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FOUR I'S PROGRAM

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What we call our Four "I's" Program covers indoctrination, instruction, inspection, and investigation. It is standard throughout the corporation.

Indoctrination

The first element of our program covers indoctrination. A slide presentation is given to all new employees and to all employees returning after a lost time accident. This slide presentation, titled "Working Safely at Todd," takes about twelve minutes and covers: entering yard, teamwork, painful injury, safety awareness, available personal protective equipment, first aid facilities, emergency equipment, dispensary pass, eye protection, fire prevention, hearing conservation, foot protection, respiratory protection, instruction in respiratory equipment, potential fire hazard, job site housekeeping, keeping traffic lanes open, working in confined spaces, common potential shipyard hazards, alertness at intersections, safe lifting, unsafe shortcuts, unsafe acts, replace guardrails, proper use of staging, personal flotation devices, life rings, overhead hazards, hazards below, ladder safety, watch your hands, the right tool for the right job, safe storage of cylinders, use of inspected and tested equipment only, proper use of compressed air, mouse your hooks, use equipment within its safe lifting capacity, return of defective tools, machinery guarding, danger of electric shock, report defective electrical equipment, using trash receptacles, know the yard fire bell number, lunch time clean up, keep the rodents out, always think safety, and safe journey home.

I think the thoroughness of our slide presentation will indicate the degree to which Todd goes and the emphasis which we place on safety.

Instruction

After being hired, we don't stop at the slide presentation. We have found that instructions to new employees on the use of proper personal protective equipment, reminders on adherence to regulations published in our employee handbooks, and obedience to caution and warning signs are essential. This must be a continuing practice. With the instructions given by our safety inspectors, foremen, and representatives of the Personnel Department, we try to impress not only the new employee but all employees with the necessity of reporting unsafe conditions or unsafe work practices observed.

Repetitive instruction is part of our weekly tool box meetings in all trades. We have recently expanded the instruction facets of our program by giving our supervisors a six-part slide presentation on safety. This is being conducted in concert with our insurance carrier.

Inspection

Earlier I mentioned the necessity for reporting unsafe conditions or work practices observed. At Todd, we have a facility safety inspection routine. We have found that self-inspections using supervisors, foremen, and others jointly inspecting zones in the shipyard on a monthly basis have proven to be a very effective means to identify unsafe conditions, situations that could expose us to an OSHA citation or criticism by our insurance carrier and other state/federal or local inspection authorities. We all know that shipyards are inspected to death. What we do is have, for example, the foreman from the electric shop inspect the steel fabricating facilities, and the machine shop boss inspect the cranes

or just general yard areas. With these random assignment zone inspections, everyone participates in the safety program. On the average, a supervisor may be called upon twice a year to participate in the inspections. The deficiencies noted are discussed at the supervisors monthly safety meetings. In spite of this, we still have our share of accidents.

Investigation

When we experience an accident we place the onus of the accident investigation on the supervisor of the craft involved. If a product, tool, equipment, or material is involved in an accident causing personal injury, the safety department takes special care to determine if it could be a third party liability due to the equipment, material, or product being used. Admittedly, accident investigation is one area in which we have some shortcomings. We are working on them.

Conclusion

There is no doubt that much of what I have said or what we are doing at Todd is being done throughout our industry. While I mentioned the four "I's"—indocctrination, instruction, inspection, and investigation—I must admit that we have a fifth "I" and, in

view of what workers' compensation is costing us under the Longshoremen's and Harbor Workers' Compensation Act, at Todd the fifth "I" covers "inquisition" by the general manager of the plant and, oftentimes, by our corporate office. The apparent giveaway under the Longshoremen's and Harbor Workers' Compensation Act has exposed our industry to nebulous and fraudulent claims. Each of you could probably cite instances regarding questionable awards. It is not going to get better. As an example, a recent U.S. Navy report revealed that for a one-ship construction value of \$125 million, workers' compensation represented \$17 million, or 13.5 per cent of the total price. Accident prevention and a positive safety program is the only way, under today's scheme of things, that we can possibly hold the line on workers' comp costs. The physical effects of an injury seem to be secondary to the philosophy of "What is this so-called injury worth to me in the compensation award?"

I and my counterparts in our company are fortunate in that our corporate management fully supports, funds, and continuously encourages the policy of "Working Safely at Todd."

SAFE HANDLING OF WELDING GASES IN SHIPBUILDING AND REPAIR

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Cutting and welding have been used almost as long as steel itself in the building and repair of steel ships. They are well-established, essential shipyard processes. To be sure, the subject of the safe use of welding gases is hardly new. But what is new, and what is needed by supervisors and operators, is a reliable, easy way to identify the hazards of any specific job.

Linde has developed a response to this need, a checklist that we call "The Five Agents That Kill." This paper briefly discusses the "Five Agents" and also applies them to the welding and cutting operations in shipbuilding. Accidents that have come to our attention as suppliers of welding gases are described. Also the subject of check valves and reported misconceptions of their functions are reviewed.

Five Agents That Kill

We've all heard the statement "Analyze the job for hazards, and then take the necessary steps to remove, avoid, or control those hazards." This is good accident-prevention practice. But if I'm a supervisor, my question is, "How do I do this? How do I analyze a job for hazards? You, Mr. Safety Man, speak in generalities, but I work in specifics. I need a simple procedure or a checklist that I can remember easily and apply to any of hundreds of different situations."

This serious deficiency came to light during Linde's recent in-depth analysis of our major injuries and fatalities. We found that there are actually five agents and injuries that produce fatalities. Keep in mind that I am referring not to the cause or type of the accident, but to the actual result-

ing injury or agent itself. We call them "the five agents that kill," since some are not truly injuries, but rather are the agents that produce the injuries. The five agents are:

- B—Burns (especially burns from clothing fires)
- S—Striking Objects (especially shrapnel and high-speed objects propelled by explosions and other energy releases)
- A—Asphyxiation (including inhalation of poisonous vapors)
- F—Falls (of 10 feet or more)
- E—Electrocution

B S-A-F-E. It is simple, easy to remember. Our supervisors like it as a list to analyze any job. Let's apply the five agents specifically to welding and cutting in your operations.

Burns. Do your welding and cutting operations involve the possibility of burns which could result from clothing fires or material fires? They sure do.

The oxy-fuel gas flame is 5000° to 6000°F. Burning steel sparks can ignite clothing and most combustible material, so they must be controlled. These are well known and recognized hazards, so I will not dwell on them.

What about the oxygen? Oxygen does not burn, but it is a strong oxidizer—it makes most things burn much faster than air does. While it takes about 99 per cent oxygen to burn steel efficiently, clothing will burn extremely fast in only 25 per cent to 30 per cent oxygen. This is only four per cent to nine per cent higher than normal air. For this reason it is extremely hazardous to "sweeten" the air with oxygen in a compartment or confined space, or to have an oxygen leak in a confined area. Moreover, craftsmen must be

trained to know that they cannot detect an oxygen-enriched atmosphere with their senses, since oxygen is odorless, tasteless, and colorless.

Striking Objects. Is there anything that could produce an explosion to propel parts at high speed? The answer is yes. The fuel gas is flammable. When mixed with air or oxygen prior to ignition, it is a potential explosive. Thus, operating procedures and maintenance of hoses, pipelines, and equipment must prevent the leakage of flammable fuel gas into any confined area.

It is good practice to avoid welding and cutting on closed containers; this prevents accumulation of an explosive mixture within the container. In one accident, a craftsman reportedly was heating steel resting on top of a large, closed, steel tool box. Apparently, he was using excess fuel from a neutral flame, and some of the unburned fuel gas entered the tool box through the opening between the cover and side. Also some oil, grease or other hydrocarbons on the inside surface of the cover could have been vaporized by the heat. The unburned gas and vapor accumulated within the tool box and, after a short time, exploded. The tool box cover blew open, striking the craftsman in the head and fatally injuring him.

A similar danger can arise when a leaking torch is left in a small compartment—an explosive mixture of fuel gas and air may accumulate.

Hydrocarbons such as oil, grease, coal dust, and paint sandings in contact with oxygen represent a potential explosion in any oxygen equipment. If ignition occurs, equipment may be ruptured with explosive force, propelling parts and fire in many directions. For this reason, oxygen regulators must be handled so that no oil, grease, or other hydrocarbon gets on the inlet nipple and into the regulator. Failure to do so can result in an oxygen regulator fire and burnout when the cylinder valve is opened.

One of the more critical safety devices in an oxygen cylinder regulator, and one which is frequently ignored, is a sintered, bronze filter inside the in-

let nipple. Make sure it is present. Inspect it for cleanliness before each attachment. Replace it with a new, clean filter every few years, or whenever it shows any sign of contamination.

Many shipyards have a central bulk oxygen unit, which should be located and installed per NFPA 50. A piped distribution system is used to supply oxygen from the unit to various parts of the yard. First, the pipelines must be cleaned and kept free of hydrocarbons to avoid an explosion. Second, NFPA 51 explains how to keep the fuel gas from backing into the oxygen pipeline, and oxygen from backing into the fuel gas line. Back flow check valves or devices are important here. Suppose the oxygen supply is shut off for some time, such as for the weekend, and there is a leak in the oxygen pipeline. Pipeline pressure could drop to atmospheric and, under certain unusual but possible conditions, the fuel gas can back into the oxygen pipeline, creating an explosive mixture, unless back flow check valves or device have been provided.

Asphyxiation. Asphyxiations can and have occurred in shipyards when argon, an inert gas used in shielded arc welding, displaces the oxygen in the air in confined spaces. The argon, which is not consumed in the process, is normally carried away with ventilation of the welding fumes so it is not a hazard during the welding operation. However, a torch with the argon flowing from it left in a compartment or confined area could create an oxygen deficient atmosphere that will not support life. So it is important that the argon gas supply be shut off when the torch is not in use.

Operators can not detect the presence of an oxygen-deficient atmosphere with their senses because argon is odorless, colorless, and tasteless. Anyone who walks into an atmosphere containing five per cent or less oxygen will pass out after one or two breaths without sensing any warning. In this state he cannot help himself. Anyone attempting a rescue without air-supplied breathing apparatus also will pass out and expire.

An incident was reported that illustrates the speed with which asphyxiation can occur and the helplessness of the victim. This incident also illustrates how argon can accumulate in confined spaces under unusual conditions, e.g., an open trench, particularly if excess argon is used. The victim had been inert gas welding with argon, which is heavier than air, over an open trench and grating. One of his tools apparently fell into the unventilated trench. He removed the grating and reached down to retrieve the tool. He never came up alive. So keep argon piping tight, torches closed when not in use, and avoid unventilated confined areas.

Falls. Falls are not an inherent hazard of the welding and cutting process, so I will not discuss them further.

Electrocution. The 440v or 220v that powers most electric welders is sufficient to cause electrocution. However, most craftsmen recognize this hazard, and welding machines and processes are designed to minimize it. Hence, injuries from electricity are apparently few and far between.

Those are the five agents that kill as they apply to welding and cutting in shipyard operations. There is another situation or hazard that I want to touch on briefly. Specifically, it concerns the use of back flow check valves in hose lines at torches; as distinguished from those in pipelines previously discussed.

Back Flow Check Valve

Much has been written and spoken about the value of back flow check valves in manual oxygen-fuel gas cutting and welding equipment. These check valves are designed for installation between torch and hose or hose and regulator. The Compressed Gas Association's pamphlet E2 correctly points out that "under certain circumstances, the user's failure to follow (manufacturer's) instructions can cause the back flow of unwanted gas into the hose lines. Back flow check valves could provide a certain measure of protection."

What concerns me is the widespread

gross misunderstanding of the type of accidents that might be prevented by back flow check valves. Also, craftsmen reportedly are developing a false sense of security and the impression that they can afford to be less rigorous in following proper procedures and precautions recommended by the torch manufacturer. This is absolutely incorrect and highly dangerous. Following the manufacturer's recommended safe practices and operating procedures is the only way to prevent most oxy-fuel gas equipment accidents.

Consider oxygen regulator fires. Very few, if any, of these accidents will be prevented by back flow check valves. What will prevent them is strict adherence to the manufacturer's recommended safe practices. This means keeping grease and other contaminants out of the regulator inlet by careful handling of detached regulators, by inspection, and by insuring that the inlet filter is clean and in place, as previously monitored. The presence of fuel gas that has flowed up the oxygen hose and into the regulator simply is not a significant contributor to oxygen regulator valve or cylinder fires. This is based on my investigation of many such accidents over 24 years. (I have seen regulator burnouts with check valves installed.)

The check valves do serve a useful purpose where long hoses are used. When an oxygen regulator is removed from the cylinder or pipeline so the inlet nipple is open to the atmosphere, and if the torch valves are left open and both of the regulator pressure adjusting screws are turned in, it is possible to get some fuel gas back into the oxygen hose. Keep in mind, however, that considerable flammable gas will come out through the torch tip at the same time. If the torch valves are then closed, when the oxygen regulator is attached, a fuel-oxygen mixture may be trapped in the torch end of the hose. If the operator does not purge the oxygen hose for a few seconds prior to lighting the torch, there is a possibility of an oxy-fuel gas flash back into the oxygen hose adjacent to the torch.

represents potential injury to the operator. Very few such accidents have been reported to us, but in this day and age of product liability we make every effort to educate our customers in the prevention of all accidents involving our equipment.

In brief, experience shows that back flow check valves in oxy-fuel gas equipment will not prevent many common accidents, such as oxygen regulator burnouts. Operators must continue to follow manufacturers instructions and safety precautions to avoid these accidents and resultant injuries.

Summary

Our supervisors tell us that the

"Five Agents That Kill" list for analyzing jobs for hazards is the best tool that we have ever given them. I suggest you try it. Cutting and welding operations in shipbuilding and repair are almost as old as the use of steel itself. The gases involved represent some significant potential hazards. It is imperative that the new operators understand these hazards and that experienced operators be retrained periodically. If this is done and equipment is kept in good condition, cutting and welding can and will be one of the safest operations in your shipyard.

THE ORGANIZATION OF TRAINING FOR THE MARITIME INDUSTRY AND ITS EFFECT ON SAFETY

By BEN BERNES, JR.
Safety & Training Supvr., Agri-Trans Corp., Ama, LA

With the inception of all the latest technology, one would speculate that it would be easier to train an individual today as opposed to 20 years ago. Well, with all factors included it just isn't so. Some may attribute it to the decline in classroom learning, others to personality, job conditions, and the list goes on. But somewhere someone must take a stand in the field of training. That person must be cognizant of all the humanities and the latest developments in the field of training, and needless to say, knowledgeable in his or her own area of endeavor.

We must begin somewhere, so let's start at the bottom, which is exactly where I am. I joined Agri-Trans Corporation in the latter part of June 1978. We are located in Ama, Louisiana, which is approximately ten miles above Avondale Shipyard on the west bank of the Mississippi River. Agri-Trans is a relatively large barge line with 350 barges and ten towboats. Agri-Trans is unique in so much as it is owned by co-op farmers. These farmers experienced the revelation that transportation of their grain via the inland waterway system was indeed the most economical mode available to them. Hence, they bought an existing barge line and named it Agri-Trans.

When I assumed my position much had already begun in the fields of personnel, safety, and training. Our personnel manager began taking an in-depth and comprehensive approach to hiring the best and highly qualified applicants to fill the job positions. Agri-Trans was plagued with high injury frequency and severity rates. To give you an example, our barge repair facility which employs 60 people total, recorded 22 lost time injuries in 1975.

Our fleet operation, both tugs and shoreside personnel, averaged 1 1/2 lost time injuries per month in 1975; this included one accidental drowning.

The owners of Agri-Trans decided that something had to be and would be done to improve the safety record of their New Orleans barging operation. They adopted the personnel approach to safety and began achieving drastic improvements in the safety records of both their Kenner Bend Fleet and Kenner Shipyard operations.

The following is an outline and general discussion of the steps taken.

It was decided from the beginning that the organizational structure which existed at the time Agri-Trans was purchased was not conducive to improving the safety record which existed in 1975. There was no personnel department to hire qualified people to do the job safely. As a result, turnover was high which added to the overall safety problem. Job training was nonexistent. New people started work not knowing the job and its hazards.

There was no safety department. There was no one responsible for safety. If a lost time injury took place, a secretary would fill out a Government BEC 202 form, and that was the extent of the investigation.

First on the list of priorities was to establish the personnel department and hire new people. Goal: to be selective so that we would hire safe workers—people who would stay with the company longer, thus reducing turnover. It has been proven that by reducing turnover you also reduce accidents and injuries.

The applicant is required to fill out application completely and have an interview with the personnel manager. Testing is done to find mental ability,

mechanical ability, and personality profile. Complete job reference checks, I.F.S., M.I.B. past employer checks are run, and there is a second interview with the supervisor (go/no go). Finally, there is a physical exam and back x-ray. Currently we interview approximately 20 people to hire one. We are not always right.

Once a new man is hired, he goes through a complete training program which, depending on the job, could last from one to two days. This, of course, is just classroom training. When he gets the job, the supervisors continue his education through OJT, with the emphasis on safety.

We currently use all forms of communication to get the safety and training message to our men. This includes: video tape (B & W—our main media); 16 mm films—safety, locks and lines, company orientation; slides and cassettes; overhead projectors; hand-out material, printed brochures; OJT—is the proper safety gear.

The video tape system is indeed a valuable asset to the training department. Presently we conduct an entire day's worth of training with the trainee seated in front of a video tape monitor. Obviously, there is some fault in this procedure. This is not to say that the aforementioned programs did not work. They did and quite successfully. In July 1978 we only recorded three lost time injuries at our shipyard operation and two lost time injuries aboard one of our harbor tugs. It is comforting to add that none of these accidents resulted in permanent disability. Up until the time of these injuries the shipyard compiled a total of 780 days without a lost time injury and our fleet operation compiled 655 days. Obviously, the plan was indeed working. However, there is always the need for improvement.

It is my contention that if we are going to pay a man for a day of orientation and training, then it is essential that he get the best training and get it first hand. My objectives for the training program are as follows. First, no more than two hours should be spent seated in front of the video tape monitor during the initial orientation. You probably are familiar with the amount

duce them to the company by means of the corporate film and actively soliciting questions. During this phase the new employee receives a general picture of the overall company objective. Second, to process all the necessary paperwork to insure the employee knows the company benefits, amount and types of insurance he is covered by, and all additional programs available to him such as educational assistance, credit union, and available testing to improve his ratings on the river. Third, and probably most important, introduce and help master his job. This includes instruction in company work policies, safety, and actual job experience.

Exactly how structured you want to be in your individual programs is entirely at your discretion. But the first and foremost thing to remember is to give the trainee an idea of what is to be learned. If the trainee is already experienced, then a simple re-affirmation of his skills will suffice. However, there is nothing more frustrating than compound anxiety due to lack of understanding of what is expected. If the training supervisor or director has approached his supervisors and constructively assembled job descriptions, definitions, and means of evaluation, then these can be compiled into what is known as a module. The module system of learning was introduced by Benjamin S. Bloom, professor of education at the University of Chicago. A module basically consists of:

1. A title; in our case it could be a job title.
2. A purpose, describing exactly what is to be understood.
3. A Rationale, simply explaining the benefits and why this should be understood.
4. Content; encompasses the questions which the trainee should be able to answer upon completion of the module or the program.
5. Module Objectives. This is a very important part. Simply stated: "Upon completion of the module the student will be able to . . . (usually written in

some accuracy expectancy, i.e.; 90 per cent accuracy, eight out of ten attempts, etc.

6. Learning Activities. Exactly what attendance, physical work, classroom, reading, verbal explanation is required from the student.

7. Proficiency Assessment. Testing period.

This is given to the student to read before any training takes place. If there are any questions, answer them, then begin your program. I said before I strongly believe in class/and practical learning. With video tape we can introduce to the trainee all the equipment he will be working with. Then with good tape editing, we can switch camera shots to the jobsite, showing the trainee how each piece of equipment is used. Is this fair? I hardly suspect so. When building or breaking tow on a barge is not experienced first hand, we have in effect lied to the trainees. The trainee watches a man pick up a 50- to 70-pound ratchet and walk away with it. We failed to explain that man has been lifting ratchets for five years and also deprived the trainee of lifting one for himself. Give the man the practical experience, either to prove his already acquired skills or to simply familiarize him with it. Believe me, it will save you time and the company money in the long run.

Modules can be drawn up for any job situation. And the best part about it is they can be transported to any jobsite. Your safety programs, training, ideas, and any company function can be converted to a module. You will find that in addition to your slide presentations, video tape programs, and lecturing sessions, the module will prove to be an invaluable tool.

One thing I would like to leave with you is another invaluable tool. That is the education department at your local university. They are usually the first to know of new and valuable tools in education and training. Establishing a rapport in that direction can be a great asset.

DELIVERY SYSTEMS FOR NAUTICAL TRAINING

By Captain RAY BOLLINGER
Training Mgr., Herbert F. Hiller Corp., New Orleans, LA

Ever since Captain Roosevelt ushered in the age of steam navigation on the Western rivers by safely piloting the *New Orleans* into the harbor of the Isle of Orleans, the calling of inland boatmen has been regarded as a highly skilled occupation. On that first of all south-bound steamer trips Nicholas Roosevelt had to overcome many obstacles. The more mundane daily dangers were the ever present bars, snags, and the idiosyncrasies of the Mississippi Valley weather. Despite the best efforts of the Army Corps of Engineers most of these dangers, though thankfully to a lesser degree, are with us still. In addition, Captain Roosevelt had to contend with one of the most devastating earthquakes ever to hit North America and attack by Indians who believed the great smoking steamer had caused the earth to tremble.

We have not experienced a major earthquake in the Mississippi Valley in well over 100 years, and the natives have stopped attacking the boats. But this is not to say that a fuel barge explosion could not have the destructive force of an earthquake. Cargo theft and even barge hijacking is not unheard of. Ice jams this past winter sank more than one boat. Today's rivermen face challenges no less difficult than Captain Roosevelt's. The only advantage today's riverman can hope for over Captain Roosevelt is better equipment. But better equipment is only as good as the people who utilize it. People effectiveness is a function of training. How to go about delivering quality training to students who are spread out along a vast inland waterway network is the subject of this discussion.

When we think of the word "training" the image that naturally comes to mind is a formal classroom. If we juxtapose the image of a deckhand, tank-

erman, pilot, or engineer with the image of a formal classroom we immediately realize that rivermen are not grown in little red school houses. Yet in this age of stringent Coast Guard licensing and certification requirements we must find ways of accelerating and amplifying the traditional apprenticeship program. The old "pick up," "learn by doing" method is simply too slow and not comprehensive enough for today's situation. However, to realize this is not to advocate the abolition of the apprenticeship or cub system of teaching the river man's art.

Educators tell us that studies reveal that while we retain only about 10 per cent of what we read and 50 per cent of what we see and hear; we retain about 90 per cent of what we say and do. Nothing involves us more in the training. This is why on-the-job training traditionally has been so effective. However, on-the-job training has two weaknesses that render it ineffective as a sole means of training today. Coast Guard license exams require a great deal of theoretical and regulatory knowledge; this type of knowledge is rarely passed on in an on-the-job situation. It is truly said that some men have 10 years' experience while others have one year's experience repeated 10 times. A modern riverman must be prepared to handle a variety of situations in an environment of constant change. This is why it is imperative today that on-the-job training be augmented with some type of formal training.

To decide what type of formal training your company will require, you must know the basic steps in setting up a formal training program. Anytime that you are dealing with students spread out over a broad expanse of the marine environment it is imperative

that you do the following:

1. Determine your real training needs.
2. Match these needs with possible teaching systems.
3. Match the possible teaching systems with the logistic realities of the situation.

Each of these considerations require further elaboration. To determine your training needs basically you must determine two things: Who requires training? What training is required? These needs will vary somewhat from one company to another. Perhaps you have no shortage of licensed pilots or operators but have a difficult time finding engineers. The main thrust of your training program might best be devoted to engineer training. Perhaps your insurance statistics indicate an excessive number of back and hand injuries among the tow-building crews. This would indicate that some deck hand training is in order. Training can also be a retention incentive. License preparation training can often keep a promising deck hand from "jumping ship" just for a few more cents per hour pay. The important point to keep in mind is that a training program where training will aid retention, decrease equipment damage, increase efficiency, or reduce insurance costs or other overhead. Investigate long and carefully before you decide who needs training and what training is needed.

Once you have decided who to train and in what areas you must decide how. Management must match the training needs with possible teaching systems. In order to effect a good match you must be familiar with the various marine training systems. A brief list of presently practiced marine training systems along with some of their advantages and disadvantages follows:

1. Paramilitary Corps of Cadets. One of the oldest marine training systems, excellent for total career preparation. Presently used in such diverse institutions as the Merchant Marine Academy and the Harry Lundberg School of Seamanship. This system mixes all types of formal training with on-the-job training in an atmosphere

of stringent discipline. It effectively teaches both seamanship and "employee manship" as a by-product of discipline; however, it is extremely expensive and time consuming. This type of training is best employed by institutions and unions as a pre-employment method of total vocational-technical education.

2. Formal Classroom Training. Another very old form of training. Excellent for presentation of theoretical or regulatory factors. It is versatile and relatively inexpensive, but is only as effective as the teacher and requires removal of students from job site. In a marine environment this is logistically difficult.

3. On-the-Job Training. Another very old form of training excellent for teaching "hands on" operations. It is relatively inexpensive and has a 90 per cent retention factor as students learn by doing. However, it is not comprehensive, theory and regulations are not adequately presented, operations common to the industry but not occurring aboard are not taught.

4. Correspondence Training. A relatively recent system of training, at its best very effective in teaching theory and regulatory aspects of a job. It is relatively inexpensive and trains the employee on the job site, but it requires a high degree of self discipline and excellent reading skills on the part of the employee.

5. Cassette Tape Training. A very recent development in training, it allows a formal classroom type presentation with sight and sound to be utilized by individuals whenever and wherever needed. Excellent for theory and regulations. It employs sight and sound and requires little reading skills to use. When employed with appropriate work books it offers a high retention rate. However, it has a relatively high initial investment and does not teach "hands on" aspects.

From the partial listing of training systems preceding one fact becomes apparent. There is no magic training bullet, no one quick and easy system that will meet any company's total training needs. You must mix and match systems with various training needs. Despite some claims by manu-

facturers of audio-visual equipment, there is no "best" training method. Any effective total training system will employ several training methods.

Perhaps we can better aid an understanding of the employment of various training methods by examining in detail successful training plans. One that I am particularly familiar with as training manager of the Herbert S. Hiller Corporation is the Hiller Offshore Division's Training Plan. Hiller offshore service technicians install, repair, maintain, and inspect fire, safety, and survival equipment on offshore oil platforms and drill ships. The work is of an electro-mechanical nature and highly skilled. It takes place in a marine environment and requires extensive safety training. The work is governed by extensive Coast Guard, Geological Survey, and OSHA regulations. Service technicians must be experts in the laws, codes, and standards that govern their trade. The technicians and their helpers at any given moment are spread all over the Gulf of Mexico and occasionally other areas of the world where offshore production or drilling is underway. Yet, to become certified each technician must absorb hundreds of hours of formal training. The delivery system for this formal training is a case study in the employment of the various training methods in an atmosphere of tight budgetary considerations. When a new "helper" is first hired with Hiller's Offshore Department, he spends his first three days on the job in formal classroom training. During this period he has the basic offshore safety rules explained to him and is introduced to some of the theoretical and regulatory aspects of his new profession. He is then assigned to a "certified" or "senior" technician and is sent offshore for the first time in the company of the more experienced man. This begins his first on-the-job training session. He does not report for the job empty handed, however. The new trainee is always sent to the job with a "practical factor check-off list." This is a list of practical skills that the certified technician must teach the trainee by a specific time. At the end of the specified time-period the trainee will be evaluated in these skill

areas by the training manager. During this initial on-the-job training period the trainee receives weekly correspondence training packets. These packets contain very short lessons on regulatory and some technical matters. Each lesson is complete in its self and followed by a test.

Upon completion of an initial three-month on-the-job session the trainee is returned to the home office for a week of testing, evaluation, and multimedia instructions. He is then sent to a one-week "hands on" factory-run training school. Upon completion of the school he is returned to the field with a new practical factor check off list. Correspondence training is resumed. During the next three-month on-the-job training session the trainee will be evaluated bi-weekly and undergo periodic testing. In addition, when not actually offshore the trainee will undergo several one day seminars.

At the end of the second on-the-job training period the trainee is required to undergo extensive certification exams. If a trainee passes these exams he will begin his next phase of training by spending some time working under the supervision of more senior technicians and going on some selected jobs alone. This training period is followed by extensive exams and another factory school. This program has cut training time from the old apprenticeship system by more than half. Yet this system requires that trainees be out of the field less than three weeks per year. In addition, the extensive testing program offers very valuable proof of training and competence so important from an insurance view point.

So, perhaps this works very well for an offshore service company. But the problems of a towboat company, while somewhat similar, are still significantly different. How should towboat companies accomplish effective training? Perhaps the real question should be: How can my company accomplish effective training? Not only are towboat company training requirements different, but they differ significantly from company to company, depending upon size and route served. Yet I submit that everywhere in the industry where

too is not for everyone. Small operators may not be able to afford the prolonged periodic absences of key employees involved in such schemes. Such smaller operators must fall back on training schemes of their own design that minimize absences. These operators can benefit greatly from a study of the Hiller Offshore division's approach to training. In putting together a training program for a small corporation, one of the questions that arises as the various segments take shape is the decision to develop or purchase the various segments. There are many fine sources for purchase of nautical science materials and programs such as Cornell Maritime Press, Houston Marine Consultants, and Western River Training Centers. In deciding whether to purchase or develop your own program or segments thereof, remember to put a dollar price on your own time. Compared to the cost of purchase, developing all of your own training material may at first appear inexpensive. Once you start on the project you may find it prohibitively time consuming.

To summarize, your training program will be effective if you:

1. Determine your real training needs.
2. Match those needs with the possible teaching systems.
3. Match the possible teaching system with the logistic realities of your particular situation.

One final point to keep in mind if you are embarking on your first training endeavor: do not write your first lesson plans in concrete. You may make a few mistakes and have to effect changes, but keep plugging; ultimately, training does not cost, it pays.

successful training is going on, you will see this mix-and-match principle at work. The Inland Boatmen's Union utilizes it in their Harry Lundberg School program. The I.B.U. begins with a pre-employment, intensive paramilitary training program. Mixing formal classroom with hands-on and multi-media training, the new trainee is given a basic introduction to the river deck hand's skills and safe working practice. Through the discipline of the paramilitary barracks life, the new trainee learns the art of being a successful employee through promptness, courtesy, developing the ability to live in close quarters with others, dressing properly for work, and following directions. After this initial orientation period the trainee is cleared for employment with a union affiliated company. Upon completion of Coast Guard required minimum service time, the trainee can elect to return to the school for resident license preparation studies. Resident college style (non-military) license prep courses are offered in the areas of towboat operator, master freight and towing vessels, and engineer. So here again we see a successful mixture of various types of formal training mixed with on-the-job training. This efficient handling of the training function is one of the major economies involved in using union crews. This practice has worked well for such operations as Dixie Carriers, Inc. Non-union companies who utilize the National River Academy are receiving a service very similar to that offered by the I.B.U.

While the orientation, on-the-job training followed by license prep scheme works well for the I.B.U. and National River Academy members, it

TANK INERTING—THE SAFE WAY

By D. H. VOGEL

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In 1933 the Motorship *Bidwell*, a Sun Company tanker, exploded with a considerable loss of life while tank cleaning at Marcus Hook, PA. Prompted by this incident, Sun Company spent considerable time and money developing means of inerting cargo tanks. The use of stack gases was decided on because of the great volume required and the supply was readily available at no cost. An inerting system adapted from a refinery procedure for inerting shore storage tanks was installed aboard ships. Over the past 45 years additional safety features and other variations have been added, gradually evolving the system into what we have today.

The inert fuel gas system is now internationally accepted as a safety feature. In comparison with and unlike other fixed smothering systems, the inert fuel gas system is in use at all times and, therefore, can prevent fire or explosion within any unbreached cargo tank.

The basic principle is very simple. If sufficient inert fuel gas is added to a mixture of hydrocarbon gases and air, the oxygen content is reduced by dilution until the mixture can no longer support combustion. The purpose of the inert fuel gas system is to reduce the oxygen level in all cargo compartments by filling them with inert fuel gas. By maintaining a low oxygen level under all conditions of operation, it increases the safety of the crew and vessel. The inert fuel gas used is funnel gas washed, cleaned, and cooled.

Oils can be divided into different classes depending on their volatility. Ordinary kerosene has so low volatility that it is unlikely that inflammable vapor can be generated without heating. On the other hand, motor gasoline has a high volatility and inflammable gas is generated at very low temperature. Fire or explosion of oil gases is

possible only in the presence of oxygen. Air contains normally 21 per cent oxygen, and this is more than enough to support combustion.

If the oxygen content in the tanks is reduced to below 11 per cent by volume it is insufficient to support fire and explosion. If the oxygen content can be reduced further, say to five per cent, this will provide an adequate margin of safety.

The gases from main boilers of turbine ships which operate at normal rate have the following approximate composition: oxygen (O₂), about 4.2 per cent by volume; carbon dioxide (CO₂), about 13.5 per cent by volume; nitrogen (N₂), about 77.0 per cent by volume; sulphur dioxide (SO₂), about 0.3 per cent by volume; water (H₂O), about 5.0 per cent by volume; solids, about 150 mg/meter³.

Motor vessels may not have the boiler capacity to generate such high quantities of inert gas; therefore, it may be necessary to inert by using a separate inert gas generator.

CO₂ and N₂ are inert gases (i.e., they do not react chemically with other matters under the conditions which are common in boilers and cargo tanks). The quantities of CO₂ and N₂ should, therefore, be kept as large as possible. This can only be achieved with an economic combustion, where the burners operate with lowest possible quantity of excess air for complete combustion. O₂, SO₂ and H₂O are undesirable elements in the gas. The O₂ content decreases with low air-fuel ratio to the burner. SO₂ can be kept low by using fuel with low sulphur content or washing out the larger part of the sulphur dioxide in the gas before the gas is permitted to enter the cargo tanks. More on this later.

In addition to sufficient oxygen to support combustion, an air-gas mixture falling within the explosive range

is required. The explosive range falls between the lower explosive limit (L.E.L.) and the upper explosive limit (U.E.L.)—generally, one per cent and 15 per cent respectively, expressed as per cent by volume of oil gases in the air-gas mixture.

During the process of loading, discharging or tank washing the explosive range is passed through perhaps many times. Unfortunately, there is nothing the crew can do about it.

As mentioned above, the concentration of hydrocarbon gases in air must be within the explosive range as one condition for starting a fire or explosive. The second condition is that the explosive mixture is ignited. The energy necessary for ignition is small and varies, dependent on gas concentration. The ignition energy is smallest for a mixture in the middle of the explosive range.

Sources of ignition can be any of the following:

1. Collision between two ships will generate sparks and heat from friction high enough to ignite oil gases.
2. Smoking can also be the cause of ignition, as the temperature in a glowing cigarette is in the range of 850°-400°C. The temperature in a match flame or a lighter is high enough to ignite gas-air mixture if the gas concentration is in the explosive range.
3. Sparks from portable electric lamps.

4. Sparks from falling matter.

5. Static electricity can be generated by different means. Great turbulence caused by ventilation and by water jets from washing machines can generate static electricity in the jets.

In large tanks, static electricity can also be generated by turbulence in the tank atmosphere. When the deck area is cooled during the night or by rain, an intense condensation of water vapor takes place in the tank below deck. This gives air turbulence in the tank atmosphere and "clouds" in the upper part of the tank. It is likely that these conditions generate high potential charges in the tank atmosphere with energy high enough to ignite a gas-air mixture.

Blowing steam into tanks with gas concentration within the explosive

range should be avoided.

Washing machines should be efficiently grounded, as static potential high enough to ignite a flammable air-gas mixture can be generated.

In the conditions described above it is supposed that cargo is replaced by fresh air during discharging and during tank cleaning. The explosive limits are defined for oil gases in fresh air with an oxygen content of 21 per cent by volume. If the fresh air in the gas-air mixture is replaced by a gas with a lower oxygen content, the distance between the U.E.L. and L.E.L. is reduced.

If the oxygen is reduced to about 11 per cent by volume, which corresponds to about 43 per cent of nitrogen in the air-gas mixture, the distance between U.E.L. and L.E.L. is reduced to 0.

In this case the gas mixture is non-flammable, irrespective of the concentration by hydrocarbon gases. If the oxygen content is reduced further to say five per cent or six per cent by volume, the safety margin against fire and explosion is increased considerably.

The best known inert gases are carbon dioxide and nitrogen.

Although vessel personnel can do nothing about the gas in the tanks, they can do something about the oxygen. They can use the inert gas system. However, there are conditions to be met. The system must be used, not merely installed. This means it must be used at all times while discharging cargo or ballast and gas freeing. The only time the system must be secured is while loading. The system performance must be constantly monitored. Although the concept of using cooled, cleaned fuel gas is a marvel of simplicity, each individual component, each control, operates under severe environmental conditions and must perform a critical function. These components must be properly maintained by a crew fully aware of the advantages of inert gas and well trained in its use. An inert gas system, improperly designed and poorly maintained, can be a source of tremendous danger because of the false sense of security on the part of the crew. We at Sun have found that without proper supervision

the crew soon loses interest in the use of the inerting system. During the past 45 years that we have had inert gas systems on our ships, the most important lesson we have learned is the importance of proper training of the officers and crews in their responsibilities in its operation.

Sun uses a basic system on its vessels. The components are tailored to the size of vessel and the type trade the vessel is engaged in. Whatever system is used it should be well designed, as simple as possible, and still be able to do the job required of it.

The system starts with the fuel. Inert gas can be generated by combustion of all types of fuel ordinarily used in boilers and diesel engines. The lower the sulphur content of the fuel, the less the sulphur dioxide will be formed. Although almost all sulphur dioxide is washed out in the scrubber, the last few per cent of the SO_2 in the flue gas is difficult to remove. (By complete combustion all sulphur is burned to SO_2).

Combustion takes place at the surface of the oil droplets from the burner; it is important that the atomization of the fuel is efficient, i.e. as small oil drops as possible. The fuel should have the correct viscosity and pressure, the mixture between oil and air should be as good as possible. The inerting system should never be operated while the boilers are in an unstable condition such as that encountered in the maneuvering mode. These factors are necessary in order to keep the air-fuel ratio at a low value and consequently get as high values of nitrogen and carbon-dioxide as possible in the flue gas.

The stack gas is drawn from the uptakes through remote-operated butterfly valves. As a safety feature the valves can be interlocked with soot blowers to close during soot blowing. In addition to assuring that excess soot will not be carried over, it must be borne in mind that during soot blowing excess air and high oxygen level can be anticipated. For these reasons it must be seen that it is necessary to stop inerting while soot blowing. The hot stack gases are then piped to the scrubber tower.

ger vessels it is necessary to change to centrifugal fan-type blowers because of the large volume of gas required to be moved and the necessity of keeping the blower a reasonable size. The fan should be of the split-casing type, to permit ready access to the impeller. Coated impellers should be avoided, as any loss of coating would result in severe unbalance. A water spray to the impeller has been installed on our larger ships. This is to help remove any soot buildup which, if left unchecked, will cause unbalance.

Two complete blowers should be installed, each with 125 per cent pumping capacity of the ship. With an inert gas system it must be remembered that in the beginning of discharge, the pumping rate, due to the cargo head in the tanks, is always greater than normal. It is especially important never to allow the flow of inert gas to fall behind the pumping capacity; otherwise, outside air would be drawn into the tanks through the venting system, negating the inerting effect. With the lobe-type blowers we use a multispeed motor, and with the centrifugal fan type the motor is constant speed. In the case of the former, excess gas is vented through the mast vents, and in case of the latter it is sent back to the scrubber via a demand-type recirculating valve. In either case, a positive pressure must be kept on the cargo tanks at all times.

Leakage of hydrocarbon gases from the cargo tanks back to the non-hazardous area (e.g., engine room or to the uptake) must be prevented to avoid any risk of explosion in those areas. Even a very small leakage can build up a dangerous concentration of gas. No mechanical valve can be relied on to give this degree of tightness after a period of service. Therefore, our newer ships have a positive liquid seal fitted on the deck just at the boundary of the hazardous and non-hazardous areas. The older vessels have a hammer-line blank installed in the same position.

In addition to the liquid deck seal and located just forward of it, the newer vessels also have a non-return valve which acts as a first barrier against returning gases.

The inert gas system is essentially a closed system. On the deck level, the main line runs the length of the cargo area with branch lines off into each cargo hatch. The trunk line vents off at the top of the king posts. Except in abnormal condition, all venting is done at the top of the king post, well away from the deck. We do not allow ullage pipes on the cargo hatches. All soundings and gaugings are done through the after ullage pipe located near the main tank suction. No difficulties have been experienced as the ullages have been adjusted to this area of the tank. This ullage or purge pipe runs to within 18 inches of the tank bottom and 36 inches above deck. Once the cargo rises above the bottom of this purge pipe, cargo levels in the tank may be visually observed through this pipe without gases blowing into the observer's face.

We believe this ullage or purge pipe should be included in the system. They are eight-inch diameter with a weighted lid which can be sealed shut. The branch lines should each have a butterfly valve and a pressure-vacuum valve by-passing the butterfly valve near the hatch.

When inerting prior to loading, the procedure is to open the purge pipe lids on several tanks and allow the gas to enter the tanks via the branch line in the hatch. The inert gas, being heavier, will drop to the bottom and displace the lighter gases, forcing them up the purge pipe. When the CO_2 and O_2 readings are the same at the inlet hatch and the purge pipe, then those tanks are purged. Close the purge pipe lids and go on to another set of tanks.

When gas-freeing a tank, the normal procedure is to close the branch vent line valve after that tank is gas free. This is to prevent gas fumes from adjacent tanks contaminating the clean tank through the branch line. Caution must be taken that these valves are reopened before loading. Should the line be left closed, the tank would vent through its branch line PV valve. The PV valves on the king posts are set to lift at 5 lb. There are gate valves fitted at the base of the king posts and PV valves set to .75 lb. to by-pass these valves in the event they are inadvertently left closed. Further

down the deck on the main line is fitted an oil seal. This will also blow out through excessive pressure or vacuum. It is filled with a light hydraulic type oil and is set to blow out at a slightly higher pressure than the PV valves.

Our foreign flag fleet uses the newer design higher pressure systems. After purging, they seal the purge pipe and pressurize the tanks. The PV valves are set to lift at a somewhat higher pressure of about 1.9 pounds. At this pressure it would be very dangerous to open an ullage lid. Gauging is done by built-in tape which can be read from the deck.

It is also very important to remember that inert gas will not support a man's life any better than it will support combustion. Any tank previously inerted must be checked very carefully before entering with an O₂ analyzer after it has been vented. It must be checked not only at the top but also throughout the bottom.

Test equipment must be used constantly to determine CO₂ or O₂ as each is related to the other. At present the best analyzers are such instruments as the Orsat or Fyrite.

Checks should be made at the boiler uptakes and compared to that obtained at the tank hatch. Any substantial deviation should be checked out immediately. Gas entering the tanks should contain no more than five or six per cent O₂ and around 12 per cent CO₂. If the O₂ reading is high on deck but normal at the boiler, then air is being drawn into the system somewhere along the line. This will negate the system's effectiveness if allowed to continue. If the flow rate is reduced, the deck lines should be opened and

cleaned out, as scale deposits can build up over a long period of time and cut down the cross section of the pipe to the point where it will adversely effect flow. To facilitate scale removal we provide clean-out holes every 50 feet or so on the deck and engine room lines. Although the principle of the inert gas system is a marvel of simplicity, the various components operate under extremely severe conditions. This means that the system must be continually maintained by people who fully understand it and realize the true value of it. If enough maintenance is deferred on the main engine the ship will eventually encounter a costly unscheduled delay. The result of deferred maintenance on the inert gas system is somewhat more subtle. It won't affect the vessels operation until you need it, and who can predict just when that will be? The fact is that fully inerted tanks can not explode. The challenge is to maintain the system at a level which ensures that the tanks will indeed be fully inerted.

This outlines the entire inerting system with what we have learned in over 45 years. In essence, efficient operation depends first on the interest of crew and supervisory personnel and secondly on proper maintenance of machinery. What do our ships average in the tanks? From 2½ per cent to four per cent CO₂. That, to a prudent ship operator, is a good safe margin to have. The use of a fixed tank cleaning system on Sun Transport ships would not be permitted unless the tanks are first properly purged. With all of the studies that have been made, no one can argue this point of safety.

THE U.S. MARINE SAFETY INFORMATION SYSTEM

By RICHARD D. WHITE
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The rash of marine casualties during the winter of 1976-77 in and adjacent to the navigable waters of the U.S. generated considerable notoriety and concern regarding the marine transportation of petroleum and petroleum products. The rapid succession of tank ship casualties underscored the fact that immediate action was required to reduce the threat of pollution of the marine environment and to improve the safety of U.S. ports and waterways. Certainly, the names *Argo Merchant*, *Sansinena*, *Olympic Games*, *Claude Conway*, and others remain as poignant reminders and examples of the kinds and magnitudes of the catastrophes which can occur in port or at sea.

These maritime disasters preoccupied America at a time when the importation of crude oil was at an all-time high and expected to increase. Additionally, the Trans-Alaska Pipeline System (TAPS) was scheduled to commence operations during the summer of 1977. Crude oil from Alaska was to be transported from Valdez, AK, to Puget Sound and southern California by vessel. In view of the sequence of tank ship casualties and the hazards associated with tank ship operations, many people were uncomfortable with the prospect of more tank vessels operating in populated and environmentally sensitive areas.

Affirmative action by the Federal government and the Coast Guard was essential to minimize the potential for vessel casualties and the resulting pollution and property damage. In a message to Congress on 17 March 1977, President Carter announced several international and domestic measures to reduce the risks associated with the marine transportation of petroleum and to reduce oil pollution resulting from vessel casualties. An important

aspect of the President's program was the initiation of a foreign flag tanker boarding program by U.S. Coast Guard personnel. This examination was designed to assure full compliance with U.S. safety and pollution prevention regulations. The President also directed the establishment of the U.S. Marine Safety Information System (MSIS) which was to record the results of each vessel boarding and examination. In his statement, the President also stated the MSIS was to maintain records of vessel pollution incidents, casualties, violations of Federal safety and environmental protection regulations, owners, stockholders, and changes in vessel names. The President further directed that the information collected on vessels was to be available to the Coast Guard captain of the port (COTP) to enable him to identify vessels with histories of poor maintenance, violations of regulations, and casualties. This information could be used by the captain of the port to impose conditions or restrictions on vessels operating in U.S. waters that have poor histories or to exclude a particular vessel from entering U.S. ports until corrective action has been completed.

In early April 1977, the Commandant of the Coast Guard directed the establishment of the U.S. Marine Safety Information System to fulfill the requirements set forth by the President. A significant amount of information required for the MSIS was available within the Coast Guard in automated or manual form. The objective of the development effort for the MSIS was to collect the various data elements, put them in compatible form and establish an automated file of vessel information which could be retrieved by the captain of the port. The violation history of vessels en-

tering U.S. ports was already maintained by the Coast Guard in the Port Safety Reporting System (PSRS). This system was originally envisioned in 1972 as a means to disseminate information to captains of the port on the federal regulation violation history of vessels entering U.S. ports. The purpose of automating these records was to encourage comprehensive, consistent, and rational enforcement of federal regulations. In addition the captain of the port could evaluate the potential hazard each vessel presented to the port, based upon its violation history, and selectively board vessels to ensure compliance with applicable regulations. At this time there was also a need for Coast Guard Headquarters to determine and analyze the kinds of violations encountered, the frequency of occurrence, and the type parties involved with the violations to permit affirmative action to be taken Coast Guard-wide on these violations and involved parties.

The operation of the PSRS relied upon U.S. regulations requiring most merchant vessels entering U.S. ports to provide the Coast Guard with 24-hour advance notice of arrival. With this lead time, the captain of the port could query the PSRS for the violation history of the vessel. In the system, vessels were primarily identified by the number assigned in *Lloyd's Register of Shipping*, but histories could also be accessed by using the name, flag, and call sign of the vessel. To ensure the same vessel was correctly and consistently identified in the PSRS, the official number, gross tonnage, length, owner, propulsion, and service were also on file and provided to the captain of the port with the violation history. All of the requests for histories were made during working hours, batch processed overnight, and the responses were ready the next morning. By reviewing the violation history, the captain of the port could determine which vessels were to be boarded that day and prepare the vessel boarding teams for the type of violations which might be encountered.

Coast Guard officers at District Of-

fices conducting civil penalty hearings were also able to use the PSRS. By requesting violation histories on individual responsible parties (master, owner, agent, shipper, etc.), the hearing officer could consider the number and type of previous violations involving the same responsible party in determining appropriate civil penalty action.

The computer software and telecommunications network of the PSRS served as the nucleus of the Marine Safety Information System. Pollution incident, casualty, and boarding and inspection data had to be added to the PSRS to enable it to meet the criteria established by the President for the U.S. Marine Safety Information System (MSIS). Pollution incident information involving vessels was extracted from the Pollution Incident Reporting System (PIRS) which is maintained by the Coast Guard. Casualty data from Coast Guard files and commercial sources was obtained for incorporation in the MSIS.

The use of the old PSRS as the MSIS could not be accomplished without some changes to system operation and capabilities. It is important to note however, that many of these enhancements to the PSRS were already under consideration as the next logical step in the orderly progression of the development of the system. The President's mandate served to accelerate the development and implementation of these modifications. The formation of these modifications. The foreign flag tanker examination program had a significant impact on the MSIS, as the Coast Guard was directed to board and examine annually each foreign flag tanker calling at U.S. ports. Frequently we found that vessels were boarded consecutively in two or three ports within several days. If the vessels are in full compliance with the applicable regulations at the first boarding, there is little reason for reboarding the vessel within a few days. The need was apparent for a rapid update capability to minimize the number of repetitive boardings of vessels in compliance and to maximize the number of vessels boarded.

As the Coast Guard does not have

sufficient personnel resources to board each vessel during every port call, the captain of the port must determine which vessels are to be boarded each day. A primary objective of the old PSRS was to provide the COTP with some information on previous vessel violations to use in managing the resources available. A violation history, however, presents only the negative aspect of the vessel's operation in U.S. ports and in fact may be misleading. Vessels with equal number of violations may have a significantly different frequency of visits to U.S. ports and of boardings by the Coast Guard. Therefore, it was necessary to record each vessel arrival, all Coast Guard boardings, examinations, and inspections, and the results of the activities in the MSIS. This kind of information would portray a more accurate picture of the vessel's compliance or non-compliance with U.S. safety and environmental regulations. Three major changes to the old PSRS were initiated to make the MSIS a more useful system for the Captain of the Port and to management personnel at Coast Guard Headquarters: all Coast Guard activities, not only violations, were to be entered in the MSIS; individual captains of the port were to have the ability to report these activities through the use of the computer terminal to update the vessel history rather than have Coast Guard Headquarters enter all the data; and the MSIS was to be operational 24 hours a day, with immediate response to inquiries.

These system changes, with the additional kinds of information required by the President, generated the development of five primary routines or files within the software of the MSIS. These are vessel identification and description, pollution information, casualty information, violation history, and boarding and inspection information.

The pollution incident, casualty, and violation files each contain identifying information on the particular vessel involved (using Lloyd's number as reference), the date of the pollution incident, casualty, or violation, and

the reporting Coast Guard unit. The pollution incident file also contains the quantity of the spilled material. For MSIS use, vessel casualties have been aggregated into ten groups consisting of collision with another vessel, collision with a structure, grounding, fire, explosion, structural failure, break-up, wake damage, and engine failure. Most of the casualty data has been procured from commercial sources. Pollution and casualty files are updated quarterly, while the violation file is updated as the reports of violation are received at Coast Guard Headquarters from the captains of the port. All of the updates to these files are accomplished at Coast Guard Headquarters.

The boarding and inspection file is the most intricate aspect of the MSIS and has developed into the largest, most active file in the system. In addition to providing identifying data, this file is a record of each port call of all merchant vessels required to provide the U.S. Coast Guard with 24-hour advance notice of arrival. It also provides the local captain of the port with the date, location, and nature of the most recent Coast Guard actions involving the vessel and the general reasons for the action. The boarding and inspection file is that part of the MSIS with which the local captain of the port interacts on a daily basis. As stated earlier, the captain of the port may retrieve information from the boarding and inspection file on the most recent Coast Guard contact with the vessel, and he also enters data to the MSIS regarding actions he has taken with respect to a particular vessel. This information is immediately entered to the vessel's boarding and inspection history in the computer and may be retrieved by the captain of the port at the vessel's next U.S. port of call. The timeliness and accuracy of this information enables each captain of the port to have the information to employ his resources more efficiently.

Data input to the boarding and inspection file by captains of the port is accomplished by means of four-digit alpha-numeric codes. A two-digit al-

phia code was developed to indicate the type of action taken or to be taken by the captain of the port. The nature of the situation which prompted the action is specified by a two-digit numeric code. Alpha codes were developed for 29 possible Coast Guard actions, while 26 numeric codes were created to indicate the situation involved. Examples of the alpha codes or actions are:

- AA Advance notice of arrival—no boarding
- CE No violations noted
- CD Violations noted, corrected
- CB Violations noted—report of violation to follow
- DA Permanent repairs required prior to entry to U.S. ports
- DB Permanent repairs required prior to cargo transfer
- DC Temporary repairs—cargo operations permitted
- DF Prior deficiencies corrected
- FA Vessel denied entry
- FB Vessel detained

Typical numeric codes which indicate the kind of boarding are as follows:

- 80 Break bulk (container)
- 81 Bulk liquid
- 70 Pollution prevention
- 40 Casualty
- 57 Tank vessel exam
- 60 Cargo handling/piping/venting
- 64 Navigation safety equipment
- 67 Marine sanitation device
- 30 Vessel movement control

Not all alpha-numeric code combinations are logical, however, as some clearly apply to tankers, general cargo, or tow boats operating on the inland rivers. A grid of acceptable combinations was assembled for use in determining the correct codes to be used. By a simple matching of the alpha and numeric codes, the captain of the port can enter the results of his activities involving vessels in U.S. waters in the MSIS. Once the codes are entered, the vessel's boarding and inspection file is instantly updated and available to the next captain of the

port requesting information on that particular vessel. While data entry is accomplished through codes, verbal descriptions of Coast Guard actions appear when the vessel history is retrieved.

The success of the MSIS is dependent upon daily and accurate use of the system by each captain of the port. Each unit generally follows the following procedures to obtain vessel information and update the boarding and inspection history: Upon receipt of advance notice of a vessel arrival, or when several notices have been received, a request is entered into the MSIS for retrieval of a boarding/inspection history. The review of this history may prompt the captain of the port to request a more detailed violation, pollution, or casualty history from the MSIS. Analysis of the available information may be used to determine which vessels shall be boarded or inspected and to prepare Coast Guard personnel for each boarding and inspection. At the end of the work day or when the majority of boardings have been completed for that day, the terminal operator is informed of the type and results of each vessel boarding and inspection. The accumulated list of previous requests can be recalled on the terminal, and the boarding and inspection results can be entered in the system in coded form. For each vessel name, an opportunity is provided to enter the two-digit alpha code, to indicate Coast Guard action taken, and the two-digit numeric code, to clarify the action taken. When a vessel history is requested, the vessel identifying information remains in the cumulative listing or queue until the four-digit code has been entered. In other words, a vessel history can be requested in the morning for an arrival scheduled for that evening. If the vessel remains in port for several days, the name will be on the queue to be recalled with any subsequent requests. Only when codes have been entered will the name be removed from the queue and that vessel's history be instantly updated with the latest boarding results. The MSIS prompts each user to enter a code for

every vessel remaining on the request queue.

The President's statement of 17 March 1977, mentioned earlier, also directed that the MSIS is to contain information on the names of owners and major stockholders of all tank ships entering U.S. waters. An advance notice of proposed rulemaking was published in the *Federal Register* on 13 April 1978, which will prohibit tank vessels of 20,000 dwt or more carrying oil in bulk, from entering the navigable waters of the U.S. or a safety zone of a U.S. deepwater port unless the ownership information is provided to the captain of the port. If the owner of the vessel is a corporation, the names of the stockholders of the corporation holding five or more per cent of the voting stock must be provided. The regulations will also have provisions requiring prior submission of owner and stockholder information to the Coast Guard for inclusion in the MSIS. As long as there is no change in the information from the last time it was submitted, and the owner, master, agent, or person in charge of the vessel informs the COTP that the ownership information is on file in the MSIS, the report is not necessary. The intent of these regulations is to have accurate information on tank vessel owners to be used by the Coast Guard to contact the party responsible for the vessel in the event of an actual or potential pollution incident. Additionally, the Coast Guard's capability to identify responsible parties may result in fewer substandard tank vessels operating in U.S. waters.

The hazards presented to the public and the maritime community by the operation of substandard vessels and the degradation of the marine environment continue to draw considerable attention. Many of the domestic initiatives the President directed be undertaken on 17 March 1977 have been accomplished or are nearing completion. As with other aspects of the President's directives, the tanker boarding program and the operation of the U.S. Marine Safety Information System are continuing. Coast Guard

activities aimed at improving the safety of U.S. ports and waterways and reducing the potential for pollution of the marine environment. Through careful analysis of Coast Guard boarding and inspection activities and the information needs of the captain of the port, the MSIS has developed into a management tool for the captain of the port in addition to recording boarding and inspection activities. Now, timely and meaningful information is available to the captain of the port to ascertain the potential threat or hazard a particular vessel presents to the safety of the port or the marine environment. With data from the MSIS, the captain of the port can decide what actions, special precautions, or operating limitations are to be employed when unusual or hazardous situations develop.

Although the operation of the MSIS at the captain of the port is uncomplicated, the software development and data base are complex and extensive. The MSIS data base is a sizeable and important source of information on commercial vessel activity in U.S. waters and also Coast Guard operations. Fortunately, the potential uses of the vast amounts of data in the MSIS were envisioned early in the development of the system, and the computer software is designed to provide the maximum amount of flexibility for retrieval of information. Through statistical and analytical reports generated by the MSIS at Coast Guard Headquarters, management officials have access to information concerning vessel activity in a given port or on a nationwide basis, numbers of vessel port calls of a particular flag or type, numbers and types of Coast Guard boardings and inspections (port-specific or nationwide), and the number and type of violations detected. At this time, the capabilities of the MSIS to provide management information have not been fully exercised. By analyzing the various descriptors of vessel activity available in the MSIS and Coast Guard boardings, inspections, and emergency response activities on both a port and nationwide basis, the Coast

Guard will be able to initiate more affirmative internal and external actions and policies to improve maritime

safety in the navigable waters of the United States.

COAST GUARD IMPLEMENTATION OF TITLE I OF THE PORTS AND WATERWAYS SAFETY ACT

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(The opinions expressed in this article are solely those of the author and do not necessarily reflect those of the U.S. Department of Transportation or the U.S. Coast Guard.)

In 1972, the United States Congress passed a major piece of maritime legislation, the Ports and Waterways Safety Act of 1972 (86 Statutes at Large 424, Public Law 92-340, 33 United States Code, Sections 1221-1227). The major thrust of Title I of the Ports and Waterways Safety Act (PWSA) is the promotion of safety and preservation of environmental quality in U.S. ports and waterways.

Although the legislation as passed gives Coast Guard district commanders and captains of the port, via delegations of authority, less new authority than they would have received under earlier proposed legislation, these individuals nevertheless are given extensive powers. These powers are exercisable by each district commander and captain of the port to prevent loss of or damage to any vessel, bridge, or other water or waterfront structure and to prevent environmental damage to the navigable waters and the resources in those waters.

This paper discusses in detail the manner in which the Coast Guard has implemented the powers given to the U.S. secretary of transportation, which have been redelegated to the commandant of the Coast Guard. In turn, many of these powers have been further delegated by the commandant of the Coast Guard to district commanders and captains of the port. Among the PWSA powers which will be discussed are the following:

1. Establishment and operation of vessel traffic services in ports, harbors, and other congested waters.
2. Control of vessel traffic in especially hazardous areas and during re-

duced visibility, adverse weather, vessel congestion, and other hazardous circumstances and mandating the anchoring, mooring, or movement of vessels.

3. Establishment of procedures and standards for the handling, loading, discharge, storage, and movement of hazardous materials on water and waterfront structures; requiring minimum safety equipment for water and waterfront structures and prescribing minimum safety equipment requirements for vessels.

4. Establishing water and waterfront safety zones for the protection of vessels, structures, waters, and shore areas.

5. Investigation of waterfront incidents.

The implementation of the PWSA through exercise of these powers has taken many forms. Mandatory and voluntary vessel traffic services have been established in certain vulnerable and heavily traveled ports and waterways. Extensive vessel traffic management authority has been delegated to district commanders and captains of the port throughout the United States, and these powers have been used to regulate the movement of LNG, LPG, and other hazardous materials. De-tailed waterfront facility regulations are in the process of being drafted. The authority to establish safety zones has been delegated to the field through published regulations. Water-front facility investigation regulations are now in the process of being fully developed.

This paper summarizes the extent to which the provisions of Title I of the Ports and Waterways Safety Act have been partially and fully implemented and the extent to which further implementation remains to be done.

Vessel Traffic Services (VTS)

The PWSA authorized the Coast Guard to establish, operate, and maintain vessel traffic services and systems for ports, harbors, and other waters subject to congested vessel traffic. It also permitted the Coast Guard to require vessels operating in an area of a vessel traffic service or system to utilize or comply with that service or system. Among other requirements, the Coast Guard may require a vessel to carry or install electronic or other devices necessary for use of such a service or system.

There are currently five vessel traffic services in operation pursuant to the authority granted in the PWSA. These are in Houston-Galveston, Texas; San Francisco, California; Puget Sound, Washington; Prince William Sound, Alaska; and New Orleans, Louisiana.

The following is a summary of the operation of each of these five systems:

Houston-Galveston VTS became operational in February 1975. This voluntary system incorporates an automated vessel reporting system, low light level television, and radar coverage.

San Francisco VTS, the first U.S. VTS, was first operational in August 1972. This voluntary system is dependent on radar surveillance and traffic separation scheme.

Puget Sound VTS, which became operational in September 1972, utilizes radar coverage of congested areas and a traffic separation scheme. There are Federal regulations in force, 33 CFR Part 161, Subpart B, requiring vessel compliance with the VTS.

Prince William Sound VTS was required by the Trans-Alaska Pipeline Authorization Act (Public Law 93-153). It is the second mandatory system and involves a traffic separation scheme, radar coverage, and nationally recommended tracks for offshore routing of Trans-Alaska Pipeline System tankers. Regulations for this system are found in 33 CFR Part 161, Subpart B.

New Orleans VTS is the most recent VTS to begin operations. It is a volun-

tary, automated vessel-movement reporting system.

There are plans to begin operations of another system in the near future. New York VTS is scheduled to become operational in January 1979. It will incorporate an automated vessel-movement reporting system, radar coverage, and low light level TV.

When the Coast Guard begins planning and installation of a VTS in an area, local maritime operators and interest are usually indifferent or opposed. However, once the VTS begins operations, the service being provided has been appreciated and support has grown. Vessel pilots have become one of the most cooperative local marine groups concerning VTS; this is evidenced by the high percentage of cooperation received in voluntary systems. Nevertheless, there have been some exceptions; for example, one pilot who violated captain of the port instructions relayed through the mandatory Puget Sound VTS was found to be in violation of 33 CFR Part 161 and received a civil penalty of \$2,500, which was approved on appeal by the commandant of the Coast Guard.

Expansions are planned for the systems at Puget Sound, New Orleans, and Houston into geographical areas not previously covered. A study is being conducted to determine whether a VTS is needed for the Intracoastal Waterway in the vicinity of the Gulf of Mexico. A planning proposal is being drafted for a Chesapeake Bay VTS. However, Coast Guard studies have not indicated a need for a service in Delaware Bay.

A five-year VTS research and development program is underway, with completion planned for 1982 or 1983. System requirements are being studied in addition to equipment development and computer programming. A modular approach is being taken in system development to reduce future design, operation, and maintenance costs. In addition, this effort is expected to produce technology which will improve future systems' effectiveness, reliability, and operations.

Vessel Traffic Management

The PWSA also authorized the sec-

retary of transportation to direct the anchoring, mooring, or movement of a vessel when necessary to prevent damage to or by that vessel or her cargo, stores, supplies, or fuel. In 33 CFR 160.35, this authority, already delegated by the secretary to the commandant of the Coast Guard in 49 CFR 1.46(n) (4), has been further delegated to each Coast Guard district commander, and captain of the port, or his authorized representative.

Even greater authority to regulate vessel traffic was provided in Section 101 (3) of Title I of the PWSA. Between February 1975 and October 1977 that authority, as delegated to Coast Guard officials by the commandant of the Coast Guard, was found in the following language in 33 CFR 160.35 (b): "Each district commander, captain of the port, or their authorized representatives may temporarily control vessel traffic in an area which he determined to be especially hazardous, or under conditions of reduced visibility, adverse weather, vessel congestion, or other hazardous circumstances by issuing orders: (1) specifying times of vessel entry, movement, or departure to, from, within, or through ports, harbors, or other waters; (2) establishing vessel traffic routing schemes; (3) establishing vessel size and speed limitations and vessel operating conditions; and (4) restricting vessel operation in a hazardous area or under hazardous conditions to vessels which have particular operating characteristics and capabilities he considers necessary for safe operation under these circumstances."

The word "temporarily" does not appear in the authorizing language of the PWSA but was inserted by the Coast Guard in these regulations in 1975 to protect against any abuse of this authority. However, in view of the successful use of this authority without abuse and the desirability of freeing the district commander and captain of the port from unnecessary restraints upon their ability to ensure port safety, the word "temporarily" was deleted from 33 CFR 160.35 (b) in October 1977. There are still sufficient restrictions since this vessel traffic management authority may be exer-

cised only in an especially hazardous area or under hazardous circumstances.

It should be noted that compliance with directions and orders issued under the authority of these vessel traffic management regulations, once there is actual notice of them, is made mandatory by 33 CFR 160.39. Failure to obey such an order or direction could lead to the imposition of a civil penalty of up to \$10,000 under 33 USC 1226 or the imposition of a criminal penalty, a fine between \$5,000 and \$50,000 or imprisonment for up to five years, or both, under 33 USC 1227. Fortunately, few violations of orders or directions have occurred during the years of existence of these regulations.

The deletion of the word "temporarily" from this regulatory authority makes it clear that each district commander and captain of the port has authority to issue longterm operational and contingency orders for the movement by vessel of liquefied petroleum gas, liquefied natural gas, and other hazardous materials through his port or ports.

In order to protect against abuse of the broad vessel traffic management authority granted to each district commander and captain of the port, the Coast Guard has provided that orders or directions issued under this authority may be appealed. Thus, under 33 CFR 160.45, any person directly affected by such an order or direction may request reconsideration of or appeal the order or direction to the district commander and then to the commandant. The decision of the commandant is considered final, although independent review by a court is always a possibility. Any order or direction being appealed remains in effect during the pendency of the appeal; the issuing official, however, could voluntarily delay its effect pending the outcome of the appeal.

Advance Notice of Arrival

An extremely valuable tool to the captain of the port in performing his vessel traffic management duties is the advance notice of vessel arrivals, departures, hazardous conditions, and certain dangerous cargoes. The cur-

rent 33 CFR Part 124 Advance Notice Regulations under the Magnuson Act are being replaced by new regulations in 33 CFR Part 161 issued under the authority of PWSA. For safety and environmental protection purposes the notification requirements are being broadened to require more notifications, particularly concerning the movement of hazardous materials and the existence of hazardous conditions. A notice of proposed rule-making to this effect was published in June 1978.

These vessel notifications are extremely important because they trigger captain of the port requests to the computerized Marine Safety Information System maintained by commandant (G-WLE) for an immediate printout of each incoming vessel's casualty history, pollution history, violation history, and other pertinent data. Based upon this information, the captain of the port can make a well-informed decision as to whether to use his limited resources to board and inspect a particular vessel.

A related regulations package published in April 1978 proposes another form of advance notice. Tanker ownership notification regulations would require all oil tankers of 20,000 tons deadweight or more that call at U.S. ports, places, or deepwater ports to report to the Coast Guard information concerning their owners and charterers. Also required would be all registered names by which the vessel has been known and the current nation of registry. All this information also would be retained in the Marine Safety Information System for ready access by captains of the port.

Waterfront Facilities Regulation

Section 101 (7) of Title I of the PWSA authorizes the prescribing of minimum safety equipment requirements for waterfront structures to assure adequate protection from fire, explosion, natural disasters, and other serious accidents or casualties. In October 1977 the commandant of the Coast Guard demonstrated that this authority was being retained by the commandant at the Coast Guard headquarters level by re promulgating the Coast Guard's waterfront facility

tory packages concerning waterfront facilities. These include regulatory packages for bulk liquid facilities, solid bulk facilities, break bulk facilities, intermodal container facilities, bulk liquefied gas facilities, and explosives facilities. Each one of these subjects will be covered in a separate notice of proposed rulemaking which may eventually lead to the issuance of final regulations. At the termination of this massive undertaking, the Coast Guard would have fully exercised in great detail its authority under the PWSA to regulate waterfront facilities.

Safety Zones

Water and waterfront safety zones are authorized by Section 101 (8) of the PWSA for the protection of any vessel, structure, waters, or shore area. Utilizing this authority, the Coast Guard has promulgated safety zone regulations in 33 CFR Part 165.

These regulations supplement the security zone regulations created under the authority of the Magnuson Act (33 CFR Part 127). Security zones cannot be established solely for environmental purposes and are enforceable only by unwieldy criminal penalties (50 USC 192).

The safety zone regulations were issued to better protect designated areas for safety and environmental protection purposes. Authorizing Coast Guard district commanders and captains of the port to establish safety zones should lead to a reduction of incidents which harm the environment or injure people and property.

A safety zone is defined as "an area of water, shore area and water, or shore area designated for a safety or environmental purpose to which access is limited to persons, vehicles, vessels, or objects with authorization to enter the zone from the captain of the port. It may be stationary and described by fixed limits or it may be described as a zone around a vessel in motion."

Safety zones may be established after a request for one is received or may be undertaken on the initiative of the captain of the port or the district commander. Any person requesting establishment of a safety zone must specify the location and the boundaries

of the requested zone; the date, time, and duration of the zone; a description of activities within the zone; and the reason for the request. Requests for the establishment of a safety zone must be made in writing unless they are made within five days, with one exception. If for good cause, a request is made within five days before the zone is requested to be established, the request may be made orally, but the oral request must be followed by a written request within 24 hours.

Once a safety zone is established, no person may enter the zone without authorization; no person may bring a vehicle, vessel, or object into the zone without authorization; no person may remain in the zone or allow a vehicle, vessel, or object to remain in the zone without authorization; and each person in a zone must obey any lawful order or direction of the captain of the port, district commander, or his authorized representative.

Notification of the establishment of safety zones is made by marine broadcasts, local notices to mariners, local news media, distribution in leaflet form, on-scene verbal notices, or publication in the *Federal Register*. Notification normally contains the physical boundaries of the zone, the reasons for the safety zone, estimated duration of the zone, and the method of obtaining authorization to enter the safety zone. The individual procedures used by each captain of the port to notify persons of the establishment of a safety zone vary depending on circumstances and emergency conditions.

As in the vessel traffic management area, there is an appeals section authorizing individuals to request reconsideration of, or to appeal the establishment of, a safety zone or any order or direction issued under the authority of the safety zone regulations.

Waterfront Incident Investigations

Regulations concerning marine safety investigations are being drafted to implement the investigatory authority found in Section 103 of the PWSA. That section provides that the secretary of transportation may investigate any incident, accident, or act involving the loss or destruction of, or damage to,

any structure subject to the PWSA or which affects or may affect the safety or environmental quality of the ports, harbors, or navigable waters of the United States.

The significance of this statutory provision is that it also provides for the issuance of a subpoena to require the attendance of any witness and the production of documents and other evidence. If a subpoena is not obeyed, there is authority to request the attorney general to seek court enforcement of the subpoena. In addition, the statute provides that witnesses may be paid fees for travel and attendance in conjunction with these investigations.

The draft investigation regulations authorize the investigation of incidents on waterfront facilities, as well as incidents which have caused damage to the environment. As such, they would provide subpoena power and witness fee payment authority for oil pollution and similar investigations.

Summary

Although limited resources have precluded immediate implementation of all the broad powers created by Title I of the Ports and Waterways Safety Act, the foregoing activities demonstrate that the Act has provided the U.S. Coast Guard with several important port safety tools.

The development of several quite different and distinct types of vessel

traffic services has demonstrated the feasibility of this formal means of vessel traffic management. The use by Coast Guard captains of the port of other broad, ad hoc vessel traffic control powers has demonstrated the workability of that type of management. Their ability to effectively use these powers will be enhanced by improvement of the regulations requiring advance notice of vessel arrivals, departures, hazardous conditions, and certain dangerous cargoes.

Waterfront facilities are the subject of intensive and extensive regulatory study by the Coast Guard, and the regulations governing them should be significantly improved within the next two years.

The ability to create safety zones has provided local Coast Guard officials with the necessary tools to unconditionally or conditionally regulate specific geographical areas presenting safety or environmental problems. Finally, the ability to effectively investigate waterfront facility and environmental casualties should enable the Coast Guard to reduce the likelihood of occurrence of similar incidents.

In summary, the Ports and Waterways Safety Act is the source of several different but complementary types of governmental authority which have been and are being utilized by the U.S. Coast Guard to promote port safety and marine environmental protection.

A SAFETY ANALYSIS OF FISHING VESSEL CASUALTIES

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The *Encyclopedia of Nautical Knowledge* defines a fishing vessel as a vessel employed in the business of catching fish. At the present time, it can be stated that the business is apparently healthy, since the number of vessels in the United States that are documented as fishing vessels has grown approximately 50 per cent within the past dozen years. However, in similar fashion, the number of fishing vessels that were involved in marine casualties has correspondingly increased during the same time span.

Annually, fishing vessel casualty reports amount to between 12 and 17 per cent of the total numbers of vessels involved in reportable marine casualties. The purpose of this paper is to examine some of the more frequent types of marine casualties involving fishing vessels and to highlight the salient aspects of these casualties as they relate to circumstances, location, fishing fleet type, and the subsequent result of these casualties, be it loss of vessel, loss of life, or both.

The presentation to follow will present a brief overview or a profile of the U.S. fishing fleet, followed by an analysis of the casualties reported to the U.S. Coast Guard during the 1972-1977 fiscal year period. While the data source utilized for the fishing vessel fleet profile was the documentation records of the USCG, there are approximately four times as many fishing boats of less than five net tons that are state-numbered. However, the casualty data base is mainly composed of incidents involving documented fishing vessels, with state-numbered boats accounting for only five per cent of the total casualty records. The final portion of the paper

will attempt to draw some conclusions from the preceding sections and to focus attention on fertile areas for possible further study.

Fleet Profile

The data utilized in the preparation of this section was obtained from the National Marine Fisheries Service and from the automated record of the U.S. Coast Guard Documentation file. The U.S. flag documented fishing fleet presently numbers over 25,000 vessels, and this number represents a 51 per cent increase within the past 12-year period. It is a fleet small in physical size as compared with other ocean and coastwise commercial vessels, with the majority of its vessels less than 20 gross tons. The major segment of the fleet is composed of wooden hull vessels, with the influx of steel and fiberglass mainly in newer vessels. It is also an aging fleet, with 50 per cent of its vessels in excess of 20 years of age.

The fleet is geographically distributed throughout the Atlantic, Pacific, and Gulf Coasts, with concentrations in certain areas commensurate with specific segments of the industry. For example, New England is the primary fishing ground for cod, haddock, Atlantic Ocean perch, while also yielding Atlantic tuna and, to a lesser degree, clams. The Northern Middle Atlantic area is also a source of Atlantic tuna and clams, while the Southern Middle Atlantic area, including Chesapeake Bay, is noted for clams, crabs, oysters, and on a smaller scale, menhaden. Southern Atlantic fishermen try for menhaden and shrimp, while the Gulf is the prime fishing area for shrimp and menhaden, with oysters and crabs also found within these

waters. The Pacific coast yields a wide variety of fish products, including Pacific tuna, crabs, shrimp, Pacific salmon, cod, and oysters. Alaska has long been known as a source of Pacific salmon, king crab, and other crab species, as well as for a wide variety of other fish catches.

With regard to the numbers of vessels engaged in the aforementioned principle U.S. fisheries, vessels pursuing salmon and shrimp each employs in the vicinity of one-third of the documented fishing fleet, with tuna vessels accounting for another 12 per cent. Crab fishing vessels number approximately five per cent of the fleet, with the remaining 16 or so per cent of this fleet of 25,000 fishing vessels distributed among the remaining fisheries segments.

Casualty Profile

The approach for this section was to compile a six-year data bank of fishing vessel casualties. The source of casualty data was the U.S. Coast Guard's Vessel Casualty Reporting System, which requires a report of any incident that satisfies the criteria specified in the United States Code of Federal Regulations 46 CFR 4.05 which is: (a) actual physical damage to property in excess of \$1,500; (b) material damage affecting the seaworthiness or efficiency of a vessel; (c) stranding or grounding (with or without damage); (d) loss of life; (e) injury causing any persons to remain incapacitated for a period in excess of 72 hours, except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty.

Casualty reports are required to be submitted by U.S. flag vessels regardless of their physical location at the time of the incident and by non-U.S. vessels when the casualty incident occurs within United States territorial waters. For this study, a six-year casualty history period was selected for the following reasons: it is a sufficiently long period for purposes of identifying trends with reasonable certainty; it is relatively current with respect to depicting present conditions

within the industry; and lastly, narrative casualty investigative reports for this period are readily available in USCG Headquarters on microfilm so as to provide additional detail for analysis.

There was a 53 per cent growth in the numbers of fishing vessels involved in marine casualties during the 65-77 fiscal year period. During the recent six-year period from fiscal year 1972 thru 1977, there were over 4,800 fishing vessels reported as having been involved in a vessel casualty, with almost 89 per cent of these casualties consisting of five general casualty types. They are: groundings; material failures; operational collisions; flooding/fouling/capsizing; and explosions/fires.

For the six year period under study, the most notable increases appear in the categories of groundings and flooding/fouling/capsizing. Collisions and explosions/fires are up-and-down during the period, while material failures are somewhat of an anomaly with a very large rise and fall in just a few years time span. This enigma will be more fully explored in a subsequent section of this paper. In considering selected casualty types in terms of the seriousness of the consequences of each type relative to personnel deaths and vessel's lost, the highest overall rankings were jointly attained by flooding/fouling/capsizing and groundings, with the former category number one in number of deaths and number of vessel's lost, while the latter was ranked number one, two, and three in casualty frequency, vessel's lost, and deaths, respectively. The seriousness of flooding, fouling, and capsizing as a cause of fishermen deaths is quite evident, as the number of deaths from this casualty type were almost four times the number of deaths in the next closest casualty type. When viewing the casualty types from a somewhat different perspective, that is, the general location of casualties in coastal and their adjacent ocean areas, the percentage distribution of casualties among the coastal areas is in general agreement with the fishing fleet geo-

graphic distribution. The Inland Pacific region had the highest number of fishing vessels involved in casualties, with groundings in this area being the most prevalent casualty type. (The distinction between Inland and Ocean in this and other references to follow conforms to the information content of the Casualty Report Form, CG-2692, and basically reflects the observance of Inland or International Rules of the Road by the vessel at the time of the casualty incident.)

The following sections of this paper will further analyze the five individual casualty types that have thus far been presented in summary fashion.

Operational Collisions

Operational collisions, for this particular analysis concerning fishing vessels, are defined as those collisions that encompass the following circumstances: collision, meeting; collision, crossing; collision, overtaking; collision with a vessel anchored or moored; and collision with a floating or submerged object. There were 661 operational collision incidents involving 880 fishing vessels during the 1972-1977 fiscal year period. Excluding the sub-category of collisions with a floating or submerged object, which is primarily a singular vessel casualty, fishing vessels had collisions with other fishing vessels in 44 percent of the reported incidents. In other words, fishing vessels collide with each other with almost the same frequency as they are involved in collisions with other type vessels.

An examination of the number of fishing vessel collision incidents over the six-year time span revealed that collisions involving a meeting situation had exhibited a relatively steady and significant rise in frequency of occurrence, while other collision situations either remained relatively steady or fluctuated without an overall rise during the same period. On a total incident basis for the six years under study, collisions by a fishing vessel with a submerged object were most prevalent but closely followed by collisions in a meeting situation and then collisions where one of the in-

involved vessels was either anchored or moored.

More than 60 per cent of the operational collisions took place in daylight hours with weather and sea conditions listed as clear and calm, while rain or fog were reported in only ten per cent of the incidents. Seasonally, the summer months of June, July, and August had the highest number of operational collisions. Wooden hull vessels were involved in 69 per cent of the operational collisions, but accounted for 89 per cent of the vessels totally lost from these collisions. Fifty-seven of the 101 wooden vessels that were a total loss were as a result of a collision with a submerged object. Evidence of the vulnerability of smaller fishing vessels is seen in that of the 158 vessels of less than 15 gross tons that were involved in operational collisions, 31 (20 per cent) were a total loss.

Regarding location distribution of operational collisions within the three large coastal areas, there were several smaller areas that are noteworthy by virtue of the concentration of collision incidents. These are Cape Cod and Nantucket in the New England region, the Mississippi River outlet area of the Louisiana coast, the Galveston area of Texas, the Mid-Gulf itself, the Columbia River outlet along the Oregon coast, and the Ketchikan region of Alaska.

The largest single cause of operational collisions was personnel fault, with Rules of the Road violations listed in almost half of the personnel fault situations. The most frequently mentioned Rules of the Road were the following: failure to keep to the starboard side of the channel in a meeting situation; failure of an overtaking or a burdened vessel to keep clear; burdened vessel crossing ahead of the privileged vessel; rule of good seamanship; lack of proper lookout; speed in fog; and improper signals or lights. Other factors listed as generally contributing to the casualty were the area itself being restricted or congested, poor weather and visibility, and adverse currents and tides.

As a result of fishing vessel opera-

tional collisions, there were 24 deaths, 31 injuries, 114 vessels lost, and over \$15 million in damages during this six-year period. The largest number of deaths, injuries, and dollar damages were as a result of meeting collisions, while the total losses were mainly as a result of collisions with submerged objects.

Groundings

There were a total of 1221 fishing vessel groundings during the 1972-1977 fiscal year period; 693 of the groundings had damages, while the remainder did not report damage. Groundings were evenly distributed over the six-year period, with no single year having an unusually high number of incidents. The summer months had the highest number of groundings, but seasonal variations were not generally in evidence, nor was there a large divergence between day and night time incidents. Fifty-eight per cent of the groundings occurred in either clear or partly cloudy weather, with the same percentage reporting calm seas at the time of the casualty. Wooden hull vessels were involved in 73 per cent of the groundings and accounted for 89 per cent of the vessels totally lost as a result of grounding casualties. Fishing vessel age appeared to have an influence on the results of the incident as vessels in excess of 20 years of age were involved in only 48 per cent of the groundings but accounted for 60 per cent of the total losses from groundings.

A number of geographic areas on each coast were the locations of a greater-than-average number of groundings. These were the Assateague Island portion of the Maryland-Virginia coastline, Ocracoke Island and Beaufort in the Cape Hatteras region, the Tampa Bay section of Western Florida, the Sabine Pass area of the Texas coast, Coos Bay in the Pacific Northwest, and the Ketchikan/Juneau/Kodiak regions of Alaska.

The primary cause of the majority of groundings was personnel fault, with the major sub-category being navigational error having to do with

failure to ascertain the position of the vessel. Other lesser reported causes in the personnel fault category include inattention, misjudging the effects of wind and current, poor seamanship, and lack of local knowledge. Other primary causes of groundings were listed as equipment failure, bad weather, and depth of water being less than that which was charted. With respect to equipment failure as a cause of groundings, the problems reported with the most frequency include failure of the main engine, loss of propeller, jammed rudder, and steering failure. The major factors contributing to the grounding incidents were basically similar and consistent with the primary causes of these casualties.

As a result of these 1221 fishing vessel groundings, 29 individuals lost their lives, 218 vessels were lost, and over \$20 million in damages were reported.

Explosions/Fires

Fishing vessel casualties in the category of explosions/fires are further segregated into the following sub-categories: explosion/fire involving the vessel's cargo; explosion/fire involving the vessel's fuel or fuel handling system; fire of the vessel's structure; fire of the vessel's equipment; and explosion/fire—other, which is intended to include other circumstances or when the circumstances were unknown.

There were 412 fishing vessel explosion/fires during this six-year period, with the sub-categories of fire of vessel structure, explosion/fire other, and explosion/fire involving vessel's fuel ranked number one, two, and three, respectively. The casualties were evenly distributed over the six-year period, with the majority (60 per cent) of the incidents occurring in the summer and fall seasons. Neither weather and sea conditions nor time of day appeared to be factors affecting the large majority of explosion/fires. The characteristics of the vessels experiencing explosions/fires were quite similar to the overall fleet profile with respect to the per-

centages of vessels of similar age, tonnage, and hull material. Not surprisingly, the percentage of wooden hull vessels that were totally lost in explosion/fire casualties was higher than the overall percentage of these vessels involved in this casualty nature.

Approximately 30 per cent of the explosions/fires occurred in the Pacific Northwest and Alaska, with concentrations in Puget Sound, Coos Bay, Juneau, and Kodiak areas. Other locations along the U.S. coast did not have an inordinate number of explosion/fires during the period under study.

The main factor listed as the cause of explosions/fires was equipment failure, with electrical equipment mentioned most frequently. Engine room fires were the second most frequently mentioned causal factor, and fires of an undetermined source were listed third. Factors that contributed or in some manner influenced the circumstances of these explosion/fires were diesel and gasoline engines, electrical wiring, gas and oil heaters, and the galley equipment, primarily the ovens and ranges.

The danger to fishing vessels from explosions/fires is readily apparent when noting that 52 per cent of all fishing vessel fire incidents resulted in the loss of the vessel itself. The most serious of the various explosion/fire categories was fire involving the vessel's structure, which was number two in deaths and injuries and number one in vessel's lost and overall dollar damages. The net result of fishing vessel explosions/fires was 20 deaths, 44 injuries, 215 vessels lost, and over \$21 million in damages.

Flooding/Foundering/Capsizing

There were 819 vessels involved in the casualty category of flooding/foundering/capsizing during this six-year period, with foundering occurring most frequently, followed by flooding and then capsizing. As previously noted, this category was noteworthy for being highest in total vessels and human lives lost. For reasons that are not readily apparent, 79 per

cent of the total casualties within this grouping occurred in the most recent three-year period, with the largest increases in the foundering sub-category.

Environmental factors exerted more of an influence on this category of casualties than most others. Weather and sea conditions, in most cases, were less than clear and calm. While the majority of flooding/foundering/capsizing casualties still occurred in daylight hours, the summer and fall seasons were not as predominant, in terms of the number of casualties, as was noted in other casualty natures.

The characteristics of the fishing vessels that were involved in flooding/foundering/capsizing casualties conform very closely with fishing fleet percentages with respect to hull material and vessel age. In other words, the percentage of wooden hull vessels experiencing flooding/foundering/capsizing casualties was the same as the percentage of wooden hull vessels within the entire fishing fleet. The number and percentage of wooden hull vessels that were a total loss as a result of flooding/foundering/capsizing casualties was also commensurate with fleet percentages for wooden hulled fishing vessels. Where other casualty types showed predominant frequency of occurrence by fishing vessels in the lower tonnage ranges, flooding/foundering/capsizing casualties were experienced by a higher percentage of vessels of 100 gross tons or greater than the percentage of this size vessel within the fleet itself. The overall result of this evaluation of the characteristics of those fishing vessels involved in flooding/foundering/capsizing casualties is the conclusion that this type of casualty is not vessel-specific in the sense of concluding that a certain size, age, or hull configuration is particularly vulnerable to this type of casualty.

Flooding/foundering/capsizing casualties do appear to be location-specific, as the Atlantic and Pacific areas each had approximately twice as many casualties as the Gulf of Mexico region. This ratio was also apparent when comparing the locations

with respect to the number of deaths and the number of vessels lost. The major concentrations within the Inland Atlantic region were noted along the coasts of Maine, Massachusetts, and North Carolina. Within Maine, the coastal segment from Penobscot Bay to Portland had a large grouping, while the Cape Fear area of the North Carolina coast had a similar concentration. The Gulf regions in the vicinity of Tampa, Florida and Galveston, Texas had noticeable numbers of flooding/foundering/capsizing casualties. On the Pacific coast, the Pacific Northwest region and Alaska were the main problem areas. In Alaska, the geographic areas near Ketchikan, Juneau, and Kodiak had numerous casualties, while the Washington coast from Cape Disappointment to Cape Flattery also had a large number of flooding/foundering/capsizing incidents. The geographic locations of those vessels that were totally lost as a result of flooding/foundering/capsizing obviously follow the aforementioned patterns and concentrations of the incidents themselves. However, the deaths as a result of this casualty nature were concentrated in the more northern locations where cooler sea water temperatures prevail. The survival probabilities appear to have a close, if not direct, correlation to casualty latitude insofar as this casualty nature is concerned.

The primary causes of these incidents were much more evenly distributed than those of the other casualty natures under consideration. Personnel fault, weather, equipment failure, and structural failure were the major known causes, with unseaworthiness listed in about five per cent of the incidents. Structural failure and unseaworthiness were similar in that they involved the entrance of water through the hull of the vessel, while the largest singular system mentioned in the equipment failure cause category was the bilge or drainage system. Of the factors contributing to flooding/foundering/capsizing casualties, those mentioned most frequently include adverse weather, machinery problems involving the engine, sea

valves, and stuffing boxes, fishing net problems, overloading, and improper loading.

Flooding/foundering/capsizing casualties had the largest death and vessel lost ratio per incident, primarily from foundering, with capsizing second, and then flooding. The dollar damages accruing from this casualty grouping were the highest of all of the casualty natures under comparison. Because of the seriousness of the consequences of this casualty type, it is felt that further analysis and research into the specifics of these casualty incidents would be very worthwhile.

Material Failure

There were 980 reported fishing vessel material failures during the 1972-1977 fiscal year period, with over 56 per cent of these casualties occurring during 1973 and 1974. Particularly noteworthy during this two-year interval were the large increases in the sub-category of machinery and engineering equipment failures. A possible explanation is the manner in which the narrative casualty cases were interpreted during the coding of the casualty report into the automated record.

Material failure casualties occurred primarily in daylight hours and in favorable weather and sea conditions. The summer months were the time of year when the highest number of material failures were experienced. Regarding the locations of material failure casualties, the Pacific Northwest was the overwhelming leader in frequency of occurrence, with Alaska, the Texas coast, and the Cape Hatteras section of North Carolina having considerably lesser numbers in their respective coastal areas. Within the Pacific Northwest, the offshore regions of the states of Oregon and Washington were the specific sections having the most reports.

The types of vessels experiencing material failure casualties were consistent with the overall mixture presented in the fleet profile with respect to percentages in the categories of hull material, vessel age, and tonnage

ranges, with one small exception; material failure casualties occurred to a larger percentage of vessels of over 100 gross tons, 15 per cent as compared to eight per cent within the fleet.

The primary cause of almost 75 per cent of the material failures was listed as the failure of on-board equipment, with structural failure of the hull noted in almost nine per cent of the casualties, and unseaworthiness of the hull in another four per cent. With respect to on-board equipment failure, the systems mentioned most frequently include the electrical installation, fuel oil and lube oil systems, engine fresh water and salt water systems, hydraulic system, and the hull drainage system. In amplification of the above, the specific equipment items reported in the majority of casualties were mainly the diesel engines, reduction gears, valves, rudder, batteries, steering gear, pumps, shafting, propellers, stuffing boxes, mooring lines, masts and booms, and fuel tanks. To a certain degree, the above is a litany of the entire spectrum of fishing vessel components and conveys rather obviously the thought that no singular area or system on a fishing vessel is the dominant cause of material failures. Rather, a picture emerges of different individual problems on different fishing vessels throughout the entire fleet.

While material failures involving machinery and engineering equipment were most frequently reported, those failures involving the vessel's structure were most serious in terms of the number of vessels lost and the number of deaths. This type of failure accounted for almost 75 per cent of the total losses and 70 per cent of the deaths while tallying only 19 per cent of the total incidents in this casualty category. Alaskan waters were highest with respect to the number of deaths and vessels lost due to material failure, again testifying to the harshness of the operating environment and the low probability of personnel survival following structural failures. Overall, fishing vessel material failures resulted in 63 deaths, 158 vessels

lost, and almost \$12 million in damages during this six year period.

Fishing Activity and Location

Specific information concerning the vessel's activity, be it shrimping, salmon fishing, etc., is not always included within the details of the USCG casualty report. With regard to the six-year period under study, only 53 per cent of the fishing vessels totally lost and 43 per cent of the vessels that were involved in a death situation had specific information as to the configuration of the vessel. Shrimping activities were highest in vessel's lost and personnel killed, followed by ground fishing vessels and salmon fishing vessels. The category listed as ground fishing vessels encompasses those engaged in catching cod, haddock, perch, and flounder.

The great majority of the shrimp vessel casualty losses occurred in the Gulf, which is the location of the largest portion of this particular fleet, and the distribution of casualties responsible for these shrimp vessel losses was quite even among the five casualty types under consideration. However, the casualty types most prevalent in shrimp vessel deaths were flooding/foundering/capsizing, and material failure, which most often involved the failure of the vessel's structure. Again, the Gulf was the location of the major portion of the shrimp vessel deaths.

A large number of those ground fishing vessels that were lost in a casualty suffered the mishap in the waters adjacent to the New England coastal region. This is consistent with the realization that New England is the center of cod, haddock, and other ground fishing activities.

A comparison of specific locations insofar as indicating the number of deaths and the number of vessels lost for the different casualty types over the six-year period shows that Alaska was first in total deaths and total vessels lost, with flooding/foundering/capsizing the largest cause of lives lost. The two categories, flooding/foundering/capsizing and groundings, were largely responsible for the ma-

jority of vessel losses in Alaskan waters. The Chesapeake Bay region was second in lives lost, primarily as a result of flooding/foundering/capsizing casualties. The Gulf region along the coast of Texas was second in overall vessels lost, largely due to groundings and operational collisions. The Pacific Northwest regions encompassing Oregon and Washington were third in terms of deaths and vessels lost. For this area, the major casualty category responsible for loss of life was flooding/foundering/capsizing, and this category, together with explosion/fires, accounted for the major portion of the vessels lost. The Northern California coastal segment placed fourth in deaths and fifth in vessel losses, the deaths largely the result of material failures and flooding/foundering/capsizing casualties, while the latter category was responsible for a goodly number of the vessels totally lost.

In general, this location comparison highlights Alaska and the West Coast of the United States as areas that can

be considered as being very unforgiving insofar as particular types of casualties are concerned. There would appear to be ample evidence to warrant additional study and research in to those incidents resulting in loss of life and loss of vessel for the purpose of ameliorating those circumstances and conditions that frequently precede tragic consequences.

Conclusion

There are many agencies and organizations having interests and responsibilities in that wide domain encompassed by the term "safety at sea." This particular effort utilizing the facilities and resources of one agency, together with supplementary information provided by a second organization, was intended to highlight and focus attention on the casualty picture of one group of seafaring personnel for the purpose of stimulating additional organizations and entities to channel their energies toward improving the total operating environment of the U.S. fisherman.

SAFETY AND PRODUCTIVITY ON OUR WATERWAYS— PARTNERS FOR A BETTER AMERICA

By RALPH W. HOOPER,
Chairman of the Board,
The American Waterways Operators, Inc.

Consider with me for a moment, if you will, this island which we call the Western Hemisphere and the island therein—the United States virtually surrounded by four bodies of water which are avenues for its commerce and upon which its industry depends. The Great Lakes opened up the Northern Mid-East to world-wide trade. The Eastern Seaboard has traditionally been the link between our nation and Western Europe. The Gulf has, with its influx of industry, become great importers and exporters of our nation's wealth, and the West Coast ties us to our non-contiguous states and to the Eastern nations.

While you still have the map of the continental U.S. in your mind's eye, please look at it in relief so that we can appreciate the geological structure of this mighty land. Note that it is divided vertically along the lines of longitude into three separate portions connected by the Old Appalachian Range with its coastal plateau to the east and the vast central plains to its west. Then, in the western continent comes the great divide of the new rugged Rockies and the hilly plains to its west, representing the Pacific coastal region. From these mountain chains drain the waters feeding our inland river system which lace the plains states. So from the Great Lakes to the Gulf of Mexico, God's land was blessed by natural avenues which became highways of commerce from colonial days to the present. Settlers in this nation saw opportunities never provided in the Old World, and waterways became essential links for the goods and materials developed by and needed in this

burgeoning continent. Without concrete and asphalt and before the development of the steam locomotive, waterways and the bays and rivers of the East were the prime means of moving the tobacco, the grain, the naval stores, the machinery, the building materials, and the fuel for a hungry population. As the new territories sought identification with the Union and while the newly-independent citizens went through their shakedown periods of accommodating the vast land and its problems, discussions on the import and use of the waterways developed a policy which was included in the Northwest Territories Acquisition Act of 1787. Here the citizens were granted fundamental rights, including qualification of voters, a complete Bill of Rights, public land for education, and freedom of religion, but also, a commitment by the government in Article IV that these waterways would be forever free of tolls and interference by the government.

Throughout the nineteenth century the railroads contributed greatly to the development of America, and in order to induce capital to flow for new rugged Rockies and the hilly plains to its west, representing the Pacific coastal region. From these mountain chains drain the waters feeding our inland river system which lace the plains states. So from the Great Lakes to the Gulf of Mexico, God's land was blessed by natural avenues which became highways of commerce from colonial days to the present. Settlers in this nation saw opportunities never provided in the Old World, and waterways became essential links for the goods and materials developed by and needed in this

door, competing with the rails. Likewise, agriculture and commerce had reached such a proportion that the river began to need controls beyond those in being for flood control and irrigation developments. So the nation continued its policy that general funding would be provided to enhance and develop the commerce so vital to farmers, heavy and light industry, power plants and municipal water supply. Particularly in the depressed period of the 1930's, our government wisely put in great structures which became the power generation units for an expanding America and provided the pools behind dams to control the merciless floods from this drainage basin land. Because these dams required locks for commerce, they were provided. In World War II, landing craft were built up and down the banks of the inland rivers, and submarines of Manitowoc, Wisconsin were floated all the way to New Orleans where they joined in battle against the Axis Powers. Until recently, these projects, often called pork barrel, were fought for by the Congressional representatives in both Houses so that their constituents would have a share of the federal development of our nation, like agricultural subsidy and defense.

Today, just a few statistics should help us to understand the contribution of this great industry. There are in operation over 4,500 towboats towing and pushing approximately 28,000 barges on the estuarine, river, and coastal waters of our nation. They carry 65 per cent of the waterborne commerce of our nation, leaving only 35 per cent for all the ocean and Great Lakes ships. Furthermore, this 16 per cent is carried at two per cent of the freight bill while employing approximately 190,000 people and scores of thousands of others in the support industries which keep American commerce moving.

If the petroleum carried on the waterways were converted to gasoline for illustrative purposes and put into a car that got 20 miles to a gallon, this car at 55 mph could make 1,148 round trips to the moon and would

take 1.1 million years to consume the gasoline the industry carries. If we say that a loaf of bread takes one pound of wheat and is 12 inches long, the loaves of bread made from the farm products carried by this industry would stretch to the moon and back 17,157 times. Assuming then that this loaf of bread is three inches wide, then laid side by side the highway on which our car to the moon would travel would be 4,289 feet wide.

The AWO is the association of the members of the towing and barge industry. It is the eyes and ears, the catalyst, the spokesman, and the lobby for their interests. Its primary job is to enhance, protect, and develop the industry. To that end, it works willingly and well with the regulatory agencies who attempt to prescribe the safety and environmental protection necessary to any commercial endeavor. Likewise, the legislators in Washington and in the various states are interested in safe, reliable, productive, and economically sound commerce. Today then, without giving statistics on safety that would tend to confuse all of us, let us briefly mention the record.

Lest we feel so perfect that our complacency breeds sloppiness, let me assure you that constantly we are embarking upon safety measures. Almost invariably such safety programs are linked with greater productivity. Herein we can be assaulted by those in our society today who have no accountability for production or the movement of goods, those for whom no growth, no stability, and no employment seems to be the answer. One cannot have a capital-intensive marine business and at the same time recklessly hazard valued vessels and skilled crews in such a manner that they are interrupted from the employment on which their profit depends. To be reckless, foolhardy, while jeopardizing the continued utilization of the assets, just doesn't make sense. There is no way that someone can reap a short term profit by overspending, proceeding into danger, or wantonly disregarding his fellow man and still not run the unacceptable risk

segment of our nation's commerce deeply feel and are committed to reliable safe transportation.

Certainly, objective analysis has shown that rail and highway transportation of dangerous commodities is much less safe than on the waterways.

We respect the regulatory authority that imposes governmental conditions upon the movement of some of these difficult cargoes. We earnestly desire to work with an efficient government staffed by those whose knowledge of the industry is sufficient to be able to understand our role. There will be no spills and there will be clean air if only this country would return to the years prior to the sixteenth century. That not being an acceptable condition, we, the inhabitants working together, can provide the best and most efficient and safest means of transportation the world has seen thus far.

of destroying the same assets which must be profitably employed. No towboat operator can last if his crews are unqualified, if he is undermanned or the men overworked, or if he forces them to proceed against their seaman's judgment.

But yet, even this moment an unforeseen and horrendous accident could occur on our waterways. So long as the United States requires and utilizes dangerous and hazardous materials, and so long as highly volatile mobiles and jet aircraft, we shall be faced with the problem of occasional accidents. We have no quarrel with the pipeline industry, but I personally would be alarmed for our national security if too much of our vital energy were committed to such vulnerable arteries. Our only recourse is that those of us responsible for this

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