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Marine Sessions

ELEMENTS OF A SAFETY PROGRAM FOR LONGSHORING

By JOHN FAULK
Safety Director, Strachan Shipping Co.,
New Orleans, LA

Approximately 6½ years ago, I started my career as a safety professional with Strachan Shipping Company in New Orleans. During this period of time, we have tried a number of different things in our safety program, which has proved to be somewhat successful. I would like to share with you some of the ideas we have put into effect and hope that they can be of some benefit to you in developing a safety program for your company or aid you in implementing the one you now have.

In New Orleans, we have what is called a "house gang system." This system enables a stevedoring company to directly involve all of their regular employees in the company's safety program. There are times, because of a heavy workload or absenteeism, when it is necessary for a stevedore company to hire non-regular employees. Even though this situation does occur from time to time, the same regular people are used most of the time. A company being able to involve all regular employees in their safety program is by far the most important element in order for a safety program to be successful. When I speak about involving all employees, this includes everyone from top management all the way down to the longshoremen that work in the hold of a ship or to the men who sweep the wharves.

Strachan, like most other companies, has developed a company safety manual. This is the first thing any company must do when developing a safety program. The manual should be well planned and written so that it is easy to understand, and designed to aid in establishing safe work practices and physical conditions on the job. Once a company sets a

policy, it should be strictly enforced and no one should be allowed to deviate from it.

At Strachan, safety training is a continuous thing. Regular monthly safety meetings are held for supervisory personnel and attended by top management, superintendents, foremen, clerks-in-charge, and other key people. The main topic of discussion for each month's meeting is planned well in advance and presented by the safety director. Movies and slides are frequently used by the safety director in delivering his presentation. Top management takes an active part in these meetings by discussing past accidents, recorded unsafe acts and conditions, among other things. Others attending the meetings also have an opportunity to express ideas and opinions during a general discussion period.

Our monthly safety meetings are held in a large room adjacent to the safety office. The availability of a facility like this makes it very convenient for scheduling the meetings and also, because of its location, allows immediate access to any safety record or other material that may be needed during the course of the meeting.

We have a safety committee consisting of approximately 20 people. These people represent various job classifications such as superintendents, foremen, longshoremen, clerks, freight handlers, etc. Because we try to include one man from each of our regular gangs, the majority of the men on the committee are longshoremen.

As a symbol of recognition, all of our safety committeemen are given green safety hats to wear on the job. Safety

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committeemen are also included in every planned safety event or activity the company might have.

Members of the safety committee are rotated on a yearly basis so that everyone will eventually have an opportunity to serve. We have found that once a man serves on the safety committee, he usually becomes more safety conscious and turns out to be a better worker.

Safety committee meetings are held on the same nights, but prior to, safety award banquets, which are given on a quarterly basis. They are very informal meetings where problems are discussed and recommendations are made. The meetings are usually well attended and the men take an active part.

When we first formed our safety committee, most of the men were very reluctant to become members. This was because they feared being ridiculed and teased by the other men. As time went on, however, others realized that the people on the safety committee were only taking an active part in something that was for the benefit of all. Now, we get more volunteers each year to serve on the safety committee than we can use.

Before work is started on a ship, one of the duties of the ship superintendent is to go aboard and make a visual safety inspection. He is given a check sheet to use as a guide and checks off each item as he goes from hatch to hatch. If anything is found to be unsafe or in violation of any safety regulation, the officer in charge of the vessel is immediately notified so that he can have the situation corrected before work begins. The completed check sheet is later turned over to the superintendent in charge of stevedoring for him to review and keep on record.

A safety inspection is also performed by each foreman, around the hatch to which he is assigned. He is also given a safety check sheet to follow as a guide while making his inspection. The check sheet will list things that the foreman should check for before his gang starts work and also during the time work is

being performed.

The safety director conducts safety inspections of every ship being worked and also of the wharves and gear shed. These are inspections that I personally perform. I try to inspect the ships we are working at least twice a day. If I find an unsafe condition and it can be corrected by our people, I see to it that the condition is corrected as soon as possible. If the condition is such that it is the responsibility of the ship to have it corrected, the officer in charge of the vessel is notified and he has his crew do it.

Each unsafe act or unsafe condition that I observe is recorded, specifying whether the gang or the ship was responsible for its existence. These records allow me to compare each gang's safety performance with that of the others and also provides training material that can be used at safety meetings.

Periodically, a safety committeeman will accompany me during my safety inspections. As we walk around the ship, I'll explain and point out to him exactly what to look for. Sometimes, I'll let him make the inspection and point out to me the things he finds wrong. If, by chance, he should overlook anything, I'll bring it to his attention. We find that by performing these types of inspections the men become more familiar with required safety regulations and more aware of unsafe acts or conditions which may exist around their work area.

Whenever an accident occurs involving personal injury, an accident report is immediately filled out. The accident is thoroughly investigated by the superintendent working the vessel and all detail information is entered on the report.

In the event of a serious accident, special forms are used to take signed statements from men working in the immediate area where the accident occurred. These statements have proven to be very beneficial during a number of court cases, especially when witnesses while being questioned on the witness stand, have changed their statements

from those originally given at the time of the accident.

We have a nursing facility located within the ports waterfront employment center, where a registered nurse is on duty five days a week. Unless an employee is seriously injured, he is sent to the nurse for treatment. If an employee is seriously injured, he is sent to the emergency room of a local hospital or directly to the company doctor. We find that the use of the nursing facility:

1. Reduces medical expenses. It costs approximately \$5.00 per visit to send a man to the nurse, compared to approximately \$15 if the man were sent to the doctor.
2. Gets an injured man, on disability, back to work sooner. An injured man can report to the nurse each day for therapy which will help him heal faster and thus return to work sooner than he would if he were only receiving therapy once a week at a doctor's office or maybe receiving no therapy at all.
3. Eliminates many needless lost time accidents. Doctors, in many cases, tend to be very lenient towards giving a man time off from work for minor injuries. The nurse will often treat a man for a minor injury and he will then return to work.

It is very important to keep a good set of records. Every accident report crosses my desk and I study it closely. If I feel additional information is needed on the report, I personally make a further investigation of the accident. Information from each report is recorded on a special log which aids me when completing my quarterly and annual reports.

Each quarter and at the end of each year, statistics are gathered and a report of injuries is completed. This report indicates types of injuries (whether first aid, medical only, or lost time); number of injuries in each job category (longshoremen, clerks, etc.); number of regular employees injured as compared to extra employees; and lost time acci-

dent frequency rate.

A code system is used for identifying every accident report which indicates the type of accident, type of injury, part of body injured, and source of injury. The code numbers are also recorded on a monthly accident evaluation form. Information from these forms is compiled each quarter and at the end of each year. The final accident evaluation report may indicate that most accidents are occurring while handling cargo such as drums. This type operation can then be studied to determine if a different method of handling is required or different type stevedore gear should be used.

The report may also show that most accidents are involving injuries to the feet and toes. This would indicate that a strong effort should be made to encourage more employees to wear safety toe shoes.

Maybe the report will indicate that a large number of injuries are occurring involving lift machines. More training of lift truck operators and a better lift truck maintenance program may be necessary to solve this problem.

The accident evaluation report serves as a source of valuable information which will identify problem areas. Studies can then be performed, recommendations made, and steps taken to reduce or eliminate accidents in these areas.

At the end of each month, information is transferred from the safety director's daily inspection sheet to a safety violation record form. When this form is completed, it indicates exactly what safety rules each gang has violated and the number of times violated. This form will also indicate the ship superintendent's safety record by showing the number and types of safety violations which existed under his supervision.

A form is used in evaluating a longshore gang's overall performance. If a particular gang is having an unusually high number of accidents, this form can

be used for determining the reason. By studying the gang closely and grading their performance, the problem may easily be recognized. For instance, the study may indicate that a lift driver, winch operator, or signalman may not be performing his job properly. If this proves to be the case, additional training may be necessary for these particular people.

We have developed quite a large amount of training material at Strachan, mostly slide presentations. Some of the slide presentations we have are: safety inspection of longshoring operations; safety inspection of wharf operations; freight handling and railroad car loading and unloading; common OSHA violations; six leading causes of accidents; slipping, tripping, and falling; preventing hand injuries; and barge loading and unloading operations. Most of the slides used in these presentations are taken right there on the wharves, and the longshoremen are the actors.

Bulletin boards are located in each of our regular berths as well as at the waterfront employment center. Posters, safety articles, news clippings, pictures, etc., are placed on these boards for our employees to see. A large blackboard is located at the waterfront employment center which indicates each regular gang's safety record for a particular period of time. This allows the men to compare their record with that of others. A large display board is located in the safety room with various pieces of gear and equipment on display which were somehow involved in an accident. Items on display often generate conversation during safety meetings. A large supply of pamphlets and other safety literature is in the safety office and is made available to anyone who desires them.

Strachan has put together a list of safety rules for various job classifications. These are passed out to the men and discussed at gang safety meetings. The lists include safety duties for hook-on men, signalmen, holdmen, winchmen, and lift truck drivers.

Every week, a gang safety meeting is held at the waterfront employment center. The meetings are held early in the morning after shape-up, but prior to the men reporting for work. Each week, the meeting is held with a different gang until all regular gangs have attended. Attendance is strictly on a voluntary basis and no one is paid to attend. Coffee and donuts are provided, however, for those who do attend. Some of the topics discussed at the meetings include the gang's accident record, the gang's safety violation record, methods of handling various cargo, individual safety responsibility, and particular gang problems.

As a certified first aid instructor, I periodically conduct first aid training classes. All of our supervisory personnel, as well as a number of other workers, attend these classes. Those successfully completing the course are certified by the American Red Cross to administer emergency first aid.

Strachan has always been opposed to cash type incentive programs. We don't believe a foreman should get paid because his men have worked for a certain period of time without having an accident. The longshoremen are the ones who are usually involved in accidents, and we believe that they, along with their foreman, should be shown some type of appreciation for working safely. A seafood party or a dinner is held at the end of each quarter for the gang with the best safety record for that period. We feel that the gang accomplished something as a team and should be honored as such. Periodically, at these functions, a gang with an outstanding safety record will be awarded safety shoes, hard hats, or jump suits for their achievement.

At the end of each year, the safety committee selects the man they feel has contributed most, as an individual, toward safety. A banquet is held in his honor and he is presented with a large trophy. The banquet is attended by top management, superintendents, foremen, safety committeemen, union represen-

tatives, and OSHA representatives, among others. The news media are contacted and a news article, along with pictures of the event, are published by a local newspaper. The safety award winner's picture is taken, blown up to a 20" x 24" poster, and hung up on the wall at the waterfront employment center. The poster will remain there for one year, when it will then be replaced by the next safety award winner.

Whenever hazardous cargo is received on our wharves, the clerk in charge of the receiving berth sends me a memo. The memo will include the type of hazardous cargo, quantity, type of package, location on wharf, name of ship it is to be loaded onto, and port of destination. This information allows me to do a number of things, such as check hazards associated with the cargo, check emergency procedures to follow in case of spill or fire, check of proper stowage of cargo on wharf, check regulations governing stowage aboard ship, plan safe methods of handling the cargo with the superintendent who will be responsible for loading it aboard ship, determine if personal protective equipment is required while handling and if so, see to it that it is made available, observe, whenever possible, loading operations to assure it is done in a safe manner. Close monitoring such as this of hazardous cargo reduces the chances of damage to the cargo due to improper stowage or handling, non-compliance with state and federal regulations, confusion and not knowing emergency procedures to follow in the event of a fire or spill, damage to ship, wharf, or other cargo due to fire or spill, and injury to personnel.

I would like to emphasize three things that are very important for a safety program to be successful.

1. Employee involvement is the most

important thing for a safety program to work effectively. To reduce accidents, you must involve the people who are having the accidents, in order to make them safety conscious and better, more efficient workers.

2. It's very important for the safety director to have a good personal relationship with all employees. Neither the "Mr. Tough Guy" attitude or the "Mr. Good Guy" attitude will be effective. The best approach is to try and get people to do things a certain way because they know it's the right thing to do and want to do it that way. A safety program can never be effective if people do things for fear of punishment or strictly because of anxiety for reward.

I've learned to know most of our employees fairly well. I know practically all of them by their first name. I know the ones who like to fish, hunt, go to church, chase women, or whatever. All the men call me by my first name and feel comfortable talking to me because they feel that I am someone they can trust. I am often stopped to hear a joke, listen to a gripe, settle an argument, or hear someone's personal problem. I have a friendly relationship with our men, but they respect my position and know that I will call things like I see them and show no favoritism.

3. Top management's attitude toward safety is a very important element to whether a safety program will be successful or not. If top management does not support the company's safety program, then everyone else is just wasting their time to try and make it work.

At Strachan shipping company we are very fortunate, because we have people in top management who support our safety program 100 per cent. Without this support, the program would be a failure.

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WE ARE OUR BROTHER'S KEEPER

By MYLES E. BILLUPS, Sr.

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In looking back over my 33 years in the longshore industry, I can say truthfully that we have come a long way in safety in the port of Hampton Roads, Virginia. For a long time, and at a cost of many lives and limbs, nobody paid too much attention to safety as being very important. The password in our industry was "tonnage and speed" and overall making money, as far as management was concerned. And the ILA members in the port were given pats on the back, based on how many tons they had deposited in or discharged out of a ship. There was a reason for that, because as the word was at that time, the swifter the movement of the hook in and out of the ship the more the praise came. But as I look back on those days, I become sad because I saw many of our members crushed, maimed, or broken up from falling in a hatch because cargo was stored too close to the open hatch or because of falling cargo from the sling load or because of deficient ships' gear, broken cables, bad shackles, etc., or men falling overboard because of backs turned on lifting cables, improper savalls and just a lack of interest in safety. People were just not programmed to make safety first, so it fell to last.

There were improper savalls—as long as something was hanging up there that was justifiable. Everybody would say, "Well, we got a savall hanging up there." Didn't matter if a thousand holes were in it, it was a savall. It met the purpose. There was just a lack of interest in safety. People were just not programmed to make safety first. So it just fell to last. I watched many times when ILA brothers would let a man stand in an improper place because he didn't know better or just was not mindful of the dangers. We

capable of performing in all of these categories that a man is needed to perform in to be head of household, is diminished or wiped out in some instances, then we find that it results many times in divorce and separation from families and children because the man can ill-afford to continue in a manner to which he has become accustomed.

All over the country foolish, senseless, needless, accidents and fires caused the longshore industry accident rate to climb, second only to the steel industry. Management always expressed their sorrow of a man injured or killed.

But it seemed it was still awe for them because it was not close enough to home to matter. Many times our members could have prevented an accident by moving an object out of the way, since he saw it in passing, remembering that his brother may follow him later and not see it. But he walked around it, not believing we should help to protect each other. Many times after an accident another member would say, "I saw that object laying there, now I wish I had moved it." Too late—another member was down. Education and safety, and programming of our minds toward it was apparent with these horrible accidents. It soon became very clear that if that trend continued, the cost of calling to the port of Hampton Roads would, regardless of tonnage volume, price itself out of the competition with any other port. Because not only were we destroying men, but killing the port's reputation for being the fast port and creating a name of being an unsafe one.

Around 1965 the ILA was able to convince the employers that even though we were doing well, tonnage wise, we were way below standards in safety. Once a year some of the stevedoring companies were having dinners for gang leaders. They were given wrist watches, etc., for good and fair performances during the year. It wasn't until 1965 that one of our local stevedores, Old Dominion Stevedoring, Inc., appointed their first company safety director and set up an

effective safety incentive program. They began to realize that for every lost time accident, profits went out the window.

In 1967 I was appointed safety director for the International Longshoremen's Association in Hampton Roads and developed what we consider the "We are our brother's keeper" concept. Because in Hampton Roads we had realized for a long time that for the port to survive we must have a safe stevedoring operation with maximum efficiency in keeping with safe working conditions. Because injuries to men resulted in a less efficient operation and noncompetitive bargaining rate.

Hampton Roads became the first hard hat port, after many meetings to convince management that the union would enforce the wearing of the hats. We had many jokes about that in the management meetings. Management would kid-ingly say, "Why do you want these hard hats, now? You want to make some more flower pots at home? You know you're not going to make the men wear them." But we were able at last to get management to see that the hard hat maybe would save a falling object from piercing a member's head and the hard hat would become a symbol and a reminder that "there's a reason why I'm wearing a hard hat. I must be in a danger area." All men were issued a hard hat. Management and the union jointly saw to it that these hats were worn at all times—a practice that is still kept. I can truthfully say that the hard hat program is at a 100 per cent level in Hampton Roads because the union supports management, and the union has told management that a member, regardless of what he works in, or what craft he works in, whether it be longshoreman or checking and clerking, warehouseman, or what have you, if he is caught without his hard hat on, he can be checked out and sent home and the union will not go down to force him to be paid for the remainder of that day, because he was checked out for not wearing his hard hat. Either we are going to have a hard hat program or we are not

going to have one. Either we are going to stand up for safety, jointly, or we are not going to do it. And the dinners and what have you won't suffice if we don't keep the practice on the job.

We are very proud our program was enacted. We were already in our hard hats when the federal government said it was mandatory. So we didn't have to run out and buy a bunch of hard hats like some people did and start passing them out. The men were already wearing them.

We jointly encouraged the use of safety shoes. These steps resulted in a noticeable, substantial reduction in injuries. The union changed its application for membership rules, which was very important, and began requiring a physical examination before we would consider an applicant and copy of a police record in the area which the applicant had lived in for the past 10 years. This improved the caliber of our personnel. Before, in the old days, we took whoever came off the street, if he was strong enough. It didn't matter if he was strong in mind, as long as he was strong in body. Didn't matter if he was a robber, thief, or what have you. We took him and we put him on the waterfront because we needed a strong, able-bodied man. But our industry has taken a change as to what constitutes a good worker, for we realize that, as the Bible says, "The world will grow weaker and wiser."

We are trying to follow that point of view and we want to become wiser, even though strength is not all that we need. We need good common sense. It became imperative that both management and labor must work jointly to protect the men and thereby retain our fair share of work. Each stevedoring company engaged their own safety director, unheard of 10 years ago. "We don't need a safety director. That's the last thing we need. We need more foremen. They get out there and drive the men on. Get the tonnage. That's what we need. We don't need a safety director. A safety director

is in the way. This guy down there, all he's going to do is create trouble. Everytime he's going to pick on every little thing that's not right. That shackle is not right! Go get another shackle! We'll work with that until he gets back." Sometimes before the man got back a major accident had happened.

But now, finally, the company saw that it was wise to bring about a safety director. That he wouldn't be in the way. That he was the way, rather than in the way. All the hatch bosses and dock bosses and gang leaders were given a 30-hour training course under the auspices of the United States Department of Labor. They were shown the correct way to handle cargo, the pitfalls to look out for the hassle to avoid in order to protect the safety of the men.

This is very important to us. We had gone to management and had several meetings. We told them that primarily the majority of the accidents we were having were coming from cargo going into or coming out of ships, and in a manner in which we could not only save the men, not only save life and limbs and keep the men from running up the sweat poles in the holes because they were running away from falling cargo or keep the men from running away from loads on the dock because they were swinging all over the place from improper handling, or something breaking loose, but what we were trying to get across was that in keeping with the concept of "We are our brother's keeper," rather than have a man holler down in the hole, "Well, get out of the way, that's all," and the guy that's hollering supposed to use a little more sweeter language, and the guy looks up at them, "You're crazy man, what's wrong with you?" "Well, just get out of the way." Zoom!

He's got to get down there with that cargo, because the stevedore is coming up the ship and I see the stevedore coming and I'm getting them in there, Captain. The men say you're a good boy. You're doing a good job there. So it meant something that these deckmen

and these people responsible with peoples' lives and cargo because we had a certain responsibility. Even though we were talking about the human side of it. We had certain responsibilities with the cargo because when people ship through our port, if they can't ship their cargo and get it safely to their destination without it being broken up and damaged and what have you, then it was still a port which people wouldn't have come to. And so if the people that were running the winches who were responsible for seeing to it that the cargo got into and out of the ships safely, were taught how to properly do it, they knew how to go on there fast. That's the first thing you learn.

I used to drive a winch. The first thing you learn is how to get two levers in your hand, stand between those two levers, and how fast you can get that cargo in and out of the ship. Didn't make any difference if some of the men were running up and down the sweat holes getting out of the way of you as long as you got it down there and didn't tear the cargo up. Cargo is the main thing. But we learn a better way with this 30-hour safety course. Management worked with us to see to it that these men were paid while they were going to school during these 30-hour courses, and it was very effective.

This was the beginning in reprogramming our members to take care of one another and to take more pride in the ability to handle cargo safely as well as swiftly. Companies began to appoint safety directors to make a constant inspection of all ships that would work. They discussed with the hatch bosses areas where risks to the men were too great and took measures to correct them. Incentives were made in the form of cash awards to hatch bosses and dock bosses, even including the members of the gangs which completed a full year without a lost time injury.

This was very important. You know one of the things that most of them started off with was grabbing the leaders.

I remember I was in a safety conference a few years ago and one of the employers was saying, "Well, you know we take the hatch bosses and the dock headers and we take them to local restaurants and we wine them and we dine them and what have you." But the key to the success of that was, the hatch bosses and the dock bosses are the supervisors of the men. It is good that they be reprogrammed toward safety, but the incentive has to reach beyond that. It has to go down to the last man. Because one man out of a 22-man gang can create a very damaging accident. And it didn't necessarily have to be the hatch boss or the dock boss. And so we told the companies if there are going to be cash incentive awards they ought to be broke up into pieces so that every member of the gang feels some incentive toward protecting one another and seeing to it that the area was safe. As I said earlier, where an object is in the way, a guy walks around it although he saw it; but you don't do that anymore in Hampton Roads. Somebody comes along and sees that board and bends that nail down and throws that board in the wing of the ship where nobody will stumble over it, because he has some responsibility toward keeping his gang a safe gang. We have some 10 or 12 gangs in the port of Hampton Roads that have been as high as four years without a lost time accident. They are given an annual award each year. They are given periodical awards each quarter. And we watch it. Every stevedoring company has the same program now, since the first one was so successful in getting down to the men, where things are safety. The insurance company attends the safety banquets and they come up and they are just as happy as a peacock because they are still drawing that premium and not paying out a lot and they are very responsive to our safety program as far as that's concerned. These awards are made at a quarterly safety banquet where the recipients are wine and dined and congratulated on their fine safety performance. Not just their tonnage per-

formance, but their safety performance. This started with one company and was so effective that all stevedoring companies in our port now have the same program. Having the complete cooperation of management and labor toward achieving safe working is evidenced by the results we have achieved. Injuries are way down, and a natural result has been that while workmen's compensation cost have increased in other ports in Hampton Roads, we are proud that we are reducing our costs in that vein by looking out for our brother. We have preserved his job security and when the day's work is over our brother can return home safely to his family.

We have tried to rebuild the image of the I.L.A. in this port, and we have worked hand in hand with management improving the rate of lost time accidents. This year our manual rate in Virginia was reduced from 22.77 per cent to 20.83 per cent, living proof that the program is working. Through the years our industry has become more technical, even more swiftly the concept has changed with the advent of containers. Larger cranes that require the training program for members who work on the deckmen ships. Container-moving equipment, hustlers, straddle carriers, etc., all require training with the giant container cranes that were built in the Port of Hampton Roads. First of all, the Port Authority thought that they were going to probably bring about special lift crane operators that they would be hiring to put on the crane that were primarily owned by the state and controlled by the Port Authority. Of course the union, in keeping with our tradition in fighting for all of the jobs that we can obtain, fought with management and the Port Authority and what have you, to be given an opportunity to prove that some incentive safety programs that we had started were working and that our people were programmed to do a job in loading these containers and do it in an efficient manner. After several meetings, the Port Authority relented and agreed

to allow the shipping association to employ some of the deckmen who had received some of the 30-hour training course to go into the cabin of these cranes. It proved very effective. Since 1967, when the first container crane was installed, we had lost only one life; almost 10 years.

We are presently setting up a drivers training and licensing program with management improving the driving habits of our members with a two-fold objective, saving life and limb, and reducing cost of repairs to the equipment. Now that's one of the things that the union have been . . . we've been fighting with management now for more than two years. We want, in the Port of Hampton Roads, and we have finally gotten management to agree to it, an incentive program toward the handling of the mobile equipment that pulls the containers around the piers, every piece of equipment that is used for the handling of cargo in the Port of Hampton Roads. We want a man, before he is permitted to operate any piece, to have gone through this program and receive a license that will be recognized throughout the Port that will ascertain what he is qualified to operate. If it is a six-thousand pound fork lift, or 25-ton Taylor, or 5th wheel or yard hustler, or a Pacoco crane or Transtanter or straddle carrier or what have you, if he is qualified to operate it, it will be stipulated on the back of his license. And for the handling of the equipment on the piers and in the general terminal areas, if a man becomes reckless, tearing up the equipment, he could lose his license, and once he loses his license after a proper hearing, he would be grounded, going back to the pile to be picking up cargo. Once a man comes off that pile and becomes a professional driver, he's a professional, instantaneous. He becomes an ace. The quicker he goes and gets a container and gets it back to the ship and he's standing there waiting, right off the bat he feels, "I'm the Ace." If he has made 15 people jump out of the way

while he was getting there, that doesn't make a whole lot of difference. The main thing is, "I'm back here."

We're reprogramming our people with our program. We have some good ones and some safe ones, but we have some reckless ones, too. That's what we are trying to control—to give everybody an idea that all of us must be safe, that one reckless driver can destroy one life, and one life is too precious to lose, a member would be licensed. If he is proven to be a careless driver, this would encourage a safe driving record among all drivers or operators of all equipment.

And so, as we move through the 70's, finally passing the country's bicentennial birthday and on to the 80's, we see an even stronger outlook toward safety, for we all recognize that safety is life. And it is money. And our philosophy at Hampton Roads is that no job in this industry is so important and no service is so urgent that we cannot take time to perform our work safely, the success of our port is still growing. Ten years ago nobody would have believed that the Hampton Roads Shipping Association would appoint a full time safety officer who would be working with the union and all of the safety directors for all of the companies in coordinating everybody into this area of safety. In

keeping with our customs and practices, we found that some companies even have safety meetings during the day, pay the gangs for coming, so that a man who is on the guaranteed annual income will be sure that he is there. Because they feel that, as far as safety is concerned, if one man in that gang is absent, it is like a link in a chain. If one link is broken, the chain is no good.

They feel that if it's important enough to happen and to involve the gang during work hours, they are saying, "We'll pay the minimum guarantee but we are summing every member of the gang to this safety meeting while we talk about some of our problems." and we try to instill that same concept in running a safety activity port as far as Hampton Roads is concerned.

We are proud of our record. If we think positive and if we instill in each member that he is not doing management a favor by working safely, he is not doing his union officer a favor by working safely—he's doing himself a favor and his brother a favor, and it means that safety must run from heart to heart and from breast to breast, down on the docks and in the holes on the ships where it is. And then people who are on the outside will recognize your record. You don't have to talk about it.

SAFETY THROUGH PHOTOGRAPHY

By W. A. KLEIN, JR.

Administrative Asst., Arthur Levy Boat Service, Inc.,
Morgan City, LA

There are many ways and means to carry out a company's safety program. At Arthur Levy Boat Service we chose the use of photography to achieve some of our objectives. We started with a Polaroid camera because it gave us instant pictures and we knew we had a picture of what damage or object we were taking at the time picture was snapped. However, the pictures, even though we used color film, were obscure and did not reveal fractures or detail very well. We purchased a good, well-known make of 35mm camera with standard lens and wide angle lens and a reliable flash attachment. The 35mm brings out all the defects, fractures, details, and extent of the damages. In our investigation of collisions, it shows the angle of impact and, in many instances, gives us evidence of the guilty party or who faulted the Rules of the Road.

The 35mm is used extensively by us in our continuing maintenance program. Like the old Chinese proverb, a picture is worth a thousand words. It also makes no excuses. Through the camera eye, management is immediately advised all about the housekeeping and preventive maintenance of our vessels. It tells us which crews are keeping up their vessel and who the slackers are. A long shot of the deck, both sides of the vessel, and one or two shots of the engine room of each vessel are dated and filed for comparison purposes with later pictures of the same shots on a periodic basis, say every three to four months, which is a reasonable length of time whereby the same vessel can be rechecked by our loss control representative.

In some instances, such as a fire in the engine room, a good clear picture may even tell us the cause or reveal the piece of equipment that failed.

ministrative, operations, and personnel departments in many aspects. The original is filed in the vessel maintenance file for future use in combating a Jones Act claim as documentary proof that the vessel is being inspected and properly maintained by ourselves in addition to the U.S. Coast Guard and American Bureau of Shipping.

In order to get our new employees started off on the right foot and safely we conduct an orientation program once or twice a month, depending on the number of new hires. It is conducted by our loss control representative in a classroom at the local vocational school, which is maritime and oil industry oriented. Visual aids are employed, together with lectures. The new employees are required to participate and actually demonstrate proper line handling procedures on a set of mooring bits we installed at the school. Since most of our new employees are deckhands, we concentrate on the correct manner to accomplish a deckhand's work safely.

Captains, mates, and engineers are given individual interviews. They are hired mostly on their sea service and experience, which is checked out carefully. Some captains elect to attend the orientation program to develop what is expected of new deckhands. Those attending the orientation class are paid a full day's wages and are fed coffee and doughnuts prior to commencement of the program. They are provided with a box lunch at noon break, thereby assuring no late shows for the afternoon session. Upon completion of the orientation class, our new deckhands are awarded \$2.00 a day more wages. This is an added incentive to encourage attendance in the orientation class. The new hires are also advised of the company fringe benefits such as group life and hospitalization insurance for them and their families. They are also advised of the profit sharing plan and pension plan, which is 100 per cent company funded. They qualify for the profit sharing and pension plan

after one year of employment.

Lastly, we hold quarterly safety meetings. Our most serious personal injury cases are briefly gone over, as well as our major hull and machinery accidents. This is done at a sit-down supper, usually held on a Monday night as we seem to get better attendance on a Monday as opposed to other week nights. Prior to the supper and meeting, we have a happy hour whereby the fleet personnel can meet their fellow workers and also the various department heads and discuss any problems with the personnel department and crew assignment meeting. To encourage participation and attendance, we have a drawing for door prizes such as fishing rod and reel, shotgun, small TV, or digital clock radio, etc. For out of town seamen, we reimburse them mileage or travel expenses.

Finally, we approach the benefits derived from this program by both the company and the individual employees. The company receives its benefits in a drastic reduction in claims, accidents, lost time, and number of seamen on the maintenance list. These are important to us, as for all practical purposes we are self-insured, based on our high deductible. Our frequency rate on accidents was reduced and our insurance premium lowered in spite of rising rates. Also, our program produces the very important feature of developing definite ways and means of accident prevention.

The individual seaman benefits by being a happier and safer worker and not having to endure pain and suffering and loss of earnings. He also participates in our Vessel of the Month award, in which each crew member of the winning vessel for the month is the recipient of a good quality jump suit or a two-piece (pants and trousers) uniform, or a \$25 gift certificate to be redeemed at one of the local chain discount general merchandise stores.

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OFFSHORE LOGISTICS' SAFETY PROGRAM

By CHARLES R. BRILEY
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Our P & I loss frequency was going up, up, up. It finally reached a point where it was felt that we had to take some measures to control these P & I claims. The average number of chargeable P & I claims was running in the vicinity of about 26 claims per month. As a company, we got together and decided that we should adopt a safety incentive plan. We knew that if we did not do this, the cost of our P & I premiums would probably increase somewhere in the vicinity of 15 to 20 per cent a year. Therefore, we decided that we needed a program where each crew member would be provided with an incentive to become safety conscious.

The plan which we alternately adopted provided that if a chargeable claim was incurred by any one member of the crew, then all members of the crew on that vessel became ineligible for a safety award within that quarter. This applied to bodily injury claims as well as to other P & I claims such as damage to piers, platforms, as well as Negligent and Hull & Machinery claims. This built into the system a method of checks and balances among the crew members themselves. That is, if one crew member was not doing his part to maintain a safe, clean ship and perform the necessary maintenance, then the other crew members would "lean" on him.

With respect to bodily injury claims, we did not want a fellow to sustain an injury and not report it merely to be eligible for a safety award, so we built into the system a feature whereby a "chargeable" bodily injury claim was one which required disablement for longer than 48 hours. This gave a crew member an opportunity to receive first aid and still not be penalized for a chargeable claim.

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second inspection to see that this has been accomplished. We have adopted a very excellent color coding system of hatches, bits, hand-rails, etc., which are easily recognizable and which we are convinced have reduced the frequency of claims.

From an insurance point of view, it is our feeling that without such a program, cost of our P & I coverage would be substantially more than it is today. With the courts becoming ever more liberal in regard to "Jones Act" cases, the annual cost of \$50,000 for such a program can be repaid, so to speak, if we can prevent one "Jones Act" case. We have been commended by our underwriters for what they feel is an example of one of the

most effective safety programs in the industry. Additionally, we have been able to truly control the cost of our marine insurance, particularly the P & I portion. The program has been extremely well received by the employees. They are enthusiastically supporting the program and the awards which are received on a semi-annual basis or in the form of gift certificates at Wilson's and an automobile. It provides a family incentive such that we hope the wives of the crew members will encourage their husbands to be safe and careful, since the family, in an indirect way, will benefit by virtue of the type of awards or semi-annual rewards that the husband receives.

RESPIRATORY SAFETY PRECAUTIONS IN SHIPYARDS

By ROBERT B. SAVIN

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We all know problems exist in the area of respiratory health. How often have we seen men given a nuisance dust mask when they need a respirator for silica dust, painting, chipping, or grinding in a shipyard? Or, how many times do we run up against the "too tough to wear a respirator" philosophy when dealing with respiratory protection? Nuisance dust masks are not designed to impede the flow of organic vapors or metal fumes. These fugitive vapors and fumes pass right through.

Let's review the basic classification of "materials-to-be-protected-from" in a shipyard. According to Occupational Safety and Health Standards 1910.134, "In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures . . . when effective engineering controls are not feasible, or while they are being instituted appropriate respirators shall be used . . ."

Respirators can be purchased through a number of manufacturers. The life of the respirator depends on the concentration of the contaminant and the amount of exposure time to that contaminant. For example, an organic vapor cartridge may last as little as several hours in extremely concentrated areas to a couple of weeks of solid use in a workspace with very diluted concentration. The best indicator seems to be that when you can smell or taste faint odors or traces of the chemical, you must replace the respirator.

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The initial symptoms of cadmium poisoning, which appear after a latency period of several hours, are almost identical with those of metal fume fever. But, if untreated, cadmium poisoning can lead to pneumonia, fluid in the lungs, and sometimes death. If what seems to be a case of metal fume fever lasts more than 24 hours, cadmium poisoning should be suspected and treatment sought at once. Long term exposures to low levels of cadmium fumes are suspected to cause emphysema. Cadmium can also build up in the liver and kidneys, causing a chronic kidney disease.

There is, however, one relatively easy way to tell if cadmium is present in an unidentified sheet of metal. If the welder heats one small spot on the metal plate, a cadmium film will glow golden-yellow, while a zinc film will be grey.

Generally, less is known about the long term effects of welding fumes than about their acute effects. The term "welder's lung"—used to describe chronic respiratory problems of welders—has fallen out of favor with medical scientists because it is too vague. One condition that has been identified as characteristic of welders is siderosis—iron oxide deposits in the lungs which show up on an x-ray. There is no evidence so far that these deposits impair lung function. In fact, none of the scientific studies of welders' lungs conclusively resolves the question of whether welding fumes are harmful over a long period. Yet, individual welders sometimes experience breathing problems after years on the job.

What can be done to minimize welder's exposure to the fugitive fumes and vapors? Much work is done in close confined areas. We recognize there is a traditional reluctance of a welder in a shipyard to accept respiratory protection. Some shipyards have reduced the amount of welding actually done inside the hull of a ship. Automatic welding and cutting machines in huge, airy buildings do much of the basic cutting

and pasting of the massive steel plates that make up the ship's hull. Another standard industry procedure is for welders to use portable ventilation devices to collect the fumes or blow them away when working on the interior of a ship. A NIOSH prepared report on the best designs for welding fume ventilation systems can be obtained from the Division of Technical Services, NIOSH, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

Another shipyard fume and dust hazard that has been recognized for years is the lead used in some types of paint. Overexposures can occur during painting, grinding, welding, or cutting operations if respiratory protective equipment is not used. While it does not affect the lungs, inorganic lead can be absorbed after inhalation and stored in the bones. The first signs of lead poisoning—insomnia, tiredness, constipation—may be so subtle that the worker suspects nothing. But as the lead builds up over time, anemia and nerve damage, evidenced in shaky hands and stomach pains, may develop. A telltale sign of more advanced stages of lead poisoning is a blue line on the gum. Regular urine and blood tests are the best way to detect dangerous lead levels in the body early. If treated properly, lead poisoning generally is not serious, though repeated overdoses may result in damage to kidneys.

Materials containing isocyanates, being used more and more, call for caution. These are mainly polyurethane paints and foams. When mixed, the components react with each other, and form a hard surface. After the chemical reaction takes place, these materials are stable and present no special health hazard. However, during preparation, application and curing, they give off toxic isocyanate vapors.

Polyurethane paints and related materials fall into four general categories: (1) aliphatic polyurethane paint—the standard topcoat for general

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exterior surfaces of many ships; (2) aromatic polyurethane paint—coating for radomes of high performance, all weather critical applications; (3) polyurethane foam—padding, packing, and cushioning material; (4) insulating and sealing materials—electrical insulation and sealing around wires and tubes penetrating ships' hulls. Some of these substances contain other materials requiring health precautions in addition to those for isocyanates.

Use of polyurethane paints and other substances containing unreacted isocyanates should be restricted to: (1) production-type mixing and spray paint operations employing the standard spray gun (whether vibrator, air supply, or airless); (2) touch-up of small, localized surface areas; (3) such other uses as may be specifically approved.

Production-type operations should be performed only in specifically designated areas with local exhaust ventilation and such other environmental control measures as may be recommended on the basis of an on-site industrial hygiene survey.

Touch-up type operations should be performed only in areas with good general ventilation. Unprotected people in adjacent areas are not to be exposed to the mist, spray, or vapor. Application must be restricted to brush roller.

Anybody preparing or applying polyurethane paints or related materials in production-type operations must be equipped with protective equipment as determined by an on-site industrial hygiene survey. People working on touch-up operations should use/wear: (1) a supplied air respirator; (2) a well-fitted cartridge organic vapor (should be used only under strict control because the odor level of isocyanates is greater than the TLV's).

You may have read an article in the September issue of *National Safety News* entitled "Statement of Concern on the Use of TCE Causing Cancer in Test Animals." TCE (trichloroethylene) has been widely used in the past. TCE is a

chemical whose main use in shipyards has been in vapor degreasing of metal parts. It is a clear, colorless liquid with a "sweet" odor. It can generally be smelled at levels lower than the permissible exposure limits. Symptoms associated with TCE are eyes irritated, throat dry, lightheadedness, headache, dizziness, nausea, sleepiness and fatigue (short-term), skin irritation (long-term), damaged nervous system, and liver damage.

TCE is a photochemically reactive organic solvent. For this reason, its use is already restricted by law in some areas of our country where photochemical fog is a problem. Some shipyards have substituted methyl chloroform (1,1,1-trichloroethane) or perchloroethylene solvents in their metal-degreasing operations. Although these can be considered health hazards if improperly used, they are considered to be less toxic than TCE. A chemical cartridge respirator with replaceable organic vapor cartridges and half-mask facepiece will provide respirator protection in atmospheric concentrations of TCE vapor up to 1,000 ppm.

I recently acquired the Department of the Navy's most recently revised Naval Ships' Technical Manual, Chapter 635, on Thermal Insulation. This new directive orders the use of Type C continuous flow or pressure-demand supplied air respirators for all personnel engaged in the spraying of asbestos, the removal (rip-out) or demolition of pipes, structures, or equipment covered or insulated with asbestos, and in the removal or demolition of asbestos insulation or coverings. This manual also states that respiratory protective devices, such as reusable single use air purifying respirators, shall be worn whenever the airborne concentration of fibrous glass may exceed the personnel exposure limit of 10 mg/m³ for fibers of less than 5-7 micrometers in diameter, or while working with fine or ultrafine glass wool. "Respirators shall be required for all rip-out of fibrous glass thermal insulation

unless measurements show that the personnel exposure limit is not exceeded. Personnel engaged in fibrous glass sanding or finishing operations which generate large airborne quantities of fine glass particles shall wear respiratory protection."

The protection of our workers' safety and health is important to all of us. As worker accidents and health problems increase, we know that labor problems increase. If productivity falls, we fail. I hope that you, as safety and health professionals, are heartened and rewarded by the progress we make together—the doers and implementers. We are—all of us—committed to safety and health in one form or another.

During the course of your daily activities, have you ever speculated on the possible connection between worker motivation and safety? As you may already know, in a viable safety program you must engage individuals other than those in the safety department. You may have to go out and borrow special talents needed at a particular moment. To get cooperation, a structure of respect must be built within the safety department, a cohesion, a low level of friction; the safety personnel must have good working relationships with the fire department, the medical group, the industrial hygienist—anybody who somewhere along the line has safety and health, protection of life, in his or her mission.

In dealing with individuals, safety people have to be ambassadors. You have to get the total aspects of a human being in this, in what the psychologists call the stimulus/response syndrome. You approach a person with dignity and respect and in turn you get that kind of response.

The ideal industrial program has a good human factors person on the staff. It's the old man-machine-environment interface. You try to make the human an integral part of the system. The work area shouldn't have undue stress patterns, excessive noise, noxious odors, etc. If a new production line or new

workplace is set up, all these factors should be considered while the paper is still white.

The second best thing to having a "human factors" person on the staff is for the safety personnel to make use of studies and recommendations in the human factors field. We know that people account for 80 to 90 per cent of all our accidents. Although it may appear on the surface that someone else is at fault, we must, as a fundamental management responsibility, deal with this problem which affects our most important asset—our personnel. We must better understand our people and the accident phenomenon and take positive action. Full production is of paramount importance, but it is unpardonable to produce at the expense of our employees' lives, limbs, and health.

It is important that we begin to operate from a basic belief that the more a person values himself, the less likely he will take an unnecessary risk, thus reducing the likelihood of accidents and increasing health protection.

Why would that work? It would work simply because it is human nature to take better care of those things we prize highly—a new car, a family heirloom. Workers should be helped to feel more important, more "O.K.," more like winners, through the development of higher levels of self-esteem. Psychologists have developed many theories to explain the unfortunate fact that many in today's world regard themselves as being very unimportant in the whole scheme of things—to the companies they work for, their families, themselves. In the transactional analysis (TA) vernacular, few of us progress beyond what is called the "Universal Life Position of Childhood": "You're O.K.—I'm not O.K."

The thrust of a good safety and health program must, in my estimation, be to influence and convince those who believe themselves "not O.K." that they are indeed unique, gifted, O.K., important human beings.

How do we achieve this? First, we must structure (or restructure) the work climate or environment so that almost every signal communicated to workers, non-verbal or verbal, reinforces the idea that each person is important. If a worker will not wear a respirator, for example, it must be pointed out that he should wear the respirator not because it is a rule of the company or a law, but simply because important people are not expected to take chances with themselves. In short, people must receive signals which uniformly and consistently reinforce the concept of self-importance.

Many well-intentioned performance improvement programs fall short because they are fragmentary. The person receives mixed signals, some positive and some negative. Certain communications—safety posters, for example—say, "You really do count for something." However, a supervisor might convey quite a different message: "I know you submitted that idea months ago, but I just haven't had time to read it." A put-down.

Because of such mixed signals, progress is impeded or stymied

altogether by confusion, skepticism, even outright resistance. People must receive signals which uniformly and consistently reinforce the idea of self-importance. There is an excellent article on the subject in the July 1976 issue of *Occupational Hazards*, by D. O. Smart. He says, and I agree, "Those companies which have the desire and commitment to develop higher levels of caring and concern for employees will, through the unleashing of latent human resources, be able to achieve great increases in productivity and, therefore, competitive advantage. Moreover, the whole quality of life in which more and more people are concerning themselves with what it means to be human." This concept affords a many-faceted opportunity.

The shipbuilding and shiprepairing industry is extremely unique. In what other area can you find such a myriad of diverse hazards? The complexities of controlling a sound program are monumental and sometimes frustrating. I recognize your task is not an easy one to which "pat" answers can be applied. There are no simple solutions. I commend you for continuing to try.

SAFETY IN THE HANDLING OF ANHYDROUS AMMONIA

By JACK THORNHILL
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Caruthersville, MO

It is a proven fact that anhydrous ammonia can be handled and used safely, provided it is handled with the proper equipment, proper care, and precautions.

Anhydrous ammonia is a chemical composed of one molecule of nitrogen combined with three molecules of hydrogen. It is generally produced from a combination of processed natural gas and air. At temperatures above the boiling point of anhydrous ammonia, which is minus 28° Fahrenheit, the ammonia rapidly vaporizes to an extremely irritating gas. The anhydrous ammonia liquid can cause very serious freeze-type burns almost instantly if flesh is exposed to it.

Ammonia is detectable by the nose even at very low concentrations. As far as we know, there is no known harmful effect from breathing up to 100 parts per million in air for up to eight hours per day. Those of us who have lived on farms and have been around livestock buildings have been exposed to concentrations of approximately this level on a hot summer day. Very few people can and will willingly stay in concentrations of over 500 parts per million for any extended length of time.

Anhydrous ammonia has a very strong affinity for water. Ammonia is one of the most water soluble of all gases. For this reason, an abundant supply of water is the best means of providing immediate first aid treatment for any exposures to ammonia.

Anhydrous ammonia has been classified by the Department of Transportation as a non-flammable compressed gas. Within a limited range of concentrations in air, ammonia

vapors can be ignited. These concentration limits as reported by the Underwriters Laboratories are between 16 and 25 per cent by volume of ammonia vapors in air. These concentrations are very difficult to obtain in the open and in addition must be exposed to a high ignition temperature in the range of 1200°F. Very rarely can these conditions be met outside of the laboratory.

Ammonia dissolved in water will readily react with such metals as copper, zinc, and many of the alloys, especially those of a copper base such as brass. Ammonia fittings, piping, and containers should be made only of iron or steel, except that certain non-ferrous alloys resistant to ammonia may be used.

Flexible hoses used to transfer ammonia must be reinforced for high pressures and be marked with the words "Anhydrous Ammonia," along with the manufacturer's name, the maximum working pressures, and the year of manufacture of the hose. This dating of the hose permits the operators to periodically replace the hose rather than waiting for an accident to require replacement. The number of years of safe service will, of course, depend on the way the hoses are stored and handled as well as their original quality.

Before any repairs are attempted on any ammonia pressure equipment, precautions should be taken to insure that all of the ammonia is out of the system. Frosting on any of the lines, valves, fittings, hoses, etc., will indicate that there is some residual, trapped liquid ammonia which is vaporizing and rapidly cooling the container. All leaks in ammonia equipment should be repaired immediately. This may be

nothing more than tightening of a packing gland nut on a valve or tightening the retainer bolts on a fitting. However, when repairs are made, repair personnel should be thoroughly familiar with precautions in being exposed to ammonia and should take precautions to locate the exact source of the ammonia leak before they attempt to repair it.

While the presence of an ammonia leak is ordinarily evident to the nose, locating the source of the leaks will often require additional procedures and equipment.

The source of a leak may be sometimes detected by the use of water-moistened strips of red litmus paper, which turns blue in the presence of ammonia. Ammonia leaks may also be located by the use of a compressed sulfur dioxide gas which is available in small containers for this purpose. The use of burning sulphur tapers should be discouraged due to the possibility of reaching the ignition temperature of the ammonia.

When it becomes necessary to open an anhydrous ammonia refrigeration system to make repairs, certain precautions are mandatory. We must first make sure that all of the ammonia is out of the system in the area before we attempt to dismantle or start repairs. Venting or purging the system should not be done to the atmosphere but should instead be done through a flexible purge hose which has its outboard end submerged in a barrel of water. This will prevent personnel in the area from coming in direct contact with the discharge from the purge hose. Care should be taken not to bleed anhydrous ammonia into water that may later be used for first aid purposes.

The loading hoses or arms from the storage facility to the barge should be capped or blanked off in some manner before the hose is moved to prevent the possibility of residual ammonia liquid spilling out on nearby operating personnel.

All personnel that might possibly be

exposed to anhydrous ammonia fumes, vapors, or liquids should be well indoctrinated in freeze and burn first aid procedures. Protective clothing is a must when handling anhydrous ammonia. This clothing may consist of nothing more than a rainsuit to which rubber boots and rubber gloves have been added. It may be desirable to have insulated gloves for operating personnel to prevent skin burns on the extremely cold pipelines and fittings that develop when the ammonia is being transferred. Cotton type clothing is preferable to all other fabrics for work clothing. Contact of the skin with the liquid freezes the tissues and then produces a caustic-type burn. All efforts must be made to prevent the injured personnel from rubbing the affected areas. As anhydrous ammonia is one of the most water soluble of all gases, an abundant supply of fresh water is one of the best means of providing immediate first aid treatment for an anhydrous ammonia casualty.

All operating personnel who might possibly be exposed to an anhydrous ammonia spill should be well indoctrinated in first aid procedures that apply to freezes and burns. These personnel should also be provided with some individual safety equipment in addition to the protective clothing mentioned earlier. This individual equipment ideally would consist of a full face gas mask and a neutralizer solution bottle which may be carried on their person to flush away and neutralize any ammonia they may come in contact with.

Furnishing all the proper equipment, building a system with the right type of materials, and taking all those operational safety precautions we possibly can, still will not be enough to completely prevent the unexpected escape of anhydrous ammonia. In those cases, the operating personnel must be trained to use the first aid and rescue equipment provided to them. All operations personnel should be thoroughly familiar with the techniques of donning and using gas masks and

breath, put the mask on, activate the canister, and fit the headbands or straps to their head.

In summary: safe handling of anhydrous ammonia depends on: (1) having the right equipment maintained in top condition; (2) having a trained operator who carefully follows recommended procedures; (3) unfailing use of personal protection equipment, impervious gloves, and goggles or face masks, having plenty of water handy which would be at least five gallons and a pocket squeeze bottle to use the water or the neutralizer solution in case of accidental exposure; (4) immediately flushing the body areas in contact with the ammonia for at least 15 minutes and then seeking proper medical treatment.

First Aid

respirators, as these are their first line of defense in the event of a large spill where it will become necessary that they re-enter the contaminated atmosphere either to make repairs or rescue other personnel.

A person's first inclination in using a gas mask is to grab the mask, swing it up, and cover the face as rapidly as possible. In doing so, usually they trap a portion of the contaminated atmosphere in the mask. Unless they know how to clear this contaminated atmosphere from the mask, it is going to be virtually useless to them. The same would apply to any respirators or any other type breathing apparatus. Personnel have to be trained to exhale their breath into the mask, blow out the contaminated atmosphere and then, while holding their

RECENT DEVELOPMENTS IN TANK BARGE SAFETY

By P. NEAL

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Mobil operates two fleets under the banner of its Inland Waterways Division, one on the waters of the Western Rivers and the other out of New York Harbor to ports along the New England coast, New Jersey and New York, state rivers and canals, and the Great Lakes. For the purposes of this paper, discussion will be confined to the latter, which we call our East Coast/Great Lakes Fleet, although the principal points apply to both of our operating areas. Our East Coast/Great Lakes Fleet is an interesting one since it encompasses many aspects of inland waterways operations including tugs, motor tank vessels, manned petroleum barges and "day boats" that are involved in the delivery of bulk lube oils and bunker fuels to Mobil's maritime customers within the New York Harbor.

We consider our major safety asset to be the quality and caliber of our fleet personnel. Many of them are long term company employees with a wealth of experience of the geographical areas in which they trade and in the safe operation of petroleum carrying vessels. Our "old hands" form a backbone of knowledge from which we can build our growing strength for the future. This experience factor translates daily into low accident rates and safe vessel operations.

Prior to accepting new employees into our fleets we make sure that they are in all respects suitably healthy for the job by means of an in-depth physical examination and their maritime claims history is checked through the marine index bureau. As a backup to this initial examination it is a corporate requirement that all of our fleet members undergo a periodic physical checkup; not a

perfunctory walk through the doctor's office but one similar to the in-depth examination that is required upon initial employment. There are no exceptions permitted to this policy and it is rigorously enforced. Additionally, if a fleet employee is taken ill, he is required to obtain a clear bill of health from a company doctor before he is allowed to return to work. This question of good health is considered to be one of our major stepping stones to maximum safety.

As operators of petroleum carrying vessels, we are vitally interested in the fire fighting capabilities of our crews. To increase their expertise in this field we operate a fire fighting school at our Paulsboro, New Jersey refinery which is located on the Delaware River. This course has been in existence for many years. Originally it was run by the refinery's fire fighting chief, but from 1962 onwards it has come within the realm of marine operating staff. For the past few years the course has been supervised by our corporate marine safety advisor, so that for at least the past 14 years we have been able to provide our crews with uniquely marine oriented fire fighting training. On an average each fleet member attends the course every two years so as to keep abreast of the latest ideas and techniques.

The course itself is split into two main parts, theory and practice. It opens with an orientation period that includes discussion on the chemistry of the fire, fire fighting equipment that will be found aboard the various vessels in our fleet, its proper use and limitations, and its care. This oral session is followed by a comprehensive period on the refinery's fire

grounds where participants in the course all have the opportunity to fight various fires, among them tank fires, simulated pump room fires, running petroleum fires, and open pit fires. At this time the correct type and use of nozzle, applicators, foam, and various fire extinguishers are demonstrated and participants are instructed on the proper care of the equipment and recharging of extinguishers where appropriate.

We have always found an encouraging willingness by our crew members to participate fully in these courses, which we believe is due to their realization that it is for their benefit as much as the company's.

Turning now to the hardware of safety on our vessels we, of course, comply fully with all the regulatory requirements and in many instances exceed them, particularly on our uninspected vessels. This year we have fitted out all tugs that are liable to trade in coastal waters with emergency position indicating radio beacons (EPIRBs). Although exempt from the Coast Guard requirement to install this comparatively recent innovation, we consider it a worthwhile investment in added crew safety. An emergency position indicating radio beacon is a radio which will float off a vessel if it sinks or, alternatively, can be thrown overboard. On contact with the water it will extend an antenna and automatically transmit a distress and locating signal. It is required on larger offshore vessels. EPIRBs came from the aviation industry and, unfortunately, only airplanes guard the two frequencies assigned.

We have installed on our newer tug boats liquid fluoro/protein foam tanks which enables them to pump a water/foam mixture for some prolonged period; our policy is that tugs will have sufficient fire fighting capability to protect themselves and the tow with foam. And, some time ago, having had some difficulty with regular protein foam, we switched to the fluoro-buffered foam.

Our older tugs also have a foam making capability, although it is less sophisticated than on our newer equipment and consists of an in-line hopper into which a dry foam compound is poured to produce the required foam mixture. This ability to pump foam supplements the fire fighting capability of the vessels and barges that are tug handled, whether owned or chartered, and is an integral step in our overall safety program.

All of our vessels are provided with fire blankets. Many of our vessels have fully automated engine rooms. In addition to the many alarm and warning systems contained in the automation panels, we have installed numerous heat sensors within these unmanned engine rooms. Occasionally we have found these sensors too sensitive, but they err on the safe side and do provide excellent protection for the crew.

We have recently equipped all our vessels with air capsule escape devices. These basically consist of a back pack of compressed air connected to a plastic hood. The air supply is of five minute duration. The purpose of this air capsule is as an escape device for someone encountering unexpected hazardous atmospheres. Some examples of possible uses are as follows:

1. A crewman descends into the pump room and, because of a sudden large leak, the pump room is gassed up beyond the capability of the exhausters. The crewman could put on the escape device and have ample time to return to the main deck.

2. On the occasion of a fire in the engine room a crewman has to leave immediately because of smoke and fear of the CO₂ being dumped. With the air capsule he could delay his departure long enough to isolate the cause of the fire. It is stressed that this equipment is for use in unexpected situations and that in no case should these capsules be used as the primary air supply device for emergency tank or pump room entry or rescue. They are escape devices or contingency

devices only. Under no circumstances should this equipment be used for normal maintenance procedures.

In recent years there has been an increase in the numbers of double-skinned barges. All seamen are suspicious of the atmosphere in void spaces such as those between the double skins, and we are no exception. Consequently, on all towboats pushing double-skinned barges we have supplied oxygen meters and given instructions that no one is to enter the void spaces until the atmosphere is tested for oxygen content—say 19 per cent and, of course, for hydrocarbon vapors.

We have a program for underwriting part of the cost of safety shoes. Now, our employees are all paid well enough to buy their own safety shoes and, contrary to some reports, we are not trying to get them to wear shoes for the first time. The reason for this program is that it substantiates the fact that the company is interested in safety.

Still another important aspect of our safety program, and one upon which we place a high degree of importance, are vessel visits by our shore-based administrative staff. Here again our marine safety advisor and port staff play an important role, not only as inspectors and demonstrators of onboard safety equipment, but as an important link in the chain of communication between vessel and operating office.

To supplement visits to vessels by

shore staff, we have a system of fleet instructions that we term "Notice to Masters" that enables us to keep the fleet advised of recently developed operating requirements, change in existing guidelines, and general information. Within this system we include advice on safe operations and safety of personnel as well as matters of hygiene.

As a guide to inspecting personnel, we have developed a safety check-off list for inland tank vessels that covers safety items in three main categories: special safety equipment, operating equipment that has an indirect effect on safety, and vessel hygiene. This check list also serves as a guide for vessel personnel to conduct their own safety surveys; in other words, a self-policing aspect of our program. These onboard surveys are conducted on a monthly basis and the results kept on record in the operating office for back reference.

Summing up, we believe our prime asset in the field of marine safety lies with the quality, knowledge, and ability of the people that man our vessels. But at the same time we realize that training and retraining are of prime importance and that even then they can only work with the tools that we provide. We believe that we have the best, but constantly review new equipment and new ideas to ensure we stay on top of the situation.

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SAFETY IS YOUR EMPLOYEE: A PERSONNEL MANAGER'S APPROACH

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Safety is where it's at! Sounds good—but where is that? Safety is, of course, an excellent word. If we, or our companies, did not believe in it, none of us would be here now. It's popular enough—we see it hung on signs about the place and certainly read about it in many publications. We like to think that everyone is "gung-ho" on safety; after all, we talk about safety so much that some of it must rub off. We know that a safe place is not an accident, and that management always wants work to be performed efficiently—and safely.

But safety has to be more than just a word. It must be the spirit of the endeavor! So let's take that safety sign down from over the front door, or off the wall, or wherever it's hanging, and take a good look at it. Where does it fit best? How may it be used with effective results? How can we cease making it just a word or an idea and finally make it happen?

Safety is your employee. Safety is not a sign, a program, an idea, a boxscore, a slogan, or a poster. These things contribute to safety, of course, but they are not where safety is really at.

I think that we all sense this, but my premise here is that we have not effectively acted on this idea. To date, a tremendous amount of emphasis has been placed on the physical plant or working environment: the government has published safety regulations, vendors have designed and sold all sorts of safety equipment, non-skid paint has been liberally applied all over the place, fire extinguishers have been checked and filled, and much else has been done to provide a safe place. Again, these are important to safety and are effective to a

degree, but we all know that our employees can still find a way to hurt themselves in spite of our best efforts.

So let's here concentrate on the key thing that makes or breaks our safety record: our employee. Let's take him apart, examine the pieces, put him back together, and place him on our boat. Let's see what we can do to execute management's desire to have work performed efficiently—and safely.

The points I wish to develop here are derived from a realm of thought and research found in the field of organizational behavior. I will lightly touch on some theoretical points which have evolved from this field and which seem to be pertinent to our problems.

I start with some observations on the individual person rather than the organizational group (whether it be a boat or a company) for three reasons: first, the characteristics of people in general are a good base from which to build up the characteristics of people in our industry; second, we, unlike parents, must work with used, not new, human beings—other people or employers have gotten to them first; and, third, we may gain some insights on ourselves as to how we relate to our employees.

To begin, let's make some assumptions on how people are alike. If I were to ask what you consider to be the fundamental truths of human behavior, you may reply that all people want security, or that they are basically lazy, or they are products of their heredity. From these and other similar "basic truths" we may deduce three general assumptions concerning behavior:

1. Causality: behavior is caused.
2. Motivation: underlying behavior,

one finds a "push" or "motive" or "need" or "want."

3. Directedness: behavior is pointed toward something—goal directed.

These assumptions may give rise to a "cycle of behavior." In a negative sense, the cycle may work thusly:

1. Stimulus (cause): employee knows that he can collect a lot of money if he is hurt on a boat.
2. Motivation: employee wants money.
3. Behavior: employee slips and falls down towknee.
4. Goal: employee collects a large settlement.
5. Stimulus (cause): it worked so well with that company, employee learns he can do it again with another.
6. And so on . . .

Considerable efforts to date have been directed toward breaking that cycle, but only to the degree that one company's misfortune does not become another's. We still have two important questions which are unanswered: (1) is this cause—motivation—goal—cause cycle necessarily true of all people in all situations; and (2) how can we utilize our knowledge of this cycle to create "safe" employees?

While people are generally alike in that their behavior is cause-motivated and goal-directed, and their physical equipment is roughly similar, they are different as to what things in particular stimulate and motivate them, what their goals are, and their physical capabilities.

Let's here take a look at the variety of possible motives which we may relate to work. Why do we fight our way out of bed in the morning and drag ourselves into the office? Or, why does someone leave his home for long periods to work aboard a towboat? I suppose that any one of a number of reasons can be given for working—money, status, security, accomplishment, adventure, whatever. The list is quite extensive, but we can safely classify them into at least two major groups: physical needs, and psy-

chological needs.

The first class of needs (physical) are clearcut and universal, such as those of food, warmth, and basic security. The second class of needs (psychological), such as those of achievement, recognition, belonging, and status, are highly individualistic and certainly are more difficult with which to work. But, they are the ones that are very significant in our dealings with our employees.

One theory states that man's needs are structured in such a way that certain ones can take precedence over the others. This hierarchy of needs may be in the following ascending order: physical, social, egoistic and self-actualization. When the physical needs are satisfied, a person tends to seek a social position, belonging to or identifying with a group. When secure in a group, the person will tend to seek recognition or status within that group, his egoistic needs. Self-actualization, though rarely achieved, may be considered as a need to fulfill oneself in one's own way.

The significance of this hierarchy is at least two-fold: first, the lower needs take precedence over the person's current need level only if they are severely threatened (i.e., a starving man is worried about food, not about gaining status), and, second, in dealing with a person we should be aware of what level of need satisfaction seeking he is on. He may seek employment so as to get enough money to feed his family (physical needs). After the pay checks start coming in, however, he may then be worried about fitting in with the crew on this vessel or the neighbors at home (social needs). Once he becomes relatively secure in his social environment, he may wish to make a name for himself, such as in being promoted on up the ladder (egoistic needs). Then, perhaps, after he gains the status he seeks (e.g., captain), he may expand his needs to something like being the best pilot on the river (self-actualization needs).

But where does safety fit into this

scheme of things? I believe that it can be fitted in at all levels if we actively attempt to understand the level of needs that our employees are at and how this knowledge can be used effectively to make them safe. To the man whose needs are on the physical level, simply the incentive of retaining a job may influence his behavior. But the person who is physically secure usually requires satisfaction of his social needs, so we could attempt to make his social acceptance aboard a boat contingent upon safe work practices. Should the man gain this social acceptance, his next needs may involve those of status and recognition including, perhaps, promotion.

We have all hired at one time or another the man who wants nothing more than time and opportunity to get an injury. This is a problem of selection and screening, not safety, so I will disregard it here. However, the man who is sincerely seeking to satisfy his physical needs can be influenced by job security, if nothing else, and rewards or punishments slanted toward this fact can be effective.

The major key to the social-need level is the crew onboard the boat when the new employee arrives. Are safe work practices truly a part of social acceptance? If so, there is really no major problem. But if getting hurt is a socially acceptable practice on that boat or in that company, then the problem is significant.

The egoistic needs of those employees who seek recognition or promotion can be used to our advantage in two main ways: rewarding our safe employees with mementoes or special promotional considerations; and including the safety records or subordinates in our evaluation (and even compensation) of supervisory personnel.

Again, I say, we must fit our safety endeavors to the right need levels of our employees, or much will be wasted in time and resources. The safety record we want will simply not happen.

Up to now I have covered a lot of

theory, albeit in a superficial way. I cannot offer a canned solution to anyone's safety problems, but I have, hopefully, given out some food for thought in our attempts to effectively improve our safety records. Following are some key thoughts or ideas which may be useful to anyone's safety program:

1. Psychological Contract. Each employee, when he starts work, enters into some type of mental relation between himself and his employer. This may be very positive, such as great happiness for getting on with that line, or quite negative, such as dreading getting on those trashy boats. The employee's initial attitudes, while not cast in concrete, are difficult to change over time and certainly affect his safety performance.

2. Expectations. Part of each employee's psychological contract and subsequent work performance is significantly affected by what he expects to encounter on the boat. A "green" man (and some older experienced ones) may expect that employment consists of riding down the river drinking coffee and watching the scenery. If the company, however, expects its employees to work their tails off while on watch, the man expecting the easy ride receives quite a shock and, oftentimes, a short stint of employment. The same idea may be applied to safety. If the employee knows, either from knowledge of the company or through pre-employment orientation, that he is expected to be a safe worker, and the vessel crew he joins reinforces this expectation through its social acceptance criteria, there exists a good start on any safety program.

3. Reinforcement. Let's say that an employee has a positive psychological contract with a company, has the right expectations about the company's safety policies and work practices, and then indeed finds them to be true when he boards a boat. He will have then been hit for the first time with "reinforcement." We all know, however, that once is not enough in any good endeavor. This is

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also true with safety. We must hit this employee again and again throughout his employment. The techniques here mostly involve the "egoistic" level of needs; recognition, status, promotion, etc. Now safety is paying off, for the employer and employee.

I wish to summarize by trying a positive basic model of behavior:

1. Stimulus (cause): Company wants its employees to be efficient and safe.
2. Motivation: Employees want to be safe workers because they need the job (physical); want to be accepted (social); desire status and recognition (egoistic); and all of the above (success!).

tion (egoistic); and all of the above (success!).

3. Behavior: Employees practice good safe work practices.
 4. Goal: Employees keep their jobs, become accepted, and gain recognition and status (company gains enviable safety record).
 5. Stimulus (cause): Company wants to maintain its enviable safety record which it gained due to its efficient and safe employees.
 6. And so on . . .
- Sound simple? Of course, it's not, but it is attainable if we remember where safety is at: Safety is your employee.

TANKER AND TERMINAL SAFETY GUIDES

By RICHARD F. MURPHY

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The International Oil Tanker and Terminal Safety Guide, commonly referred to as IOTTSG, is more widely known and referenced throughout Europe and some parts of the Eastern world than it is in the United States. I believe there is much useful information in the guide that you would find helpful in your operations. There is a somewhat different approach to safe operations between shore facilities and tankers, which would be expected due to the inherent differences in the facilities and method of manning. Therefore, a guide was thought desirable to smooth out this interface area. I would like to give you a brief outline of the subject matter contained in this safety guide, but first it might be appropriate to give you some background on its development.

Representatives of international operators of oil terminals and tankers formed 10 years ago, in 1966, to develop a guide or set of recommendations for loading, discharging, and related operators of oil terminals and tankers intended to give guidance to both the operators of the terminals and the tankers in the safe handling of crude oil and petroleum products and to accustom the need for understanding and cooperation between terminals and tanker personnel in the mutual interests of safety and fire fighting. In addition to over two dozen individual companies, assistance in preparing the guide was also given by the American Petroleum Institute (API), International Chamber of Shipping (ICS), International Association of Classification Societies, and the Institute of Petroleum (London).

The recommendations in the safety guide are intentionally of a general

nature. It is hoped that they will provide a sound basis for operators of terminal and tanker facilities to prepare instructions and rules appropriate to their own particular operating conditions and be also within internationally accepted and compatible procedures. There may be circumstances which require further precautions in addition to those recommended in the guide as covered by local laws and regulations in force. At the same time, it is hoped that a set of guides accepted on an international basis would tend to discourage the establishment of overly restrictive local requirements that are inconsistent with world-wide practice.

In regard to the overall effectiveness of the guide, it is my opinion that the most significant contribution has been the acceptance of a ship/shore safety check list that has been adopted at some locations. It is a short list of items that are checked by both the shore and ship personnel after the ship has berthed but prior to landing or discharging operations.

The guide is presently being revised to include the information contained in the ICS Tanker Safety Guide, which is primarily concerned with the tanker operation. The thought was that a single combined document would be more useful than two separate guides that might have gaps or overlapping interface areas. At the same time, the guide is being updated to cover more recent developments in tanker inerting systems, static electricity, combination oil/bulk/ore vessels, and fire fighting, in addition to major revisions to most chapters.

OFFSHORE TANKER LIGHTERING SAFETY

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When we view the topic of tanker safety today, we must include consideration of tanker operation in a mode that is becoming prevalent, but is still somewhat unusual for the American experience. I refer to the operation of tankers in an off-shore ship-to-ship oil transfer evolution that has come to be known as "lightering." Tanker safety in a lightering operation must include the dimensions of personnel safety, material safety, and environmental safety.

It is a well known fact of life in the tanker business that the ships we operate are becoming larger and larger. About 15 years ago the size of these larger tankers started to exceed the capability of United States harbors and terminals. At that time, however, the amount of crude oil imported into the U.S. was relatively small and the economic penalty that resulted from our using smaller tankers that could be accommodated by U.S. oil terminals and harbors was not significant.

This picture began to change a few years ago when crude oil imports into the U.S. became an increasingly larger and larger portion of our total requirement. Rather than forego the lower transportation costs of the large tankers, even though U.S. harbors and unloading facilities remain inadequate, we bring the larger tankers as far as we can, into the Gulf of Mexico, and offload them into smaller tankers that can enter and unload the crude oil in U.S. harbors. In this way, the overall economical transportation cost is preserved to the maximum extent possible.

At the present time, regular lightering takes place in the Gulf of Mexico as a part of the transportation program of

four oil companies. In the short term there are no viable alternatives to this operation if we are to participate in the economically beneficial aspects of the large tanker transportation costs.

The lightering operation consists of the mooring, transfer of crude oil, and unmooring of two ocean going tankers. The larger tanker, a VLCC of 200,000 deadweight tons or more, having completed a 12,000 mile voyage from a crude producing location, offloads to a smaller tanker of about 50,000 to 70,000 deadweight tons. This tanker then completes the voyage of from 60 to 100 miles to the crude receiving terminal in a U.S. harbor.

This lightering operation should not be confused with ship-to-barge transfer, which has been going on for many years with the objective of lifting a ship to some inner harbor draft or of facilitating delivery of some special parcel of cargo. Such barging off is usually done in the shelter of a bay and ultimately the bigger ship completes offloading at a harbor berth. The safety aspects of such operations are well known and will not be covered in this paper.

The lightering procedures and techniques that are described in this paper were devised and developed so as to make the operation a safe one in all respects, safe for personnel, safe for material, and safe for the environment. These procedures have been employed by my company for almost three years in lightering more than 60 million barrels of crude oil from more than 40 VLCCs in the Gulf of Mexico. I would note, with some pride, that these operations have been conducted without serious incident. This record is in no small measure due to the

expertise of the people involved and to their total dedication to the safety of the operation.

At the outset, site selection for the lightering operation is a prime consideration that contributes directly to the safety of the operation. There are many factors that influence this selection, and judgment plays a significant part in this decision. The most significant of these considerations are: clear of shipping lanes, adequate water depth, adequate maneuvering room, good communications to shore, proximity to shore discharge terminals, and proximity to adequate logistic support base. Additionally, although most waters close to the U.S. are serviced by good weather forecasts, the availability of good long-range and short-range weather forecasts should not be overlooked.

The location that we have selected on the basis of the above considerations is 70 miles south of Sabine Pass in the Gulf of Mexico, in the center of a large, open area where water depths of 100 to 120 feet exist. The location is clear of the shipping lane approaches to Sabine, Port Arthur, Beaumont, Houston, and New Orleans. Shore discharge terminals are six to seven hours (running time) distance from the lightering locations, and logistic support is provided from Morgan City and Cameron, Louisiana, and Beaumont, Texas. We depend on single sideband voice communications with our Beaumont office, which serves as a communication relay point for all ship-to-shore requirements, and a company low frequency band network that is maintained for communication with our platforms in the Gulf.

Logistic support for the lightering operation and for the ships involved are closely intertwined and interdependent. It must be recognized that the VLCC's cannot come this close to land, after a long voyage, without requiring shore services related to bunkering, crew changes, provisioning, storing, and repairs. Support for the lightering operation itself includes the transport of lightering

supervisory and rigging personnel and the maintenance, repair, and transport of fendering systems, cargo transfer hoses, and pollution control systems.

To provide the logistic support to the ships and to the lightering operations, we use two main avenues. A work boat carries the fender system, pollution control equipment, cargo hoses, and rigging personnel. Additionally, this same work boat is used, as available, for the transport of provisions, stores, repair equipment, and lightering supervisory personnel. The work boat also stands by the operation in progress as a service boat and as a pollution control boat. Since the offtake tankers, in the process of cargo delivery to shore, are making frequent transits between the terminals and the VLCC, these offtake vessels are also used for bunker delivery to the VLCC and for personnel and equipment transport.

It should also be noted that the presence of logistic support bases for offshore drilling and producing platforms, as well as the refining and terminal facilities in the Gulf area, add a significant dimension to our ability to react to unforeseen emergencies at this particular lightering location.

As indicated above, our extended period of safe operation is due in large measure to the people involved. I would add that our organization for the operation consists of a lightering superintendent, who is an experienced ship master with extensive experience in ship handling, operation, and cargo transfer. He is in overall charge of the operation at the scene. The masters of both the VLCC and the offtake tanker, although never relieved of their command, are directed to respond to his orders and advice in regard to mooring of the ship and in regard to the cargo transfer itself. The lightering superintendent's responsibilities include the scheduling of the offtake events and the revision of these schedules to optimize the safe conduct of the operation, particularly as it relates to weather and the cargo/ballast condition

of both tankers. He is also responsible for communications with shore and for the upkeep and maintenance of the special lightering equipment, such as the fendering system and pollution control equipment, and dispatches the work boat. The lightering superintendent is assisted by a cargo officer who, being particularly experienced in cargo transfers, supervises this phase of the operation.

By placing the responsibility for the safe conduct of the entire operation on one officer, recognized by the masters of both tankers, we have successfully avoided any confusion, misunderstanding, or conflict that might arise between the two masters. We believe that this organizational arrangement contributes significantly to the safety of the entire operation.

The lightering operation, itself, given the preparation and preplanning that have gone into the arrangement, is not a complicated operation and in the normal course of the evolution each event is carried out quietly, efficiently, and without confusion. Behind the scene, however, judgments and decisions are being made by the lightering superintendent so as to assure the eventual safe departure of both vessels. To provide some insight to the lightering operation, I will describe the events and some of the considerations and decisions that contribute to the safe conduct of these events.

Days before the VLCC arrives at the lightering position we are in communication with the master to confirm his arrival schedule and his service requirements and to assure his knowledge of the exact location and the events to take place upon his arrival.

At Morgan City or Cameron, the work boat and the crew are readied to meet the VLCC at the lightering position with the fenders, cargo hoses, the emergency pollution control equipment, riggers for assisting in hose hookup, and any urgently required stores and provisions.

The lightering superintendent verifies the schedules of the one or more offtake tankers and confers with these masters so that they clearly understand what will be expected of them. It is worth noting that we have found it desirable to dedicate these offtake tankers to this work as much as practicable so that the crews of these ships are quite experienced in the procedures and special requirements.

The lightering superintendent keeps a constant watch on the weather through the National Weather Service reports and by communication with the ships involved. He is always prepared to reschedule the offtake on an hour-to-hour or day-to-day basis in the event of a less than favorable weather condition.

At an appropriate time, the work boat is dispatched to the lightering position with the lightering superintendent aboard to rendezvous with the VLCC.

The first project is to transfer two strings of cargo hose to the VLCC and place and secure the fendering system alongside the VLCC. The fendering system consist of four large Yokohama fenders secured in the middle body of the VLCC and one small Yokohama fender secured at the bow of the VLCC. They are floated into place and secured to the VLCC. The additional riggers, from the work boat, assist in this work. The offtake tanker carries one small Yokohama fender secured at her stern.

The offtake tanker has by now arrived in the vicinity, and the lightering superintendent boards the tanker from the work boat. On the bridge of the offtake tanker he then, observing wind and sea conditions and the ballast condition of the ship, as well as the load condition of the VLCC, selects an optimum course for mooring the tankers. This judgment must include the observed manner that the VLCC and the offtake tanker are riding in the seaway and wind, and at times requires changes in the ballast condition of the offtake tanker to cause it to ride better in the seaway. If satisfactory conditions cannot be obtained, the

mooring is rescheduled. Normally a course into the swell serves best. At times, however, putting the VLCC beam to the swell so as to create a lee for the offtake tanker approach provides optimum conditions. There is no way of prejudging these decisions and they must be made on the scene by an experienced officer.

With the course selected, the fenders in place, the work boat standing off at a safe distance, and the lightering superintendent on the offtake tanker bridge in communication with the VLCC master by walkie-talkie radio, the mooring approach is started. The VLCC maintains way at about three knots, usually with the wind and sea slightly on the port bow. The offtake tanker, abeam on a slightly converging course, also maintains way at about three knots. With both ships underway, and with direct bridge-to-bridge communication, the approach can be precisely controlled. The open water between the ships acts as an additional buffer and as the offtake tanker is pressed to the VLCC, first contact is made deliberately with one of the forward fenders. Heaving lines and mooring lines are passed and the offtake tanker is brought parallel and alongside the VLCC in contact with the fenders fore and aft. At this point both vessels are still underway at about three knots.

Of course, the longitudinal positions of the two ships has been pre-selected so as to minimize the possibilities of the superstructures making contact with each other.

When the mooring lines are reasonably secured and with the aid of bridge-to-bridge communications, both ships are slowed until both are dead in the water. This process is one that requires care and vigilance so as not to overstress the mooring lines. Experience has taught us that long leads for the synthetic mooring lines assist greatly in maintaining the integrity of the mooring during the slowdown evolution.

With the tankers now alongside and dead in the water, the VLCC anchors by

walking out the ten-ton anchor about ten fathoms before letting go. This technique is a well known precaution for anchoring in deep water.

The mooring lines are now secured and decisions are made relative to cargo transfer and ballast. The offtake tanker usually comes alongside the VLCC with some ballast, the amount judged at the time to provide optimum riding characteristics relative to the VLCC. Now that judgment can be refined, and as cargo is taken aboard the ballast is adjusted by transferring it to the VLCC, retaining only enough so that with the cargo taken aboard, the offtake tanker continues to ride easily alongside the VLCC.

It should be noted that at no time is a signal "finished with engines" given on either ship. The engineering watch and the bridge watch is maintained on both ships throughout the lightering and cargo transfer operation so as to permit rapid response to any unexpected difficulties that might warrant taking the ships apart.

A safe gangway is rigged between the two tankers and hoses are put into place and connected up by the riggers from the work boat, assisted by the hose handling booms of the VLCC. The cargo transfer hoses are usually brought from the VLCC to the offtake tanker. Care is taken to secure and suspend the hose strings so that the relative motion between the two ships will not stress the hose strings.

These cargo hoses are subject to periodic pressure testing for tightness and inspection as is required for hoses used in ship-to-shore cargo transfer. The work boat carries one string of the ten-inch hoses as a spare.

Cargo discharge rates from the VLCC are determined by the safe fluid velocities for the hoses in use and the receiving capabilities of the offtake tanker. Usually no more than two hose strings are connected, and only two of the VLCC's four cargo pumps, operated at reduced speed, are used for cargo

transfer.

The VLCC cargo tanks are inerted with cooled, scrubbed flue gas, and as the cargo is discharged an adequate supply of inert gas must go into the tanks to maintain the inert atmosphere. The use of two cargo pumps helps to maintain a boiler firing rate that will provide the adequate supply of inert flue gas.

The VLCC has a capability of pumping at 15,000 to 20,000 tons per hour when hooked up to adequate shore receiving facilities. However, in the lightering operation, to maintain precise control of the operation and the cargo/ballast condition of the offtake tanker, cargo transfer rates are purposely limited to something less than 5,000 tons per hour. Of course, walkie-talkie communication is constantly maintained between the cargo officers of the VLCC and the offtake tanker so as to insure the capability of instantaneous cargo transfer shutdown. It is expected that the ships will remain alongside for about 14 hours.

Although we hope that it will never be needed, practice has indicated that cargo transfer can be shut down in 15 seconds and that the ships can be disengaged, unmoored, and steaming independently in 20 minutes.

The whole lightering operation is weather dependent. Recognizing that the ships are in the open sea, subject to wind, sea, and current conditions, because of their different sizes, the VLCC and the offtake tanker can be expected to react differently to all of these varying conditions and forces. Throughout the lightering operation the bridge watch of both ships and the lightering superintendent are constantly alert to changes in weather and forecast changes in the weather reports so that there are no surprises from that quarter. It helps if ships engaged in these operations are fitted with more than the usual weather indicating equipment and ability to receive weather forecast information. Some of our vessels are fitted with facsimile recorders which give visual indication of

the area's pressure system.

As indicated before, logistics support for the VLCC itself is an integral part of the lightering operation. As time permits, with the tankers securely moored, the various activities concerned with this support are carried out. With the assistance of the hose booms, the stores boom, and the gangway, personnel, stores, provisions, and repair equipment are transferred to the VLCC. For these events paramount concern evolves from the problem of handling weights when there is relative motion between the two ships. Care must be taken to insure that these dynamic effects do not overstress the booms and tackle and that the load remains under control through the use of tending lines and good winch operation. Experience has taught us that containers not only preserve the material while being transported to the VLCC by the work boat or the offtake tanker but also facilitate the transfer of the material to the VLCC, as long as the container is not too large or too heavy. We have found that two metal containers of eight feet cube serves us well. One container is insulated to preserve frozen provisions when packed with dry ice.

As for the environment, primary effort is directed to prevent any discharge of oil into the sea. These precautions are an integral part of the whole lightering operation from the mooring, fendering, cargo transfer rates, and communications. It should be noted that the offtake tanker ballast, which is normally dirty ballast, is transferred to the VLCC and serves as the VLCC ballast upon its departure. As indicated before, the work boat carries pollution control equipment and acts as a pollution control vehicle.

Primary reliance is placed on oil boom containment and on our ability to call on the extensive oil industry resources in the Gulf area. Additionally, absorbent material is carried for small clean-up jobs, and low toxicity dispersant material is carried for use in the open sea when a high degree of dilution can be assured.

Our three years of incident-free operation in the Gulf of Mexico is reasonable evidence of the adequacy of these measures, and our ability to call on the extensive pollution control resources in the Gulf area contributes to our confidence that unusual problems can be handled adequately.

When the cargo transfer is completed the cargo hoses are disconnected, drained of oil, and returned to the VLCC. The ships are then ready to disengage. This process is simpler than the mooring evolution. When the mooring lines are let go, with the VLCC remaining at anchor, the offtake tanker drifts away from the VLCC by the natural forces of the wind and sea. Having drifted to a safe distance the offtake tanker gets underway for her discharge terminal ashore without the need of any unusual maneuvers.

The VLCC retains the fendering system secured alongside and usually remains at anchor until the next offtake tanker arrives, at which time the anchor is raised and a second lightering operation starts.

The VLCC carries cargoes of more

than 200,000 tons of oil and the offtake tanker's capacity is limited to about 50,000 tons at drafts that will permit entry into the harbor terminals. It therefore requires up to 10 days and from five to six offtake evolutions to completely unload the VLCC.

This paper has followed through the events of a VLCC lightering and provides some insight into the considerations, decisions, and judgments that contribute to the safe conduct of the operation.

Planning and site selection certainly contribute to the very good safety record that has been attained to date. The uncontrollable factors of wind, sea, and weather can be mitigated by good judgment to reschedule and the ability to break off and disengage the ships safely on short notice. With an experienced officer in overall charge taking the precautions that have been planned and developed for this operation and exercising good judgment, lightering of a VLCC at sea can be a safe and efficient operation which contributes significant economic benefits to meeting our energy needs.

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SAFETY FROM A NAVAL ARCHITECT'S VIEWPOINT

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The naval architect begins the design of a new vessel with the sole purpose in mind of producing a ship which will perform its required mission in the most efficient and safest manner possible. The ship must be laid out so space available for cargo, machinery, and quarters provides for efficient and safe cargo stowage, machinery arrangement, and quarters arrangement. These spaces must also be arranged so that sufficient strength is available in the steel hull girder so that the vessel can withstand safely waves and seas that the vessel will encounter over its trade route and also be strong enough to carry its cargo distributed in the cargo hold. The spaces must be arranged so that the center of gravity of the vessel loaded with fuel, cargo and/or ballast will float on the required waterline or draft and will have sufficient stability so that when the vessel rolls she will safely return to an upright condition. For crew safety, the ship should not have too much stability, since excessive stability produces a fast, snappy roll with high velocities and accelerations which strain gear and make people hang on or be snapped out of the sack.

The naval architect designs the vessel to safely operate under anticipated loading and sea conditions, but this information must also be transmitted to the crew of the vessel so they can operate the vessel safely. The advent of modern technology has enabled the naval architect to design a vessel with much more knowledge of the loads to be imposed upon a vessel, but this ability has also required that accurate loading information be available to the operators of the vessel. Today, we do this through the

use of small on-board computers which enable the operators to check beforehand how loading or ballasting will affect the strength of the vessel or its stability. These computers also allow the operator (crew) to check the variations of ballast or cargo and fuel while underway to maintain a safe condition of strength and stability during the trip.

Over the years, the classification societies (American Bureau of Shipping, Lloyd's) and regulatory bodies (U.S. Coast Guard) have established minimum standards and requirements of strength and stability for the guidance of the naval architect and the vessel operator.

Arrangement of spaces on a vessel is effected by watertight sub-divisions. If a vessel is damaged by collision or grounding, it should survive at least long enough to allow the crew on board to safely evacuate the vessel. Watertight sub-division and placement of watertight bulkheads today is also influenced by pollution. Recent designs of ships have avoided fuel bunkers common with the side or bottom of a ship, which allow the fuel to be freed in the case of bottom or side damage.

Once a vessel's arrangement of cargo, machinery, and accommodation spaces are made, then considerations are made of the safety of operations as influenced by maneuverability, handling, steering, docking, and mooring access such as boarding.

Maneuverability in close quarters is extremely important from the standpoint of safety. If a vessel requires tugs to maneuver in close quarters, each tug in assistance increases the probability of an accident. Over the past 20 years, almost all vessels on the U.S. Great

Lakes have been provided with bow thrusters and, more recently, stern thrusters to enhance the maneuverability of the vessels in close quarters. The bow thrusters in most cases have minimized the need for tugs. One 1,000-foot vessel on the Great Lakes which has both bow and stern thrusters is able to back into its principal harbor a distance of several miles with no outside tug assistance.

Safety in underway maneuverability involves a rudder of sufficient size and rate of turning to cause the vessel to turn out of danger if necessary. From this standpoint, newer Great Lakes vessels have used a steering which will turn the rudder twice as fast as those steering gears on ocean vessels; concurrently, the rudders on Great Lakes vessels are larger than those on comparably sized ocean vessels. Maneuverability during open water steady running or turning is a simple situation and presents few problems to the naval architect. It presents more problems to the operator, as evidenced by some spectacular collisions resulting from insufficient observation of vessels on converging oceans. These situations have resulted in the development of a new family of collision-avoidance electronic hardware.

A more difficult area of maneuverability which we on the Great Lakes are more concerned with is the area of interaction between vessels passing in close proximity of each other and the effect of narrow and shallow channels.

A vessel proceeding through the water creates a bow and stern wave and associated pressure increases at the bow and stern. Along the mid-body, there is a corresponding decrease in pressure (a so-called suction). This is a natural balance for the hydrodynamic condition of a ship being propelled through an incompressible media such as water. The important characteristic is vitally important in that it transmits forces in all directions in a relatively undiminished manner within the pressure field. The velocity of the surface waves (wave

trains) is a function of the depth of the water and channel cross-sectional properties with respect to bed clearance. The wave system, consisting of transverse and diverging waves as in deep water, advances with the velocity of the pressure point at the bow. As the velocity (ship's speed) increases, the pattern of the waves changes, and when velocity approaches a critical speed, the pressure point at the bow is generating a disturbance which is traveling at the same speed as the ship. All of the wave making energy is now concentrated in a single solitary transverse wave crest through this point and is almost at right angles to the direction of motion. This wave is called the "wave of translation," and the speed at which the ship and wave are moving is called the "critical speed" at that particular water depth. The resistance bow and stern pressures at this speed, as well as the decreased pressures along the hull, are appreciably increased.

This must be viewed as three-dimensional flow around and radiating downwards and away from the underwater hull form. The only visible sign of its presence at deep sea conditions is the local pressure rise in the bow, building a wave which is followed by a train of transverse and diverging waves along the hull and a stern wave. The distances between the crests and the heights of the waves are a function of the length and speed of the ship.

If the water is shallow, the three-dimensional flow is disturbed, and a blocking effect of the under-hull flow to the aft section occurs, creating separation, eddying, diminished effectiveness of the rudder, bodily sinkage of the ship and trim by the stern (squat).

If the waterway is both shallow and restricted, the flow of water around the underwater vessel hull is more radically altered than even that of shallow water of unrestricted width.

For example, if a ship was moving in a waterway with her own longitudinal axis parallel to the bank on the starboard side she would first encounter a lateral force

towards the bank when that decreased pressure area (suction) came into contact with the bank. Some yaw may be experienced, depending on where the field of influence (suction area) first comes in effective contact with the bank or channel boundaries. If this vessel is turning, the increased pressure areas of the bow and stern coming in close proximity to a pier or shoreline mass will impart yaw (deflection off the desired course).

Sloping bottoms, banks, and asymmetrical properties of most rivers and channels deflect the pressure boundaries back into the vessel hull, creating unequal yaw forces.

When two ships pass each other at a relatively close distance, each vessel exerts its hydrodynamic influence on the other in a complex relationship to its particular displacement, speed and length, and draft. These forces interact with the specific channel cross-sectional geometry, which is continually changing. The rapid pressure changes which occur as one ship passes the other imply forces and turning moments (yaw) of immense magnitudes.

In a study in 1957 done for replenishment at sea, which involves two vessels at the same speed in unrestricted waters, Dr. B. L. Silverstein, in *Linearized Theory of the Interacting of Ships*, developed equations for lateral force and yawing moments due to the interaction of two vessels in an ideal fluid. A portion of his summary of conclusions is of importance to note: "The interaction of the surface waves created by the two ships governs the behavior and magnitude of the lateral force and yawing moment. This force and moment vary as inversely as the lateral separation of the ships for large lateral separation. For large longitudinal and lateral separations of the ships, the force and moment vary inversely as the square root of the longitudinal separation . . ."

One of the important assumptions was that the speed be kept constant. It is noteworthy that at one discussion apart from the paper, it was stated that

replenishment-at-sea operations were avoided in areas where the effect of shallow water was possible.

Two models were run in the testing basin to physically obtain some values and relationships for the forces involved in one large Vessel A, of 740 feet overall and 36,890 tons displacement, overtaking a smaller Vessel B, of 567 feet overall and 23,570 tons displacement. The ships were initially repelled as A comes within 100-150 feet of B's stern quarter. The force of repulsion was present until it was reducing to zero when the bow of A was abreast of midships of B. The vessels were then attracted, the (suction) force becoming a maximum soon after the ships were abreast, then reducing and becoming a repulsion force as the stern of A passed the bow of B at a longitudinal separation of approximately 350 feet.

A summary of results showed that:

1. The magnitude forces (of both repulsion and attraction) vary approximately as the square of the ship speed and inversely as the longitudinal separation.

2. Both ships were subject to "yawing" when approaching and also breaking away.

3. To counteract the forces (suction and repulsion) the vessel had to use its rudder and also run generally at a slight angle of yaw.

4. Propeller action (the models were run with and without propellers running) was found to be of small influence.

After this discussion of the technical aspects of the safety of maneuverability and the unseen forces which can operate on a vessel to change its course, let's look at some legal consequences of what might be considered unsafe maneuverability characteristics from the operator's or naval architect's view.

The master must be aware at all times of his own vessel's suction with regard to shore and property damage, suction while passing other vessels, and bank suction effects. This, of course, is not a new concept. As early as 1898, Judge

Turton, in the case of the *Ohio*, 11 Fed. 547 (6th Cir. 1898) stated: "That 'suction' is a force to be reckoned with and guarded against when vessels pass in too close proximity is a fact which cannot be denied upon the evidence found in this record. To this force has been attributed many marine disasters: *The Minnie*, 31 Fed. 201; *The City of Brockton*, 37 Fed. 897 . . . The extent to which this force may be exerted depends primarily upon the proximity of the passing vessels, and secondarily upon their relative speed and size and character of the channel or water in which they pass."

The overtaking vessel must use particular caution to see that her suction does not adversely affect the overtaken vessel. This is amplified in the quoted case where two lake vessels, the steamers *Siberia* and *Mather* were proceeding down the St. Mary's River. The *Mather* was overtaking the *Siberia* on the *Siberia*'s starboard side. The *Mather* (the overtaking and burdened vessel) was proceeding at a speed of about 10 miles per hour, and the *Siberia* (the overtaken and privileged vessel) at a speed of about nine miles per hour. The steamer *Ohio* was upbound in the St. Mary's River and going to meet and pass both downbound vessels. When the *Siberia* was from 800 to 1,000 feet from the *Ohio*, she suddenly sheered to her port and struck the *Ohio*.

The evidence showed that when the *Siberia* sheered there was a distance of about 40 to 75 feet between the *Siberia* and the overtaking *Mather*. The court said: "The stern of the *Siberia* seems to have drawn towards the *Mather*. This necessarily threw her stern to starboard and the swing to port began, which resulted in her collision with the *Ohio*."

The case resulted in the *Mather* being found at fault for passing in such close proximity to the *Siberia* as to interfere with her navigation. The *Siberia* was also held at fault, on the grounds that the *Siberia*'s helm at the time of the sheer was not at once put hand right, and hence the sheer was not broken as quickly as it might otherwise have been.

There is also the responsibility upon the overtaking vessel to properly signal the privileged vessel of his intention to pass. Common practice on the Great Lakes is also to discuss the intended pass by radiotelephone with the other master. The obligation is clearly shown below. A vessel which fails to give required whistle signals is guilty of a statutory fault which places a greater burden of proof upon her. As stated in *Garland Steamship Company v. Great Lakes D.&D. Co.* 165 F. Supp. 769 (DCND Ohio ED 1958): "The rule clearly gives the vessel ahead the right to determine whether an overtaking vessel shall pass; and the overtaking vessel must keep out of the way. This would be more especially forceful of application where no signals were given or exchanged."

In the above case, a tug attempted to overtake a large lake vessel in the Cuyahoga River (Cleveland, Ohio), and no whistle signals were exchanged. The tug, coming abreast of the steamer's stern, got out of control due to the steamer's propeller wash, struck some piping along the edge of the channel, bounced off, and sheered into the starboard side of the steamer.

The court held the tug solely at fault for attempting to pass the steamer where she did without signal, holding that such action on the part of the tug constituted unsafe navigation.

In the *Fontana*, 119 Fed. 853 (6th Cir. 1903), the steamer *Interocean*, while overtaking the barge *Santiago* on the latter's port side, caused the *Santiago* to sheer to starboard and come into collision with another vessel proceeding in the opposite direction. In that case the Court said: "It was the duty of *Interocean*, if she came up abreast or passed or attempted to pass, to keep at a distance which would allow a safe margin against every reasonable anticipation of danger of suction or other danger due to or increased by proximity to the *Santiago*."

The court further said: "But when the *Santiago* has shown that her sheer was caused by the influence of *Interocean*'s

suction, and that she was not in fault for coming within the sphere of that influence or in respect to her management after the sheer commenced, she has shown that she was the blameless instrument of a collision for which the *Inter-ocean* is responsible." The *Inter-ocean* was held solely at fault.

In a review of responsibility, the privileged vessel must: determine if burdened vessel may pass; maintain course and speed; take immediate action if suction effect deviates course, (i.e., hard-over helm). The burdened vessel must: notify the other vessel by radiotelephone of his intent; signal that he is commencing the intended maneuver; keep at a safe distance away in order to avoid suction or any other effect due to close proximity of his vessel; be aware of effect on other vessels in the area.

Both vessels must constantly be aware of the influence of any oncoming traffic, shallow water effects (bed clearance) to speed or ability to steer, changes in the bank contour and its effects, and suction that would also deviate the vessel from its intended course.

Safety during movement and traveling is, unfortunately, not the only thing the naval architect has to consider. Economically, a vessel has to be moving to make revenue and a profit, but in its 50 trips per year a new large vessel on the Great Lakes must approach the dock for loading, unloading, and locking for a total of 200 dock contacts during a season. This means moving an 80,000-ton vessel to a standstill without rubber fenders and not doing damage to the dock or vessel. The main requirement for safe operation is gentleness. Any magnitude of speed in association with the weight of the vessel can do large amounts of damage to both the vessel and dock.

Years ago, we reached the maximum size of wire mooring line that a man can handle, so increasing mooring wire size is no longer possible. The trend on the newer vessels is to provide better control

of the sideways movement of the vessel by use of bow and/or stern thrusters to ease the vessel sideways and alongside a dock safely. These thrusters give an infinite amount of force control, so the gentleness criterion is upheld. The thrusters provide a force at 90° to the centerline and move the vessel sideways. In conjunction with the thrusters, we are using controllable pitch propellers which allow for infinite variations of force ahead or astern, again aiding the gentleness criterion.

Once we have a new larger vessel docked we have another group of safety problems. These new vessels are physically larger, with greater distances from deck to dock. Instead of 15 to 20 feet, the deck-to-dock distance is now 30 feet, and climbing a 40-foot rung ladder which is almost vertical would scare anyone. On the newer vessels, we have begun to provide an accommodation ladder which can be sloped to 45° and run along the side of the vessel. This has been a simple change but should greatly improve safety.

With the advent of larger vessels with their required larger horsepower, a new safety problem has developed. This is the area of structural and mechanical vibration and the effect on the crew's tolerance and fatigue. It has been determined that excessive amplitudes of higher frequency vibration of a deck or bed can adversely affect crew performance. Now, when the naval architect is faced with a new design, vibration must be considered in design, and when vibration is a problem in a ship it must be investigated and eliminated. So far we have been able to correct or anticipate vibration in our designs, but if we had to do very large horsepower, high speed vessels on the Great Lakes, vibration problems could be monumental, with resulting problems in crew morale, comfort and, as a result, safety. So far, on the Lakes the correction of vibration required only a simple change of flow into the propeller in most cases, and in one case a two or three rpm change of the

propeller stopped a problem.

In conclusion, the naval architect is deeply concerned with safety in the design of a vessel, and he has many technical phenomena which affect a ship, but for successful operation of a vessel, certain phases of the naval architect's reasoning and technical thought must be made available to the operator (crew) of

the vessel through trials or instructions. Written instructions are too often difficult to understand and are tossed into drawers unread. Seminars and question-and-answer sessions could be more productive. The naval architect's concern of safety does no good if confined to the drawing office.

HUMAN ERROR IN MERCHANT MARINE SAFETY

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The first in a series of studies that were completed by the Maritime Transportation Research Board was entitled "A Study of United States Merchant Marine Safety Regulatory System" and was completed and published in 1970. The second was a study entitled "Merchant Marine Casualty Data," which was published in 1973. The latest effort has just been released by the National Academy of Sciences and is entitled "Human Error in Merchant Marine Safety." The findings of this study recently appeared in the *Journal of Commerce*, September 23rd, 1976, which some of you may have read. I will concentrate on the findings of this study in my comments.

To bring the study on human error into proper perspective, it is necessary to deal briefly with the problem. Since the early 1970's, *Lloyd's Register of Shipping* statistical tables have shown rather consistently that ships of the world's merchant marine are being lost through casualties at the rate of a ship a day. In 1973, the *Register* reported that some 363 vessels of 100 gross tons and over were completely lost through casualties.

The United States has contributed to this problem, as confirmed by both *Lloyd's* and U.S. Coast Guard statistics. In 1973 *Lloyd's Register of Shipping* reported that 21 of the 363 vessels reported lost were of U.S. flag. U.S. Coast Guard statistics for that period are not directly comparable, since their's are maintained on a fiscal basis. However, U.S. Coast Guard statistics for fiscal year 1973 show that 19 U.S. flag vessels in the "inspected" category were lost to casualties. For fiscal year 1974, the Coast Guard reported the loss of 54 U.S.

flag vessels. In addition, in fiscal 1974 the U.S. Coast Guard reported 199 deaths and 3,388 merchant marine casualties involving 5,413 vessels under its jurisdiction.

The current cost of merchant marine casualties, excluding human lives lost, has been estimated at \$300 million per year for the U.S. ocean going merchant marine alone. It has been estimated that the loss of a VLCC off the coast of the United States could cost in the order of \$100 million in terms of the value of the hull and cargo alone. This excludes environmental damage, which is almost impossible to estimate. These costs, however, are insignificant when compared with the potential destruction that the merchant marine casualty can cause. The classic example, of course, is the collision of the merchant ships *Eno* and *Mont Blanc* in Halifax Harbor in December 1917. These two vessels exploded and eventually claimed the lives of 1,600 people, completely devastating the city of Halifax. By comparison, the San Francisco earthquake claimed only 452 lives.

The prospects for safe merchant marine operations in the future are not promising. Trend-line projections show that 75,000 merchant vessels, totaling over 400 million gross tons, may be plying the world's trade routes by 1980. If current tonnage loss ratios are maintained, some 1,400,000 gross tons of shipping may be lost in 1980. Perhaps even more disturbing is the fact that vessels involved in hazardous cargo carriage—tankers, chemical carriers, liquefied natural gas carriers, etc.—represent the fastest growing segment of the world's merchant marine. At the

same time, some of the merchant fleets that are growing the most rapidly are those with the least regulation and the poorest safety performance.

Contrary to public opinion, the United States is not a leader in the safe operation of its merchant vessels. The National Academy of Sciences' Merchant Marine Safety Study, published in 1970, found that the United States ranked eighth in safety performance in terms of tonnage lost through casualties as a percentage of active tonnage. Although no new studies of this type have been done since 1970, a cursory inspection of Lloyd's statistical tables shows that this pattern has not changed significantly.

Merchant marine casualties can result from a number of factors, including a series of combination of events and circumstances. In most cases, human error or personnel fault is a contributing, if not fundamental, causal factor. According to *Lloyd's Register*, the greatest number of vessel casualties can be traced to groundings, collisions, fires, and foundering, all of which invariably involve human judgments. The chairman of the American Hull Insurance Syndicate revealed in 1972 that 85 per cent of his claims payments were for human error-caused casualties. U.S. Coast Guard figures for fiscal year 1974 showed that only 15 per cent of the vessels involved in casualties cited material or mechanical failures as the primary cause. These and other data point to the overriding importance of human performance in the operation of our merchant fleet.

This was the problem that was presented to the Maritime Transportation Research Board. Accordingly, the Board formed a panel, which eventually published the study on Human Error in Merchant Marine Safety. The panel undertook its responsibilities in a systematic manner designed to develop conclusions and recommendations. During its early deliberations, the panel concluded that it would have to develop its

own data base in order to come to grips with the basic causes of human error in merchant marine casualties. Although the U.S. Coast Guard and National Safety Board records on major merchant marine casualties were comprehensive and well documented, the panel felt that they represented legal truth rather than technical truth. What this means is that because of legal safeguards for personal rights during hearings and court cases, sometimes the real or underlying causes of a casualty are not determined. The panel was convinced that full disclosure concerning casualties was not always possible in a judicial or regulatory form. As a result, the panel asked the Maritime Administration to conduct an in-depth survey of merchant marine personnel in order to determine the underlying causes of merchant marine human error casualties. This survey was undertaken by the National Maritime Research Center (NMRC) and completed and released to the panel in July 1975.

The survey conducted by the NMRC employed questionnaires and in-depth interviews with merchant marine operating personnel. Approximately 1,500 questionnaires were distributed throughout the U.S. merchant marine; 359 individuals responded for a return rate of 25.6 per cent. The analysis of the in-depth interviews and the questionnaires provided both quantitative and qualitative inputs to the panel. The qualitative element consisted of interviews and written responses to questions concerning dangerous conditions in the U.S. merchant marine.

The NMRC survey findings tend to group causes of human error in roughly two dozen major categories. The most significant of these categories, in terms of officer training and licensing requirements, were physical fitness, emotional stability, alcohol use, fatigue, personnel turnover, and operational discipline. For each of these categories, I will present samples of both quantitative and qualitative responses from the in-

depth survey. First of all, I think it is important to know who answered these questions: 10 per cent were pilots, 20 per cent were masters, 38 per cent deck officers, eight per cent chief engineers, nine per cent engineering officers, 10 per cent tug and harbor craft operators, and five per cent were in other categories.

Physical Fitness

The questionnaire and interview responses to the issue of physical fitness aboard ship were quite revealing. When asked if they had ever been in a casualty or near casualty situation where a sudden illness, heart attack, fainting, stroke, dizziness, etc., of someone aboard was a major causal factor, 15 per cent of those responding to the question answered "yes." When asked if impaired eyesight of someone on the bridge had been related to an emergency condition, 23 per cent of those responding to the question answered "yes." Of those responding to the question of eyesight, 33 per cent identified the pilot and 25 per cent identified the master as the individual experiencing the impaired eyesight. When asked whether height or weight of a man had been a factor in an emergency situation, 14 per cent of those responding to the question answered "yes."

The qualitative responses concerning physical fitness were also very revealing. In one interview, a master stated that his current second and third mates were 65 and 73 years old, respectively. He was concerned about their abilities to climb ladders, inspect hatches, and adequately perform other necessary functions. The following are samples of quotations from the questionnaires:

1. A chief engineer stated: "Another guy would fail to call us when he got in trouble, then he couldn't stay down there to sort things out. He would begin to throw up. After a while, I made him carry a bucket."
2. A deck officer recalled: "An AB was sent aloft. It was unknown that he was an epileptic and had run out of pills."

None of this was known until the incident occurred. Such a thing should be noted on a man's Z-card. It could have happened on the wheel in confined waters."

3. Another instance: "The captain had a heart attack near Hell's Gate. The mate took over. The captain was 70 years old."

4. One pilot admitted: "I dropped my glasses and couldn't read the compass for the whole voyage."

5. A deck officer stated: "The master was virtually blind and refused to recognize such. He failed to recognize a radar interpretation, creating a near casualty."

6. A master revealed: "Overweight prevented a man from proper watch standing. He fainted if he stood on his feet for more than half an hour."

7. A chief engineer noted: "A man on watch could not change the atomizers because he was too old and fat to reach the work area."

The advancing age of merchant marine personnel is becoming a problem. For instance, the median age for licensed deck officers has advanced steadily in the past ten years and is now 48.5 years of age. The median age for licensed engine officers is 48.7 years of age. This means that one-half of the deck officers in the U.S. merchant marine are over 48.5 years of age, and one-half of the licensed engineering officers are over 48.7. Many of these men are ranging into age 70. By contrast, the median age of an airline pilot in the United States is 39.

Life at sea can be very demanding and, on occasion, require the highest level of physical and mental fitness. In the absence of required physical examinations, it is not clear that men in the upper age categories can always meet these demanding requirements.

Emotional Stability

Closely associated with physical fitness is emotional stability. When asked whether emotional stability of anyone aboard ship had ever been a con-

tributing factor to a casualty or near casualty, 27 per cent of those responding to the question answered "yes." In the qualitative responses, numerous examples were given:

1. A master recalled: "His second officer was changing courses and plotting false positions with no apparent reasons."

2. A deck officer noted: "Two men cut three fire hoses into pieces and threw them overboard . . . locked in ship's hospital . . . endangered ship and lives."

3. Another master revealed: "Emotionally unfit engineer stopped ship without orders while in dense coastal traffic."

Alcohol Use

The use of alcohol is apparently a significant problem for merchant seamen. More than half of those responding, 53 per cent, cited instances where drunkenness of a crew member, officer, or pilot was a factor in an incident. Drugs, on the other hand, do not appear to be a serious problem, with only nine per cent of those responding to the question indicating that drugs were a causal factor in merchant marine casualties. There are many references in the interviews on the use of alcohol and its detrimental effect on the performance of crewmen. The following are just a sample:

1. One interviewee: "I have sailed with three or four mates drunk. The captain still took her out, seaworthy or not; that's what he was being paid for."

2. Another interviewee: "The second officer was a good man when sober, but every trip on night watch he would take over the watch while gassed up."

3. A master noted: "The quarter-master relieved the wheel in an intoxicated state and then swung the ship's rudder to starboard in a narrow channel."

4. Another master stated: "A man in an emergency resorted to drinking and fell overboard, drowning."

5. In another instance: "The master

was inebriated upon leaving anchorage; the chief mate quietly took over and an alert QM cooperated."

6. Another master recalled: "A problem drinker had whiskey aboard and had the whole watch drunk. Several mates saved the ship before running aground. No action was taken because of the seniority of the men."

7. A deck officer noted: "One bad day it seemed as if everyone on the bridge had a snoot full. The helmsman was unable to steer; mates on watch unable to obey orders; and the master gave improper orders."

Fatigue

Of those responding to the question, 31 per cent said that excessive fatigue had contributed to a casualty or near casualty; 61 per cent of those answering said that the amount of time on watch or work tired the men involved. In most cases, they were referring to captains on watch continuously for long periods and to men involved with docking, undocking, and canal transits without adequate rest periods. The qualitative responses from the questionnaire were numerous:

1. One interviewee noted: "The chief mate suffers from chronic fatigue. I was up when they brought her in, worked hard all day, and will be on the anchor when she goes out. Tomorrow morning I am working at 8 A.M. to give the bosun instructions."

2. One pilot indicated: "Excessive tiredness caused hallucinations vivid enough for a pilot to order a course change in the middle of a narrow channel, resulting in a grounding. He had been on duty continuously for 18 hours, working in bad weather without a rest period."

3. Another master indicated: "Fatigue is dangerous, an all too common characteristic on short turnaround container ships. I have been up for 48 hours continuously piloting, docking, and undocking."

4. Another interview stated: "I get

more calls between the hours of 10 P.M. and 5 A.M. This is because with the contract inexperienced watch officers are on duty and no one else is around. Today there are no permanent deck officers. The contract says they have to get off after six months. The 12 to 4 is perpetually tired and he misses a meal. My 12 to 4 brought the ship in, stands a watch until 5 P.M. tonight, and will take the ship out at midnight tonight. Nothing will happen, but he is just not going to be sharp."

Excessive fatigue is characteristic of a merchant marine working environment and further emphasizes the need for physical fitness.

Personnel Turnover

Excessive personnel turnover is another area of major concern in merchant marine casualties. Seventy-eight per cent of those responding to the question in the in-depth survey felt that there was a slight to very high relationship between personnel turnover and casualties. There were numerous responses in the qualitative portion of the interviews and in the questionnaires that referred to personnel turnover.

1. One interviewee noted: "At one time there were very similar ships and very similar cargoes. Men could take what they learned from one ship to another ship. Handling characteristics, engine rooms, and routines were all similar. Today, however, the fleets and cargoes are heterogeneous. A mate from a 500-foot ship can bid and get a job on a 900-foot ship."

2. Another indicated: "They can transfer to whatever they like without being qualified to handle the equipment. They can learn by on-the-job experience. Some captains and companies could care less about training."

3. Another interviewee noted: "Rotary shipping constantly recycles second and third mates. There is a constant training process, educating about the hatches, winches, bridges, etc. Although the concept is good, there is

less officer stability."

Operational Discipline

In addition, there seems to be a failure in operational discipline. Twenty-six per cent of those responding to the questionnaire recalled casualties resulting from failures to follow operational procedures; 32 per cent of those said that the procedures were not followed because personnel "did not want to bother;" while 43 per cent of those said that when they reported aboard a new ship they were usually left to shift for themselves. There are a number of qualitative responses to this problem.

One interviewee noted: "Some masters even expect you to work on charts running the coast. When the vessel is on iron mike, the mate on watch can be working in the chart room and both he and his AB and OS are absorbed in other pursuits. No one is minding the store."

When there is a breakdown in operational discipline, there are indications that appropriate disciplinary action is rarely taken for violations of regulations or rules. For instance, 44 per cent of those responding to the question recalled a casualty or near casualty relating to drunkenness in which no disciplinary action was taken.

The problems of physical fitness, emotional fitness, alcohol use, and fatigue can be addressed through the effective use of periodic, required physical examinations. As a matter of practice, many of those sailing do have some form of periodic physical exam. In some cases, companies require pre-employment physicals before a job assignment. Only 16 per cent of those queried in the interview indicated that they had not taken pre-employment physicals. Some, 22 per cent, indicated that they had taken a physical before every ship.

The panel considered the findings of the survey, together with an extensive literature review and job descriptions in reaching its conclusions. The panel also developed casualty flow diagrams on the

causes of merchant marine casualties.

In its final conclusions, the panel identified 14 factors that were either major or potential causes of casualties or near casualties. These factors are: inattention, ambiguous pilot-master relationships, inefficient bridge design, poor operational procedures, poor physical fitness, poor eyesight, excessive fatigue, excessive alcohol use, excessive personnel turnover, high level of calculated risk, inadequate lights and markers, misuse of radar, uncertain use of sound signals, and inadequacies of the rules of the road.

From its conclusions, the panel made 21 study recommendations. Of the 21 recommendations, I have listed eight that I consider to be the more significant. These eight recommendations are:

1. That the U.S. Coast Guard should take immediate action to require that anti-collision devices be installed aboard all ocean-going merchant vessels to reduce human error casualties.

2. That the U.S. Coast Guard propose changes in legislation and regulation to resolve the ambiguity in the authority and responsibilities of pilots and masters.

3. That the U.S. Coast Guard formalize bridge and engineering operating procedures for ships in the U.S. Merchant Marine and take action to enforce use of these procedures.

4. That the U.S. Coast Guard develop criteria and standards that would include operating proficiency checks for bridge and engineering watch standers, either aboard ship or with simulators, for issuing and renewal of licenses.

5. That the U.S. Coast Guard establish a program requiring annual physical examinations for active seafarers.

6. That the U.S. Coast Guard establish a program for qualifying key crew members by vessel type.

7. That U.S. operating companies and U.S. unions should increase their efforts to control alcohol abuse by establishing procedures and enforcing existing rules

to discourage crew members from performing duties while under the influence of alcohol.

8. That the U.S. Coast Guard consider taking action internationally to relegate sound signals to use in emergency situations only.

For those of you who are interested in reviewing the full study, I suggest that you write Harvey Paige, Executive Secretary of the Maritime Transportation Research Board of the National Academy of Sciences, 2101 Constitution Avenue N.W., Washington, D.C. 20418.

In December 1975, just prior to my leaving the Academy, I had an opportunity to cite some of my own opinions in testimony before the Subcommittee on Merchant Marine of the House of Representatives Committee on Merchant Marine and Fisheries. I felt then, as I still feel, that the NMRC in-depth survey was perhaps the most significant step that has been taken in the last 20 years toward solving our human error problem. I would caution, however, that the conditions cited are not common to all operating personnel. I know from personal experience that our merchant marine has many competent, physically and mentally fit officers and men who continually meet the highest standards of safety through prudent and efficient operation. However, it is also true that the merchant marine is becoming a potentially more hazardous mode of transportation and we can no longer tolerate even a few officers or men who are unfit, for whatever reason. The conditions revealed in the survey have not been allowed to exist in the air transportation industry, yet the potential for destruction is as great, if not greater, in our merchant marine.

I concluded my presentation before the House Merchant Marine and Fisheries Committee by recommending three specific steps:

1. A program of required annual physical examinations for key operating positions aboard ships of the U.S. Merchant Marine. These physical ex-

aminations should be based on a thorough study of the physical requirements by job description and by vessel type. Doctors should be fully briefed on the seriousness of these examinations and should be held responsible for their judgments in declaring men either fit or unfit for duty.

2. A mandatory retirement age should be established for key operating positions aboard ship.

3. The U.S. Coast Guard should develop and institute dynamic proficiency checks either aboard ship or with simulators in the issuance and renewal of licenses.

Since my presentation in December 1975, I have not been involved in merchant marine safety affairs. As a result, my perspective has changed somewhat. Although I still see human error as an extremely serious problem, and the three steps I recommended as the most effective means of dealing with that problem, I no longer see legislation or government administrative action as the best means of implementation.

Several days ago I received a letter from the Committee on Merchant Marine and Fisheries of the U.S. House of Representatives. Among other things, the letter stated: "At the present time, the ship owners and operators are not willing to implement your recommendations. It will take some work to prove to them that they will reap economic benefits for protecting the public interest by improving their safety records. The unions remain opposed to any change that might adversely affect their membership."

In making my recommendations before a legislative body, and in stating and implying the need for federal action, I may have violated one of my personal axioms on the American system, which says essentially that if you can accomplish a goal with less government rather than more government, you will probably be more successful and more economical in the long run.

With that in mind, I would point out

that merchant marine casualties are in fact big business. As our studies have shown, at least \$300 million a year flow out of the pockets of U.S. flag ocean carriers to pay for merchant marine casualties. If you work for an ocean carrier, look at your annual insurance premium, your uninsured casualty and cargo losses, and your maintenance and repair expenses. By reducing human error in your organization, you can expect to have an 80-85 per cent impact on casualty and casualty-related costs. With this kind of leverage, you can influence your company's bottom-line performance with as much effectiveness as any of the line officers in your organization.

The three steps I called for before the House Merchant Marine and Fisheries Committee as a means of reducing human error are useful goals that can be implemented effectively by individual carriers in cooperation with their unions. For example, annual physical examinations by doctors who will be held responsible for their decisions can serve to improve the quality of working seamen and at the same time be consistent with the unions' goals of ensuring the welfare of their members. It is in the interest of all involved to select out of the system those individuals who are not up to the demanding rigors of a life at sea. As it now exists, if a situation develops where there is some question concerning a man's physical fitness, he is examined by a Public Health Service doctor. If he passes a Public Health Service examination, he is given a fit-for-duty slip and is returned to duty. However, Public Health Service doctors are not always willing to deny a man his employment by withholding a fit-for-duty slip. In some cases, the doctors are not fully aware of the physical requirements of a working life at sea and are seldom aware of the extremely demanding requirements and critical responsibilities of key positions aboard ship.

Mandatory retirement is a policy that is common in almost every industry in the United States. I think that once U.S.

in a shotgun blast of new regulations.

In the course of my research in merchant marine safety, I came across a series of books on naval architecture and vessel damage control written in 1970 by Robert Macy for Sea-Land Service.

These books serve as a kind of seaman's guide to the principles of naval architecture, buoyancy, and stability. The readability is enhanced by small quotations used as a lead to each of the major topics. The volume on damage control begins with a quotation by Melville, which goes as follows: "Sailor or landsman, there is some sort of Cape Horn for all. Boys, beware of it, prepare for it in time: greybeards, thank God it is past." On reflection, this quotation may say more about human error than all the research that has been conducted on this subject in the past 20 years. The key, of course, is prepare for it in time.

maritime unions overcome their current retirement fund difficulties, they will be more willing to accept and perhaps even seek mandatory retirement for their members at age 60 or before.

The use of proficiency checks for key personnel by vessel type can also be accomplished by union management cooperation. Even now, many companies are requiring simulator training for many of their deck and engineering officers. The more this type of training and testing is required, the more opportunities we will have to develop and test skills that will have a positive impact on reducing human error in casualties.

The voluntary approach to implementing changes in merchant marine safety does have its pitfalls. If voluntary action is not taken or is not taken effectively, there will inevitably be the great marine disaster. As always, these incidents result

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SAFETY THROUGH HAZARDOUS MATERIALS INCIDENT REPORTING

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The Coast Guard has a long history in the field of safety. Consider for a moment some of the areas related to maritime matters in which the Coast Guard plays an active role. Boating safety includes operator training and compliance as well as pleasure boat standards. Port safety is personified by the captain of the port who exercises control of vessel traffic in the port area and has overall responsibility for the safety of the port. Merchant marine safety which embodies all of the U.S. Merchant Marine and foreign commercial vessels while in U.S. waters. Such things as ship design, life-saving appliances, and licensing and documentation of personnel are included.

As a part of the Merchant Marine Safety Program, the Coast Guard also prescribes minimum safety requirements for the transportation of hazardous materials by vessel. This is part of the overall regulatory umbrella of the Department of Transportation that controls the movement of hazardous materials. These regulations are found in Title 49 of the Code of Federal Regulations, Parts 170 to 189, and apply to all modes of transportation when transporting hazardous materials in packaged form. When hazardous materials are transported in bulk (without the benefit of a package) by vessel, such as in the vessel's own tanks, the applicable regulations can be found in Title 46 Code of Federal Regulations, Subchapters D, I, N, and O.

In order for everyone to fully appreciate the need for controlled movement of hazardous materials, a short discussion of their properties is appropriate. The properties of materials

dictate whether control in transportation is necessary, and the degree of control is determined by the appropriate hazard class which best describes the properties of the material. For packaged cargo the following hazard classes apply:

Explosives Class A—exhibit a mass explosion or detonation hazard.

Explosives Class B—exhibit a major fire or rapid burning hazard.

Explosives Class C—exhibit a minor hazard, such as small arms ammunition.

Flammable Compressed Gases—exhibit a hazard of flammability in addition to the hazard associated with pressurized container.

Nonflammable Compressed Gases—exhibit a hazard associated with pressurized container (internal pressure of 40 psia or greater).

Flammable Liquids—exhibit a flammability hazard (flash point of less than 100° F).

Combustible Liquids—exhibit a flammability hazard (flash point of less than 200° F).

Flammable Solids—exhibit a flammability hazard compounded by ease of ignition.

Oxidizing Materials—exhibit a flammability hazard through exothermic decomposition and by forming rapid burning mixture with organic materials.

Poisons Class A—exhibit a hazard of toxicity due to inhalation (no quantitative definition) applicable to gases and liquids only.

Poisons Class B—exhibit a hazard of toxicity due to ingestion, inhalation, and skin contact (LD50, 50mg or less; LC50, 2mg or less).

Irritating Materials—exhibit a hazard manifested by irritating or incapacitating

fumes.

Etiologic Agents—exhibit a hazard of disease-causing capability (limited to agents listed in HEW regulations).

Radioactive Materials—exhibit a hazard associated with radioactivity and criticality.

Corrosive Materials—exhibit a hazard associated with corrosion to skin, steel, and aluminum.

For materials transported in bulk on board vessels, a similar assessment of hazard is made; however, the parameters do differ since larger quantities are involved and the potential for disaster is greater. For example, vessels transporting flammable and combustible liquids in bulk must meet certain requirements based on the flash point of the liquid cargo. However, as opposed to flammable and combustible liquids transported in packages, when these materials are moved in bulk an upper flash point limit where the regulations do not apply is not specified. This consideration of the hazard is based on the large quantity of the material available to become involved in a dangerous situation such as a fire.

My presentation will address an often overlooked element of the hazardous materials regulations: the hazardous materials incident reporting system. What is a hazardous materials incident? According to the applicable regulations, a hazardous materials incident is an unintentional release of hazardous materials, or a damaging incident which occurs as a result of the carriage of hazardous materials. In either case, the incident must be reported. For packaged cargo as well as bulk cargo, the reporting requirement for hazardous materials incidents is a carrier requirement by Department of Transportation regulations. If an incident occurs with a hazardous material while in an operation other than a carrier operation (such as warehousing, storage, manufacture, etc.) the DOT reporting requirement is not obligatory. Requirements for reporting hazardous materials incidents outside of

the carrier operation fall under the regulations of other administrations, such as OSHA and EPA. The Department of Transportation incident report form does, however, provide for the report of incidents which occur outside of the carrier operation.

Who do you report to? For incidents involving packaged cargo the report must be submitted to: Director, Office of Hazardous Materials Operations, Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590. A form is available from the same office for this purpose.

For incidents involving bulk cargoes the report must be submitted to the nearest Coast Guard District Commander. A form is available from the District Commander for this purpose.

Shipments of hazardous materials move in many forms and sizes, in quantities ranging from ounces to thousands of gallons. I am sure you are all familiar with some of the more spectacular incidents which have occurred involving large quantities of hazardous materials; however, many of the smaller incidents go unnoticed and even unreported.

The Department of Transportation has recently embarked on a program which emphasizes incident reporting. This effort involves the cataloging and storage of all reported incidents by computer. To date, some 35,000 incidents have been cataloged, covering all modes of transportation. Of this total, only one or two per cent represent incidents which have occurred during water transportation. There are two schools of thought surrounding this percentage—either there is a low occurrence of hazardous material incidents in water transportation, or the reports are just not being made. Ideally, the first choice appeals to me; however, realistically, the latter would seem to be the case.

Historically, the regulation of hazardous materials in transport has been stimulated by death and property damage. Several examples come im-

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mediately to mind: Texas City, Port Chicago, and more recently in the port of New York, an incident involving a shipment of butane gas lighters which exploded upon being opened for inspection by a customs official.

The incident reporting system can provide an alternative to the old way of introducing regulations. It is my opinion that the catastrophic incidents which occur are not acts of God or random freaks of nature. The root causes are with the transportation industry every day, and these causes manifest themselves in the form of incidents of smaller magnitude, (a ruptured drum, a leaking gas cylinder, interaction with other cargo, and so on).

The incident report, when submitted, supplies approximately 35 separate items of information surrounding the incident, which are fed into a computer data bank. These data will include the type of operation, date and location, reporting carrier, shipment information, deaths, injuries, or property damage, hazardous materials involved, nature of package failure, package information, and remarks, to name a few.

That raises an issue which I am sure is on your mind. That is, by submitting an

SAFETY IS NOT A FOUR-LETTER WORD

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Many of you are probably wondering about the title of this paper. You are aware that safety as a subject is variously cursed by people. These people generally fall into one of two categories: those who think that too many accidents of any particular type occur, and those who find that for these same accidents the corrective cost seems, in their opinion, to be out of proportion to the perceived danger. In other words, the cure is worse than the disease. The central question raised by these people, even though they don't articulate it, is how does one define an acceptable level of safety, or, is there a level of accidents which must be tolerated? I would answer this question in a nebulous fashion by saying that there is perhaps a developing solution.

I will confine my remarks primarily to the safety problem posed by tankers moving in the marine mode of transportation. Last year at this session, Admiral Benkert, Chief of the Office of Merchant Marine Safety, presented a paper entitled *Tankers: Safety and the Environment—An Appraisal*. Admiral Benkert's paper dealt with the technical problems associated with the Coast Guard being challenged by the Ports and Waterways Safety Act of 1972 to a higher level of safety for the marine environment. When we examine that act specifically, we find in Section 201 a very general statement of policy which is quite unchanged from the original act except that it speaks to improving the safety record of tankers, particularly with respect to the damage they cause to the environment. It is extremely important to note, however, that the level to which the improvement is to be expected or directed toward is unspecified. Another par-

ticularly interesting aspect of this act, Subsection 4, lent the Coast Guard considerable direction in how the improvement was expected to be implemented. That subsection briefly defined establishing a need for regulations, examining alternative improvements to reach the level established by the need, and then evaluating each of the alternatives with respect to cost and technical feasibility. The underlying presumption is that the most cost-beneficial solution or alternative would be selected for implementation.

Application of the above methodology implies the availability of a great deal of background knowledge. Let us examine just what elements of knowledge are expected. First, it is assumed that one is able to define all aspects of the scope of the risk. Secondly, it is assumed that policy makers are able to define, or perhaps divine, as the case may be, what constitutes an acceptable level of risk taking. Thirdly, it is assumed that one is able to quantify the results of the available alternatives to a common base such that they can be properly evaluated with respect to altering the level of safety. Fourthly, and perhaps the easiest of all, is to determine the cost of each alternative and to assess whether that particular alternative involves state of the art technology or whether it is necessary to push technology, that is, enter into the R&D field or provide incentive for the necessary R&D to be rapidly accomplished. It is important to appreciate that each of these elements must be capable of being quantified in order to reach rational solutions. A deficiency in this respect in any one of these elements means failure or limited

use of the total effect. Let us examine each of these elements in more detail.

Risk (safety level) is defined as the estimation of consequences per unit of exposure. Traditionally, the consequence of interest is fatalities. Here risk can be measured in terms of fatalities to the crews of vessels and possibly to the public. However, secondary consequences such as number of injuries, again to both the crew and the public, and property damage suffered by the vessel, the environment, and perhaps to public property also need to be measured. For decisions related to management of risk levels, it is insufficient to estimate risk levels only, since each risk level has a cost associated with it. Consequently, these costs must be estimated also. There also are some indirect costs which certainly should be accounted for if one is to arrive at a rational definition of the total cost of not instituting a safety action. These can be characterized as the cost of delay to the vessel and the cargo; the cost of the repair to the vessel, which may not be the same as the property damage suffered by the vessel; the cost to the government in terms of search and rescue and enforcement; and the very important cost to the public as a whole, especially in cases of serious accidents, where possible interruption of other services to the public are caused. Having recognized that these are the various aspects, that is, the undesirable aspects of accidents, still unresolved is the question of whether all of these various factors can be integrated into one quantitative measure, and if so, in what terms. Although it seems likely that dollars might be a more impersonal term, it yet remains to be seen whether it is the best. There are other obvious problems in defining the cost of accidents. one of the primary ones being, of course, how does one arrive at the cost of damage to the environment when the subject is too little understood at this stage of our knowledge? Another potential problem is the assignment of a dollar figure or some other measure to fatalities

and injuries, all of which is necessary to reduce these costs to a common value.

One example of the use one can make of quantitative estimates of safety levels (risk level) is in a comparison of the individual risk of death for several human activities, whereby one is able to obtain a reasonable idea of how safe one endeavor is relative to another. The risk levels are based upon a measure of exposure in terms of person-hours, and indicate the risk of death per person-exposure-hour per 10 persons. These risk level comparisons represent one type of input in risk management analysis since they point out areas needing more safety improvement effort.

The decision to proceed with a safety improvement effort in one or more components of the marine mode (or any other mode) must be based on more detailed data, which must be generated through risk analysis that involves alternative remedial actions. The main output of this analysis is the resulting risk levels and required costs. These data can then be used to compute the incremental cost per increment improvement in system risk level.

Thus far we have insufficient information to provide a rational decision concerning the proposed improvement alternatives. At least two more inputs are needed. These are budgetary constraints and acceptable level of safety. The real questions involved are: who makes these determinations, and are they defined in quantifiable terms?

Let us examine certain of these aspects. First, who establishes a need? One important feature of the marine mode is its very international aspect. We do, of course, have certain domestic trades, and they certainly play an important part in the economy of the nation. But overriding this is the international nature of marine shipping. So, obviously, there is one source where a need may be established, although probably not in quantifiable terms, where several governments would join together in calling for reform of some sort; or a less

likely case may be where a single nation requests a reform. Fortunately, in the marine mode there is an international framework established to process requests of this sort. This type of request would be settled by slow movement through the grinding wheels of the International Maritime Consultative Organization (IMCO), a specialized agency of the United Nations. The resolution of requests to IMCO may be in one of two forms: (1) resolutions which are not binding on nations; and (2) international conventions which do become binding on nations that become signatory to those conventions.

Closer to home, everyone is aware of legislation at all levels of the government, the Ports and Waterways Safety Act of 1972 being just one particular example. Need may also be established by a regulatory agency in the normal course of events of doing its day to day work.

Another aspect of the acceptability level, and this may or may not be fortunate, is the motivation behind the request for change. In most cases it appears to be simply economic, where those making the requests feel that the "cost" of the accident now outweighs the cost of the cure, and that they have facts to justify this position. One could say, and many have lately, that this is simply another form of liability measurement where, by trying to anticipate the results and make the change, the liability is imposed before the event rather than after the fact, as occurs with liability insurance.

For those of you who operate vessels carrying bulk oil cargoes, you should be familiar with the Coast Guard regulations codified in 33 CFR 157. These rules all deal with seagoing tankers engaged in the carriage of oil, including both domestic and foreign vessels which desire to trade with the U.S. The rules require satisfactory hull construction and equipment to properly carry out the necessary operations to reduce the large bulk of the pollution of the oceans that has resulted from the

normal deballasting operation and tank cleaning operation of tankers. The rules are not, however, silent with respect to accident protection features in that they do establish a higher level of subdivision and stability for tankers and also establish an absolute maximum tank size for the individual tanks on a tank vessel. The rules that I have just outlined are all drawn from the "International Convention for the Prevention of Pollution from Ships, 1973." This Convention is not yet in force, and yet the U.S. has been able to use the need established in convening a conference that led to that Convention as a basis for determining a reasonable stringency level for a regulatory scheme.

One aspect of the above regulations which I did not mention was a requirement dealing with how required segregated ballast spaces would be distributed to achieve a secondary benefit in respect to reducing accidental outflows in case of an accident. The need for that particular regulation was established by national action with respect to the total rule making package where it was pointed out that the Coast Guard's original proposal was deficient and, therefore, the Coast Guard was required to respond.

Let us move on now to discuss how various alternatives may be evaluated with respect to their contributory improvement in satisfying the incremental need which may have been established above. The primary necessity is statistical data which will support the various alternatives, and this gets to be a very sticky problem because in many cases statistics have not been kept with respect to various aspects of accidents. Another potential problem in gathering the data is the protection afforded by the privacy act. A very real question rises when a direct confrontation of the interest of safety and the necessary data to support needed changes runs head on into the desire to protect individual privacy from undue government interference. Nevertheless, this hopefully can be worked out such that the

necessary information can be developed directly or by inference.

I have already discussed the problems associated with cost and technical feasibility. Only one further remark is really needed, and that bears on the same problem of gathering sufficient statistical support regarding the alternatives. The same problem arises concerning the gathering of economic data; in fact, it may be a much greater problem here than it is in gathering data such as ship movement, ship arrivals, sizes of cargoes, etc., because here there may be very direct inferences of government control of the economy.

In conclusion, I must admit that personally I am skeptical that such a scheme

as I have outlined here today can be made to work. Perhaps I am being unduly pessimistic, but I envision that the obstacles to be encountered in data gathering and also the very real problem of establishing credible needs will be the primary drawbacks. By the same token, I am well aware that there are great advantages to be gained from the institution of a system such as I have outlined here not just for the marine mode but for general use in measuring all the activities that man engages in. It has the further great advantage, and perhaps this is too much to hope for, of blunting emotionalism which, however much we may dislike it, has always been one of the prime movers of further safety efforts.

PAST HOLOCAUST GENERATES FUTURE SAFETY MEASURES

By CDR W. E. WHALEY, Jr.,
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Each casualty should provide a lesson and usually does—emphatically—to the participants involved. My job is to get this lesson to others so that similar casualties can be prevented. This is done by the review of casualty reports prepared by individual investigating officers in our field organization and initiating corrective action. About 5,000 commercial vessel casualty reports are prepared each year. From these reports information is gleaned to analyze trends and causes and thereby establish sound justification for the promulgation of safety regulations. Good safety regulations that prevent future casualties are welcomed by everyone and save many, many dollars. Practical regulations that are based on lessons learned from prior actual casualties are good regulations.

Today there are lessons to be learned from the collision between the C. V. *Sea Witch* and the *Esso Brussels* in New York Harbor.

The misnomer "the normal malfunction" played a significant part in the cause or origin of this casualty. How many times throughout the course of our lifetime do we hear the words, "Oh, that rattle, don't worry about it, it's normal," or, "It does that sometimes, but don't worry, it's nothing serious." Statements like these are ever present when describing minor improper functioning of equipment. It is just a matter of time before these so-called normal malfunctions endanger life and property. There is nothing normal about a variance from normal operation. Malfunctions are telltale warnings that something is afoot. They should not be ignored! There is no design that allows for a malfunction, no

reason to overlook it, and steps should be taken to eliminate it.

On 2 June 1973 the SS C.V. *Sea Witch* experienced a loss of steering because of a failure of a component in the steering engine room on its outbound transit of New York Harbor. The vessel collided with the Belgian tankship *Esso Brussels*, which resulted in major structural damage to the bow of the *Sea Witch* and an intense fire which ravaged both vessels. Sixteen persons died as a result of this casualty.

As tragic as this casualty was, the results could have easily been worse. Had there been any different tidal, current, or wind conditions it would have been highly probable that the Verrazano Bridge could have been destroyed, or that the Staten Island waterfront could have been affected, and that numerous other vessels in the anchorage area could have been involved. And why? Simply because of neglectfulness, oversight, or inattention to detail.

The cause of the steering failure was the wearing down, loosening, and slipping of a 3/16-inch square key which connected the after half of the universal coupling to the differential gear mechanism stub shaft. An Allen set screw in the hub of the universal also loosened, allowing the input shaft from the hydraulic rotary power units to rotate the control shaft without transmitting this rotation to the differential gear mechanism, thereby making it impossible for the helmsman to control the rudder from the bridge.

Your first impression would be that it was a simple mechanical failure. But this is not quite so! The *Sea Witch* had ex-

perienced a series of steering failures for approximately two years prior to this casualty. These casualties were not reported to the Coast Guard. Repairs were made to correct these casualties without any notification to the Coast Guard. On 23 April 1973, less than two months prior to the casualty, there was a modification to the steering gear which was improper and not inspected by the Coast Guard. As the scenario unfolds, it presents a series of steering failures which had no catastrophic results and therefore were considered of little importance. Through neglect or oversight, the Coast Guard was not informed and improper repairs were made. In time the inevitable occurred—one of these "minor" steering failures resulted in a casualty with catastrophic results. This instance points out why we should not judge the importance or seriousness of malfunctions on their results, but rather on their possibilities.

As a result of this casualty, many marine safety measures are being generated and/or expedited. Among these are the following:

1. The steering gear on all U.S. vessels having similar steering gear to the *Sea Witch* was examined by Coast Guard marine inspection personnel and owners of such vessels were notified of the problem experienced by the *Sea Witch*. Corrective action was taken and no further failures of this type have occurred.

2. Action has been initiated to amend regulations to require combination solid steam and water spray fire hose nozzles at all fire hose stations. Fire fighting efforts were hampered aboard the *Sea Witch* because accessible fire hose nozzles were of the straight stream type which could not be used to provide a water spray for cooling exterior doors.

3. An amendment to the International Convention for the Safety of Life at Sea, 1960, requiring fireman's outfits which include oxygen breathing apparatus and other emergency equipment to be stowed, convenient for use, in widely separated accessible locations, has been

made. On the *Sea Witch* the breathing apparatus was stowed below, where it soon became inaccessible due to the rapid spread of smoke.

4. The Coast Guard is proposing a change to their regulations which will require duplicity of steering gear contact systems through the differential gear mechanism. The current regulations do not require duplicity of connecting linkage between the rotary actuators and the differential gear box.

5. Proposed rules have been published which require the manning of the after steering station on oceangoing vessels in restricted waters. Current regulations are silent in this area.

6. Our federal regulations are being amended to require that one steering gear power unit and its control systems be supplied through the emergency switchboard. Current regulations only require two sources of power.

7. A regulatory project has been initiated which will require all U.S. ocean going vessels to establish written emergency procedures and alarms for loss of steering control. It will also require emergency drills for loss of steering control.

8. Proposed regulations are being drafted to require lights on life preservers for various vessels in various services.

These safety measures are being implemented in an effort to prevent similar occurrences like the *Sea Witch/Esso Brussels* disaster. However, this brings us back to the original premise—the normal malfunction. There is no such thing. The price has been paid for the generation of these new safety measures. The value of property damage is measurable, the value of life is not. Had these "normal" steering failures not been ignored, the major casualty could have been averted.

It is my request that you let abnormal occurrences serve as a warning and by their elimination we can do much more than generate safety measures after the effect of major casualties—we can prevent their occurrence altogether.

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Marine Sessions

SAFETY AT SEA

By RADM SAM MOORE
Commander, Military Sealift Command, U.S. Navy,
Washington, D.C.

Safety is not a dramatic subject.

Safety programs and their accomplishments seldom make newspaper headlines—or the television news. Safety programs are not often discussed in the car pool, on the bus, or in office conversations. As a conversational tidbit, safety ranks well below such universally interesting topics as sex, politics, sports, or crime.

But the results of ineffective safety measures produce tragedy—and tragedy is news. For example, consider these headlines: 49 Die in Air Crash; 29 Missing as Ships Collide; Teenager Fatally Injured in Auto Accident; Train Rams School Bus, 16 Die.

There are two other common factors in the examples cited. All involve the ultimate consequence of poor judgment or failure to obey the rules of safety. And all involve some form of transportation.

Most accidents still occur in the home, or the neighborhood. In the office or factory we still face real hazards, despite safety laws and programs which have greatly reduced accident frequency and severity. But without overlooking the tremendous safety records compiled by the airlines, the railroads, the bus and trucking companies, and the maritime organizations, I would suggest to you that renewed emphasis must be given transportation safety.

That need is a product of two accelerating trends. Spurred by the goal of continually improving productivity, and thus profits, our transport carriers are becoming bigger, faster, and mechanically more complex. We rely more heavily on technology and machines, but machines do fail. Technology can in itself create new hazards. And, man, the master of the machine, still makes errors. Human

error has more significance because it may have an impact upon the lives of hundreds, even thousands, of other people.

A recent report by the Maritime Transportation Research Board listed 14 types of human errors which they identified as "major or potential" causes of marine casualties. That report also claimed that 80 per cent of all marine casualties are related to human error—and that those casualties cost the United States more than \$300 million each year.

In June 1973, the *Sea Witch*, an American cargo ship, and the *Esso Brussels*, a Belgian tanker, collided off Staten Island in New York. Both ships burned in a furious fire and 16 people died. That collision was the result of the loss of a small key in the steering system, which caused *Sea Witch* to veer from her course, and the 13-knot speed of the *Sea Witch*. Causes: failure of a 3/16-inch key, and excessive speed. Effect: 16 deaths and millions of dollars of property damage.

Modern transportation carriers operate in hostile environments, above and across oceans, mountains, and deserts, in good weather and bad. Reliability is the key to the safety of those who ride them and those who man them. That reliability is a direct product of human concern, of human judgment, of human skill. Reliability of man and machine requires involvement of every man or woman who has a role in the development and operation of the transportation carrier.

Across-the-board involvement, I think, is the single most important factor in the success of the Military Sealift Command safety program.

Human involvement is a vital element of shipboard safety, more important

than in previous years because of changes brought about by advancements in maritime technology. Many modern ships are highly automated. Their crews are much smaller than in the past. And the work the crewmen do is highly specialized.

One result is that there is greater compartmentalization within the shipboard community. Crewmen have little chance for social interaction with their shipmates. Because fast turnaround time is essential to productivity, modern mariners spend long periods at sea and have limited time in port. Routine tasks inherent in an automated work environment also tend to make shipboard life more boring—and boredom has a direct and substantial influence on accident frequency.

For those of you who may not be familiar with MSC, let me very briefly describe what it is, and how we operate. MSC is the operating agency for Department of Defense sea transportation. We deliver fuel and cargo worldwide for the Army, Navy, Marine Corps, and Air Force, in peacetime and in emergencies or contingency situations. While we rely heavily on the U.S. Merchant Marine, we maintain a nucleus fleet which provides a base for wartime expansion.

In that nucleus fleet are dry cargo ships, tankers, and ships which directly support the Navy fleets. Included are civilian-manned oilers which provide underway replenishment service, ocean-going tugs, a stores ship, and fleet ballistic missile resupply ships.

The cargo we carry includes ammunition, petroleum products, nuclear weapons, heavy and outside equipment, vehicles, and many other types of supplies and equipment needed by our military forces worldwide.

In addition, MSC civilian crews operate ships used in scientific research of our environment, in cable laying and repair, in support of U.S. space programs, and other special project missions.

The size of our fleet varies in response

to changing requirements. We now have more than 100, of which 40 are chartered commercial ships. Although chartered ships are manned by crews provided by their owners, nucleus fleet ships are civil service manned or operated for MSC by private contractors.

MSC employs approximately 4,000 civil service mariners, and these are the people I am talking about when I speak of our safety program. They man ships which operate literally around the world. Cargo ships and tankers, for example, supply Arctic and Antarctic bases. Ice strengthened ships fight their way through the ice and navigate in weather where visibility is often near zero—always on the lookout for icebergs that can send a ship to the bottom at any time. And they always face the danger of being ice bound.

In Southeast Asia, MSC ships and crews were targets for saboteurs and underwater attacks. In the Atlantic and Pacific, they cope with the tremendous furies Mother Nature can unleash—forces that can send dangerous explosive cargo rolling about or cause containers holding equally dangerous chemicals to leak. Fire or explosions always are a threat aboard our tankers. And ships involved in underway replenishment operations, steaming alongside one or more other ships while fuel is transferred by hose and cargo by line or helicopter, are never far removed from potential disaster.

Despite these types of operation, around the clock and around the world, MSC civil service mariners have compiled an enviable safety record. In the first seven months of this year, we have had only 2.58 accidents per every million manhours. That is about one-third of the accident frequency rate for U.S. flag commercial ships. In 1974, based on one million manhours, the MSC accident frequency rate was 3.4—well below the industry figure of 4.95. Comparable statistics for 1975 show MSC with an accident rate of 3.08, less than the industry rate, which again was 4.95.

It will be of interest to you to know that we will begin using 200,000 rather than one million manhours as a base in January 1977. The purpose is to insure reporting compatibility with other safety programs. And I am certain you also know that marine safety figures are based on a 24-hour day, not an eight-hour work period. Obviously, ship's crews do not return home each day as do those who labor in office or factory. The extended time and the dangers inherent in the seafaring profession make the rates I have cited even more impressive.

In the past three years, six MSC ships have won Jones-Devlin Awards for outstanding safety records. One, USNS *Bariletti*, an oceanographic research vessel, has gone nearly five years without an accident. The others are shooting for three-year marks. One is the USNS *Mirafak*, which operates in the Arctic and Antarctic. Another is the USNS *Norwalk*, which delivers fleet ballistic missiles to our Navy submarine force.

I noted earlier that individual involvement in MSC safety programs is an important factor. Our people think and practice safety for two primary reasons—training and fear. The first category is easily understandable. However, both require some explanation.

Training in MSC falls into three general categories; individual, team, and shipboard. It begins with the individual. For example, those who will be assigned to fleet support ships are sent to Navy schools to master the technical aspects of handling refueling rigs and to become familiar with helicopter flight deck operations. They learn more about ship handling, maintenance, and all of the tasks associated with fleet support operations.

These individuals eventually become part of ship crews and intensive team training takes place. For example, Navy instructors go to sea with fleet support crews to watch them at work, to evaluate their capabilities, and to retrain when that is necessary. Re-evaluation and

reteaching are continuing processes within MSC.

In addition to the Navy instructors and fleet observers who board MSC fleet support ships to assist in crew training, the master of each ship is responsible for continuing training. Fleet support ships conduct practice runs with Navy fleet ships. They are involved in readiness exercises. And their crews return to the classroom for refresher training whenever required.

Fire fighting and damage control training is given continuing emphasis aboard MSC ships. In addition, we send our crewmen through our own fire fighting schools at Treasure Island, California and Bayonne, New Jersey, where emphasis is on realism. Instruction takes place both in the classroom and on the fire line. Obviously, a fire at sea aboard a fleet support oiler or a tanker is not a thrilling experience. The best word to describe it is probably "terrifying." How to prevent fires? Effective training.

Training is comparable for other type MSC ships. Those carrying nuclear missiles, for example, must pass a rigid nuclear technical proficiency inspection periodically. I am intensely proud of the fact that not one MSC civilian crew has ever failed to pass the first time. They have never had to repeat an inspection as have some military manned ships.

Safety and training, of course, go hand in hand. We preach safety, think safety, and practice safety. We do all of the normal things—conduct lectures, display posters and warning signs, use slogans, show movies, and hold safety-oriented meetings. Once each month each ship master conducts a meeting during which shipboard practices and hazards are reviewed. Minutes of those meetings are then reviewed by MSC commanders. The minutes are even assigned adjective ratings. Any report rated less than excellent immediately draws a great deal of command attention.

In addition, weekly meetings are held

in each department of every MSC ship, and every man on every job is directly involved in spotting hazards and recommending corrective action. That is why I noted earlier that involvement is the key to our excellent safety record. It is also why I said "fear" is a primary ingredient of our program.

I do not intend to suggest that MSC people are threatened or intimidated. What I do mean is that we seek to do more than develop management-centered programs aimed at motivating people. Just as people cannot be hypnotized unless they are willing subjects, a man cannot be motivated unless he perceives that what he is being encouraged to do has some benefit for him as an individual. Management can inform, but people must motivate themselves based upon their understanding and self-perception.

It is easy to look at commonly accepted hierarchies of human needs and say that survival is our paramount concern. But man is a complex animal, and even though physical survival is a primary need, our behavior often is conditioned by other needs. Some of those threaten our survival.

For example, the teenager who drives 90 to 100 miles an hour in Dad's car may be seeking recognition of his peers. The man who neglects to shut off the power while working on an electrical line may be too tired to take a few extra steps. The driver who weaves in and out of traffic, hoping to save a few seconds, often is rushing to an engagement of no consequence. The man who forgot to install a safety pin or to reconnect a part had his mind on other matters.

Examples are endless, in our own experiences, of acts that jeopardize our survival. And yet we do them. Man tends to think of war as the ultimate horror, and yet there were more than 62,000 accidents last year in transportation alone. Nearly 9,000 involved pedestrians, more than 3,000 involved motorcyclists, about 1,500 involved aircraft, and 400 involved commercial ships. Nearly 50,000 people

to fulfill our worldwide commitments.

Safety is never far from a seaman's mind, since the environment he operates in is beyond his control. Neither can he easily flee the confines of the small, self-contained community in which he lives and works when fire, explosion, or other disaster threatens. That partially explains why helping one another is a strong seafaring tradition.

In 1975, MSC-controlled cargo ships rescued nearly 180,000 South Vietnamese refugees fleeing before an advancing enemy. As many as 16,600 were transported, housed, fed, and given medical care on a single cargo ship.

A year prior to that, an MSC tanker rescued 257 people from a burning British cruise ship off Key West. In 1973,

an MSC ship located and rescued 36 survivors in the dead of night after their ship had exploded and sunk. And in 1972 another MSC cargo ship spotted and rescued 12 men who were adrift in a lifeboat off Puerto Rico. Their ship had also burned.

In each case, the crews of the ships involved received high-level awards for their skill, their dedication, and their performance.

While our training and safety programs are not different, or innovative, or dramatic, they pay off—and they sometimes even make news—because they save lives, because they avert tragedy. There is no more valid measure for success.

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National Safety Council

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March 21, 2001

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