs been in conformance with the manufacturer's instructions? The area where we find most unauthorized repairs are those which are conducted in the field on the boom assemblies. Many of these booms are made of an alloy steel, where field welding isn't feasible, and a poor repair without due considerations can actually make a boom unsafe although it may appear satisfactory. And we get a lot of questions, especially in our training program, as to how much bend is allowed in a lacing, or how much is allowed in a chord.

Our criterion, which is consistent with most manufacturers, is the structural members of the boom. To do the job they're intended, they must remain in a straight and true condition. The lacings are designed to take a compression loading. Any disturbance of the line of compression caused by a bend in a lacing will disturb the compression loading on the boom. Hence, overload that one lacing or one section, the chances of a failure of the boom are greatly increased, because bent lacings usually bend the chords out of the design plane. The same holds true or even more critical for the chords. Most crane manufacturers will state that certain lacing repairs are possible. However, in the replacement of chords, they almost invariably recommend a new section be purchased.

The other areas where we look for repairs on the machine are the carrier of the carbody assembly, the draw-words, or any other component on the unit. On each page of our inspection report, which is devoted pretty much to a specific area or component, the number one question on the top of it is: "Are there any modifications or repairs to this component. Does the customer or owner of the unit have, in fact, adequate documentation to verify the adeqnacy of the repairs?"

Safety Devices

Another inspection point, of course, is the safety devices that come on the machine, and there are many of them. Are these devices operational? We verify this by putting the unit through an operational test during the inspection. For example, checking out the boom hoist disconnect or cut-out. This is a device that limits the maximum angle that is permissible by the manufacturer. It interrupts the raising of the boom by various methods, normally by setting a brake and disengaging the boom hoist clutch simutaneously. At the same time this is being done, we are observing the boom stops on the unit if so equipped. The rachets and pawls which lock the boom on the respective hoist drum and their conditions and positions—are they automatic or are they manual? If they are manual, can they be engaged or, like we find on many units, have they been wired back because the klick-klick-klicking of the pawl against the ratchet makes a somewhat irritating sound that bothers the operator, so he just wired it back to keep it quiet? Are those indicating devices on the unit operational? The boom angle indicator, whether it be mechanical or electronic, is it accurate? Has either a load indicating or load moment device been installed on the unit? There again, is it operational? Is it accurate? Those guages which are critical to the operation, such as air pressure, hydraulic gauges, or drum indicators, or other type of indicators, are they operational and are they accurate? Can the operator see them all? Does he have a warning system on the machine? Does it work? These are some of the things that we check out during the operational check on the machine.

Wire Rope

Another item, of course, that deserves considerable attention is the wire rope. And when we talk about wire rope, we talk about it as a precision machine. The wire rope is what really puts everything together, what creates the movement and does the hoisting. And talking about wire rope is like talking about the chicken and the egg; which came first, the rope or the crane?

It has been our experience, especially in the training program where we get people with many, many years of hoisting experience, that the field knowledge of wire rope is severely limited. We look at the wire rope, using the ANSI B30.5 recommended inspection criteria, which designated the number of broken wires, whether they be in running ropes, or standing ropes. We pay particular attention to the end connections. Especially those end connections that have a mechanical splice or swage fitting on them, such as on pendant lines. We look very critically at any broken wire that we find on the wire rope. To do a real inspection on the rope when you find a broken wire, a determination should be made as to what caused the wire to break. By examination of the broken ends of the individual wire, using a small magnifying glass, you can get a general idea of what caused the wire to break. For example, looking at individual wire that has broken, one end of the wire has the

appearance of a cup and one end of the wire has the appearance of a cone. This indicates a tension break, which deserves special attention. Further investigation is required which includes the measurement of the diameter of the rope to determine if it is below the diameter of what the standards have so prescribed. Backed up with the physical measurement of the length of the lay of the rope which would indicate that the rope has been overloaded which caused a reduction in diameter or the increase in length of lay. So one broken wire that is broken by a straight tension break in which there is no appreciable wear in the wire could be the criteria for removal of the wire rope. Very little wire rope really wears out. The majority of the wire rope where we recommend replacement has been subjected to either physical damage or just poor maintenance.

The individual wires in the wire rope must be free to move and adjust. There are very, very close tolerances on these wires. The tolerance is comparable to those of an internal combustion engine. So when the wires are not allowed to move within each other or adjacent to each other, you set up localized stresses. Which in turn, can cause your wires to break; or where a kinked or severe bend is present, it prevents those wires and the wires adjacent to it from moving and adjusting as they pass through the sheaves and the drums. The wire rope on virtually all mobile cranes is preformed. Broken wires down in the valley or in those areas where the rope does not make contact with the sheave of the rope will lay dead. In other words, what you have is a broken wire that does not protrude like you think it would. We have to look for these very carefully. This is one of the reasons for going to the operational test; you will normally find these wires protrude when they pass over a sheave or pass around a drum.

We pay particular attention to wire rope of the non-rotating construction, which is common on hydraulic cranes. The non-rotational characteristic of the rope is in the design where it is actually two ropes in one. You normally have an innercore of six strands laid in left-lang-lay and an outer wrap of 12 strands of right-regular-lay. So what you end up with is actually two ropes in one. Lubrication of this rope is extremely important, because the ropes are constantly fighting each other, having a different directional twist to them, giving the total rope the non-rotating characteristics. Most crane manufacturers and wire rope manufacturers state, when you use non-rotating wire rope, they will specify a much higher factor of safety for the rope to retain its non-rotational characteristic. There are some other restrictions on the use of non-rotating wire rope. ANSI B30.5 specifies it will not be used for boom hoist reeving, and it is not recommended for multiple part reeving, the main reason being that non-rotational characteristic makes it extremely difficult for this wire rope to bend because of what is happening within the wire rope.

In conjunction with the wire rope inspection, particular attention is devoted toward the condition of the sheave which the wire rope passes over. A sheave that is corrugated or one which is improperly sized can cause severe damage to the rope, especially when the wire rope is replaced. As it is first put on the machine, although being preformed, the wire rope really doesn't get into its operational configuration until the construction stretch has been removed. Therefore, the lay measurement is different from the corrugation on the sheave, causing concentrated loading on individual wires of the new rope, causing breaks and distortion almost immediately. So, the sheave must be smooth or free of any surface defects and, of course, the sheave must be sized to the wire rope. The purpose of the sheave is primarily to change direction of the wire rope. But the primary design of the sheave is to support the wire rope, to prevent the wire rope from crushing, pinching, or flattening. This is checked with a standard sheave gauge. Most wire rope manufacturers recommend when you insert the sheave gauge for that particular size wire rope that the contact area is approximately 150 degrees within the sheave root.

Clutches and Brakes

During the operational check of the crane, the controls, of course, are checked for proper function. These controls activate and deactivate the numerous brakes and clutches that actually transmit power from the power source. Needless to say, failure of a brake or clutch can be disastrous. Once again, we rely upon the manufacturer's information and our experience in the examination of these components. Proper operation, maintenance, adjustment, and repair is essential not only for a productive machine, but also for a safe machine.

Rotating Gear

The rotating gear, swing, or slew assemblies are extremely critical, whether a rotex type, ball bearing or a system of hook and horse rollers is the component or system of components that holds the rotating superstructure to the base. The majority of these components are indirect shear and require special attention, excessive clearances or cracks in these components spell trouble. We pay particular attention to what may appear to be environmental cracks in paint. In many cases, it isn't the paint that cracked, it's the metal.

Load Blocks

If there is an end item on a crane you could classify it as the hook or load block or speeder or clamshell or any devices that grabs or holds the load. Like all other components, it is critical. The majority of deficiencies we find in this area are the result of improper operation or poor rigging procedures. Spread hooks are not that uncommon. We tram each hook in addition to a non-destructive-test, for a bench mark for the next inspection.

Inspectors

The designated crane inspector must be knowledgeable and experienced and must have authority. The best crane inspector in the world is useless unless he has the authority to do something about deficiencies he discovers. One last word on inspection: dirt and excessive grease hide defects and other problems. It has been our experience that when we find poor housekeeping, we find poor maintenance, and that's what inspection is—an evaluation or check of a maintenance program. Inspections must be by an unbiased and independent third party. The foundation of the hoisting triangle is machine condition; it must be safe to operate.

Limitations

Another element that we talk about in formation of this hoisting triangle is the operation of the machine. There are numerous limitations on crane operations.

Of primary consideration to the operator is whether the machine is within the tipping limitation or the structural competence of the machine. This is indicated on the load rating chart by an asterisk, shaded areas, or other means. Most new machines have an extensive structural competence range. Therefore, if the operator is not aware of the structural limitations and relies on the feel in the seat of his pants for such as indications that the machine is tipping, a structural failure can occur without any indication.

Load rating charts provided by the crane manufacturer are not guidelines; they are, in fact, his bible. Exceeding these ratings or not taking into full consideration the operating and set-up notes provided has resulted in numerous accidents. It has been my experience that many crane operators and supervisory personnel cannot interpret all the stipulations of a load rating chart, especially when a jib or other attachments are involved.

I personally feel that the crane manufacturers need to standardize and simplify load rating charts, so that an operator can go from one machine to

another with standardized rules, which is not the case at present.

In addition to limitations prescribed by the manufacturer, environmental limitations also prevail in many cases. Let's review some of the major limitations.

Ground

One of the first environmental limitations, of course, is the ground. The manufacturer specifies and indicates on his load rating chart that the machine must be set on a firm level supporting surface—the ground or other supporting surface. When he's talking about level, he is talking about level in all directions, within one degree in all directions. Many crane manufacturers specify that the machine being off-level, for example, three degrees can reduce the capacity of the machine as much as 50 per cent. So the physical setup of the machine on the ground, whether it be crawlers or outriggers, is especially important.

Outriggers

The use of outriggers on truck cranes, and, of course, hydraulic cranes, does give the operator the capability to level the machine if he has a spirit level within his view—not only prior to, but during the operation of the machine, to maintain its level. It is an inspection point that we always check to see the amount of leak down on the outriggers. It should not be excessive, but it's not uncommon during the operation. The operator should have a spirit level so he can make the necessary adjustment. In the use of outriggers, the manufacturer here again specifies they will be fully extended. He furnishes a load rating chart on these units for on rubber. He gives you a load rating chart for outriggers fully extended. If the outriggers are not fully extended, there is nothing in between. He indicates if they are not fully extended that you use the load capacity that's on rubber. And he also specifies when using outriggers that the carrier be relieved of all weight on the carrier tires. In other words, you take all the weight off the tires. The purpose of the outriggers is to increase the stability of the machine. There is a tremendous amount of load on these outriggers and on the floats that are attached to the rams of the outriggers.

Let's take for example a hydraulic crane with a capacity of 100 tons. The weight of the machine is in the neighborhood of 75 to 80 tons. So what we're talking about is a total load imposed on the outriggers in the neighborhood of 350,000 pounds. Supporting this 350,000 pounds are four floats which are attached to the outriggers; they are roughly 30 square inches, so we're talking about 900 square inches on each float. Divide the number of square inches into the load, assuming that you're lifting over the rear where your two rear outriggers are carrying virtually your entire laod. What you are talking about on these outrigger floats is 300 pounds per square inch pressure. If you rotate the load and go directly over one outrigger, it is quite possible that one outrigger can carry the majority of the load, in which case it will be possible that the one outrigger can see in excess of 500 pounds per square inch. So it's very important that you set the machines up to provide adequate support to distribute that load over as much ground surface or bearing service you can. This also holds true for crawler machines.

Radius

Perhaps the most important operational consideration of the machine is what the operating radius of the machine is during the operation. The radius of the machine is measured from the center of the rotation of the machine before loading to the center of gravity of the load after loading. Any increase in radius, of course, can increase the moment of the loading on the crane. This increase is the result of an operator or the responsible individual not taking into consideration the deflection of the boom on the machine, which will cause an increase in radius by the machine not being level. Rotating from one side to the other increases the radius, or too rapid movement of the load can increase the radius. There are also some rigging considerations that we will be getting into a little bit later. A large machine with 200 to 250 feet of boom picking up maximum capacity could change as much as seven or eight feet as a result of boom deflection. Here again are some operational considerations—the good operator or the individual responsible for the unit knows how much deflection he will get in that boom and allows for it.

Quadrant

Another limitation is the quadrant of operation of the machine. The load rating chart or the manufacturer's manual gives the quadrant of the operation. It tells what constitutes over the side, what constitutes over the rear of the machine, and a good safe rule to follow is you never lift over the rear of the machine what the capacity of the machine is over the side, because in moving a load from one position to another you invariably rotate to that position and here again, you have to look at the load rating chart to see what the particular manufacturer has designated over the side and over the rear. Lifting over the front is out, unless specified by the manufacturer.

Shock

Another operational limitation restriction, of course, is when you induce shock loading into the machine. Shock loading is commonly introduced by allowing the wire rope to become slack on the drum and by the presence of slack in sheaves. Hoisting at normal hoisting speed can increase the loading on the wire ropes and the rest of the machine as much as 100 per cent if you allow, let's say, a foot or 18 inches slack. Shock loading is mainly the cause of not having the wire rope properly seated on the sheaves or on the drums. And, of course, by improper application of hoisting and braking action.

Dynamic Loading

Another limitation, of course, is dynamic loading. Dynamic loading is loading which is imposed on the machine by other than the load it is carrying. It is caused by centrifugal force, by rotation of the machine, by not having the load line directly over the center of gravity of the machine, and, of course, it can be caused also by environmental conditions such as high winds.

One of the other limitations, of course, on the operation of the machine is present and anticipated weather conditions during operation, especially on objects that have a large sail area. The presence of high winds can add appreciably to your load, not only making it difficult to control the load, but also imposing additional loading on the machine. Wet weather also can affect footing.

Work Area

Another consideration is the operational area that the machine has to work in, especially on a construction site where environment is constantly changing because of the addition to the building, the addition of steel, or addition of piping and pressure vessels. Is the operational area clear, does the operator have a clear envelop to lift the load, or is there a strong possibility of it becoming fouled? Does he have enough machine, either the capacity of the machine, the length of the boom to actually land the load where he wants to land it? The proximity of high voltage overhead lines may further reduce the operational area.

Signals

Another operational limitation is the communication between the crane operator and the individual giving the signals. This could be in the form of hand signals, which there are standards on. However, it has been our experience that we see hand signals that we really don't understand what they mean and we seriously doubt that the operators understand. Poor communication has resulted in many accidents. Good, ac-

curate signal information is absolutely necessary.

Operator

A tremendous amount of responsibility ends up at the operator's seat. The operator is responsible for anything under his control, but he needs help. He needs guidance, and he is one individual we always talk to. It is our opinion that many accidents could have been avoided if the responsible people would listen to what the operator had to say. A good operator is a curious individual. He may not know exactly what is wrong, but he's got the feeling that something is. The operations should cease until he has been assured that somebody has made the necessary investigation to determine that none of the operational safety aspects of the operation had been compromised.

We have completed two sides of the triangle. The third side of the triangle is sort of my favorite, and that's rigging, below the hook considerations, how the load is attached to the crane. Now there are no two rigging operations alike. Each lift is always a little different. However, due considerations being taken, it can be performed safely. There are numerous rules of thumb involved in rigging that are in use today and have been used for years. Some of these rules of thumb pertain to sling angles, some pertain to size of the sling and various other considerations. We do not object to rules of thumb provided the individual who is using the rules of thumb, whether it be the rigger, the operator, or foreman, know how these rules of thumb came about. Ninety times out of 100, the rules of thumb get you by. But in unique or different rigging operations where the rule of thumb does not apply, is where the trouble starts. The following are some of the basic considerations in rigging a load.

Weight

The first consideration, of course, is the weight of the load, and sometimes it is not easy to get. Sometimes getting a weight is troublesome, it may involve the use of a dynamometer, getting the weight run over a public scale, or what have you. But if you don't know exactly what you're lifting, there is really not much need in thinking about anything else. Weights are very difficult to estimate. A cubic foot of carbon steel weighs approximately 491 pounds. Of course, what happens a lot of times is a weight will be specified on an object. It is not, in fact, what the weight really is. This is one area in which load indicating devices are really valuable. The operator knows exactly what he has on the hook, including the rigging. In case of a mobile crane, your rigging equipment plus your load block is part of the load. Rule number one—know the weight exactly.

Center of Gravity

Another consideration in rigging is where the center of gravity is on the object. Here again, this is not easy to determine. In our rigging program, we go through a couple of procedures in which we determine the center of gravity. The operating radius is from the center of rotation of your machine before loading to the center of gravity of the load after loading. So if you don't know what the center of gravity is of the object, there is a strong possibility that you will increase your radius upon lifting the load. The center of gravity of the object you are lifting is going to end up directly under that hook, whether you put it there or not. You may get by in a balancing act for a while; however, sooner or later that center of gravity is going to land under the hook. Knowing this makes rigging a lot easier and safer when the center of gravity is known. You can size your slings accordingly.

The center of gravity is one of the prime considerations when you attach the sling or the lifting device. It should be fastened above the center of gravity. In other words, you have the heavy end down. Here again, for the same reason, if the heavy end is not put down initially, sooner or later it's going to end down there. Which, of course, can introduce shock loading and dynamic loading not only to your machine, but also to the

rigging equipment that is being used in the operation.

Sling Angles

Another rigging consideration is the angle that the slings make with the load. What happens here is the smaller the angle that the sling makes with the horizontal axis of the load, the more increase in tension loading over and above what is already placed upon the sling. This can probably best be understood by placing a five-gallon bucket of sand right along side of you. You can reach down and lift it with reasonable ease. You take that same five-gallon bucket of sand and place it two or three feet over to your side; remaining in the same position, you try to pick it up. You have an invisible force in which you have the weight of the load that has to be overcome, plus the tension in your arms, which is legs of the sling, necessary to do it. If you can do it, you can surely feel the increase in the loading of your body, which is the same thing that happens to your sling. There have been many, many crane accidents as a result of people not taking into consideration the sling angles.

I investigated one accident in which a sound machine, operated by a capable operator, had been inspected and found in good condition. Upon lifting a side frame from another crawler machine, the load was attached by the means of two chokers around each side of the crawler frame. They in turn were attached by another sling in which the chokers were joined and placed over the hook, resulting in a severe sling angle. When the load was lifted, it didn't even come off the ground. The sling that was attached to the two chokers broke. The operator estimates he had in the vicinity of 35 to 40 tons on the machine when the sling broke. When it broke, of course, the boom on the machine was preloaded with all that weight. The boom sling shot back over the machine and the operator was severely injured. Fortunately, no one was behind the machine as the boom came over, but the machine had suffered extreme physical damage. Many crane accidents have been rigging failures involving sling angles.

D/d Ratio

D/d ratio is the radius of the wire rope versus the diameter which the wire rope bent around. When you bend the wire rope around a small radius, you set up internal loading, and it is not efficient. It doesn't have the same strength as a rope that is not bent. So the D/d ratio is an important rigging consideration and we go through a lot of practical questions and discussions in our training program.

Certified

The slings or their lifting gear should be rated with the maximum capacity of the sling. Identification tags are required on some slings under the general industries standards. We feel that all slings should be identified—it's sort of like operating a crane without a load chart. Without a rating, sling angles, and D/d ratio, calculations cannot be performed.

Inspection

Inspection is required on the rigging equipment quite similar to what we do on the machine, the condition of the rigging equipment, using the criteria specified under the various standards, as to the reduction of the diameter, corrosion, broken wires, condition of end connections, the hooks, the shackles, the pins, and what have you.

Hitch

The type of hitch that is used varies with the type of load that you're going to be lifting. However, the rigger or the individual responsible should keep in mind that the primary purpose of any hitch attached to a load is to hold and control the load. The load should not be allowed to rotate or move within the hitch. Many loads have been lost and injuries occurred using a basket type hitch where the load has shifted due to the inability of the hitch to control and hold the load. Of course, the sling selection is

extremely important in attaching the load. For example, three- and four-legged slings are rated the same because it's almost impossible to get equal loading on each leg of the sling. In fact, on a four-legged sling, it is quite possible that two of the legs will carry the entire load, the other two legs will merely act as stabilizers. So there are many things taken into consideration in rigging, and a good rigger will observe not only the machine, but also the slings as they take up, especially bridle slings, to see that each sling is carrying its own load. Once again, the majority of our rigging program is devoted to actual rigging problems.

Rigger

All of the aforementioned rigging considerations and many more are the responsibility of the rigger, so he, with the crane inspector and crane operator, plays an equally important role in a safe, productive hoisting operation.

The above is a very brief outline of what I refer to as the hoisting triangle. The three basic elements:

1. The machine and its condition, which are the responsibility of the crane inspector.

2. The operation of the machine and its limitations, which are the responsibility of the crane operator.

3. The rigging of the load and its considerations, which are the responsibility of the rigger.

If we are to improve our performance, and by performance I mean both production and safety, we must consider this hoisting triangle in our material handling operations. There is no easy or quick solution and many areas still need study, but a foot in the right direction is to train the inspector, train the operator, and train the rigger.

78 2063

PUBLIC RELATIONS AND SAFETY DOES WORK

By JAMES E. FEENY
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My interest in a public relations approach to selling safety started during the 1974 National Safety Congress. One of the speakers at the Shipbuilding session was Raymond Ewart. His presentation was entitled "Public Relations and Safety" and made some points which I am taking the liberty of quoting:

"Recruit management to take an active part in your program, to write letters, to publicly endorse any safety action, and to speak on safety whenever possible.

"In selling to the general public, you are faced with the problem of making the community aware of your company as a safety-conscious organization vitally concerned with the well being of its employees. Any releases to the news media must be accurate, timely, and thorough.

"Selling to the employee is a constant project but, basically, it should perform the following:

1. It must remind. The message must be presented in as clear and concise a manner as possible. It should attract attention and it must be repeated to such an extent that the employee is bound to see it.

2. It must impress. It must have meaning applicable to the specific audience and it must make an impression. To do this it must be both professional and in good taste.

3. It must motivate. Once observed, it must be strong enough to make a lasting impression that will motivate the individual throughout every waking hour. If a danger situation should arise the message should immediately come to mind.

"In my organization the safety director, like the director of public relations, is basically a communicator. The opinions and attitudes which are created by his department set the safety stage throughout the organization."

As I said, my interest was aroused, but we were at a loss as to how to implement such an approach.

But let me digress for a moment. We, as safety professionals are peddlers. We are peddling a most tenuous and hard to define commodity: attitude. And it is the employee's and employer's attitude toward safety that we are attempting to influence. All the safety slogans, posters, safety rules, inspections, and control of physical conditions are meaningless until the man at the top says, "Do it," and means it. We found out that the word can filter down through the organization quite fast that there is no substitute for the safe way.

In late 1974 we had meetings with a public relations and advertising company based in Pittsburgh on how to add a second facet to our safety program. A plan was mapped out which would use an approach similar to that used for another of their clients, one of the nation's largest coal producers.

Statistically, coal mining is one of the most hazardous occupations in existence. This one company included the public relations approach as an integral part of the company's new safety program. They effected the following results:

1. During the first four months of 1975, the disabling injury frequency rate was 8 per million manhours worked. It was also the same during all of 1974.

2. This same company's rate for 1972, by way of comparison, was 23.5. The

entire soft coal industry frequency for the same period was 30.

3. The rate published for all manufacturing during that period was 16.

One thing I think we are all aware of is that safety awareness can be very short-lived, even after intensive training classes and safety meetings. The traditional safety posters go unnoticed after a few days. A new approach was needed to get the employee's attention.

Through our meeting with the public relations people, we learned that this coal producer involved the man's family as well. A newsletter, posters using members of employees' families, and passouts with safety messages were some of the ingredients of this public relations approach to the program.

We opted to use a similar approach. The following is an outline of that program:

In line with the total management commitment toward promoting safety, it is recommended that the E.W.D. Safety Communications program will commence as follows:

1. Establish a cost center to accrue all charges for the Safety Communications program.

2. Notification to all key division administrative heads to attend a safety meeting to be chaired by the Division General Manager. Purpose: (a) to outline the campaign; (b) to impress the attendees on importance of total commitment; (c) to restate and confirm safe operations as vital a consideration in the business plan as profit; (d) to announce a renewed commitment toward better plant safety to all media.

3. Meetings of department heads, general foremen, and foremen. Purpose: (a) impress attendees of total management commitment; (b) outline program; (c) relate scheduling.

4. Meeting of top management and union leaders. Purpose: (a) outline program; (b) obtain total support.

5. Meeting with insurance carriers to outline program.

6. Notification to all employees: (a) Division general manager's letter; (b) initial distribution of symbol materials, i.e., pins, decals, etc.

7. Develop, produce, and disseminate a continuing campaign to all employees.

Communications Plan: A logo for use on all items of program. Use suggested on all internal correspondence sheets.

"Fulltime" newsletter. Direct mail piece will maintain program continuity, invite family participation, relay safety messages.

Safety posters using children and wives of E.W.D. employees as models, stressing personal safety messages (e.g., "Work safely, dad, we love you"). Decals—constant reminders of safety, worn on hard hats. Bumper stickers distributed to all employees. Safety stickers

Pay stuffers included at intervals to reinforce the need for safety awareness. Plant entry signs, crane signs, key area spot signs, also for use on equipment.

Birthday cards to all employees. Theme: "Happy (another safe year) Birthday."

Luncheon kits. Sandwich bags with safety slogans. A supply sent to each employee's home.

Button box mailing to employees' wives and mothers to enlist their aid.

The emblem chosen reflected the Division's maritime nature and the slogan "Safety Works Fulltime." This was also used as the title of the newsletter. In each issue we incorporated articles and messages to reflect our involvement with each man's safety on and off the job as well as the safety of his family. A photographer went to local schools to take photographs of employees' children for use on the safety posters. The impact of these was outstanding. One parent obtained 12 extra copies from me to send to all his relatives.

Passouts and mailings to the home were also used. We mailed a small first aid kit, a box of assorted buttons (this was a real point-maker with the wives and mothers), each containing the program's emblem and motto. During the summer of 1976, we sent out a notice to employees

that we were going to issue "T" shirts to them. The notice requested them to inform us of their size requirements. During an earlier period of the summer, sport caps were passed out to each employee. But, by far and above, the most popular passout so far was a knit cap. I don't think there is anyone here who doesn't acknowledge that this was an awful winter. At any rate, anywhere in the Pittsburgh area, Dravo employees were easy to identify because they almost all were wearing these knit caps. Many employees wanted to buy additional caps, because bringing one cap into the house caused arguments and disagreements. In my own house, I could have used seven more caps. After coming in from the outside, I had to hide mine so no one else would take it.

Earlier, I mentioned our newsletter. As it was originally published, the public relations people were responsible for writing, editing, printing, and preparing the newsletter for mailing. In the fall of 1976, plans were formulated to develop an editorial committee within the division responsible for developing a more personal and diversified newsletter. Five people were chosen, three of whom represent the division; one of them represents the workers. The frequency of publication was increased to ten issues a year from the quarterly publication used before.

The first issues carried no name in the title block. It was our intent to let the employees submit proposed names for the newsletter. The prize for submitting the selected name would be a $50 savings bond. Well over 150 entries were submitted. Some employees submitted more than one name for consideration.

When we of the editorial committee began our deliberations, we had no idea who had submitted the entries. Each one had been assigned a code number so that confidentiality was maintained. The winning name was "EWD Matters." We and the young lady who submitted the name thought that there was a good double play intention on the word "matters."

Does it work? I am going to say that it is beginning to. During the first nine months of 1976, we experienced one of the highest disabling injury frequency rate in our history. But, the last quarter of 1976 started to show a reduction in the monthly frequency and severity rates. This has continued so far in 1977 in spite of layoffs, reassignment of personnel, and contract negotiations.

I cannot and will not give total credit to this program for the reduction in our accident rates. We have been developing and implementing a more formal, planned, and structured safety program for the division. As a matter of course, this must be our focal point. As an aside, the Federal Mediation and Conciliation Service conducted courses in "Relationships by Objectives" that both management and labor considered to be a great help. I think the headline on the front page of the September issue of "EWD Matters" speaks for itself. This is the first time since WW II that we did not have a strike when the contract ran out. But the RBO program could be the topic of a paper all by itself.

We do feel this program has gone far to change the old attitude of "Get your safety glasses on—here comes the boss," which was so prevalent. One indication of this improved attitude occurred during a recent wall-to-wall inspection by OSHA. The compliance officer remarked that he had found few employees in his interviews who had anything bad to say about the company. Other employees took me aside and stated, in effect, "Why doesn't he get out of here? We can solve our own problems." Believe me, this is a far cry from our experience of a few years ago.

 78 2064

FORTY YEARS OF SAFETY COMMUNICATIONS ON THE GREAT LAKES BY MEANS OF RADIO

By J. D. CAIN
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For centuries, the world's adventurers struggled along in lonely silence as their ships sailed the oceans of the world. Many were not heard from for months or years, and others were never heard from again. Crews fought shipboard disasters alone while in range of immediate help that never knew of their needs.

History

Wireless

At the turn of the twentieth century, several men of science laid the foundation for Guglielmo Marconi to apply for a "wireless"* telegraphy patent in 1896; the British Marconi Company was founded in 1900. The German *SS Kaiser Wilhelm der Gross* was the first commercial ship to be equipped with wireless, in the year 1900, and a new industry—even more, the long-missing lifeline of the sea—came into being.

The first shipboard wireless operators were recruited from the land telegraph operators who used "CQ", their general call to all stations, as a distress call. The Marconi Company in 1904 realized that a standard distress call was desirable, so they instructed their operators to add the letter D for danger, and the distress call became "CQD." After several international conferences, the distress signal "SOS" was adopted in 1908, not because it had any special significance but purely because of its distinctive characteristics—three dots, three dashes, and three dots.

In 1909, CQD was still in use by the British when Jack Binns sent out the famous distress call from the 15,000 ton White Star Liner *Republic* after she had been rammed by the Italian freighter *Florida.* The 460 passengers from the *Republic* were transferred to the *Florida,* which did not carry wireless. When the *SS Baltic* responded and appeared on the scene, 1,650 passengers were transferred from the damaged *Florida.*

In 1912 John George Phillips, the wireless operator aboard the *Titanic,* sent out both the CQD and the SOS; 712 passengers and crew were saved and 1,517 were lost. This was the last distress call in which CQD was used.

Wireless on the Great Lakes

Although Great Lakes cargo freighters were not required to carry wireless, by 1908 three merchant vessels were equipped, and by 1913 this number had increased to 40. As of June 30, 1935, at the peak of wireless activity on the Great Lakes, 195 ships carried wireless equipment. There are many documented distress messages and numerous other messages in which wireless played an important part in the safety of lives and property on the Great Lakes. One of the most dramatic distress calls was sent by wireless operator Stephen Sczpanik from the *SS Pere Marquette No. 18* which had left Ludington, Michigan, at 11:40 P.M. on September 8, 1910 and about 3:00 A.M. was sinking in mid-Lake Michigan. The distress call was heard by radio station WLD at Ludington and several ships. Her sister ship, the *SS Pere Marquette No. 17,* arrived in time to rescue 32 people from the lake; the captain, the wireless operator, the chief mate, and 23 of the crew were lost.

With this brief introduction of how it all began, let me relate two personal experiences as a wireless operator aboard Great Lakes ships. During the summer of 1937, aboard the *SS John J. Boland,* I received an urgent call from the *SS Standard Portland Cement* which was drifting without a rudder near Thunder Bay on Lake Huron. After reporting this to Captain Charles McNalley, we had the wireless operator on the the distressed ship transmit the International direction finder signal letters MO, which consisted of two long dashes, a space, and three additional long dashes. This was repeated every 15 minutes. I then went to the pilothouse and took radio direction finder bearings on these signals. Every half-hour we kept the other ship informed of our progress and our estimated time of arrival until we pulled along-side. Lashed along side, the helpless vessel was taken to Port Huron, where two tugs were waiting to take her to the Great Lakes Engineering Shipyard at Ecorse, Michigan.

On a later occasion the same year, I was called to the pilothouse by Captain McNalley while we were downbound on Lake Huron in a very heavy fog and was asked to take radio direction finder bearings on the *Huron Light Ship;* thanks to those bearings, we entered the St. Clair River at Port Huron, Michigan with no difficulty. Visibility in the river was good, but about 45 minutes later a river fog shut in very quickly and Captain McNalley stopped the engine and dropped anchor. The *Boland* swung around in the swift current and hit the Canadian shore. Because the rudder indicator went hard to one side, Captain McNally called the engine room and asked the chief engineer, Ray Carter, to give him the rudder position. Carter, who two years later became fleet superintendent, said, "Captain, the rudder is about one mile astern." Wireless again played a major role; the captain arranged by wireless with his company office, and then with the wrecking ship *Maplecourt* and two Great Lakes Towing Company tugs towing the *Boland,* we proceeded to Fairport Harbor, Ohio for unloading, before drydocking in Cleveland.

Disconnect

Enter the Radiotelephone

Wireless had the distinct disadvantage that every message was thirdhand, that is, it was of necessity converted by the sending operator to the telegraph code and translated back to words by the receiving operator. However, as the state of the art advanced it was inevitable that radiotelegraphy would give away to radiotelephony; the advantage of personal voice contact was a powerful incentive. Perhaps the earliest move in that direction was in the year 1933 when Robert Fox and Edward Dugan called on William N. Krebs, chief of the Marine Division of the Federal Communications in Washington, D.C. They were representing Herman E. Hageman, president of The Lorain Telephone Company, and they were seeking a license for a ship-to-shore radiotelephone station at Lorain, Ohio, to serve Great Lakes ships. Eventually, an experimental license was issued to the Lorain County Radio Corporation to construct a ship-to-shore radiotelephone station in Lorain, and within one year this station became WMI, a public service coastal harbor station.

The first Great Lakes ship to be equipped with a radiotelephone installation was the *SS William C. Atwater,* owned and operated by the Wilson Marine Transit Company. One of the early calls from this ship was an emergency call from Lake Superior to WMI when the captain fell down a stairway and suffered serious injuries. By radiotelephone the first mate was instructed to divert the ship to Marquette, Michigan. There an ambulance, doctor, and relief captain waited on the dock. Immediately the Wilson Company ordered radiotelephone equipment for its entire fleet.

The early radiotelephone sets installed aboard Great Lakes' ships had four channels; one was an inter-ship channel and three were public correspondence.

* The term wireless (without the quotation marks) became the accepted name for the radiotelegraph in those early days

The aboard-ship equipment included a dial-type telephone; the appropriate channel was selected by dialing the digits 10, 20, 30, or 50, the latter being the inter-ship channel. One ship called another, and shore stations called ships, by tone signals corresponding to the official whistle signals of the individual ships; such signals consisted of short and long whistle blasts, transmitted by dialing, respectively, the digits 2 or 8.

The Safety/Distress Channel, 2181 kHz

The international distress call for radiotelephony was, and has remained, *MayDay*. It was adopted from the French fishermen's traditional cry for help—"M'aider," meaning "help me." The use of radiotelephony soon proved its value in enhancing the safety of ships, property, and navigation on the Great Lakes. Perhaps the greatest weakness of the early radiotelephone system was the lack of a single channel that was a common meeting place for both ships and shore stations—a channel on which a cry for help would be heard by other ships and by shore stations.

In the year 1936, the Lake Carriers' Association retained Dr. C. M. Jansky, Jr. and his firm Jansky and Bailey to assist in the development of an adequate safety and distress radiotelephone system for the Great Lakes. Congress designated the Federal Radio Commission (now the Federal Communications Commission) to conduct an extensive study into Great Lakes Communications with a final report to Congress no later than December 31, 1939. The study included several hearings and extensive tests of both radiotelegraphy and radiotelephony on the Great Lakes. An important event occurred on October 14, 1939, when William N. Krebs, by directive from Commissioner Brown, met with officials of the Canadian Department of Transport at Ottawa, Canada, and agreement was reached to adopt the Commission-selected frequency, 2181 kHz, as the common channel restricted to safety and related uses; this was in lieu of the Canadian frequency 1630 kHz which was then in use. The U.S. Coast Guard, the governmental agency basically responsible for ships' safety, immediately equipped their stations and ships with 2182 kHz. At the same time, Great Lakes ships and Coast Stations installed 2182 kHz.

2182 kHz Use Further Disciplined

It was already evident that the new 2182 kHz safety/distress channel could become an invaluable aid to ships in distress, but it took a dismaying experience in 1939 to point up the necessity for restricting its use even further than the former concept allowing safety-related broadcasts without time limitation.

A distress situation the night of November 7, 1939, was the case in point. Shortly after the general call by WMI Lorain to all ships for the 10:00 P.M. weather broadcast, a *MayDay* call was heard on public correspondence channel 20 (6470/6660 kHz). The call was from the *SS Carl D. Bradley*, then flagship of the Bradley Transportation Company (U.S. Steel); the *Bradley* was standing by the Great Lakes Dredge and Dock Company's tug *Badger State* in a severe NW Lake Michigan gale. The Bradley did not yet have 2182 kHz but would have had difficulty getting its distress call through on 2182 kHz since shore station WAY, Chicago, was broadcasting weather and hydrographic reports on that channel. This, in fact prevented the WMI operator from using 2182 kHz for its intended purpose to notify nearby ships and the Coast Guard. Fortunately, he was able to reach the Coast Guard's Charlevoix station by telephone without serious delay, and lifeboats were dispatched from the South Manitou and Charlevoix stations. The cutter *Escanaba* was finally dispatched, but since the *Bradley* did not have 2182 kHz and the tug was not yet equipped, there was no common channel of communications; it was thus necessary for the operator at WMI to relay messages cross-channel and finally to

"talk" the operator aboard the *Escanaba* to channel 30 (2158/2550 kHz) by having him manually tune his receiver and transmitter while the WMI operator made test transmissions and frequency measurements. Then, with both the *Escanaba* and *Bradley* in direct communication, the rescue efforts could be conducted more effectively. A 6:32 A.M. call from the *Bradley* reported rescue of the *Badger State's* crew and recovery of its captain's body before the tug sank.

The lessons were obvious; every ship should be equipped with 2182 kHz, and there should be no lengthy transmissions on that channel. Several important radio rules were implemented promptly:

1. All ships were required to carry 2182 kHz.
2. All ships and stations were required to continuously monitor 2182 kHz.
3. No lengthy transmissions, even those which were safety-related, such as weather and hydrographic broadcasts, would be permitted on 2182 kHz. Such transmissions would be made on the public correspondence channels after brief announcement on 2182 kHz.
4. It became necessary to listen on a channel before transmitting.

2182 kHz Proved Itself

Radiotelephony continued to play an important role in distress situations, but inconspicuously, until 1942. About 8:00 P.M. on Sunday night, June 21 of that year, two technicians from Lorain County Radio Corporation were installing equipment at a remote new receiver site of shore station WAS at Duluth, Minnesota. When they turned on the newly-installed receivers, the first call heard on channel 30 (2550/2158 kHz) was Captain George C. Chambers of the 600 foot *SS Eugene S. Buffington*, owned and operated by the Pittsburgh Steamship Company (U.S. Steel Corporation) calling Captain William F. Meister, Marine Superintendent in Cleveland, Ohio. Captain Chambers reported that his ship was aground on Boulder Reef on Northern Lake Michigan. Captain Meister inquired about the safety of the crew. Captain Chamber said that he had called the Coast Guard on 2182 kHz and that boats from Charlevoix, Frankfort, South Manitou, and Beaver Island were on their way to remove the 39-member crew. When asked about the weather, sea, and the condition of the ship, Captain Chambers reported that the weather was clear, the sea was calm, but the ship had broken in two and was a total loss. No lives were lost. Again the common channel, 2182 kHz, had proved its worth in a distress situation. Interestingly, the *Buffington* was, in fact, not a total loss; it was lightened, raised, and with temporary bulkheads and strappings installed, was towed to South Chicago where it was rebuilt at the American Shipbuilding Company and restored to service.

Another 1942 distress call firmly established 2182 kHz (by that time better known as channel 51) as the generally-recognized distress medium. At approximately 1:00 A.M. on September 3, 1942, a *MayDay* call was broadcast on channel 51 from the *M/V Steelvendor*. This call was received by WAS Duluth and rebroadcast at the shore station's higher power. Several ships responded. The *Steelvendor* was owned by the Isthmian Steamship Company, a subsidiary of U.S. Steel Corporation, and was carrying a load of steel billets when her cargo shifted during a storm. When her engine room started to flood it became necessary to abandon ship while her engine was still operating but her steering gear jammed. The crew launched life boats under extreme difficulty at 3:45 A.M. and she sank only six minutes later. The radio transmitter was operated by a voice control relay which kept it on the air from the noise of the water as it poured into the pilothouse; the WAS operator reported that he actually heard the rush of water as the ship sank. By daylight two of the ships which had responded to the broadcast were on-scene; the *SS Charles M. Schwab* of the Interlake Steamship Com-

pany picked up 22 of the crew, while the *SS William G. Clyde* of the Pittsburgh Steamship Company picked up two crew members and recovered one body.

Again in 1942, the common channel 51 proved its worth. During the night of December 2 the tug *Admiral,* towing the Cleveland Tanker Company's oil tanker *Cleveco,* sank in Lake Erie off Avon Point during a severe storm. Captain William H. Smith aboard the *Cleveco* had made his first call through WMI Lorain at 12:17 A.M. to report an expected arrival in Cleveland at 5:30 A.M. At 4:02 A.M. Captain Smith reported the loss of the *Admiral;* a call on channel 51 advised the Cleveland Coast Guard, and the cutter *Ossipee* was dispatched. The *Cleveco* had both anchors down but was drifting, with its position uncertain. The tanker *Comet* was laying up in Cleveland when, early in the day, she also joined in the search for the *Cleveco.* A heavy fog closed in. The radiotelephone, not only the safety/distress channel 51 but also numerous calls on the public correspondence channels, played the vital role of coordinating the search efforts of the *Ossipee, Cleveco, Comet,* Coast Guard Cleveland, and WMI. The *Ossipee* reported seeing the *Cleveco* for one brief period, and the *Cleveco* reported seeing the terminal tower in Cleveland, but the visibility remained close to zero throughout the day. The last call reported from Captain Smith was made to WMI when he reported that sea was entering the *Cleveco's* hawse pipes and he would soon lose power when the water reached the donkey boiler located in the windlass room; his ship foundered about nine miles N-E of Cleveland East Entrance Light with 18 lives lost. Fourteen went down with the *Admiral.*

Potential and real distress situations, mostly involving non-commercial craft, are not uncommon in the Great Lakes with their characteristically heavy fogs and sudden and severe storms. For those also, channel 51 was generally the medium for coordinating search and rescue. Larger-ship distress situations are relatively infrequent. The next was, however, during the early morning hours of a particularly eventful day, April 27, 1944, while the entire Lake Erie was blanketed in a dense fog. The Interlake Steamship Company's *SS James H. Reed* and the Canadian ship *Ashcroft* collided approximately 20 miles north of Conneaut, Ohio. At 6:59 A.M. the *Ashcroft* asked WMI to use its higher power to rebroadcast her *MayDay* call, and also to notify Interlake's Marine Superintendent in Cleveland that the Reed had sunk. The following ships responded to the WMI broadcast on Channel 51: *SS Frank Vigor, SS Donnacona, SS Gleneagles, SS Clarence Randall, SS Viscount Bennett, SS Arthur Orr, SS John Sherwin, SS Pathfinder, SS Sinaloa, Tanker Mexoil.*

WMI reported to the Coast Guard in Cleveland, and the Coast Guard asked WMI to continue as a control station. At 7:45 A.M. the *Ashcroft* reported that she had 26 men on board, 10 were still missing, and three of the 26 were badly injured. At 10:05 A.M. the *Arthur Orr* reported that she had picked up two bodies. At 10:32 A.M. the *Pathfinder* reported picking up four bodies. At 10:56 A.M. the *Randall* reported picking up two bodies. At 12:09 A.M. the *Sinaloa* reported picking up one body. At 12:33 the *Sinaloa* reported picking up one more body. At 1:00 P.M. the *Mexoil* reported that she was spreading oil and would lay abreast of the *Ashcroft* so that a Coast Guard Amphibian could put a doctor and nurse aboard.

It is ironic that one of the ships that had responded to WMI's rebroadcast of the *Ashcroft's MayDay* call was later sunk in the same fog. At 9:15 A.M., during the extensive distress traffic on Channel 51 that morning, the *SS Philip Minch* broadcast a *MayDay* call which was answered by WMI; the *Minch,* owned by the Kinsman Marine Transit Company, reported its collision with the *SS Frank Vigor* in the dense fog at Pelee Passage in western Lake Erie. The captain of the *Minch* advised that although the *Vigor* had sunk there was no immediate danger

to his ship, since it was not damaged critically and he had the entire crew of the *Vigor* on board, 32 men. The Coast Guard sent the cutter *Plaintree* to stand by the wreck, while the *Minch* took the survivors to Lorain. The *Frank Vigor* was owned by the Oglebay Norton Company.

Safety Innovations

Immediately following this disastrous night on Lake Erie, H. E. Hageman was called by Captain Zeeland and asked to meet with the Electronics Committee of the Lake Carriers' Association. He was asked for suggestions as to how radiotelephony could be used to aid in avoiding future collisions. Mr. Hageman suggested "safety" calls, that is, blind broadcasts on Channel 51 as warnings to other ships when a ship is moving under any unusual or potentially hazardous conditions such as fog, backing out of river-side docks into ship traffic lanes, and other situations for which a warning to other ships could avoid hazard. The logic was apparent, and the practice quickly became widespread throughout the Great Lakes. However logical, it was in fact contrary to Rules of the FCC which, at that time, forbade any transmissions (other than distress) not addressed specifically to another ship or a shore station; accordingly the FCC monitoring stations issued a flood of Rule-violation citations. Mr. Hageman and Mr. Zeeland again picked up the cudgel, this time journeying to Washington for a conference with FCC staff members. Rules were changed appropriately, now requiring only that ships precede their safety broadcasts by the identifying word "security" repeated three times. Such calls are now standard practice, used extensively by ships throughout the Great Lakes area.

Another safety innovation that is universally used on Great Lakes ships is the radio telephone remote control located at the pilothouse forward window, the captain's traditional post when under way; it permits the watch officer to talk bridge-to-bridge with other vessels for passing and other information exchange without leaving his post. This was first suggested by Captain Arthur W. Dana when he was master of the *SS Alva C. Dinkey* of the Pittsburgh Steamship Company (U.S. Steel). The safety value of his proposal was recognized immediately and the first installation, early in the 1940-decade, was followed quickly by others, eventually including all large ships on the Great Lakes.

The US/Canada Great Lakes Communications Treaty

The Great Lakes are international waters, navigated extensively without regard to boundaries by ships of both the United States and Canada and, increasingly, by ocean-going ships of other countries; thus it is logical that Lakes ships' use of the marine radiotelephone channels be coordinated, particularly as concerned with safety. This was accomplished, after many years of meetings, in the US/Canada Great Lakes Communications Treaty, commonly called simply the Treaty; it was ratified and became law on November 13, 1954. The Treaty required all ships navigating the Great Lakes to carry 2182 kHz, the safety/distress channel, and 2003 kHz, the internationally allocated inter-ship communications channel; it also required that ship radio installations be government inspected every 12 months and certified as to safety provisions. It is worthy of note in this connection that all United States and Canadian ships on the Great Lakes had, in fact, been meeting the logical safety requirements since 1940.

The Treaty was an important forward advance in Lakes safety communications. It accelerated the already safety-conscious thinking of the Great Lakes shipping industry. The tragic loss of the *SS Daniel J. Morrell* in 1966 pointed up a weakness in Lakes ship radiotelephone installations which had not been fully appreciated in its potential hazard to ship

safety.

On November 29 of that year, the *SS Daniel J. Morrell* broke in two on Lake Huron. The 580 foot *Morrell* was owned and operated by Bethlehem Steel Company, Great Lakes Steamship Division. Of the 36 crew members, 35 were known dead; only one survived. No distress call was received from this vessel; it was learned later that all power on the forward end of the ship was lost when the power cables parted as the ship broke in two. The lesson was vividly apparent. Great Lakes shipping companies responded immediately and, without waiting for regulatory imperative, provided a continually-charged battery in the forward end for emergency power supply to the radiotelephone. Such provision is now mandatory for all Lakes ships subject to the Treaty requirements, in accordance with FCC Rules changes which grew out of the *Morrell* incident.

The Advent of VHF

By the mid-40s the 2-3 mHz (AM) marine radiotelephone channels were becoming overloaded. No additional channels were available in those bands, but there was promise in the early technical advances in VHF (very high frequency) employing frequency modulation (FM). Accordingly, Lake Carriers' Association petitioned the FCC for enabling Rules necessary for channel assignment and use of the untried VHF in the Great Lakes marine radiotelephone service. The objective was to relieve the serious overload on the 2-3 mHz channels. FCC proved to be appreciative of the VHF potential for marine applications and developed the proposed new Rules.

In the early 1950's, Lorain County Radio Corporation (now Lorain Electronics Corporation) developed an eight-channel marine VHF/FM radiotelephone which centered around 156.8 mHz (now channel 16) for distress and safety purposes; it also offered use of other channels in the 156-162 mHz bands for intership and other navigational purposes, and still others for public correspondence. The newly-available VHF service based on that development spread rapidly. It was soon offered by all of the Great Lakes shore stations as a supplement to their long-established 2-9 mHz service. Each station used VHF for local service, that is, for service to ships within its "line-of-sight" transmission distance (usually 35 miles or less) from the station; VHF's generally noise-free signal and the fact that its use avoided the bad overload on the 2-3 mHz channels led to its provision on practically all commercial ships on the Lakes. Notably, the highly effective Great Lakes application of VHF to marine communications became the model for use in other parts of the world. The 1955 Conference of the International Telecommunications Union based its recommendations for world-wide use of marine VHF on the Great Lakes plan.

Safety Services in the New All-VHF Great Lakes System

Lorain Electronics Corporation is in the final stages of establishing a new all-VHF marine telephone system to serve ships throughout the vast Great Lakes area. Its concept is unique, as is the system itself, which will offer all of the services of the most modern land telephone system plus a number of special services needed by Lakes ships and shippers. This new system is a story in itself; only its safety features will be described in this presentation.

The Channel 16 Watch. During the summer of 1974 the technical provisions of the Great Lakes Agreement were rewritten in order to make VHF, Channel 16 (156.8 mHz) the principle means for distress and safety on the Great Lakes. The new Great Lakes agreement was ratified and became effective on May 6, 1975.

As required by FCC Rules, each of the system's stations throughout the Great Lakes area maintains a channel 16 monitor; each monitor is the audio output of a continuously operating channel 16 receiver which is picking up the oftentimes "babel" of voices from channel 16 users (and misusers) throughout the station's service area of 600 square miles or more. By FCC directive, all 16 monitors are brought to the System Control Center where there is an operator to maintain the required listening watch. Such watch is ineffective at frequent times during the summer months. This alarming situation occurs because individual station watches are frequently an unintelligible cacophony of voices certain to effectively submerge a distress alert should such be present; with the individual station watches often a jumble of voices, it is not surprising that the 16-station conglomerate to which the operator is subjected is very often a hopelessly meaningless "noise" which could completely mask any *MayDay* that a ship in distress may be transmitting at the time. Obviously, the voice watch on channel 16 is inherently undependable at times; add to that the fact that the operator has other duties which demand attention and, further, the natural human tendency to unconsciously shut out the nerve-wracking conglomerate of voices, and it must be concluded that the traditional spoken alert/listening watch approach is obsolete; it is no longer acceptable, with respect to VHF channel 16 at least, under present-day conditions.

The logical answer is the use of the already internationally standardized distress tone signal as the alert instead of the spoken word, with automated detection at the shore stations. This is a proven approach; Lorain Electronics Corporation, applying no more than proven modern technology, has completed development of the tone signal receiver for the shore stations, and the tone signal generator for shipboard use which, together, constitute the complete tone signal alert/automated detection system. Notably, the tone signal receiver, as developed, has proven itself capable of detecting the tone signal alert dependably through a typical babel of voices which would completely mask a spoken alert *MayDay* were it transmitted at that time. Once the alert is detected, the system operator can clear the channel of traffic in order to talk with the distress caller as necessary to handle the call.

The tone signal generator, the shipboard unit which sends the distress tone signal automatically on momentary operation of a button protected against accidental operation, is applicable to shipboard radiotelephone equipment at an added selling price of about $20 as a built-in component or about $35 as a separate unit for use with already-installed radio equipment. The tone signal alert/automated detection approach waits only for regulatory requirement of its use to provide the dependability of channel 16 watch, which is an unquestionable essential for ship safety on the Great Lakes.

The Safety Value of the Public Correspondence Channels. While the prime safety/distress communication in the Great Lakes resides in an effective channel 16 watch, the public correspondence service of the new all-VHF Lakeswide radiotelephone system also offers a highly dependable means by which any ship, whether equipped for dial service or with the simplest manual ("push-to-talk") equipment, can reach the system operator promptly, to obtain needed assistance.

Weather Broadcasts. The new Great Lakes system, as one of its special services, broadcasts the weather forecasts and other weather-related information prepared and furnished by the National Weather Service particularly for the Great Lakes. The network of lines and shore stations which connects all stations together for the broadcast is planned for automatic setup by the computer which controls all automated services of the system. Such computer-controlled setup avoids human involvement, with its likelihood of occasional tardiness in setup or omission of a station from the network and thus a hole in the broadcast coverage. Both the broadcasts and the computer control of setup which insures total coverage of the entire Great Lakes

area are vital to Lakes ship safety because of the notorious fogs and sudden and violent storms characteristic of the Lakes area.

Navigational Hazard Broadcasts. Like the weather broadcasts, the navigational hazard bulletins usually furnished by the Coast Guard are broadcast, also planned for computer-controlled setup. Such broadcasts, also, are of vital concern to Lakes ship personnel in view of the restricted passages and relatively shallow waters characteristic of Great Lakes navigational areas.

Conclusion

The Great Lakes region has always been a leader in marine communications because it has always been blessed with a great spirit of cooperation. Led by the Lake Carrier's Association and the mutual understanding that exists with the Dominion Marine Association, its counterpart in Canada, the Lakes shipping industry has enjoyed the support of both the Canadian and United States Governments. The Federal Communications Commission has been quick to respond to Lakes ship communications needs with necessary rule changes, and the United States Coast Guard and Army Corps of Engineers have always been ready to cooperate in the implementation of new communications systems. The Coast Guard channel 16 monitor now blankets the Great Lakes with 27 high level stations and 43 search and rescue stations, all equipped to respond to safety and distress calls. During the year October 1, 1976 to September 30, 1977 the United States Coast Guard answered 8,475 calls for assistance in which a vehicle was actually dispatched.

In speaking of communication safety on the Great Lakes, we must recognize the important safety contribution of the Federal Communication Commission's field service in its inspection of all shipboard radio equipment at least once every 12 months.

In closing, I would like to submit three recommendations for increasing the efficiency of Great Lakes radio communications, not alone those concerned directly with ship safety but also the others, most of which become involved indirectly in one way or another with the safety as well as efficiency of Lakes ship operations:

In general, no obstacle should remain that would handicap or discourage fullest possible use of the radiotelephone. Specifically, to this end:

1. The FCC should be petitioned to eliminate the requirement of maintaining a radiotelephone log book. Instead, failure of ship radiotelephone equipment and all distress traffic should be entered into the ship's log. A radiotelephone log book is a hang-over from radiotelegraph days when the operator kept the log. It could actually be dangerous to turn on the pilothouse light at night in order to make a radiotelephone log entry.

2. The FCC's thoughts on automatic identifications should be supported. A small inexpensive chip could be installed on all transmitters. This would eliminate the need for a ship's master to identify his ship by name and call letter at the beginning and end of each transmission. The marine frequencies must not be permitted to be degraded as are the citizen-band frequencies. With automatic identification of the transmitter, the FCC monitoring stations could do a far better job of policing the marine frequencies.

3. The proposal for universal use of the international two-tone distress alarm should be supported strongly. Again, this is basically a small, inexpensive chip. Automatic tone generators and automatic detection devices have already been developed with MARAD cooperation as noted in the sub-section of this paper titled "The Channel 16 Watch."

78 2007

MARINE FIRE SAFETY TRAINING PROGRAM AT TEXAS A & M UNIVERSITY

By ALBERT G. STIRLING
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In view of the Coast Guard's pending regulations requiring fire suppression training for tankship and tank barge personnel, it seems appropriate to present an example of one such training program. Texas A&M University is regularly conducting a five-day, forty-hour fire suppression training program specifically designed for tanker personnel. But perhaps before delving into the program in detail a little history would be helpful.

Texas A&M conducted its first fire training program some 47 years ago. In the summer of 1930 some 196 firemen attended the first annual school designed to provide rural volunteer fire departments with the essentials for a boot-strap training program. This program has continued and grown until this summer some 4,885 firemen from all over the world attended our annual school. In addition, Texas A&M provides contract training to the chemical and petroleum industrial fire brigades of the United States and on-campus and extension service training to the fire departments of the State of Texas. In 1977, 14,389 persons received nearly a quarter million student hours of training.

With this background of fire training experience in mind, the maritime industry asked if Texas A&M could develop a maritime fire training program. This initial request evolved into the present program, which is directed primarily toward tank ship operations. Based upon the tentative curriculum developed by industry and their expressed desires for realistic training, it was apparent that an additional training aid simulating a ship would be necessary. It was finally agreed that the super structure of the liberty ship *William S. Allen* would be erected at the Brayton Fire Training Field located near the main A&M campus at College Station, Texas. This 62-acre facility, valued at more than five million dollars, can provide complete facilities for any type of fire training from fire extinguishers to large LNG spill fires and chemical process plant fires.

To better understand the operation of the marine fire fighting program it is perhaps appropriate to quickly review the university system organization. Texas A&M University as a land grant college is charged "to promote the liberal and practical education of the working classes." Thus within the university system there are the usual college degree programs and also the Agriculture Extension Service, the Engineering Extension Service, Adult Continuing Education Service, and the Agriculture and Engineering Experiment Stations. The Engineering Extension Service under the Dean of Engineering provides the practical and vocational continuing education programs in the non-agriculture areas to meet the land grant college charter. It is within this umbrella that the Fire Protection Training Division functions to provide the practical education and training of fire fighters generally. It is university policy to provide only those practical programs for which there is a demonstrated need. Not the least of the reasons behind this policy is that the programs must be self-supporting from course tuition fees. Just as the original fire school in 1930 was established at the request of the State Association of Fire Chiefs and Fire Marshals, so your marine fire fighting school was established at your request to provide training the marine industry deemed necessary. As such, the Engineering Extension Service provides the expertise, faculty, and facilities, while the in-

dustrial user specifies the basic course objective, criteria, and curriculum. I wish to emphasize this point so that if, as I discuss the curriculum and field exercises in detail, you note areas in need of revision or change in emphasis, it is clear that it is within the industry's prerogative to have such changes made. We wish to provide what is wanted, not what we think you need.

The industry advisory board developed a very comprehensive course curriculum covering fire fighting and related emergency rescue and first aid activities. Based on this curriculum, the course was titled "The Marine Fire Fighting and Emergency Training Course."

The major subjects in the approved curriculum were: Chemistry of Fire; Sources of Shipboard Fires and Their Prevention; Fire Fighting Agents and Equipment; Emergency Equipment; Emergency Rescue Procedures; First Aid; Fire-Related Stability Problems; Specific Cargo Related Fire Hazards; Shipboard Fire Organization; and Fire Fighting Tactics and Logistics Planning.

The field exercises in the curriculum are: Nozzle, applicator, and hose handling; Portable Extinguishers; Emergency Breathing Apparatus; Pressure Fires; Liquified Petroleum Gas Fires; Open Tank Fires; Galley Fires; Cabin Fire; Machinery Space Fire; Cargo Manifold and Drip Pan Fire; Tank Hatch Overflow Fire; and Rescue Problem.

This is indeed a comprehensive curriculum, and our experience to date has shown that we are unable to adequately cover all topics in the allotted five-day period. Several factors enter into this, not the least of which is the physical condition of the students. Fire fighting is a strenuous occupation, and two hours of fire fighting equates to eight hours of strenuous physical labor such as ditch digging. Therefore, all the field exercises must allow ample time for rest periods. First aid has been deleted because of the time required. For example, the American Heart Association Cardio Pulmonary Resuscitation (CPR) refresher course is recommended at four to six hours. To attempt such a course in less time can be detrimental to CPR effectiveness and, in fact, can be hazardous to the victim. Also, as the lesson plans have developed, the fire fighting topics are amply filling the time available. Plans are being made to provide a one-day first aid refresher course in conjunction with the five-day suppression program.

When such a curriculum is contemplated, the advantages of having a marine fire fighting course as an adjunct to an existing fire training facility are apparent. For example, the emergency breathing apparatus can be used in the existing smoke house maze and obstacle course, the open fires, fire extinguishers, and foam applications can use the facilities all ready designed for that purpose. Should we wish to cover dry cargo hold fires, an existing warehouse structure amply duplicates a large cargo hold. For fixed extinguishing systems, we have a large training aid which allows the students to observe the real fire development and subsequent operation of the real fire suppression system and fire extinguishment of any of four systems; CO_2, Halon, sprinklers, and one yet to be selected. With the basic skills and knowledge gained from the elementary training aids available, the students can experiment and practice their application in the simulated marine environment of the ship mock-up.

It is in this area of technique that we feel Texas A&M has a great deal to offer the marine fire fighter. Through our experience and knowledge of fire fighting generally, we can introduce the seamen to the latest techniques and extinguishing agents. Then, using marine equipment that would be available to him, he can determine for himself what he can and can not do should fire occur aboard ship. It is most unlikely that our practice fires will duplicate any real life situation, but a basic understanding of fire, his equipment, and its capabilities will give the seaman the confidence and ability to respond to the real life situation.

Perhaps it is in the area of confidence that we do most for our students. The most common remark the students make to us is that they'd now tackle a fire that prior to training they wouldn't have even considered. Although most of the students have had previous fire training, never have they had fires of the magnitude available at Texas A&M.

Also in the area of confidence building is our instructional methods. After the first few days of basic instruction the students are formed into teams. Each team is then free to attack various fires which they have not previously been exposed to, using tactics and equipment of their own choosing. I may add here that we use Coast Guard approved equipment and systems so that the students practice with the same equipment available to them on shipboard. Each fire is attacked with an absolute minimum of personnel to again simulate conditions which could occur aboard ship. We have found this controlled trial and error approach to be very successful and well received.

As you are well aware, the Coast Guard is proposing mandatory fire training for tank vessel officers and for tankermen. Our present program appears to meet the proposed 32-hour course for officers. We are prepared to provide the proposed ten classroom hours and four field exercise hours of training for tankermen on an extension basis. This means we would take the course to the students probably in Port Arthur/Beaumont, Houston/Galveston, and the Corpus Christi/Brownsville areas.

By establishing our maritime fire training program at our existing training facility, we are able to offer many variations of our program to meet the different needs of the maritime community. For example, we presently provide an annual LNG class. It is relatively easy to combine this with the marine program to provide specific training for crews of the LNG ships. Similarly, by using some of our industrial sets, we can provide training to terminal personnel. With some modification we can also provide for the specific problems of the off-shore oil industry.

There are other organizations, notably the maritime union schools, providing basic fire training for seamen. The U.S. Maritime Administration has contracts in process for a marine fire training manual and for a fire school curriculum and facility design. We support these efforts.

Texas A&M has begun a fire research program and baccalaureate degree program in fire technology. The combination of our academic and vocational program can provide advanced fire training, which is an asset to the maritime community. Texas A&M is committed to the need for fire safety and suppression educational programs and therefore stands ready to assist any organization or program in furthering the goal of fire safety. How can we help you in your quest for greater maritime safety?

78 2006

SAFER TANK ENTRY

By HUGH M. STEPHENS, CSP
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Historically, most seagoing tankers' cargo tanks have been checked prior to entry with only a combustible gas indicator, usually called an Explosimeter. The term Explosimeter is often erroneously used, just as the term Kleenex is often misused to describe any brand of paper handkerchief. However termed, the combustible gas indicators are usually of the aspiration type, which means that a squeeze bulb is the means used to draw a sample from the area in question. With the advent of larger and deeper tanks, some manufacturers have added battery powered pumps to handle this sampling. I have seen vessels using the prism type combustible gas indicator, with color spectrums, which is rather frightening. More frightening is a report I heard from a person attending an international safety standards meeting. At that gathering some tanker representatives expressed surprise when compulsory use of CGI's was suggested. "You mean one on every tanker?" was their surprised reaction.

Now on freighters, container vessels, bulker, and ore carriers personnel might go so far as to use a flame safety lamp to determine if adequate oxygen is present. If the lamp goes out when lowered into the tank, so would a man. I had thought the use of canaries outmoded because it was so primitive. I learned of a recent instance in which canaries were used in Singapore. The reasoning goes that if this small bird dies, so would a man. Thus in general, tankers check for combustibility and the others may check for oxygen content.

Today this is not enough. Our industry is becoming more sophisticated in vessel design and operation. Our scientists and industrial hygienists have become more knowledgeable about chemical agents and the harm they can cause to human life. Our government regulations in some instances are demanding more safeguards for personal health and safety. We, as vessel or rig operators, equipment designers, as safety professionals, have to be equally aware, even if regulations don't require certain procedures as yet. We must be more professional in our outlook toward making life safer for the individuals who enter enclosed spaces.

We feel we should voluntarily check for more than combustibility, oxygen content, or both, and check for toxicity as well. Indeed on December 27, 1977, Coast Guard Part 153, "Safety Rules for Self-Propelled Vessels Carrying Hazardous Liquids," goes into effect, basically requiring equipment to perform these three tests on a wide range of chemical cargoes aboard chemical tankers of all flags entering U.S. waters (see *Federal Register* 9/26/77, Part III).

I have created the term "Infernal Triangle" to better illustrate the importance of testing for all three conditions—combustibility, oxygen content, and toxicity. Whether it be a tanker or dry cargo vessel, personnel are usually checking for only one side of this Infernal Triangle. Testing for one and overlooking the other two is like driving through a busy intersection looking only straight ahead. You'll probably get clobbered.

As sporadic deaths in tanks and confined spaces continue year in and year out, many groups and individual shipowners have tried to do something to educate, warn, and set up procedures to stop these unnecessary tragedies. The CG, GCBS, IOTTSG, API, ANSI, NFPA-306—all have published various suggested standards.

From a shipboard standpoint, we are aware of one owner who not only insists upon tri-detection (combustibility, toxicity, and oxygen content) but has adopted a "Tank Entry Permit" as well. It's actually a check-off list which must be signed by all men about to enter a tank as well as by the officer in charge. Such permits have long been standard practice in the shoreside petroleum industry. But it will take training to induce the hardy seafarer to use meters, forms and check-off lists, and not rely on his nose to tell him if a peak tank has adequate oxygen.

The GCBS has a plasticized check-off list—in two-color printing with most critical items in red. A grease pencil can be used, erased and the card used over and over again.

Other progressive owners insist upon dual-detection for combustibility and O_2 content. These are usually remote readings only and usually in line with the tank opening. What about the cloud of gas—so-called "regeneration"—after mucking for a period of time? What about that pocket of gas in the far corner of the football field that some tanks equate to in size? Has your ventilation circulated adequate O_2 throughout the entire tank? It really behooves one to monitor all reachable areas and surely those in which men are working. This is where the personal-type monitor is best utilized. The monitor must be light, simple, rugged, and require no hands for it to operate. It should alarm the man in the tank and possibly the stand-by man at the entry.

Even with dual protection, we still find men in empty crude oil tanks getting "high" and staggering a bit from the effects of various hydrocarbon fumes, usually the aromatics. We tested a dual unit with a different combination than most units. It monitors combustibility and toxicity, but we were told it was ashore more often for repair than it was aboard. There is a single tri-detector instrument which is a combination combustible gas/oxygen deficiency/toxicity monitor all rolled into one. Pending our tests of the practicality of this unit, we find the chemical or detector tube hand pump a most proficient go/no-go toxicity indicator. The old familiar bellows type is possible more rugged and positive than the piston type. Either one of these or something more sophisticated should be used not only prior to entry, but during the time men are in a tank.

Integrated Tank Entry Equipment

This concept began to grow in our firm some three or four years ago when we first noticed a small, lightweight compressed air escape device at the Delta Safety Conference. It dawned on me then, and I know on others who were present, that such a device might offer a measure of protection never available before. It had been developed for the Navy under contract after the tragic loss of a number of aircraft pilots in a ready-room of an aircraft carrier. A smoky fire occurred in an alleyway, and the men all piled up at the one exit and lost their lives. Most certainly an escape device should not lull a man into a false sense of security. Carrying one does not obviate the necessity of the tests which we have just discussed prior to a man's entry into a tank or enclosed space. But as a man's ally in possible danger, it held promise.

This in turn led us to wondering if there weren't better combustible gas indicators; perhaps there was something easier to use in the oxygen deficiency area, and some helpful tool to use from the toxicity standpoint. We spent considerable time then testing various manufacturers' products aboard tankers. It had always been my experience that many things looked great in the catalog—or even when demonstrated in the office—but when they got to banging around a ship, often we couldn't count on them. Therefore we compared different combustible gas indicators, oxygen monitors, toxicity indicators and compressed air escape devices. Each of these had its advantages and disadvantages, and I think these contrasts and comparisons will interest you.

First, in the group we reviewed, there were on the market approximately nine

manufacturers of indicators for combustible gas/oxygen/toxicity, or combinations thereof. Two of them cover all three areas of concern, four are combination combustible gas/oxygen, one combustible/toxicity only, one combustible only, two O_2 only, and two toxicity only.

Second, two of the combustible gas indicators are MOS (metallic oxide semiconductors) and six are hot wire. Basically, the MOS type are low current, no burnout, and are unaffected by silicones, leaded gasoline, etc. The hot wire type have a higher current, burn out more frequently (especially from leaded gasoline) and need more frequent calibration.

Third, in the oxygen deficiency group, four were galvanic and three were polarographic. In the polarographic group, electrolyte could be replaced in two, and in the other the entire cell had to be replaced. The galvanic sensor requires no maintenance, can be used ten to eleven months and then be replaced. It has a high output and its cost is low. The polarographic requires replacement of the electrolyte every three to four weeks (a simple operation which can be done aboard with little training). It has a low signal, complex electronics, and costs more than galvanic.

Fourth, in the combustible gas/oxygen indicators, there are three ways the units obtain samples: by aspiration (squeezing a bulb or using a battery-driven pump); by electronic transmission from a probe through up to 200 feet of wire; or by lowering the unit into the area. Based on considerable personal use, I must admit aspiration through a hose bothers me. I feel there could be too many close calls with this type. Perhaps this is because a ship's officer or safety man doesn't use one often enough. Marine chemists swear by them and use them a good part of every working day. For the periodic user, and the way situations seem to stack up on most ships, the type that take initial readings and then monitor continuously for up to 200 feet from the main unit seem to me to offer a greatly increased safety range. True, one must take care not to get the probe into any cargo and not let it bump into ladder on its way down. But the great advantage of an audible alarm in the tank, plus audio and visual alarms on deck should the tank go into the LEL or drop below 19.5 per cent oxygen content, outweigh the other shortcomings. The advantage of "no-hands on" continuous monitoring while men are in a confined space is invaluable.

Fifth, the typical hot wire percentage LEL combustible gas meter indicates the importance of monitoring, or at least taking readings, of all three points of the "Infernal Triangle"—combustibility, oxygen content, and toxicity. A 20 per cent LEL methane in air reading on a hot wire combustible gas meter could be failing to indicate: a fatal H_2S reading (700 ppm = .07 per cent by volume); a fatal CO reading (1000 ppm = 0.1 per cent by volume); a fatal oxygen deficiency (10 per cent by volume). Or a zero per cent LEL methane in air reading could be caused by: fatal H_2S; fatal CO; fatal O_2 deficiency.

On the typical oxygen meter you could meet the OSHA/NIOSH 19.5 per cent oxygen content lower limit but still have explosive gasoline vapors (1.3% by volume). Or, a 20.9 per cent O_2 reading which could, in fresh clean air, be caused by: fatal H_2S or fatal CO.

To summarize, if one relates percentage of, say, methane to the LEL readings on a combustible gas indicator, you'll see that 20 per cent LEL is only one per cent by volume of methane. One-hundred per cent LEL is only five per cent by volume of methane. Yet, if H_2S should be involved, four per cent of the LEL is 40,000 ppm (and there are some crudes being loaded at the moment that are that high in the ullage area).

Oxygen cannot be overlooked, as most people merely drop off to sleep when it gets down in the 12-14 per cent area. Moral: check for all three conditions.

Here's a look at some of the equipment that seems to offer new potential for safer tank entry readings as well as monitoring:

1. Combination combustible gas/oxygen; remote electronic reading up to 200 feet; individual meter readings; visual and audible alarms on unit; audible alarm in tank; an "OK" and audible security beep on deck and in the tank while monitoring; hot wire combustible gas; replaceable electrolyte polarographic cell; rechargeable Nicad battery with 8-10 hours continuous monitoring on one charge. It has a fail-safe audible and visual alarm of different sound and light color if any part of its electronic circuits fail. It has 15 feet of cord-storage built in and MESA 8-C approval for use in gassy coal mines. CG acceptance is pending UL two-fault testing.

2. A tri-detector combustible gas/oxygen/toxicity monitor. It measures combustible hydrocarbon gases with an MOS sensor, its oxygen side is galvanic, and its toxicity side, which handles H_2S, CO, etc., is also handled by the MOS at a lower voltage. It must be preset at the factory for the vapor alarm readings (20 per cent LEL combustibility, 10-100 ppm H_2S, etc.), type of vapor and oxygen level (19.5 per cent NIOSH, 18 per cent if permitted). It must be lowered into a tank for initial readings. The manufacturer recommends its Nicad battery be left on charge when the unit is not in use. We have not yet had the opportunity to see whether the visual and two different audible alarms can be seen and heard on deck under typical conditions. However, it should be an ideal unit to wear on a man's belt while men are in a tank after initial readings with a conventional combustible gas indicator. It is being tested by the Bureau of Mines for the Coast Guard.

3. A polarographic oxygen monitor which can take initial readings from six to 150 feet, then may be worn over the shoulder or on the belt to constantly monitor and audible alarm if the O_2 content drops below 19.5 per cent. It has already saved a man's life on an inerted tanker. An unsuspected leak in a scrubber room activated this unit and warned a man to leave the area. He had fortunately turned this unit on a little early before taking O_2 readings of the inerted cargo tanks. It will also measure dissolved oxygen in water (the probe can be submerged in water, but not petroleum). Marine chemists use these as part of their control of underwater burning in barge ballast tanks. It has MESA approval 2G. Its two 9v batteries last about six weeks or more, depending on use. Its polarographic cell electrolyte lasts four to six weeks, or longer if the probe is kept in fresh water when not in use. It is quite rugged. I dropped one, it bounced off my shoe in its plastic carrying case and on to a marble step—no damage, and it continued to work well.

4. A polarographic pocket size oxygen monitor for personal use. It audibly alarms at 19.5 per cent O_2 and 24 per cent (the high alarm can be used on ships for leaking burning or medical O_2 bottles or gauges). It clips on to a shirt pocket, weighs little, and uses a small replaceable camera-type battery. Its polarographic cell must be replaced at the factory after six months to two years of use. It has BASEEFA one-fault approval for use with all flammable gases except hydrogen, acetylene, or carbon disulphide. It will be manufactured in this country late this year or next and undoubtedly be put through two-fault testing to meet CG acceptance.

5. A bellows-type detector tube toxicity indicator with tubes for over 130 different gases and vapors. Different types of tubes provide direct reading or color comparison.

Compressed Air Escape Devices

The key word about this equipment is ESCAPE. It must not be used for entry. We are urging the use of the units by everyone who must enter a tank or other confined space. Seamen are not known for their great interest in carrying additional weight into tanks; but you'd be surprised at how many experienced unlicensed American tanker seamen, especially those that have had some close calls, would be willing to wear them. One

five-minute model weighs less than five pounds; a three-minute unit, less than a pound; and the new 10-minute device for use in large tanks, seven pounds.

The five-minute unit has been adopted by many fleets for use at the bottom of pumprooms and for the watchstanders in machinery spaces. In case of smoky fires, the plant can be secured and the men escape. Should the CO_2 be tripped, the men can also secure and escape.

These are of two types: compressed air in coiled stainless steel tubing at 5000 psi or in cylinders at 1800-2845 psi. We tested one of the popular cylinder types aboard ship and in a swimming pool. After one hour, it caused back strain. In the water, a part of the valve froze after use and it could not be filled without repair. Both types use a polyurethane hood. The American one resists 950° F at four inches for 5.48 minutes. The hoods fit any facial contours and have 360° visibility. Neither can be used under water, as the mask collapses over the face. They can be used on the surface of the water.

The 10-minute unit came about due to the additional time needed to get out of larger tanks. In our preliminary tests, I got out of a point in the furthest corner of a center tank of a 120,000 tonner crawling through some 10 frames with approximately 18 inch openings, walking the longitudinals using only light from a high-intensity lightstick, and up a 90 foot ladder in 6.5 minutes.

This somewhat larger unit has a cross chest belt; the reservoir can be carried at the back hip with the weight evenly distributed between waist and shoulder. When needed, the case is swung to the front, the hood removed from the pouch, the pin release ring pulled and the transparent hood donned over glasses or facial hair. Once the ring is pulled the air cannot be stopped. It cannot be started even if the ring is pulled if the hood is not out of the pouch and the hose out of the case. Like the five-minute unit, it has a shelf life of three years, does not have to be "hydrod," and is refillable. The belt fittings are all non-general purpose safety lightstick. A pouch on the side of the case holds a high-intensity lightstick. Pressure gauges on both units indicate pressure of the reservoirs. Wordless operating instructions on the 10-minute unit obviate the necessity for translation into other languages. Posters, movies, or video taped operational training materials are available.

Safety Light-sticks

Safety light-sticks are non-toxic, non-explosive emergency lights. They are non-flammable and waterproof and have a four-year shelf life.

The idea first came about when the owner of a number of VLCC's mentioned he had lost contact with three men in one of his large center tanks for half an hour. One man had hurt his ankle and the other two were helping him bandage it. This caused so much consternation aboard, and might have been such a serious incident, that it occurred to me that the lightstick we had been testing might be ideal on each man's shoulder in a tank. As long as he was in the line of sight, he could be spotted from the bright deck while he was in the semi-dark tank. We tested this theory in actually simulated practice, and it worked.

A brighter type can also be used for emergency escape light. The half-hour high-intensity light-stick yields four times brighter light than even the generous glow of the 12-hour type. It can be used to illuminate intricate repair work in an otherwise totally dark area. It throws light for 20 feet. This also makes it excellent for emergency lighting in any of the following places: alleyways, machinery spaces, steering engine room, gyro room, radio room, and the like. It floats on the water and will operate on or under the water to at least 30 feet depth.

We recommend that all personnel entering a tank be equipped with one 12-hour light-stick activated and attached to their shoulder, as well as one high-intensity type should it be needed. A metal bulkhead mounting case will hold 10 packs of the lightsticks for ready availability. It has a phosphorescent label on the outside that not only locates it in a blackout but illustrates its operation. Many owners have mounted these cases in the engine room, emergency generator room, fixed CO_2 control stations, gyro room, and the like.

78 2067

RO/RO — THE VAN SHIP STOWAGE FOR SAFETY

By CAPT. R. J. MURRAY
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Nothing can be reasonably built that can survive, undamaged, every condition of the sea. Basically, a ro/ro ship is closer kin to a general cargo ship than a container vessel. The problems of stowing and securing the cargo are the same as those of a general cargo vessel.

Basic equipment consists of permanently mounted truck vans on wheels. The vans are dry vans, reefers, liquid tanks, and flat beds. The dry vans may also have certain interior modifications to handle a regular specific commodity.

Ideally, today, the equipment is carrier owned and supplied. That is, from the carrier's viewpoint. In some cases, the shipper owns his equipment and prefers to ship his goods in that equipment even though it means it will be tied up for one or more round trip voyages. While it is costly, it may be economically justified if a two-way movement of goods is involved. Otherwise it is difficult to understand why a shipper or consolidator would wish to tie up his equipment for a period of time when he has the option to use carrier owned equipment. We prefer the shipper to use our equipment primarily because it is constructed to better withstand the rigors of the sea. In the case of reefer equipment, we have better control over spare parts for our own equipment, and ships' personnel are familiar with it. It has also been our experience that outside reefers require more shipboard maintenance than our own equipment. Repair of reefers on board is difficult and hazardous and should be kept to a minimum.

Liquid bulk vans, especially those carrying hazardous materials, are another real problem if they come aboard the van ship in shipper equipment, primarily because they lack well located padeyes to permit good securing and often are poorly constructed for a sea voyage.

Additionally, the outside equipment may be odd sized, which makes it more difficult to properly secure against movement at sea. This supports the arguments for standardization.

Loading Methods

The van ship may be served by one or more ramps, either of the type carried on a vessel or permanently located ashore. It is not intended in this paper to describe the pros and cons of the various systems. Suffice it to say that in Puerto Rico Marine Management's operation we utilize the shore ramp system using three semi-fixed ramps: fore, midships, and aft. The ship is discharged first and reloading commences after discharge is completed or nearly so.

The ship is prestowed on paper, ideally. On board ship the stowage spaces are outlined with paint and each space is numbered to correspond with the plan. This facilitates the loading by assisting the drivers to easily determine where they must park their vans.

Each van in the yard is positioned on a roloc box. This is a device designed by Sun Shipbuilding & Drydock Co. to support the forward end of the van when disconnected from the tractor and is designed in such a manner that a tractor may engage the roloc box, lift both box and van, transport it to its stow position on the vessel, and leave both in place. The box is positioned over a button welded to the deck and is secured by means of a key and a locknut.

The aft end of the van is secured by two lashings attached by longshoremen to the ring bolts strategically located on the chassis of the van.

Traffic patterns must be established in advance for both good stowage and safety. Since the crew access to the vessel is in the path of the traffic patterns, a yellow safety zone is painted on the deck and drivers are advised of special caution when working the area.

The center loading ramp has a specially constructed walkway with a guard rail that crew and visitors are urged to use for safety. A gangway watchman is positioned at the head of this walkway at all times.

Good lighting in the under deck areas is provided; however, regular cleaning of the lenses is necessary as they become clouded over with carbon from exhaust of tractors as well as diesel powered reefers stowed in the main deck area.

Good lighting in the under deck areas is provided; however, regular cleaning of the lenses is necessary as they become clouded over with carbon from exhaust of tractors as well as diesel powered reefers stowed in the main deck area.

The location of numerous pillars in the main deck area is cause of considerable damage to vans, and various attempts have been made to preclude these damages. These mainly consist of painting the pillars with high visibility paints in order to draw them to the attention of drivers and by wrapping the pillars with various substances to cushion the effect of striking or brushing against them. Mirrors are strategically placed to assist drivers. These efforts have been of some help; however, the ultimate determination of whether or not damage occurs is in the skill of the drivers. This is a very important point as it becomes essential to have regular drivers who become totally familiar with the particular vessels that are being worked. This, of course, is a matter of negotiations with the union which represents the longshoremen in the individual ports where the vessel is worked. In later versions of van ships, efforts are being made to reduce the number of vertical support structures to minimize such damages.

It is essential that the securing of the vans should be ongoing throughout the entire loading operation for ease of handling and expeditious loading. As a result, the men engaged in securing these vans must take normal precautions not to walk into the path of oncoming traffic. Specifically, if two men are placing lashings on a van, they must be aware that an adjacent empty space will shortly be loaded with another van and for this reason must studiously avoid stepping into adjacent spaces. This has occurred with disastrous results. Any attempt to load a ship before commencing lashings would make the lashing operation extremely difficult and, in some tight spaces, impossible.

Other difficulties encountered during the loading operation include the passage through watertight doors in the bulkheads. In the design of these particular vessels, the watertight doors are on hinges and open out. Vans and vehicles, while being stowed, at times strike the locking dogs, and these must be repaired in order that the doors may be made properly watertight when closed.

In new construction it is recommended that the doors open up and are either secured to the overhead or provided with sliding doors to lessen the incidence of damage caused by being struck by vans.

Another area of difficulty is the lip of the watertight doors. In our present vessels the lip is raised off the deck and it is necessary to have portable ramps on both sides of the lip, primarily to protect the lip itself and also to protect the tires of the tractors, vans, and roloc boxes. The ramps have hooks to hold them in position, but these are damaged and broken by roloc boxes that are dragged over them. We are still exploring better means to protect the lips necessary for watertight integrity. Now we must constantly repair them. These ramps basically are positioned by means of a fork lift, as they must be heavy enough to take the weight and volume of traffic. A sliding door,

possibly eliminating a lip and this entire procedure, would certainly be an advantage.

During periods of rain or, even worse, snow and ice, the hazards of loading a van ship are considerably increased. It becomes necessary to use sand on the decks in order to provide improved traction for the vehicles. Extreme driver caution is necessary under these circumstances, as the decks are still going to be slippery. It is advisable to establish a company policy on what is to be used on the decks in these instances. We have had some bad experiences where terminal people have attempted to use Stay Dry or other substitutes for sand and, while these substances absorb moisture, they themselves become as slippery as ice. During periods of inclement weather, you must anticipate a lesser rate of production in order to maintain proper safety standards.

Securing

During the course of a voyage, damage may occur, after the vessel is loaded and when at sea encountering heavy weather. We offer the following observations on why vans may be damaged or lost in a heavy sea: cargo shift within a van; vans not designed to go to sea (inadequate securing rings or none at all); in some cases, the sheer force of a roll has separated cargo and walls of a van from the floor of the van with lashing gear holding; loose vans pushing adjacent vans over; loose lashings; improper lashings (such as auto lashings on vans); roloc boxes loose; damaged or defective roloc box; seas on deck; improperly secured loads on flat beds; improperly secured loads within a van; and overloaded van.

The problem of cargo shift within a van is something which all of us in the ro/ro and container industry as well are fully familiar with. If the boxes are loaded in a marine terminal area, generally the supervisors are aware of ocean carriage requirements. If the shipper stows with his own people at his plant or warehouse, we must instruct him with regard to the hazards which may be encountered on a vessel at sea and how to secure the cargo within a van.

We previously outlined problems we have with outside equipment that is not designed to go to sea. There are a number of people involved in developing recommendations for standardization and construction of ro/ro vans. However, we are certain that in spite of this we will always encounter the problem of outside equipment which is not designed to go to sea. In one particular area, we find this problem unacceptable; that is in the carriage of liquid bulk vans, especially those carrying hazardous cargoes. A liquid bulker not specifically designed to withstand an ocean voyage or properly equipped with securing ring bolts when carrying a hazardous cargo is a time bomb. Attempting to jury rig lashings is courting disaster, and it is only a matter of time until it occurs. That is, unless the proper precautions are taken now.

When we secure the vans, the method we utilize is securing the roloc box at the forward end as previously described, then criss-crossing two lashings connected to ring bolts at the rear of the van to "D" rings on the deck or "start" which are cut into the upper deck where watertight integrity is not required. For the most part, Peck and Hale lashings are used. We have had experiences in the past where the locknut which tightens down the roloc box would vibrate loose. This has been under study by Sun Shipyard, and they are about to come out with a means to correct this in the form of an overlapping, grated washer which can only move a fraction of an inch before it engages and will not move again. This is tantamount to a double locking device. On the rear end of the vans we find there is motion due to the fact that there is certain expansion within the tires as well as flexibility in the springs of the vans. We are currently investigating other means of securing the after end of the vans. One method which we like is the use of a closed turnbuckle

secured with a chain through the ring bolt on the chassis and with the ability to quickly tighten up the turnbuckle by means of an electric or pneumatic wrench. We favor this, and we are about to test out the system as far as its practicability and acceptance by the people working with it.

One of the problems we currently experience is during heavy weather—it becomes dangerous for men to go out on deck to check the securing of vans. We, therefore, feel we must make greater attempts to insure that the means of securing are unlikely to slacken. All lashing materials should be stoutly constructed, because no matter how hard we try, they are inevitably going to be run over from time to time by loaded vans. In order to minimize this hazard, lashing gear boxes should be conveniently stowed along the bulkheads in many areas to encourage people to use them rather than leave the gear lying on the decks. You must remember that since the ro/ro ship is a fast turnaround vessel, union contracts generally call for considerable time off for vessel personnel, and all your planning must be made with this in mind.

Under-deck areas of ro/ro vessels must be fitted with air testing devices to constantly monitor the presence of exhaust fumes in order to insure that the level does not exceed U.S. Coast Guard regulations.

The enclosed areas of the lower decks are susceptible to an accumulation of exhaust fumes from autos, producing dangerous levels of carbon monoxide. This is not generally a cause for concern. Our major problem is the result of exhaust fumes from diesel operated reefers. At the request of the U.S. Coast Guard, we conducted extensive tests to determine if they created an excessive amount of carbon monoxide in areas of heavy concentration of diesel exhaust fumes. The tests proved diesels do not produce carbon monoxide. Therefore, it was not a serious health hazard. However, a real problem existed in that the diesel fumes were obnoxious to ship's personnel who must attend the reefers. This problem was resolved by restricting the location of diesel reefers to certain areas of the ship where ventilation is the greatest.

We have a similar problem with tanks whose commodities produce noxious fumes. They must be placed well away from the engine room intake vents.

As you can see, the problems of stowage grow with the requirements of hazardous cargo stowage, reefers, and noxious fumes to challenge the stowage coordination.

78 2668

WATERFRONT FACILITY SAFETY

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Under the impetus of the Ports and Waterways Safety Act of 1972 (33 U.S. Code 1221-7), the United States Coast Guard is taking a fresh, comprehensive look at the issue of waterfront facility safety. This past June the Coast Guard Chief of Staff established an interoffice Waterfront Facilities Task Force to undertake the review, revision, and reissuance of all Coast Guard waterfront facility regulations.

The passage of the Ports and Waterways Safety Act provided permanent legislative authority for safety regulations previously issued pursuant to the security-oriented Magnuson Act (50 USC 191-2), which had been passed in 1950. Under the authority of the Magnuson Act, the Coast Guard during the 1950's and 1960's issued various waterfront facility safety regulations and published them in Title 33, Code of Federal Regulations, Part 126 (33 CFR 126). Although some sections were revised in 1970, many have remained unchanged since the early 1950's. As a result, existing regulations do not take into account such intervening developments as the growth of a vast intermodal container industry; use of new types of vessels (Ro-Ro, Lash, container, etc.); the great increase in the number and complexity of petrochemical facilities; and the transportation, stowage, and handling of a wide variety of new hazardous chemicals and dangerous cargoes.

Significant legal and regulatory developments also have occurred during the years since most of these existing regulations were issued. In addition to passing the Ports and Waterways Safety Act, Congress also has enacted the Federal Water Pollution Control Act (33 USC 1321 *et. seq.*) and the Transportation Safety Act of 1974 (which includes the Hazardous Materials Transportation Act) (49 USC 1801 *et. seq.*).

Also, existing Coast Guard facility regulations in 33 CFR 126 do not reflect the issuance of the Coast Guard's own pollution prevention regulations (33 CFR Parts 154-156) and the packaged hazardous materials regulations (49 CFR Parts 170-189) of the Materials Transportation Bureau's Office of Hazardous Materials Operations.

The Coast Guard and its Waterfront Facility Task Force are moving to take into account these technological, statutory, and regulatory developments in the rewriting of 33 CFR Part 126. This will necessitate addressing each type of facility in considerable detail, which in itself will represent a significant change from the rather brief provisions existing in Part 126.

It is important to note that the Ports and Waterways Safety Act provides that state and local governments may prescribe even higher safety equipment requirements or safety standards for waterfront facilities than might be prescribed by the Coast Guard. In this way, the option has been preserved for localities to address safety issues of particular local concern which might not be addressed in the nationally applicable Coast Guard regulations.

Another contemplated change in the regulations should benefit facility owners and operators by making the regulations more usable. At present the Coast Guard's safety and security regulations for waterfront facilities are in 33 CFR Part 126, while its facility environmental protection regulations for the prevention of oil pollution are in Parts 154-156. Although the oil pollution prevention

regulations themselves are currently being updated (*Federal Register*, June 27, 1977) the facility portions of those regulations eventually will be moved to 33 CFR Part 126. Thus, a facility owner or operator will be able to find all Coast Guard safety, security, and environmental regulations for waterfront facilities in a single CFR Part.

The following tentative outline of the proposed new facilities regulations includes: General Facility Requirements; Bulk Liquid Facilities; Liquefied Gas Facilities; Bulk Solids Facilities; Container Facilities; Break Bulk Facilities; Explosives Facilities; and Other Facilities. Each of these subparts will contain sections possibly grouped into the following categories: General; Definitions; Design, Construction, and Equipment; Fire Protection; Maintenance; Inspection and Tests; Records; Operations; Facility Security; and Personnel Qualifications and Training.

A separate regulatory subpart package is contemplated for each of the types of facilities itemized above. As indicated, there would be a parallel organization within each of the subparts. Each of the subparts will be developed simultaneously under the direction of the Task Force. The general regulations subpart will be developed first. Then each of the other subparts may be the subject of separate notices of proposed rulemaking. The timing of each of them will depend upon several factors, including the extent of public comment, resources available to draft them, and complexity of coordination with other agencies.

The general regulations subpart may contain a definitions section and regulations applicable to all waterfront facilities. To carry out the purposes of the Ports and Waterways Safety Act and the Federal Water Pollution Control Act, under the authority of which these regulations would be issued, such terms as "waterfront facilities" and "shore area" may be defined broadly.

Numerous sources of information have been and will continue to be tapped in order to make the Coast Guard's proposed facilities regulations as realistic and responsive as possible. Among these sources are National Transportation Safety Board reports, Captain of the Port reports of unusual occurrences, information and opinions being submitted by Coast Guard District Commanders and Captain of the Port, national consensus standards (NFPA, ANSI, etc.), and subcommittees of the Coast Guard's Chemical Transportation Industry Advisory Committee. These subcommittees are those on liquefied gas facilities, bulk liquid facilities, and break bulk and container facilities. All meetings of CTIAC and its subcommittees are announced in advance in the *Federal Register*. Additional comment on the proposed regulations is being sought from state and local governments, marine and other industry representatives, port and harbor authorities, environmental groups, and other interested parties.

The Coast Guard is attempting to develop comprehensive waterfront facility safety, security, and environmental protection regulations which can achieve all of these purposes at the least possible cost to industry, consumers, and government. Through the issuance of an advance notice of proposed rulemaking which soon will be published in the *Federal Register*, the Coast Guard is soliciting comments providing cost/benefit analyses and suggesting economically efficient but effective regulatory approaches to these issues. The information being sought includes the number and location of facilities affected; quantities of hazardous and other materials affected; the scope and degree of safety and environmental hazards; time and costs required for compliance (equipment, personnel training, procedures, etc.); relevant local practices, and customs; and effects upon facility productivity, efficiency, and profit.

Also being sought by the Coast Guard are comments concerning the possibility of utilizing concepts now found in the oil

pollution prevention regulations, 33 CFR 154-156 (such as persons in charge, declarations of inspection, eltters of intent, and operations manuals) as models for regulating all waterfront facilities.

One of the interesting issues yet to be resolved is the extent of the application of these proposed regulations. This involves defining such terms as "waterfront facility" and "shore area." In the proposed regulations, a waterfront facility is defined as any building, refinery, tank farm, warehouse, dock, pier, wharf, or other structure in, on, or immediately adjacent to the navigable waters of the United States or on a shore area immediately adjacent to those waters, including federal, state, municipal, and private facilities.

To understand which facilities might be regarded as waterfront facilities, it obviously becomes necessary under the above definition to understand the meaning of "shore area." The proposed regulations define shore area in two different ways. The first proposed definition is "an area of land, including waterfront facilities thereon, immediately adjacent to the navigable waters of the United States and extending inland only to the extent necessary to prevent damage to, destruction, or loss of a vessel, bridge, or waterfront facility on or in those waters or to protect those waters from environmental harm resulting from vessel or facility damage, destruction, or loss."

The second proposed definition indicates that a shore area "extends inland to the far property line, to the point where Coast Guard jurisdiction terminates, or to a natural separation point as is determined by the cognizant Captain of the Port. A natural separation point will be considered a roadway, barrier, or similar physical structure that excludes other areas from the waterfront facility prime function." There are many other possible definitions for this term, including one which might simply state that shore areas are all areas of land within a certain distance from any navigable waters of the United States. Comments on the proposed definition and suggestions for better definitions will be very helpful to the Coast Guard in resolving this complex issue.

In addition to outlining proposed Coast Guard actions affecting waterfront facilities and soliciting comments on them, the Advance Notice of Proposed Rulemaking also contains a preliminary draft of proposed regulations which would apply to all waterfront facilities. These are only preliminary draft regulations designed to stimulate comment and thoughtful suggestions by raising a variety of issues. No effort has been made to structure these regulations within the foregoing outline because both the regulations and the outline are intended as tentative suggestions of possible approaches which might be taken. The Coast Guard is seeking to avoid being committed to any particular approach during this conceptual stage. The proposed waterfront facility safety and security requirements does not reflect the possible shifting of the environmental protection regulations into Part 126. That major step will not be taken until public comment is received concerning it.

In addition to the general facility proposals, this Advance Notice contains a preliminary draft of proposed liquefied natural gas (LNG) waterfront facility regulations. The detailed content of these proposals is a reflection of the several years of work spent in their development by CTIAC and its Liquefied Gas Facilities Subcommittee. Their work has been reviewed and revised by the Coast Guard Task Force and, as changed, now has been set forth for evaluation and comment. Again, the Coast Guard is not committed to these proposals, but is interested in generating substantial comments for use in developing a Notice of Proposed Rulemaking on the subject of LNG waterfront facilities.

It is likely that many subjects covered by these LNG facility proposals eventually would be covered either in the general facilities regulations or regulations applicable to all liquefied gas

facilities. In turn, those regulations would be cross-referenced or incorporated in the LNG facility regulations.

Persons familiar with LNG facilities are aware that the Office of Pipeline Safety Operations (OPSO) of the Materials Transportation Bureau on April 21, 1977 *(Federal Register)* issued an Advance Notice of Proposed Rulemaking concerning safety of LNG facilities used in connection with pipeline transportation. To assist the owners and operators of LNG facilities which would be subject to both Coast Guard and OPSO regulations, a Memorandum of Understanding between the two agencies will provide for appropriate division of areas of responsibility. This will eliminate overlapping and duplication of LNG facility regulations. This MOU will be published in the *Federal Register.*

A tentative decision has been made to incorporate by reference consensus standards throughout the waterfront facility regulations when those standards are sufficient to provide appropriate safety or environmental protection. Partial incorporation and incorporation with exceptions also are contemplated. Additional Coast Guard requirements may be imposed. Comments are being solicited concerning which, if any, national consensus standards should be adopted, and the environmental and economic impact of such adoption.

With thoughtful input from safety-conscious individuals such as yourselves and from representatives of environmental, industry, consumer, and other groups, the Coast Guard hopefully will be able to issue waterfront facility regulations which will achieve safety, security, and environmental protection without imposing unreasonable obligations and expenses on industry, consumers, or government.

78 2369

A SAFETY ANALYSIS OF THE FOREIGN TANKER BOARDING PROGRAM

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As a prelude to the discussion of the foreign tank vessel examination program, it is important to realize that there is a great deal of difference in the scope of involvement and control that the U.S. Coast Guard exerts over U.S. flag tankers vs. that of the foreign flag tanker calling at a U.S. port. From the initial review of its plans before construction until it is scrapped or sold to a foreign owner, the U.S. flag tank vessel has continuous involvement with the U.S. Coast Guard to insure that it is in compliance with applicable federal regulations and international agreements. A foreign flag tanker, on the other hand, having the necessary certificates and being from a nation signatory to the international convention for vessel safety, is largely exempt from domestic regulation. The primary exceptions to this are those vessels required to obtain a letter of compliance due to the carriage of hazardous cargoes in bulk, and those vessels examined for cause, such as involvment in a vessel casualty in U.S. waters. While there are other reasons for U.S. Coast Guard involvement with a foreign flag tanker, such as examination for compliance with the pollution prevention regulations, essentially, from the standpoint of the Commercial Vessel Safety Program, reoccurring examination of a foreign flag vessel was out of the ordinary. That state of affairs changed dramatically this past winter. Case history cited

The present expanded foreign tank vessel boarding program was born on the evening of 17 December 1976 in Los Angeles Harbor with the explosion of the *SS Sansinena,* resulting in six deaths plus three missing and presumed dead, injuries to 58 persons, release of approximately 20,000 gallons of bunker oil into the harbor, and loss of a vessel valued at $21.6 million.

This casualty was one of a number of tragic incidents that began two days earlier (15 December) with the grounding of the *Argo Merchant* 28 miles southeast of Nantucket Island, resulting in the spill of 7.3 million gallons of number 6 fuel oil and the loss of the vessel. These two casualties were quickly followed by a pollution incident involving the tank vessel *Oswego Peace* wherein 5000 gallons of bunker oil leaked through the skin of a tank into the Thames River in New London, Conn. on 24 December; the grounding of the *SS Olympic Games* in the Delaware River on 27 December resulting in the spill of 133,000 gallons of crude oil with no loss of life; the grounding of the fully loaded ore/oil carrier, *SS Daphne* while approaching a harbor in Puerto Rico on 28 December; the explosion and fire on board the ore/oil carrier *SS Mary Ann* on 1 January in the Atlantic Ocean, resulting in injuries to two crewmembers; the disappearance of the fully loaded (8.2 million gallons of number 6 oil) tank vessel *Grand Zenith* in the North Atlantic ocean enroute Providence, R. I. around 2 January 1977; the grounding on 4 January 1977 of the tankship *Universe Leader* in the Delaware River with no loss of cargo; the loss of the coastwise U.S. tanker *Chester A. Poling* on 10 January due to structural failure in the Atlantic Ocean with the loss of one life; the loss of the tanker *Irenes Challenger* in the North Pacific Ocean on 17 January with three

crewmembers missing; the explosion of the *Exxon San Francisco* while in a U.S. port on 27 January with the loss of three lives; the striking of the Hopewell Bridge in Virginia on 24 February 1977 by the U.S. flag chemical carrier *SS Marine Floridian* as a result of a steering gear malfunction; and the explosion of the *Claude Conway* in the Atlantic Ocean on 27 March 1977, resulting in the loss of 12 lives and the vessel itself.

The U.S. Coast Guard, in response to conditions found by the *SS Sansinena* Marine Board of Investigation, on 21 January 1977 issued a Commandant Notice to Marine Safety Offices and Marine Inspection Offices to immediately assign qualified marine inspectors to examine the cargo venting and handling systems of foreign flag tankships calling at U.S. ports. Subsequent Commandant Notices were issued in the next several weeks in amplification of the original order, detailing the goal of the program, i.e., the elimination of possible dangerous cargo vapor emissions and likely sources of ignition. Field offices were instructed to conduct the examination in accordance with the General Safety Control Premises of the Safety of Life at Sea (SOLAS) Convention.

In the 7-1/2 months (21 Jan. '77-12 Sept. '77) that the foreign tanker examination program has been in effect, there have been 1959 examinations of 1151 different vessels in United States coastal ports as well as ports in Puerto Rico, Hawaii, and Alaska. With respect to these foreign flag vessels, seven tankers have been examined six times, 14 have been examined five times, 47 have been examined four times, 134 vessels have been examined three times, 301 have been examined twice, and another 655 vessels were examined only once.

Out of this total of 1959 vessel examinations, 938 examinations revealed no deficiencies aboard the vessels, while the remaining 1021 examinations resulted in the issuing of deficiency letters to the masters of these foreign flag tankers. While the continual rise of the deficiency curve can be viewed as an indication that conditions are not improving, the impact of the Navigation Safety Regulations, (33 CFR 164), which became effective 1 June 1977, is considered to be the influencing factor in maintaining an upward slope to that line. Since that date, there have been 243 deficiencies found involving noncompliance with these regulations.

The number of foreign flag tanker examinations by country of registry shows that tank vessels from Liberia have been examined almost 2.8 times as frequently as tank vessels from Greece, which in turn is followed closely by tank vessels from Norway, Great Britain, Panama, Japan, and vessels from 39 other countries.

As early examination results were received in U.S. Coast Guard Headquarters, the year each vessel was built and its tonnage was researched in an effort to correlate vessel age, country of registry, dead weight tonnage range, and deficiency profile. It was found that the average age of foreign flag tank vessels being examined was slightly less than 10-1/2 years. The age profile revealed that 27.6 per cent were 1-5 years of age, 22 per cent were 6-10 years of age, 24.2 per cent were 11-15 years of age, 20.4 per cent were 16-20 years of age, with the remaining 5.8 per cent in excess of 20 years of age. The largest grouping of foreign flag tank vessels fell into the 20,000 to 40,000 DWT range. This sizing is quite comparable to active U.S. flag tank vessels of similar ocean service and relates, to a great extent, to the configuration and controlling depths in U.S. navigable waterways.

In the foreign tanker examination program thus far, 6076 deficiencies have been found and a comparison of the number of deficiencies by country of registry is shown in Figure 1. The ages written on the graphs for each country represent the average age of the tank vessels of that registry that have been examined under this program. In Table 1 vessel examinations and deficiencies for

FIGURE 1

Defiencies By County of Registry

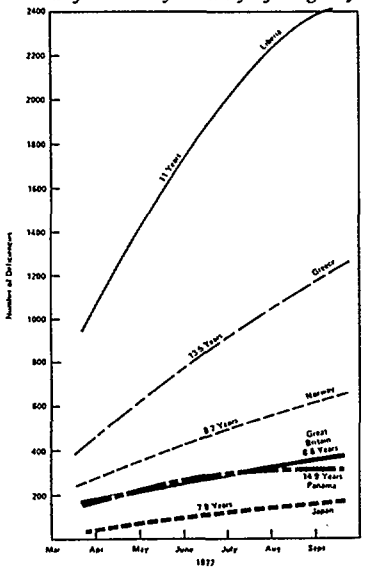


TABLE 1

Country	Vessel Examinations No. & % Of Total		Deficiencies* No. & % Of Total	
Liberia	728	37.2	2402	39.5
Panama	131	6.7	316	5.2
Greece	263	13.4	1225	20.2
Norway	210	10.7	648	10.7
Great Britain	149	7.6	361	5.9
Japan	58	3.0	165	2.7
Singapore	53	2.7	70	1.2
Netherlands	33	1.7	14	0.2
Italy	35	1.8	88	1.4
France	28	1.4	88	1.4
Finland	23	1.2	57	0.9
Denmark	25	1.3	15	0.2

*Data as of 9/12/77

each country are compared as a percentage of the total number of examinations and deficiencies. Among the vessels of the six most frequently examined countries, Greece shows the largest negative spread (a higher percentage of total deficiencies than per cent of total examinations) with Liberia exhibiting a slight negative spread and the other four countries either being equal or showing a lesser deficiency to examination percentage.

A vessel's age grouping was contrasted with the overall number of deficiencies for that vessel to develop a deficiency distribution by age. Table 2 compares the age profile developed earlier with this deficiency distribution and reveals that the 50.4 per cent of vessels in excess of ten years of age account for 75.5 per cent of the deficiencies discovered in the administration of this program.

TABLE 2

Comparisons By Vessel Age

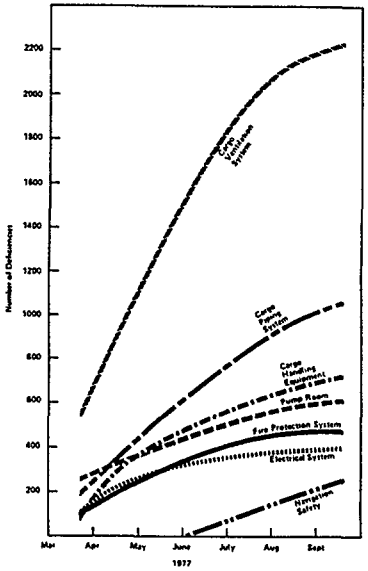
Age Group In Years Of Age	% Of Vessels Examined		% Of Deficiencies Found*	
1-5	27.6%		7.7%	
6-10	22 %		16.8%	
11-15	24.2%	50.4%	37.1%	75.5%
16-20	20.4%		30.1%	
Above 20	5.8%		8.3%	
	100.0		100.0	

Age Group	Deficiency Type	Percent Of Total Def. Of That Type
1-10 Years	Ventilation System, Cargo Piping System, Pump Room, Electrical System, Fire Protection Systems	20-30%
> 10 Years		70-80%
1-10 Years	Cargo Handling Gear	36%
> 10 Years		64%

The deficiencies shown in Figure 2 reveal the relative frequency of major deficiency types with cargo ventilation system deficiencies discovered at a rate twice that of the next nearest deficiency type. Similar to the age grouping in the overall distribution of deficiencies, the individual deficiency types exhibit a similar percentage distribution, again using vessel's age as a basis. For example, between 20 to 30 per cent of the deficiencies discovered in the ventilation system, cargo piping system, pump room, electrical system, and fire protection systems were found aboard vessels of less than ten years of age with the remaining 70 to 80 per cent found on vessels older than ten years of age. The only one of the six major deficiency categories that did not exhibit as high a percentage favoring older tank vessels was in the area of cargo handling gear deficiencies. The distribution for this category was 36 per cent for vessels one to ten years old, with the remaining 64 per

FIGURE 2

Deficiency Data



cent attributable to tankers over ten years of age. This is logical, considering the vital role that the cargo handling system plays in the daily operation of a tank vessel. It is the attention given to this system, vice the others, that accounts for the closer percentage distribution between age groupings. An evaluation and enumeration of the deficiency types is as follows:

Cargo Venting System (2206 deficiencies). This singular area accounts for the largest number of deficiencies. The most common of these are defective or missing flame screens, defective or missing pressure/vacuum valves, wasted and holed vent piping, and wasted and holed vent masts and vent headers. The above four items have been reported with almost equal frequency.

Cargo Handling Equipment (706 deficiencies). There are five discrepancies reported with equal frequency and a number of others of lesser frequency. The former include inoperative cargo pumps or cargo pumps leaking excessively; wasted and leaking steam piping to cargo pumps; leaking, wasted, or inoperative cargo valves; inoperative stripping pumps; and cement boxes in way of wasted sea suction connections to ballast piping, while the latter group includes inoperative cargo pump remote shutdowns; inoperative gauges and cargo monitoring equipment; and leaking or inoperative cargo heating coils.

Fire Protection Systems (476 deficiencies). There has been a variety of discrepancies in this area, with the first five items below being reported most frequently. The deficiencies are wasted, missing, and holed steam smothering system piping; inoperative valves in steam smothering system; inoperative fire dampers in pump room ventilation systems; wasted and holed firemain system piping; inoperative fire pumps and firemain valves; missing firehose; portable fire extinguishers missing or requiring service; semi-portable CO_2 systems requiring service; and inoperative sprinkler systems or foam monitors.

Pump Room (612 deficiencies). The most frequently found pump room deficiencies consist of the presence of excessive product in the bilges; wasted and missing ventilation supply and exhaust ducting; and missing or holed ventilation supply and exhaust duct flame screens. Other deficiencies found within the pump room areas include inoperative bilge pumps and disconnected reach rods; flammable materials and loose tools adrift; defective pump room weather deck watertight doors; and missing or broken ladder rungs.

Electrical Systems (401 deficiencies). The electrical examination is concentrated mainly in the pump room areas and on the weather deck, with the primary deficiencies being defective explosion-proof lights and junction boxes; and jury rigged wiring and installations. Other electrical deficiencies include dead ended wiring, and inadequate or non-

and has detained six additional vessels under the control provisions of SOLAS 60, Chapter 1, Regulation 19 which states that such steps shall be taken to insure that the ship shall not sail until it can proceed to sea without danger to the passengers or the crew.

On another level, the U.S. Coast Guard is vigorously pressing to have those tanker initiatives announced by President Carter in his 17 March 1977 message to Congress adopted by the international tanker community. This is being pursued through established committees for Maritime Safety and Marine Environmental Protection as well as special working groups at the International Maritime Consultative Organization (IMCO). At this time, it is too soon to predict the outcome of these endeavors.

In closing, it has been shown by an analysis of available data concerning the results of the examinations that the program has achieved a certain measure of success with respect to raising the overall level of safety of tankers calling at our ports. What remains now is the true test, that is, a period of time free of tanker casualties caused by those shipboard systems associated with the stowage and movement of the liquid cargo itself.

78 2070

IMPROVED MARINE SAFETY THROUGH LICENSE EXAMINATION MODERNIZATION

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In the long maritime history of the United States, there have been many technological innovations and advances involving ships, particularly those involved with the transition from sail to steam propulsion.

As those innovations and advances occurred, they were accompanied by associated problems which involved the safety of lives and property carried in steam ships. The most dramatic and disastrous of those early problems usually involved boiler explosions and fires which resulted in substantial loss of life or property damage.

Prior to 1838, for example, accidents involving steam ships comprised approximately 83 per cent of all steam plant accidents which resulted in substantial loss of life or property damage. Later examples are the boiler explosion and fire aboard *S.S. Sultana* which killed 1700 persons in 1865, the fire aboard *S.S. Morro Castle* which killed 124 persons in 1934, and more recently the loss of the small passenger vessels *Jack* and *Pelican* in 1951 with loss of 11 persons and 45 persons respectively.

All of the disasters cited received national attention and resulted in either actual or pending legislation or rules changes. Following initial federal legislation in 1852, various federal agencies were established from time to time in an effort to ensure the safety of lives and property aboard ships. Since 1942 the U.S. Coast Guard has been the federal agency responsible for that effort.

All of the disasters cited were followed by investigations to determine their cause and to recommend methods of prevention. Of significance in all of these investigations is the finding that human error was involved in either causing or contributing to the disasters.

As a result of the early investigations and findings of human error, license examinations came into use in an effort to determine the competence and qualifications of persons licensed to serve in responsible positions aboard United States merchant ships. The earliest attempt at ensuring safety through license examinations came in 1852 when the Collector of Customs directed locally appointed inspectors to establish a licensing examination program for engineers and pilots. In 1871 license requirement for masters and chief engineers were established, and the license agency was given authority to revoke license issued by that agency.

Through the years the license examinations had evolved into an essay format, and by 1942 that format had become firmly established. The administration of examinations was decentralized in 45 or 50 examining centers located at ports throughout the United States. The examinations were locally prepared, administered, and scored, which resulted in great variation in testing standards.

Some attempts were finally made to establish and maintain standardized license examination procedures throughout the country. Official correspondence in Coast Guard files indicates that those attempts met with little success. This same correspondence shows, as early as 1937, a growing dissatisfaction with the examinations themselves and the procedures for administering them. This dissatisfaction grew from the increasing obsolescence of the examination questions, the evident

compromise of those examinations, and the tolerance of archaic methods of administration. Also in 1937, Congress spoke to the necessity for centralization and standardization of license examination, preparation, and administration.

In 1933 and 1941 further attempts were made to modernize the examination questions and centralize control of examination standards in Washington, D.C. Neither of those attempts was particularly successful due in part to the reluctance of the licensing agency to change the status quo. This was the status of license examinations in 1942 when the responsibility for marine inspection and licensing was temporarily transferred, along with the Bureau of Marine Inspection and Navigation, to the Coast Guard. Little change in that status occurred during the years of World War II, except for adding examination subjects and establishing stringent examination requirements. In 1946 this responsibility was made permanent and the Bureau of Marine Inspection and Navigation was abolished.

In 1945 the Coast Guard made its first attempt to standardize the license examinations by culling obsolete questions from the immense accumulation then existing. The remaining essay questions were then assembled into a standard set on file cards. Duplicate sets of cards were provided each marine inspection office involved in licensing. This was the first time all licensing offices had exactly the same examination to administer.

This attempt at standardization was intended to provide total equality of examinations, allow continual modernization, and assure that all licenses were issued based upon a definite standard of basic qualifications, a standard that would tend to protect lives and property aboard ships.

In 1953 a study was conducted by the Merchant Vessel Personnel Division of Coast Guard Headquarters. This study was directed at further standardization of examination procedures and equality of conditions which an applicant must meet to qualify for a license. The results of that study showed there was need of greater central control over examination content and procedures to ensure all applicants for a particular grade of license were tested identically.

In addition to the problems of obsolescence and lack of centralized control, other problems existed in the form of examination compromise. This compromise occurred with the compilation of "ponies" which accurately reproduced license examination questions. Allegedly, some were exact duplicates of the examination card files. A part of the compromise problem was the tendency of some schools to teach from such ponies and the inclination of some license applicants to learn solely from ponies by rote memorization. The Coast Guard was partly responsible for the existence of such ponies through its failure to conduct timely revisions to eliminate obsolete, ambiguous, and incorrect questions. Some license applicants felt compelled to study such ponies in order to know the "answers required by the Coast Guard," thus enhancing their chances of passing the examination.

An indirect result of the 1953 study was the introduction of multiple choice objective questions into some fields of license examinations. This was the first move away from the traditionally subjective essay questions in continuous use since 1852.

By 1960, conversion of essay questions to multiple choice questions was underway as an authorized project involving seven different fields of examination subjects. Those subjects were: Ocean Winds and Weather, Fire and Organization, Rules of the Road, Instruments and Accessories, Refrigeration, Chart Navigation, and Electricity. That project was never fully implemented, and the questions that had been converted were also soon compromised. This condition remained essentially unchanged until 1969, when a new attempt was begun to update and standardize license examinations.

In 1969 the Coast Guard contracted with Educational Testing Services, of Princeton, New Jersey, to conduct a research project designed to review all aspects of merchant marine licensing. The specific objectives of that study were to: (1) identify problems and shortcomings in the existing licensing system; (2) recommend changes or modifications for improving the system.

During that study, members of the Educational Testing Services staff visited Coast Guard Marine Inspection Offices in New York, Miami, New Orleans, Cleveland, and San Francisco. Those ETS staff members questioned Coast Guard officers involved in the license examination process to determine how that process functioned. The questioning was also directed toward finding problems in the license examination process and to solicit suggestions for improvement. The ETS staff also visited the Merchant Vessel Personnel Division of Coast Guard Headquarters, where similar discussions were held with officers involved in preparing examination questions and in supervising licensing operations.

Discussions were held with personnel from the U.S. Merchant Marine Academy at Kings Point, New York and with representatives from the New York State Maritime College at Fort Schuyler, New York to seek their views on the licensing process. Additional views and suggestions were obtained in discussion with representatives of three labor organzations involved in training merchant marine officers. These organizations were the International Organization of Masters, Mates, and Pilots, the Marine Engineers Beneficial Association, District 1, and the Marine Engineers Beneficial Association, District II. The principal ETS investigator for this study also attended a one-day conference with the heads of five state maritime colleges and academies and a one-day conference sponsored by the Maritime Administration of the Department of Commerce. Those conferences discussed all aspects of the Coast Guard licensing process.

The recommendations made as a result of that study fell into two categories: those designed to produce an interim program for immediate use, and those designed to produce a long range program whose goal would be an "ultimate" examination and procedure. A synopsis of those recommendations is as follows:

The Coast Guard should:

1. Appoint a broadly based advisory committee that would make recommendations as to necessary changes in the license procedure and structure for merchant marine personnel. This committee would also assist in developing procedures and policies to enable the Coast Guard to carry out its licensing responsibilities effectively and efficiently.

2. Appoint a committee consisting of representatives from marine industry management, labor, and educational institutions. This committee would assist in developing specifications reflecting the minimum requirements for safe operation of ships in today's merchant marine. These specifications would be the basis for developing new license examinations.

3. Centralize in Coast Guard Headquarters all responsibility to develop quality examinations, establish standard procedures for administering examinations, and conduct research necessary for examination improvement.

4. Augment headquarters staff with sufficient professional and clerical staff to install and operate an effective and efficient examination system.

5. Convert all examinations to an objective question format.

6. Change the procedures governing examinations so as to set enforceable and realistic time limits for each examination section. Provide license applicants with reference materials and formulas during the tests unless memorization of test material is desirable. Permit any applicant to complete the entire examination regardless of failure in one or more test sections. Establish necessary guidelines to allow applicants to be retested within a

definite time period. Complete failures should be administered a complete examination while partial failures would be retested only in the sections failed.

7. Establish standard conditions for test administration and scoring. Discontinue the practice of allowing and encouraging discussion between the examiner and applicant concerning test questions. Require evaluation of each applicant to be based solely on written records.

8. Establish effective procedures for statistical analysis of all examination questions to determine their difficulty and discriminating power. Analyze the comparability of various test forms and the reliability of the scoring system used. Initiate effective procedures for statistical analysis of all examination questions to determine their difficulty and discriminating power. Analyze the comparability of various test forms and the reliability of the scoring system used. Initiate effective procedures for continuous review of examination specifications, questions, and scoring guides to ensure they are accurate and applicable to the job.

9. Initiate studies for effecting long range improvements in the license examination system. The improvements should include simulators for applicant testing, advanced technology such as computers and optical scanning devices for scoring examinations, and automated high speed typewriters for assembling examinations from a data bank.

These are not all of the recommendations made, but they are illustrative of the scope of the study done by ETS and of the problems brought to view.

As a result of this study, the Coast Guard decided on the following immediate course of action:

1. Develop modern job specifications for master, chief mate, second mate and third mate deck officer licenses and for chief engineer, first assistant engineer, second assistant and third assistant engineer officer licenses. These specifications are the foundation of a new and professionally valid examination program.

2. Eliminate essay questions from the license examinations and replace them with objective multiple choice questions. The five major reasons for action 2 are as follows:

(a) The majority of marine industry personnel contacted expressed preference for such a change.

(b) The ETS study determined there is great variation in the expertise and experience of officers assigned as license examiners. This variation is due in part to duty assignment rotation. As a result of this variation, unequal examination standards are being applied.

(c) A multiple choice examination can be administered in less time than required for an essay examination.

(d) Multiple choice examinations can be processed, analyzed, and scored in a central location. This eliminates any subjectivity in scoring, applies standardized scoring criteria to all applicants, and allows all applicants to benefit from item analysis applied to each examination.

(e) The new multiple choice examinations would be developed with assistance from all segments of the marine industry, including management, labor, and educators. This would result in an examination having maximum validity and job applicability.

To implement this course of action, the Coast Guard contracted with Educational Testing Services for the development of job specifications applicable to deck and engineer licenses and for development of multiple choice examinations to replace the essay examinations.

Development of job specifications was accomplished by using consultants from every segment of the marine industry. The consultants wrote job specifications individually, then met in discussion groups over a period of many months. The discussion groups served to resolve differences and conflict in the written specifications.

This body of consultants, representing every segment of the marine industry, created a very diverse group and, as such, experienced great difficulty in arriving at a consensus on each specification written. Such a consensus was eventually developed and substantial acceptance of the specifications achieved. This has been substantiated by the fact that few complaints have been received concerning the subject matter in the examinations developed from those specifications.

The development of multiple choice examination questions followed Coast Guard acceptance and approval of the written specifications.

The examinations for second and third mate, second and third assistant engineer were developed by ETS following a method very similar to that used to develop the job specifications. The consultant item writers used came from the same industry sources and were all licensed officers holding master, chief mate, chief engineer and first assistant engineer licenses.

These consultants wrote test items individually, using the written specifications as a guide to subject matter. The completed items were then forwarded to ETS in Princeton, New Jersey where the items were reviewed by panels of marine industry personnel. These review panels critiqued each item for relevancy, accuracy, clarity, and conciseness. As a result of review, many questions were deleted as lacking one or more of these desired qualities. Specialists at Educational Testing Services then made their final refinements and organized the questions into examinations.

Experimental pretests were then conducted in 1972 at various maritime academies, union schools, and marine inspection offices. Test analysis was applied to these pretests, which resulted in additional questions being deleted. The remaining acceptable questions were then arranged in test forms deemed suitable for printing.

Early in 1973 these test forms were sent to the newly formed Merchant Vessel Personnel Research, Development, and Testing Division of the Coast Guard Institute in Oklahoma City, Oklahoma. This division was established in the summer of 1972 specifically to introduce the new multiple choice examinations. This new division was also given the responsibility to score all new multiple choice license examinations, conduct standard item analysis on the examinations scored, conduct revisions based on analysis, and develop new examinations on a continual basis.

Officers of the Merchant Vessel Personnel Division of the Institute made some final refinements to the examination structure and some minor revisions to the questions prior to the examinations' first printing in the summer and fall of 1973.

The first administration of these new multiple choice objective examinations occurred in December 1973 at Texas Maritime Academy. These examinations, or their revised editions, have been administered on certain specified days each month since then.

In the first months the new examinations were administered, it became apparent that the pass/fail rate was less than acceptable to both industry and the Coast Guard. This rate ranged from a high of approximately 68 per cent passing for third mate applicants, to a low of approximately 19 per cent for second assistant steam and motor applicants. The overall passing rate for all license applicants was approximately 50 per cent.

Immediate action was taken to discover the causes of this less than acceptable rate. A strenuous series of examination review conferences was conducted throughout the country. Those conferences were conducted by officers of the Merchant Vessel Personnel Division of the Coast Guard Institute. Participants in the conferences included the staffs of every maritime academy and union training school and those of most privately operated upgrade schools. The majority

of the participants arrived with the preconception that a large proportion of the examination questions were invalid. That preconception was erased from the minds of most during the course of the conferences.

This is not to say problems were nonexistent in the examinations, for they did exist in some specific areas. Those areas were: questions that were vaguely worded; questions that were ambiguous; unfamiliar question format; questions concerning design or theory were considered inappropriate for lower level license examinations; poor quality illustrations accompanying some questions; regulations questions at random throughout the examinations, which prevented concentrated reference to those publications; insufficient time to complete navigation problems; a lack of feedback to failing applicants concerning areas requiring additional study. All of these problems were resolved either during the conferences or immediately following.

Other problems also existed external to the examinations and had an equally adverse impact. Those problems were:

1. Applicant and instructor unfamiliarity with the new examinations and procedures.
2. Doubt in the various training institutions as to what subject matter should be covered in preparing students for the examinations.
3. Old habits used in studying for the essay examinations had become unbreakable for some applicants.
4. Anomalies in the early pass/fail rate statistics as a result of some applicants taking the examination simply to have a look at it.
5. Dilution of the professional mariner courses of instruction at some schools as a result of expanding curricula to include nonprofessional courses.

All but the latter problem were essentially overcome with the passage of time, and the initial adverse reaction as a result of the unfavorable pass/fail statistics has passed. The overall results for 1976 and 1977 show a pass rate of approximately 74 per cent for third and second mate and third and second assistant engineer applicants.

At this point it seems appropriate to further comment on the Merchant Vessel Personnel Research, Development, and Testing Division of the Coast Guard Institute.

As noted earlier, this division was established in the summer of 1972 at the Coast Guard Institute where the division was organized into a Deck Branch and an Engineering Branch under the direction of a division chief. All of the officers assigned then and now have a background in the marine industry. The majority of these officers are maritime academy graduates and all but one hold licenses as either master, mate or engineer. The one officer without a license has sailed in the merchant marine in an unlicensed capacity, has spent 30 years in marine engineering, and has better than seven years experience in technical writing and examination preparation. The civilian staff includes a personnel research psychologist with an educational and experience background in test construction, analysis, and validation, and a technical writer with an educational and experience background in writing concisely and explicitly. The clerical and logistics support is provided by one clerk-stenographer, one clerk-typist, and two enlisted yeomen.

The branch chiefs and their assigned officers are responsible for writing questions to be used in examination development. All officers assigned are involved in interpreting analysis to assure valid examination content and thereby establish a basis for examination revision. One of the officers currently assigned was involved in the initial revisions. All of the officers currently assigned have been involved in all subsequent revisions and have applied the knowledge gained to the development of a standardized set of examinations for unlicensed ratings in the United States Merchant Marine. This acquired knowledge was also applied to development of the current examinations for master, chief mate, chief, and first assistant engineer.

The methods employed in developing these examinations closely paralleled those used during the review and revision of the ETS-developed examinations. The same type of review conferences were conducted throughout the country. The same industry personnel were participants in those conferences, with the addition of actively sailing licensed masters, mates, and engineers, and senior port captains and port engineers of some of the major shipping companies.

Those conferences were conducted between June 1975 and September 1976. During that time each new examination for the upper level licenses was reviewed by a representative group in at least three different ports. The consensus developed during those conferences determined if a particular question required revision, should be deleted, or was acceptable as written. As a result, these examinations do not contain questions on obsolete equipment or methods. In fact, these examinations contain as many questions on modern equipment and methods as were acceptable to the majority of those who reviewed them.

This exhaustive review produced what are considered to be valid and job oriented examinations for determining the basic qualifications of licensed officers in the United States Merchant Marine.

These new examinations were first administered in September 1976 and have been administered on certain specified days each month since then.

The overall pass rate for the engineer applicants was approximately 54 per cent during the period September through December 1976. The average passing score for a chief engineer applicant was 82 per cent correct answers, and an average failing score was 54 per cent. The passing score for a first assistant engineer applicant was 81 per cent correct answers, and the average failing score was 53 per cent.

For the deck officer applicants, the average passing/failing scores were master 83 per cent and 63 per cent respectively, and for chief mate 83 per cent and 61 percent respectively. The overall pass rate for the deck officer applicants was approximately 39 per cent.

These results were not surprising and, in fact, were anticipated after our experience with the lower level examinations.

Standard item analysis was applied to the examination questions, which indicated that most of them were statistically valid. Those few that were not were identified and credit given to all applicants. This is a standard technique that has been in use since the lower level examinations were introduced in 1973.

For the period of January through June 1977, these statistics have improved to approximately 60 per cent overall pass rate for the upper level engineer applicants. The average passing/failing scores for chief engineer had changed slightly to 83 per cent and 60 per cent respectively. The average scores for first assistant had also changed to 77 per cent and 58 per cent respectively. The overall pass rate for deck applicants had doubled to approximately 68 per cent, and their average passing failing scores had also improved to 87 per cent and 63 per cent for master and to 85 per cent and 67 per cent for chief mate respectively.

And these statistics are expected to improve further in 1978 when the anomaly caused by the option to take the essay examination no longer exists.

There has been relatively little adverse reaction to these new multiple choice examinations. This is due primarily to the exhaustive review conducted prior to the examinations being used and secondarily to the uninhibited dialogue between instructors of the various training schools and officers of the Coast Guard Institute Merchant Vessel Personnel Division.

What little adverse reaction there has been is usually directed at individual questions. This reaction is usually a complaint that some distractors are almost

correct answers or that certain questions require applicants to exercise too much judgment. Frequently the complaint is that applicants are being questioned in areas they have not had to deal with in examinations before. This latter complaint is invariably directed toward questions on new methods or equipment.

These complaints come from individual applicants or training school instructors. Written complaints are replied to by letter, if possible. Telephone complaints from instructors are usually resolved during the initial conversation. Individual applicants who telephone are requested to forward any complaints in writing. There have been no complaints received from management in the marine industry to date.

These new examinations for all grades of unlimited licenses are in place and functioning as intended to determine the basic professional qualifications of merchant marine officers. They are analyzed and reviewed each time they are administered. These analyses give us data which form the basis for validation of the examination. That data is also one of the bases for any revision that must be done.

The examinations are administered throughout the country following standardized procedures. Each applicant for a particular grade and type of license takes exactly the same examination as every other applicant for that license that month. They are all examined at essentially the same time on the same day, under essentially the same conditions. There is no subjectivity involved in scoring the examinations, as they are all scored at the Coast Guard Institute using automatic scoring machines. The answer sheets from each applicant receive exactly the same treatment and evaluation as all others. If statistical analysis indicates a question is not valid and evaluation supports the statistics, that question is credited to all applicants taking that examination, and the question is rewritten or replaced at the first opportunity.

These methods will continue in use for all existing examinations and for any that are developed in the future.

At the present the Coast Guard is developing specifications and examination questions for master and mate, chief and assistant engineer for certain types of uninspected motor vessels and vessels of the offshore mineral and oil industry. The same methods used to develop the existing multiple choice license examinations will be used again.

In the near future, development will begin on examinations for Great Lakes pilots. We will also develop additional examinations for unlimited master, chief mate, chief and first assistant engineer. There are other categories of license or operators examinations to be developed which will require approximately eight more years of work at the present manning level of the Coast Guard Institute Merchant Vessel Personnel Division. The eventual goal is to compile a valid data bank of questions which will allow an essentially new examination to be produced every month.

All future examinations will test on new procedures, methods, and equipment as they come into use in the marine industry. All obsolete questions will be either updated or deleted. Future examinations will also test on the rules and regulations as they apply to new procedures, methods, and equipment. As an example of this, the current master and mates examinations test on the new International Regulations for Preventing Collisions at Sea which went into effect in July 1977.

As the examinations are developed and evolve, the extent and degree of knowledge required to pass them will become greater. As this occurs, the basic professional qualifications of merchant marine officers must necessarily follow.

This will lead to an ultimate goal of the Coast Guard. That goal is improved marine safety through license examination modernization.

73 2871

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National Safety Council

A Membership Organization Dedicated to Protecting Life and Promoting Health

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To Whom It May Concern:

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