The deaths as a result of casualties to fishing vessels continue to remain relatively high with a total of 41 deaths. Fourteen cases of foundering and 1 capsizing accounted for 30 of these 41 deaths.

Deaths as a result of casualties involving towing vessels have decreased; however, collisions continue to waste lives. One life was lost when a towboat was operated despite knowledge that there was a crack in the stern area. The tug subsequently flooded, took a severe trim by the stern entrapping one crewmember in the pilothouse. The others were fortunate enough to be rescued during the dark night by a Naval vessel which happened to be in the vicinity. Three more lives were lost as a result of foundergmg or floodings while three lives were lost as a result of fires and explosions involving towing vessels.

This year there were only three lives lost as compared to 10 reported during 1964 and 14 during 1963 as a result of fires or explosions involving tank vessels or tank barges. These three crewmembers were killed as a result of a flash fire while working on piping in cargo tanks and using portable extension lights for illumination. With reference to casualties involving inspected freight vessels, two casualties which were investigated by Marine boards took a total of 14 lives. These casualties were the foundering of the SS Smith Voyager with the loss of four lives and the collision involving the SS Cedarville-MV Topdalstfjord with the loss of 10 lives. There were no passenger lives lost during this year as a result of marine casualties to large inspected passenger vessels or small inspected passenger motorboats.

The most serious casualty involving loss of life involved a foreign freighter when it ran aground in U. S. waters. The total crew of 32 persons perished when the Liberian freighter SS San Patrick grounded on the southeastern tip of Ulak Island, Alaska. This vessel was a total loss and broke in half with the bow twisting back over the forward part of the hull.

As previously stated, the use of automated data processing assists in determining problem areas and provides information which may be helpful in preventing further accidents. Let us examine two of the areas in which it is considered that problems exist:
explosion, the vessel was blown in two and one crewmember died of a heart attack. At the time of the explosion, the vessel was enroute to a shipyard for drydocking and repairs. Throughout the day, prior to the explosion, the crew was engaged in gas freeing the cargo tanks. At the time of the explosion, No. 8 center tank had been water washed but not gas freed.

The board in its report concluded that the explosion was most probably caused by a magnesium anode falling in the tank creating an incendiary spark. As the result of this casualty, the commandant promulgated regulations to prohibit the installation or use of sacrificial anodes of a type capable of producing a spark as the result of falling in tanks used for the carriage of inflammable or combustible liquids.

\textit{SS Bunker Hill}—On 6 March 1964, while enroute from Tacoma to Anacortes, Washington, a series of explosions occurred in the No. 9 tanks of the T-2 type tank vessel \textit{SS Bunker Hill}. This resulted in the vessel breaking in two and within less than an hour all major parts of the vessel sank. Of the 31 persons on board, the master and four crewmembers who were in the midship house, are missing and presumed to have been lost.

Prior to the explosion, the crew had been involved in cargo tank washing operations in preparation for the loading of a petroleum cargo and to assure that there would be no cargo contamination. The No. 9 tanks across had been water washed, stripped and dried by use of the vessel’s gas exhauster. The gas exhauster is a device operating on the venturi principle utilizing auxiliary steam under pressure to draw liquid and vapor from a tank via its cargo suction and discharge lines.

The board in its report concluded that the use of the gas exhauster probably lowered the petroleum vapor-air concentration to the critical range for explosion. It further concluded that the source of ignition was probably a magnesium anode or a piece of the no longer used chemical wash pipe system falling in the center tank.

\textit{Drilling Barge C. P. Baker}—During the early morning hours of 30 June 1964, the \textit{C. P. Baker}, a catamaran type off-shore drilling barge was at anchor and drilling a well when the drill penetrated a shallow high pressure gas pocket. The well blew out, enveloping the barge with gas which ignited and burned fiercely for about 13 hours. When the well blew out, the water geysered up between the two hulls, struck the drilling platform and cascaded down onto the vessel, entering the hulls through opened deckhouse doors.

The vessel sank in less than an hour while the crew abandoned the vessel over the bow of the port hull. Of a crew of 43 men, eight are dead and 13 are missing and presumed to be dead. The drilling procedure being followed by the \textit{C. P. Baker} was substantially the same as that used for many previous wells. Federal regulations require a blowout preventer to be installed at 3000 feet. The \textit{C. P. Baker} planned to install this device at 750 feet; however, the well blew out at about 680 feet.

Concurring with the board’s recommendations, the commandant in his action has referred this case to the Offshore Oil Panel of the Merchant Marine Council for further study with regard to safety procedures on offshore oil drilling rigs.

There were four major marine casualties investigated by marine board during the past fiscal year.

\textit{SS Santa Maria-M/V Sirrah}—collision—On 19 October 1964, the United States tankship \textit{SS Santa Maria} was in collision with the Dutch tankship \textit{M/V Sirrah} in the harbor at Anchorage, Alaska. The collision occurred during daylight hours with excellent visibility. The weather played no appreciable part, although a three knot current is considered to have contributed to the casualty. The \textit{Sirrah} which was in the process of shifting from the anchorage to the unloading dock, was weighing anchor and had two tugs alongside in attendance. The \textit{Santa Maria}, approaching the anchorage, planned to pass the \textit{Sirrah} and anchor to await its turn at the dock.

The board in its report concluded that the tidal current caused the \textit{Santa Maria} to set down on the anchored \textit{Sirrah} in such a way that the starboard wing tanks came in contact with the bow of the \textit{Sirrah}. Although the collision was little more than a glancing blow, the side shell plating of the \textit{Santa Maria} was fractured beneath the water line and an intense and uncontrolled fire followed immediately.
There was no loss of life on the M/V Sirrah. All of the crewmembers of the Santa Maria were rescued except one who is missing and presumed to have perished while attempting to abandon the burning vessel. The fire on board the Sirrah was quickly extinguished; however, the Santa Maria burned for many hours. Although the engine room and the after quarters of the Santa Maria were severely damaged, only the gasoline cargoes in Nos. 9 and 10 starboard wing tanks were lost and approximately 105,000 barrels of cargo were salvaged with little or no contamination. Since the fire did not spread to adjacent tanks, it is considered that the safety devices such as PV valves, flame arresters and steam smothering served their purposes.

SS Daniel Pierce—On 13 July 1964, the Panamanian tank vessel SS Daniel Pierce suffered uncontrolled leakage while loading sulfuric acid at the Port of Guanica, Puerto Rico. This resulted in contamination of the harbor and the closing of the port to all marine traffic. Because of the extreme danger of an explosion of hydrogen gases, it was necessary to temporarily evacuate the town and for the crew to abandon the vessel.

It is common knowledge that the vessel was not equipped or designed to carry such cargoes, and that the gasket and packing material in cargo lines and valves was that which is ordinarily used in the oil trade. The approximate cause of this casualty, therefore, appears to be the attack by acid in the valve packings, flange gaskets, and brass trim of the valves of the cargo piping systems, ballast sea suction and associated piping which allowed progressive and uncontrolled flooding of the cargo tanks and pump room with sea water.

SS Cedarville-MV Topdalsfjord, collision—On 7 May 1965 the Great Lakes self-unloader SS Cedarville was in collision with the Norwegian freighter MV Topdalsfjord about one mile east of the Straits of Mackinac Bridge. The collision occurred during daylight hours under conditions of heavy fog. The Topdalsfjord, bound towards the St. Mary’s River, had cleared the bridge about ten minutes prior to the collision. At the time of the collision her engine was on stop while moving ahead dead slow on an easterly course. The Cedarville, upbound towards the Straits, was underway at full speed of 12 mph.

Within 45 minutes after being struck on the port side forward of amidships, the Cedarville suddenly rolled over and sank with the resultant loss of 10 lives. The Topdalsfjord received extensive bow damage but suffered no personnel casualties.

The gallant rescue operations of the German freighter MV Weissenburg which resulted in the rescue of all survivors is worthy of comment. This vessel immediately proceeded to assist and in a matter of 15 minutes passed close aboard the stricken freighter. Since the master of the Cedarville reaffirmed his intentions of beaching the vessel, the Weissenburg continued to follow the vessel by radar. When she capsized, the German freighter immediately launched lifeboats and rendered assistance which resulted in the rescue of 26 persons.

The survivors were lavish in their praise of the quick actions of the German master and crew in effecting the rescue and in the care and comfort they received.

These rescue operations were conducted in accordance with the highest traditions of the sea, and the Coast Guard recommended that action be initiated towards appropriate recognition of the meritorious acts performed. The report of the Marine Board of Investigation is still under review.

SS Smith Voyager—Another serious casualty which occurred during the past year was the loss of the Victory type freighter SS Smith Voyager. You will recall that the vessel, loaded with a cargo of wheat, developed a severe starboard list in heavy weather while in a position approximately 600 miles ESE of Bermuda. Of the 38 crewmembers who abandoned the vessel on 20 December 1964, four lost their lives when a water filled lifeboat capsized. The master, one mate and two able seamen who remained on board for another day were subsequently rescued by the USCGC Rockaway. On 27 December the vessel sank while under tow of a commercial vessel.

Although the commandant has not completed his review of the board’s report, some of the contributing factors of the casualty are readily apparent and widely known. The public testimony strongly suggests that the vessel was overloaded, which reduced her reserve buoyancy and her ability to survive.
the adverse weather and sea conditions. The cargo of wheat shifting due to the ship's rolling and resulting in an initial list of approximately 10 degrees to starboard, leads one to question whether or not the cargo was adequately and properly stowed. In addition, the failure of a gasket in the main steam line prevented the vessel from maintaining headway and proceeding on a favorable course to minimize the effects of the sea and the list. In conclusion, this casualty has placed the varied problems concerning both load line regulations and the carriage of grain type cargoes under active consideration.

The overall casualty statistics have revealed cause for optimism. There has been a marked reduction in the number of serious casualties; however, needless casualties are still occurring. If during the coming year the present casualty rate can be held, and hopefully reduced, it will be a major achievement for all of us associated with the American Merchant Marine.

SAFETY GROWS WITH UNDERSTANDING

By WILLIAM E. McCONNAUGHEY
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Ignorance may be bliss but it certainly isn't safety—and especially in modern marine bulk dangerous cargo transportation.

The rapid changes and increasing complexity of this dynamic field are making knowledge of safety and understanding of hazards take on new dimensions and importance. In fact, probably the most important job in dangerous cargo safety today is assuring that knowledge in the right form is in the right hands at the right time—knowledge which leads to understanding of hazards and to safety through proper designs and operating procedures.

I doubt that any of you will challenge this statement and you're probably wondering if the idea didn't originate with some ancient Phoenician sea captain. Perhaps it did but, nonetheless, developing and applying safety knowledge is a very modern problem and one which needs everyone's attention today.

All of us are aware that this is a period of change, although probably few can really comprehend the magnitude of the changes which undoubtedly lie ahead. We can make only very uncertain predictions of what marine transportation will be like after concepts such as nuclear power, hydrofoils, hovercraft, submarine tankers, automation, etc. have been thoroughly exploited. However, we can take a look at some of the changes already underway that affect safety in shipping bulk dangerous cargoes.

One of the most important of these is the rapid growth in the amount of chemicals being shipped by water. Production of basic organic and inorganic chemicals has doubled in the last ten years and, since 1958, it has grown at a rate which indicates a doubling in seven years. A prediction for the future along one of our important inland waterways indicates we apparently are in the early stages of a tremendous increase in the production and per capita use of chemicals. Since chemical manufacturing is now a major industry, expected percentage growth represents many tons of products, much of which will require transportation. Another observation is that chemicals can be expected to become an increasingly large percentage of all dangerous commodities transported in bulk since petroleum products comprise the largest single class at present.

However, from the standpoint of safety and the need for knowledge, variety of commodities is as important as volume. Growth and economic success in the highly competitive chemical industry are based on research aimed at finding new products and new processes to make large scale production of laboratory chemicals economically feasible. Chemical producers spend more of their own money on research and development than any other industry and at a rate which is well over twice the general industrial average. The intensity of this drive to be first on the market with a new or cheaper product is indicated by the fact that over 500 new or improved chemicals are intro-
duced each year, and also by the fact that
over half of the products sold today have
been introduced since 1939.

As a result, we can expect the great
growth in volume of chemicals transported
in the future to be accompanied by a great
growth in variety—a situation which clearly
indicates the need for a new scope of
knowledge and understanding of hazards
by all concerned with transportation.

One of the characteristics of the chemical
industry which is of special interest to the
Coast Guard is its water orientation. Almost
without exception, new chemical plants are
built on navigable waterways to obtain
needed process and cooling water and to
obtain the economic benefits of low cost
water transportation. In 1964 alone, some
426 industrial facilities were built, expanded
or planned along inland navigation channels
and, of these, 116 were chemical or petro­
leum plants. Thus, much of the expected
increases in volume and variety of bulk
dangerous cargoes can be expected to be
seen in water transportation.

There is another possible development
which could have a sizeable effect on the
amount of chemicals moved by ship in U. S.
waters. This is the foreign trade subzone
concept which appears to have a good chance
of more widespread use. Under this system,
designated chemical plants are operated in
the United States using foreign feedstocks
brought in by ship without import duty or
restriction and the chemical products are
then freely moved by ship without export
restrictions. An essential element of this
procedure is water transportation and, if
this procedure becomes common, it will fur­
ther accelerate the growth in bulk shipment
of chemicals.

Thus, for several reasons we can look
forward to sizeable increases in the amount
and variety of chemicals shipped in bulk
in the future. The significance, of course,
is that a much broader knowledge of com­
modities properties and hazards will be
necessary in the marine industry than has
been the case in the past.

Actually, these remarks are not referring
to some abrupt occurrence in the future—
bulk chemical transportation is already in­
creasingly evident on the water. Ships like
the “drug store tanker” are no longer rare,
although they may escape notice because
they look like conventional petroleum
tankers. These are called “drug store”
tankers because their function is to carry
a wide variety of cargoes and whose key­
word is flexibility. You may have noticed
the advertisements by a foreign flag operator
that say “we carry any cargo—so long as
it is liquid.” This one company alone has
increased the number of such ships in its
fleet from 5 to 16 in the last three years.
The ships carry diverse cargoes such as
caustic soda, styrene, carbon tetrachloride,
and ethylene glycol and facilities include
such things as ventilation air dryers, nickel
clad tanks and pumps, vent line dessicators,
and insulated and heated tanks.

Obviously, safe design and operation of
this type of ship requires a more extensive
understanding of commodity properties and
hazards than does a conventional petroleum
tanker. However, the more sophisticated ship
which is probably more indicative of things
to come. Here, liquefied gases at low tem­
peratures, as well as a variety of true
liquids, are carried in integral and deck
tanks. Facilities include inert gas generators,
vapor compression and indirect cargo cooling
equipment, centralized cargo transfer con­
trols, etc. The initial proposal called for
carrying ethylene oxide, propane, anhydrous
ammonia and styrene but already at least 22
other chemicals have been proposed. The
breadth of knowledge required to understand
the cargo hazards involved in operating this
ship is truly impressive, and it includes com­
prehension of such things as thermal sta­
bility, cargo compatibility, toxicity, catalysis,
and polymeric reactions.

Bulk chemical transportation is increas­
ingly evident on the rivers, too. A molten
sulfur tow might be over 1000 feet long and
contain 9200 tons of cargo. Each barge has
its own unmanned boiler room for heating
and circulating heat transfer fluid to main­
tain the cargo at 260-270°F.

Undoubtedly, the fastest growing chemical
on the river these days is anhydrous am­
monia, carried as a refrigerated, liquefied
gas. Cooling is provided by vapor compres­
sion refrigeration equipment.

Again, these examples really only indicate
things to come. We can expect the present
trend toward converting solids and gases
into liquids for transportation and storage
to grow and cargo temperatures will range farther and farther from ambient.

On the high side, molten aluminum at over 1200°F appears to be a possible future cargo and, on the low side, liquid hydrogen at -423°F is making its debut on the water in barges.

There are many economic advantages in handling gases as low temperature liquids and the growth of interest in this practice is rapid. Cryogenic gases are the extremely cold ones which boil below -135°F but there is equal interest in the somewhat warmer gases which are still cold enough to create new problems in containment and casualty control.

One of the important elements of changing conditions is population. Projected increases in the number of people in the United States and the world are truly awe-inspiring, almost impossible to comprehend. Effects will be felt in all areas, and this will include water transportation. Obviously, more people means more congestion on and around waterways which, in turn, increases the possibility of accidents involving dangerous cargoes and the potential seriousness of their effects.

Less obviously, however, more people means much greater concern with the conservation of our water and air resources. Each type of user—sportsman, marine transporter, industrial consumer, etc.—will have to consider more and more the interests of others and to understand the technical nature of these interests. Pollution to the marine industry has traditionally meant oil but, in the future, it will be necessary to understand the consequences of introducing dangerous cargoes and the potential seriousness of their effects.

As one example of the growing concern over water pollution, the State of West Virginia has a surveillance boat which monitors water quality in the Kanawha River near Charleston, W. Va. While this activity is not directed primarily at transportation as a source of contamination, it is certainly included. Air is also being increasingly monitored for pollution levels and sources, and there is little doubt that release of cargo vapors in water transportation by venting, gas-freeing, spills, etc. will attract closer attention in the future.

A new type of knowledge will be necessary both in the design and the operation of vessels engaged in the transportation of bulk quantities by water if these pollution aspects are to be approached intelligently.

From this, it is evident that the Coast Guard feels that the transportation of bulk dangerous cargoes is in the early stages of a period of rapid change and that we are convinced that a broader understanding of hazards will be essential in all phases of marine transportation in the future. The logical question then is, "what are we doing to promote safety through understanding and to keep our regulations in step with changing times?"

Before answering this with a discussion of some of our current and recent activities, let me say a word about a couple of elements of our regulatory philosophy. First, we believe very strongly in a preventive approach, rather than a corrective approach, and we expend considerable effort in predicting hazards without waiting for them to become casualty statistics. Of course, we study the past for its lessons, too, but constantly changing cargoes and conditions as well as the potential magnitude of casualties involving modern chemicals make statistical studies only one of the tools to be applied. We can't afford even one more Texas City disaster or SULPHUR QUEEN disappearance or chlorine barge sinking if advance thinking and analysis can prevent it.

Of course, it's extremely difficult to anticipate all the casualties which might occur with widely varying chemical cargoes, but we believe much can be done by developing principles and fundamentals which can be used to evaluate and compare the hazards of commodities as they are proposed for bulk shipment.

Another element of our philosophy is that we should draw on many outside sources for assistance but should also maintain a competent staff to evaluate the advice which thus becomes available. In other words, we must avoid the extremes of being either an isolated, "know-it-all" organization, or of being merely a rubber stamp for vested interests. So far as staffing is concerned, I will only say that we feel we have a good, well-rounded team and, as a chemical engineer, I personally, am proud to be a member of it.

However, perhaps a few words are in order about our methods of getting outside assistance in the complex business of danger-
ous cargo regulation. A diagram would show the general arrangements in a highly simplified manner. The product is regulations which, as most of you know, flows in the form of proposals to a public hearing and then in final form to the Federal Register and finally to industry for compliance.

Of course, public hearings are an important source of advice, but a great deal of knowledge and advice is obtained before that stage. Four groups that would be listed in such a chart are our formal, continuing advisory groups which fall into two main categories. The first category consists of the NAS-USCG Advisory Committee on Hazardous Materials and the Advisory Center on Toxicology. They may be classed as scientific, and their function is to provide assistance on technical problems arising in connection with regulation development. However, they do not deal directly with regulations. Members of these groups are selected by the National Academy of Sciences on the basis of personal qualifications and each serves as an individual rather than as a representative of an organization or industry.

The other two groups, the Chemical Transportation Advisory Panel and the Western Rivers Panel, may be classed as industry. They provide a vital service by advising the Coast Guard on commercial practices and problems and by assisting in the detailed preparation of regulations which are economically feasible. Members are appointed by the Commandant on the basis of industry recommendations, with the objective of obtaining broad representation for the chemical, petroleum and marine industries.

Such representation is essential in the development of sound regulations and these groups have made major contributions to all of our recent bulk dangerous cargo regulations—for example, the drafting of ethylene oxide regulations by the Chemical Transportation Advisory Panel. Thus, “scientific” and “industry” advisory groups complement and supplement each other in their assistance to the Coast Guard.

On such a chart a block entitled “All Other Sources of Information” would refer to a large number of organizations and individuals who assist the Coast Guard on an intermittent, limited scope basis. It includes safety and trade organizations, individual companies, government agencies, professional societies, academic organizations, etc. These are all very important to the Coast Guard and our personnel actively participate in or closely associate with many such groups. However, they differ from our four advisory groups and serve a different, although complementary, purpose.

After this somewhat philosophical digression, let’s return to the question of what the Coast Guard is doing to promote safety through understanding and to keep our regulations in step with changing times.

In the area of increased understanding, we feel that the new requirement that warning signs, information cards and specially qualified personnel be used with certain bulk dangerous cargoes is an important step forward. As many of you know, barges carrying any of 19 specific bulk commodities must follow these special handling procedures. A typical display of warning signs would be based on a corresponding information card for a particular hazard.

The purpose of these new requirements is to provide personnel moving and handling commodities which have significant hazards, other than or in addition to fire, with information—and, hopefully, an adequate understanding—about these hazards. This, of course, is an example of trying to “get the right information in the right form in the right hands at the right time.”

The main problems have been in deciding what the right information and the right form are. The right information in this case is certainly not everything that is known about the commodity and the right form is not a technical treatise written for professional chemists and engineers. In this case, emphasis should be more on the “what” than the “why”—what to do in case of exposure to acetone cyanohydrin but not why amyl nitrite vapor is an effective antidote.

Although a relatively low level of understanding is adequate for users of information cards, a much higher level is necessary for their preparation, and the conversion problem can be difficult.

Although our regulations do not prescribe wording or require detailed approval of individual information cards and warning signs, we have worked closely with several companies and trade associations in developing wording which meets the intent of the
regulations. This has been very helpful to us in increasing our understanding of the problem of interpreting and communicating technical information to non-technical personnel.

There are no firm plans about the future of this program but, in spite of very limited experience to date, several observations can be made. One of these is that the rigid requirement for giving commodity classification on the warning sign is probably of questionable value. It does not appear logical to warn people that chlorine and anhydrous ammonia are nonflammable gases—especially since this is not strictly true in the latter case.

Another observation is that commodity coverage probably should be extended in the future. If safety does indeed grow with understanding, the program to put information on hazards, properties, and emergency procedures in the hands of transportation personnel probably should be enlarged beyond the presently specified groups to include any dangerous commodity.

Furthermore, such information undoubtedly should be in the hands of seagoing personnel, too, although their conditions are different and the safety knowledge they need would not necessarily be the same as for barge operations.

Another of our actions in the area of increased understanding has been preparation of a book entitled "Chemical Data Guide for Bulk Shipment by Water." In this case, the intended users, or "right hands," are our own Coast Guard field personnel who face a broad spectrum of questions on chemical hazards in coordinating rescue operations, reviewing vessel plans, inspecting vessels and carrying out port security operations. The "right information" is broader and more technical than for information cards and it must satisfy needs which range from a convenient compilation of physical, chemical and toxicological properties for use in barge and ship design considerations to terse information on recommended emergency procedures for use in the event of casualties.

Developing an answer in the "right form" for these needs, and others which may not have been recognized, is a difficult task. Our approach has been to prepare a very limited first edition which has been sent to our field personnel and to a limited number of outside individuals for constructive criticism of format and content. It is planned to prepare a revised and improved edition in the near future which will have widespread availability—for outside organizations, this will probably be by purchase from the Superintendent of Documents. The target date is March 1966.

The flood of requests for copies of the first edition and the enthusiastic cooperation received in making improvements indicates that there is a great need in the marine industry for such a publication. We view it as a living document which will remain flexible and grow and change to meet changing needs. One of its useful functions may be to identify holes in our knowledge and to stimulate efforts to fill them.

For instance, preparation of the first edition has revealed that there is a general lack of information on what concentration of cargo vapors are safe for humans to breathe for short periods of time—such as when entering tanks or taking ullage readings, or in public exposures resulting from accidental release of volatile cargo. The need for such knowledge to permit predictions and assessments of hazards is evident and the Data Guide may be the means of getting the missing information developed or uncovered from unpublished files.

One of our sources of information which will become more important in the future is a questionnaire with the self-explanatory title, "Characteristics of Liquid Chemicals Proposed for Bulk Shipment." This is used to request fairly extensive information from the manufacturer on flammability, reactivity, compatibility, toxicity, production and use, and proposed cargo handling methods for any commodity which is new to bulk water transportation and which may present significant hazards differing from those of normal petroleum products. Although such a questionnaire is not new, it has been revised recently and will be used more extensively in the future. While there is no doubt that this is an important source of information, its value in developing an understanding of hazards depends on asking the right questions and on the availability of answers.

As was mentioned earlier, we feel that the proper approach to safety with widely varying bulk cargoes is to develop principles and
orderly hazard evaluation procedures. Much of our effort along these lines is centered in our two scientific advisory groups, the NAS-USCG Advisory Committee on Hazardous Materials and the Advisory Center on Toxicology.

Although molten sulfur transportation by ship and barge has become quite common in the last few years, the loss of the MARINE SULPHUR QUEEN raised some question about the adequacy of our knowledge of the commercial product. As a result, the Committee on Hazardous Materials has asked to review existing knowledge about hazards associated with commercial molten sulfur, determine if there are any "holes" in our understanding of the hazards and, if so, make recommendations on any research necessary to fill the gaps in our knowledge. A task group of industry, government and academic personnel was formed under the Committee and it has now completed the review phase and has identified the following needs:

(a) A method of predicting the rate of explosive gas generation as a function of temperature, agitation, and composition. (This is important in setting minimum cargo ventilation rates.)

(b) Resolution of the controversy about the presence of carbon disulfide in the evolved gases. (This is important because CS₂ has an extremely low ignition temperature and ignition energy.)

(c) Determination of flammable limits of mixtures of carbon disulfide and hydrogen sulfide, if both are present.

(d) Development of a standardized test for determining the compatibility of organic heat transfer fluids with commercial molten sulfur.

Answers to these questions will give the Coast Guard a sound basis for generalizing sulfur transportation requirements and eliminate the present uncertainties about the effects of changing conditions and cargoes. Typically, close and enthusiastic cooperation is being received from industry technical personnel and the necessary experimental work is underway in laboratories and on sulfur carrying vessels.

Part of the effort to develop and understand underlying chemical safety principles is the holding of periodic symposia on subjects of direct interest to water transportation. Two meetings of this nature have been held by the NAS-USCG Advisory Committee on Hazardous Materials, the first at Warrenton, Virginia in July 1964 and the second at Charleston, W. Va. in July 1965. Subjects covered have included stability and compatibility of substances, sources of chemical safety information, barging of chemical cargoes, chemical plant safety, and water pollution. These meetings have been of great value to the Coast Guard and to invited attendees in developing a better understanding of chemical safety in water transportation.

From these remarks, I think it is evident that the Coast Guard is quite active in promoting safety through understanding and that this activity is stimulated by our belief that bulk dangerous cargo transportation is in the early stages of a period of rapid change. What, then, are we doing with our regulations to keep them in step with the times? In the last couple of years a number of additions and changes have been developed and promulgated, such as those for open hopper barge special operating requirements, ethylene oxide, barge hull types, information cards and warning signs. All of these are concerned with the general problem of safety in bulk transportation of dangerous cargoes other than conventional petroleum products.

However, for some time, we have felt that a more comprehensive approach is needed. A Coast Guard Special Task Group established to study the problem concluded that a new subchapter should be developed to properly recognize all types of hazard which may be created by such commodities in water transportation and to consolidate pertinent regulations presently scattered in three other subchapters. Further development of the Task Group’s concepts and the actual drafting of proposed regulations is now underway as a special project in the Merchant Marine Technical Division at Coast Guard headquarters, with the close cooperation of a Chemical Transportation Advisory Panel task group. A great deal of work still lies ahead, but the task has been pretty well defined and the underlying concepts developed.

Perhaps a summary of our present thought will be of interest. The objective of the new regulations is to prescribe, in a single subchapter, the cargo carrying requirements for bulk water transportation of all hazardous commodities other than those liquids whose
only significant hazard is flammability or combustibility (i.e., requiring oxygen and an ignition source). The scope will be such that on a commodity basis, all dangerous and hazardous cargoes will be included except the following which are provided for in Subchapter D (Tank Vessel Regulations):

(1) Flammable and combustible liquids which have no other significant hazard

(2) Liquefied flammable gases which have no other significant hazard

(3) Solids carried in molten form at elevated temperatures which have no significant hazard other than flammability or combustibility

On a vessel and containment basis, the new subchapter will include barges, tankers, cargo ships and portable tanks. The tentative title of these regulations is "Subchapter O—Rules and Regulations for Bulk Dangerous Cargoes."

The following principles are being used in developing Subchapter O:

(1) Only cargo carrying requirements will be included. General vessel construction and standard operating requirements already contained in other subchapters will not be repeated.

(2) Commodities will be listed by name and will not be classified by hazard.

(3) All commodities having significant hazardous properties other than flammability or combustibility (requiring oxygen and a source of ignition) will be included even though requirements may not differ from those due to flammability alone. When available, a hazard rating system will be used as a guide for determining which hazards are significant.

(4) Primary assistance will be obtained from the Chemical Transportation Advisory Panel, the NAS-USCG Advisory Group on Hazardous Materials and the NAS-NCR Advisory Center on toxicology.

(5) Requirements presently given in Subchapters D, I and N governing bulk transportation of commodities having significant hazardous properties other than flammability or combustibility will be deleted and incorporated in Subchapter O.

(6) Commodities governed by Subchapter D will all be chemically compatible and need not be identified in transportation other than by present flammability or combustibility classifications.

As presently envisioned, Subchapter O will consist of four parts—general provisions, unmanned vessels, manned vessels, and portable tanks. Initial efforts will be confined to unmanned vessels (inland and seagoing barges) and the carriage of liquids and liquefied gases. Elements of Containment and handling will be arranged in separate subparts to provide gradations of requirements based on potential hazards to operating personnel and the public. A chart will be used in each part to list requirements applicable to specific commodities. A table will be incorporated in both Subchapter O and Subchapter D listing all regulated bulk commodities that are permitted to be carried by water and specifying which subchapter is applicable.

This paper is not an effort to push a panic button. However, it is intended to be a strong reminder that one of the fundamentals of safety is understanding of hazards and that, in the face of changes underway and envisioned for bulk dangerous cargo transportation, we all face a challenging job in developing this understanding and in getting the right information in the right form in the right hands at the right time.

Along with its statutory responsibilities for safety of lives and property on the water, the Coast Guard feels a duty to provide leadership and inspiration wherever possible and not to function merely as a police force. It is hoped that this discussion has contributed to that endeavor.

REFERENCES


PORT SAFETY—A NEW LOOK

By CAPT. WILLIAM A. JENKINS, USCG
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The challenge of accident prevention in our ports is the greatest at any time in our peacetime history. During the past two decades the production and transportation of industrial chemicals on our waterways have increased manyfold. Our ports are visited by increased numbers of special vessels of novel design, both foreign and domestic, carrying cargoes which, during transport, must be highly refrigerated, heated or pressurized, such as liquid propane, molten sulphur, butane, anhydrous ammonia and many others.

Radioactive spent fuel elements from our reactors abroad are being returned to the United States for reworking. These highly radioactive sources, together with the transport of other radioactive materials, have now become commonplace.

In addition to the hazards normally associated with certain dangerous cargoes, the problem of water pollution by some materials, as well as by oil and refuse, has similarly increased. Local, state, and federal authorities are becoming more and more concerned over this problem and public pressure is demanding removal of safety hazards and control of pollution.

How did the Coast Guard acquire its present role in port safety?

In World War I the United States Coast Guard was made responsible for enforcing certain regulations issued under the Espionage Act of 1917 concerning the anchorages and the safety of shipping. At the end of that war, port security ceased to be a federal function. In 1940 the President again invoked the Espionage Act and the Coast Guard re instituted its port security program. In February of 1942, the President extended this program to include waterfront facilities and areas. With the ending of World War II port security operations were terminated.

In October 1950, with the beginning of the Korean conflict, the President once more initiated a program of port security. When the truce treaty was signed, the port security program should have followed the pattern established at the close of other wars and ceased to be a federal function. However, it did not. The program continues to exist. It exists because the necessity which engendered it continues in being. The port security program is a part of our over-all national security program. It is directed by Presidential Executive Order, supervised by the Secretary of the Treasury, and operated by the Coast Guard.

We have established a program of port safety which consists of four parts: regulatory control, correction of hazards, enforcement, and review of casualties.

The regulations, based in law and issued by the Coast Guard, are first studied and publicly accepted by industrial representatives, safety engineers, and interested shipping and transportation personnel. They provide national standards for safety and public protection. These standards govern the stowage and handling of dangerous cargo on vessels and waterfront facilities, the packaging and labeling of articles, the separation of incompatible commodities, and the handling and stowage of commercial and military explosives, to name a few.

In our concept of government and private enterprise, port safety depends primarily on the efforts of owners and operators of the ports and vessels.

In some port areas the owners and operators have formed associations and mutual aid organizations on the basic premise that, where all unite to assist one, each best protects his own. But, more on this later.

This concept of self-policing to obtain port safety is subscribed to by the Commandant. It is found in the legislative history of the Dangerous Cargo Act as the intent of the sponsors of this legislation. Also the final paragraph of Executive Order 10173, which sets up the Coast Guard Port Security Program, states this very clearly over the signature of the President:

"Primary responsibility. Nothing contained in this part shall be construed as relieving the masters, owners, operators and agents..."
of vessels or other waterfront facilities from their primary responsibility for the security of such vessels or waterfront facilities."

The enforcement phase is a major responsibility of the Coast Guard. Approximately 1400 officers and men are specifically assigned to the function of port security. The senior operational Coast Guard officer in each of the larger ports is designated the Captain of the Port and made responsible for enforcing the port security and dangerous cargo regulations. His enforcement authority extends to all privately owned or operated piers and vessels on the federal waters within his area, and on them he may make inspections, conduct searches, control the access of things and persons, and supervise and control operations involving dangerous cargo.

In general the Coast Guard secures compliance by fostering a program of public understanding and support, by issuing advisory warnings to operators of facilities as necessary, and by encouraging enforcement of local ordinances by local authorities.

In the meantime the Captains of the Port are fully occupied in hazard correction. Harbor patrols on the water and inspection details on shore daily check the port area for hazardous conditions. Stowage of cargo, whether of dangerous cargo or not are considered by the inspecting personnel from all aspects of safety.

They evaluate procedures, stowages, compatibility of cargoes, housekeeping, safe practices. They identify the nature of the hazard. Is it incendiary, toxic, radioactive, corrosive? Is it combustible, flammable, deflagrating or detonating? They estimate the probability and the imminence of an accident; the capability of available forces to control the accident.

If from the reports of his inspecting details a Captain of the Port judges that a vessel, or a pier, or part of the harbor area is in danger, he may take immediate steps to lessen the danger. If the fire protective equipment on a pier is not sufficient to provide a reasonable degree of safety to a vessel moored alongside, the Captain of the Port may require the vessel to shift to an anchorage or to another pier. If the stowage of a substance in a hold is incompatible with other commodities, he may order that substance removed from the vessel. If the bulk packaging operations in a nearby handling shed endanger the transfer of flammable cargo at the terminal, he may suspend the general permit for handling dangerous cargo until safeguards have been established.

If urgent necessity requires acetylene burning on a pier during the shipment of sensitive explosives, he may require that the entire scene be put under his immediate supervision and control. If any hazard severely threatens the safety of a vessel, terminal, or area of the port, he may establish a protective zone under guard with access limited to his control, may require the safe withdrawal of all vessels, equipment and personnel, and may enlist the aid and cooperation of all federal, state and local authorities.

The last phase of the port safety program is the review of casualties. Marine accidents in port are thoroughly investigated by personnel from the Coast Guard Marine Inspection Office for the main purpose of obtaining serviceable information for preventing similar casualties. Fires and other accidents on waterfront facilities are the subject of inquiry by the Captains of the Port. Investigations and reports made public by local authorities and insurance associations are reviewed.

The Coast Guard also administers a special program for preventing sabotage which complements the safety program by attempting to eliminate those occurrences which are not accidental.

But let's turn to a major immediate task in this complicated port safety mission—the handling and transportation of dangerous cargoes. The question arises as to the future strategy to combat the ever-increasing disaster potential due to the increasing volume and types of hazardous materials now being shipped via water transportation. The problem has been made real by actual accidents, some of which could have produced a major disaster or holocaust.

Perhaps someday we will see pertinent data of the transportation of hazardous cargoes maintained accurately on a computer similar to the flight plan data used by aircraft. Then a spill or casualty at any location along the route could be referred to the data center and an immediate "read-out" obtained which would identify the product, the hazards of toxicity, reactivity and flam-
mability, give first aid precautions, firefighting and fire control procedure and locations of the nearest control equipment and expertise. Such a sophisticated system is in the future.

What is being done now?

As I mentioned previously, a need exists for not only an understanding by industry of its responsibilities, but for the same understanding by local, state and federal authorities. And in the process of carrying out these responsibilities, immediate consideration should be given to a plan of mutual aid.

Such a plan has recently been established in the Port of Houston. Let me briefly explain the workings of the Channel Industries Mutual Aid Plan, with emphasis upon the U. S. Coast Guard Casualty Information Center operated by the U. S. Coast Guard, Captain of the Port, Houston.

Houston is a port area abounding with several dozen chemical plants and ships hundreds of chemicals by water. Of 150 known chemical products manufactured along the channel, at least eight are explosive within certain ranges of mixture with air; two are unstable and explosive; one ignites and explodes when exposed to air; and some may detonate under heat or shock. Explosive, toxic and corrosive hazards exist. Safety must be the byword!

As a measure toward exercising more control over emergencies in this congested area, the Captain of the Port, Houston set up a system for rapid retrieval of information to identify hazards, to suggest methods of control, and to disseminate this information to Coast Guard personnel and other interested groups. A card file is maintained for each chemical which is shipped through the Port of Houston. This program is coordinated with the Channel Industries Mutual Aid (CIMA) which at present represents only 23 of the 36 chemical manufacturing plants along the channel.

The Captain of the Port will be capable of:

1. Maintaining an up-to-date check of all chemical movements on vessels and terminals.
2. Immediate access to pertinent and vital information on each chemical.
3. Contacting promptly those industrial safety directors and casualty control personnel in the Houston area who are most expert on each specific chemical. Each chemical plant maintains personnel of the highest training and experience for each of its products. Their advice and assistance would be highly desirable, perhaps essential, to the safety and success of Coast Guard personnel and others called upon to combat a chemical accident.

The Captain of the Port maintains a Casualty Information Center in which he displays a large metal wall map of the Houston Ship Channel showing all waterfront and contiguous facilities, chemical storage areas, manufacturing plants, and chemical pipe lines crossing under the channel. Magnetic tabs are posted daily to indicate the location of dangerous chemicals on piers and vessels. Should a casualty occur, other magnetic tabs would indicate areas of spillage or fire, traffic control posts, direction of wind, and areas threatened by a movement of the spillage or fire.

When a casualty is reported, an inspection of the wall map should reveal what chemicals are known to be in the area. If the initial reports of fires or spillages fail to identify the chemical involved, the wall map will assist the Duty Officer in making a reasonable estimate.

Upon ascertaining what chemical is involved, the Duty Officer (OOD) will pull from a drawer of a special file cabinet a pair of kardex cards, one white and one pink, each titled with the name of the chemical. Similar pairs are filed alphabetically for each proper, trade or other name of the known chemical products of the port. The face of the white card lists those physical properties of the chemical which are most relevant to port security; the classification according to Coast Guard regulations (for law enforcement) an estimate of its hazard to health, its capability of burning, its reactivity or stability. The reverse of the white card gives information important to Coast Guard personnel committed to controlling a fire or spill of the chemical. This information is expressed entirely in non-technical terms.

The OOD will alert a Coast Guard Casualty Control Team to provide communications from the scene to the station and to assist the local civilian authorities in establishing control. However, before this team is dispatched from the station, the
OOD will first instruct them according to the complete information found on the reverse of the White Card. This will insure that the team has the proper equipment and protective clothing, knows the health hazards of the operation, and the normal procedures for effecting control.

If a vessel or waterfront facility is involved, the OOD will dispatch a second team to investigate the locale of the casualty and to report what other chemicals are stowed there. Chemicals so reported by this team will be indicated by the tabs on the wall map. The OOD will draw a white card for each new chemical. By studying the face of these cards and the wall map he will be able to determine whether there is a likelihood of an explosion, fire detonation, gas or corrosive danger. This likelihood, if there is one, will be immediately reported to the chief civilian authority on the scene and to Civil Defense. The progress of the casualty toward the possibility of explosion will be closely watched. Adjacent plants will be alerted using appropriate phone lists.

Information contained on the white card will assist the OOD in preventing the approach of his team to a locale of danger for which they are not properly equipped, protected or instructed.

The format of the white card will probably be changed by experience. Its main purpose is to predigest essential information and to make it readily available in simple and practical language.

The pink card contains a list of names and phone numbers of the casualty control personnel in the industrial plants along the channel who are expert in handling fires and spills of this particular chemical. The OOD will call one or more of the experts listed on the card to alert and advise of the nature of the casualty involving this chemical and to request advice as to the safety of his team and the effectiveness of current and planned procedures.

General Phone Lists are prepared according to the different types of accidents expected, such as, fires of flammable liquids, fires of liquefied petroleum gas, spills or corrosive liquids, and spills of lethal poisons. These lists give the names and phone numbers of all organizations which have an interest in such casualties. Prompt use of these lists will insure that these agencies "get the word."

Fire-Fighting Equipment Lists and Spillage Control Equipment Lists specify what equipment should be used for each type of casualty.

Fire-Control Procedure Lists give brief standard fire control instructions and cautions according to the type of chemical involved. The OOD will use these lists to insure that his teams are accurately briefed on proper procedures. For those cases where the Coast Guard team arrives on the scene before the local authorities, the OOD will have to rely heavily on these lists to insure that the efforts of his team are effective. It goes without saying that point-to-point communications are a must.

Such then is a brief description of the Casualty Information Center at Houston. It is important to repeat that it is merely an aid to the Captain of the Port. It is not intended that the Captain of the Port assume control of any civilian operation or relieve anyone of his responsibility. It serves two purposes only:

1. It alerts interested civilian resources of a casualty involving chemicals along the channel.

2. It enables the Coast Guard Duty Officer at the station to maintain control over the safety of his team on the scene and to insure effective assistance.

This brief description of the Captain of the Port's Casualty Information Center which has been set up primarily to protect his men when faced with the hazards of a chemical spillage of fire, also shows one example of joint Coast Guard-industry cooperation to meet the threat of challenge of the changing situation in our ports. Other areas may have different problems.

I call upon each of you to examine your own safety requirements. The Coast Guard and its personnel in each and every port are ready, as always, to cooperate and assist to the limit of its authority, facilities and personnel in any local undertaking to enhance port safety. It is possible that some suggestions may occur to you. If so, please don't hesitate to share them. Any idea that will improve the safety of your port or the effectiveness of the Coast Guard's port safety program is welcome.
KEEPING ARC WELDING SAFE

By HOWARD B. CARY
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You don't like to get hurt. I don't like to get hurt. Every time an employee is hurt, we lose money. Each major injury means time off the job, but frequently overlooked is the minor hurt with its discomforts, annoyances and consequent reduction of efficiency.

Arc welding is by no means dangerous. For all practical purposes the major injury, just does not exist. However, possibilities do exist for many types of painful, but minor, hurts and discomforts which irk and slow down employees. A burn the size of a dime, stinging eyes, burning smoke in the nostrils—each of these can be extremely annoying and disrupting. However, each is temporary and, in arc welding, each is easily prevented.

Before I go any further, I would like to lay a ghost to rest. In early arc welding days, and even yet, people worried for fear the dusts, gases, radiation caused permanent bodily damage. Investigators checking thousands of welders, with one exception, have never found pneumonia, cancer, eye damage or any other disease caused by or traced to arc welding. The one exception is fume poisoning sometimes dangerous but preventable in the welding of certain alloys. Arc welding is not harmful to the weldor. It can sometimes become distressing.

A few precautions in physical plant, operator technique and protective clothing prevent every arc welding hazard.

We're going to discuss arc welding hazards, compare the hazard potential for various welding processes, and discuss how you can prevent or correct them.

We'll consider hazard prevention for sparks, hot metal and slag, radiation, fumes and smoke, electrical shock, fires and explosion.

Like fireworks, one of the intriguing factors of arc welding is the spectacular sparks and flying hot metals. These burn. They burn flesh, get in eyes, ruin clothes and start fires. These sparks will fly 15 to 20 feet on ground level and still be hot and hazardous for 50 to 60 feet when welding at heights.

The various arc processes are somewhat equal in the amount of sparks they produce; however, the MIG, TIG, and fine wire CO₂ have smaller sprays. Flying slag and grit and dust in deslagging operations, chipping, grinding and machining are an additional eye hazard.

Shielded metal-arc (stick) produces the most slag to chip away, cored wire and large wire CO₂ produce less, fine wire CO₂ and MIG produce negligible amounts. TIG none.

Insist that your welders wear face shields, safety goggles, gloves and other protective clothing. Spark resistant aprons, gauntlet gloves, leggings and/or shoe protectors, jackets, ankle height shoes and helmets are standard uniform for your arc welders at all times. More than once welders have set themselves afire and, because of their helmets, not known it until their flesh scorched. Now don't think that you are immune. Around our establishment, we say that good clothes attract sparks, old ones don't. So use caution at any time you are near welding.

Make sure your welders keep areas clean of all oily or greasy wastes or other flammable materials. Where welding is unavoidable near flammable items or passing people, your welder should use spark resistant screens. Maintaining a clean area also removes the hazard of metal dust which can get into equipment, lungs and eyes.

Welders are notoriously careless when chipping slag, grinding, machining or performing other operations dangerous to eyes. These are all short, intermittent tasks and people just don't wear goggles on this type of thing unless management lays down rules and emphatically insist that welders follow them.

The welder should always chip away from his face so that the bits of metals fly in a harmless direction.

Welding arcs produce rays which temporarily damage eyes and burn the skin. Ultraviolet is the most serious since it not only burns the skin but also "sunburns" the eye. Arc flash or eye burn occurs in a few
seconds even though the victim isn't looking into the arc. The flash is unnoticed at the time and the victim is completely unaware until two or three hours later the eyes redden. He wakes up between midnight and 3 o'clock with extremely painful sensations of eyes full of sand. Though extremely painful, arc flash is only temporary and the victim usually recovers within 24 hours.

The bright light of the arc causes minor immediate eye discomfort but no damage. Infrared rays in the arc produce uncomfortable heat but no serious problem.

All arc processes produce these rays at hazardous levels so that the variations in intensity have no bearing.

The standard clothing and helmet with appropriate lenses protect the welder from both skin and eye burns. The welder himself, though sometimes careless, is quite conscious of these hazards and needs little warning. He has learned from experience. However, the casual visitor, passing employees and other uninformed personnel need planned protection. Welding is fascinating and the arc naturally attractive. So the arc at all times must be shielded from the innocent bystander.

Victims of arc flash can relieve symptoms with ice packs, boric acid, a 2 per cent solution of butyn-sulphate, or 1/2 per cent pontocaine hydrochloride. Both of these last two solutions are available on prescription only but one at least should be in your shop first aid kit. Check it to see. Boric acid, though less effective, is still more likely to be in the home medicine chest and available in an emergency.

Fumes, gases and smoke are not the serious hazards they were once suspected of being, but they are irritating and develop alarming, but generally non-damaging, symptoms. The welding gases — CO₂, helium, argon — are themselves non-irritating and could present no problem other than possible oxygen displacement inherent in any gas. The arc welding processes develop or free varying amounts of carbon monoxide, oxides of nitrogen, ozone, fluorine and silicon, smoke dusts, and metal fumes which can be extremely unpleasant in eyes, nostrils and lungs and at times can be dangerous. With adequate ventilation, all concentrations of these irritants are in the immediate arc area and not harmful to the welder himself.

The metals which have the most welding hazard potential are mercury, zinc, bronze, beryllium, chromium, manganese and particularly lead and cadmium. Metal fume fever, usually lasting only 24 hours, develops from welding these metals or coatings. It appears within a few hours after exposure, is usually over in 24 hours, and continual exposure develops some immunity.

The most serious of these metal fume fever developing metals are lead and cadmium. Metal fume fever from lead or cadmium is the one exception in arc welding hazards which is potentially fatal. Therefore, the operator must be alert to the danger and insist fullest ventilation whenever he is welding cadmium plated metals or lead coated steel. If he has no ventilation, he should not weld. Metal fume fever symptoms are 103° fever, and chills and whenever they appear the welder must get to a physician immediately.

One hazard which combines radiation and fumes is rather odd and startling. The arc rays will break down trichloroethylene into the phosgene gas used as a world war weapon and will break it down even as far as 20 feet from the welding. This is another instance of the need to protect the innocent bystander. Be sure that no one becomes contaminated with trichloroethylene in welding vicinity.

Smoke, gas and fume dangers depend not upon the particular process used but upon the metals being welded.

Now I want to hit proper welding ventilation. Book after book, pamphlet after pamphlet says, “adequate.” Nothing could be truer! But what’s “adequate”? I’m going to give you specific figures that will do the job.

Normally, natural air ventilation is adequate if the welder has 10,000 cubic feet or more with 16-foot ceilings. If he has a lower ceiling or less than 10,000 cubic feet, he should have mechanical ventilation giving a complete change of air three or four times per hour. Sometimes he’ll need mechanical air replacement.

For outdoor welding, you need to worry only when you have zinc, cadmium, lead or mercury fumes. Then, the welder should wear a respirator or should use a suction exhaust at the arc. Whenever the welder is producing dangerous metal fumes or is welding in a confined area, indoors or out, he
should wear his respirator and use an arc area exhaust.

Remember that I have actually overstressed this hazard since there is no cumulative effect and the welder actually even develops temporary immunity to metal fumes. It is only the exceptional welding situation which demands more than ordinary ventilation precautions.

Shock is a hazard when welding just as it is when using electrical equipment in other tasks and the causes are just as typical: worn or frayed wires or cables, improperly grounded equipment, wet floors and carelessness.

Seldom is a welder shocked, and even then there is no real danger unless the voltage line of travel includes the head or heart. Of course, he might not like it, but he won't get hurt.

Gas tungsten-arc welding's higher voltage provides more hazard potential than found in other processes, generally, and the constant current processes use higher voltages than the constant voltage. Also, the AC of transformer welders is more harmful to the body than DC.

However, the standard electrical precautions of grounded equipment, attention to equipment overload, dry floors, firm connections, good wiring, dry gloves, and operator respect and caution eliminate the hazard of electrical shock. Two things especially the stick welder should remember: never to lay his electrode holder on his table or floor and never let his holder touch any gas cylinder. When temporarily not in use, he should hang his holder on the front of his welding machine since the cable, holder, and electrode are electrically hot until the machine is turned off.

The hazard of fire is always present and most bothersome in transient welding tasks. In a shop situation, most fire potentials are easily and almost automatically eliminated.

Sparks landing in oily materials, paper, cracks can start fires easily. Floors are frequently cleaned with flammable solvents easily fired. Unknowingly, a welder may start a fire by welding metal backed by wood or near other flammable materials.

Every arc welding process creates a potential fire hazard, but the high spark processes—stick electrode, cored wire, large wire CO₂—need to be watched most closely.

Be sure welding areas are cleared of all flammables or screened. Know what floor cleaning compounds are used and, if necessary, reclean with water and dry. Check new welding environments closely for potential fires. Whenever you're uncertain or worried, have appropriate fire extinguishers present and establish a fire watcher for the first 30 minutes of welding. These precautions will make your welding operation fire-safe.

There are two types of explosion we need to consider—hot and cold. By cold explosion we mean a sudden release or expansion of gases without fire.

The potential for hot explosion always exists when people are spray painting or working with other fume producing materials and even when the materials are stored near welding. The arc can easily ignite these gases when the air concentration reaches the critical point.

Another similar potential explosion exists whenever we weld containers which have held combustibles. The procedures for welding these containers is carefully spelled out in the American Welding Society's pamphlet, "Safe Practices for Welding and Cutting Containers That Have Held Combustibles." The welder should have these procedures and follow them carefully or not weld. Essentially, the container should be thoroughly cleaned, depending upon the particular combustible it held, with water, soap and water, hot chemical solution, or steam. Certain industries have their own special procedures for air or inert gas purging. But such cleaning and welding should always be supervised by someone who knows thoroughly the chemical the tank has held.

There is no hot explosion hazard in arc welding gases since these are all non-flammable. However, the arc welder will frequently use oxyacetylene welding, and oxygen and acetylene gases do present this hazard. One exploding cylinder can trigger others, spreading damage and death.

Whenever you work with gas cylinders you have potential cold explosion and, in addition, you have potential hot explosion with any flammable gas.

A gas cylinder with its valve knocked off acts like a rocket gone amuck. It skitters in one direction after another with great force and no predictability. If other cylinders
are near, they too may be knocked over, have valves broken, and add themselves to the melee. Buildings, equipment, and humans are all endangered.

All gas cylinders should be handled gingerly and carefully with great care taken to protect the valves. When in use, they should be chained upright. All cylinders should be stored outdoors, but the main precaution with gas cylinders is always careful handling.

Three areas give you your biggest hazard problem—hot sparks, fumes and radiation. But a clean shop, equipment in first class electrical condition, careful handling of gas cylinders, protective clothing and screens and appropriate ventilation will minimize all your welding hazards.

PRACTICAL GUIDES IN THE APPLICATION OF THE U.S. DEPARTMENT OF LABOR SHIPYARD SAFETY REGULATIONS

By JOSEPH J. LaROCCA,
Chief, Shipyard Branch Office of Occupational Safety, Bureau of Labor Standards

Much has been said in these yearly sessions, and in the various associational and union conferences held around the country, about the broad intent, scope, and requirements of the federal shipyard regulations, but little about the specifics of their applications.

This year, it has been suggested that we point up practical guides that should be followed in the application of the Federal regulations, in order to attain more effective results in terms of reduced number of accidents.

We, at first, would like to identify the basic causes underlying the misapplication or the absence of the application of the regulations. These are:

1. The lack of awareness or recognition of the potential accident causing conditions or practices.
2. The application of regulatory precautions and controls to only parts of the hazards, because the remainder are not deemed imminent accident producing hazards, or important enough to warrant consideration for control.

We are discounting such causes as willful disregard, in which the regulations are purposely set aside because of expediency or because they are considered unnecessary.

In carrying out its inspections, investigations and enforcement responsibilities, over the last six years, our field staff has reported many hazardous conditions and practices, observed in the job operations, that fit into the pattern of the aforementioned underlying accident causes. In my inspection trips about the country, I have made similar observations.

The purpose of this paper is to identify and discuss these conditions and practices in order to guide you to a more effective application of the safety regulations and thereby effectuate a betterment in your accident experience.

We feel that a frank discussion of these points, at a session such as this, can be of mutual benefit to all of us. But, we must be sure to not only point out the shortcomings, but also to provide the remedies.

Regulations Related to the Competent Person

The regulations on which we presently are placing a great deal of emphasis are those which deal with the responsibilities of the competent person, primarily in situations posing flammable hazards.

I should like to parenthetically state that the emphasis the Bureau has placed on this program since April, 1964 is now paying off dividends. We would like to believe that the training efforts expended by our staff throughout the nation, in a large measure, has been responsible for the downward trend
in accidents attributable to fires, explosions, and toxic materials. But, we have a great deal farther to go, if we ever are to become satisfied with our accomplishments.

The conditions and practices with which we are concerned in this category are:

1. The designation of a Marine Chemist by an employer as a competent person, without informing him that he has been designated. This lack of communication between the employer and the marine chemist has resulted in misunderstandings and faulty performance by the marine chemist of the regulatory requirements.

2. The inability of the marine chemist designated as the competent person to perform all of the duties required by the regulations, because of the press of other work.

3. The inability of some marine chemists to cope with ship-breaking operations because of their lack of experience in this activity.

4. The refusal on the part of some management to encourage or assign supervisors to our competent person training classes, which are being held by our district offices throughout the nation. This same attitude has been assumed by some of the union leadership.

5. The negligence displayed by some shipyards to keep a log or record of the tests and instructions issued by the competent person of the precaution and control measures to be taken.

The regulations require that this record, known as the Log of Inspections and Tests by Competent Person, or the MAR-9 form is to be kept by the competent person. The marine chemist designated as the competent person must also keep this log acting in his capacity.

Suggested guides for overcoming these deficiencies are as follows:

1. The employer should inform the supervisor, or the marine chemist he chooses to designate as the competent person, of his designation, and arrive at a clear understanding of what he expects of him with respect to meeting the requirements of the regulations which apply to his particular operations.

2. The marine chemist must make a definite commitment of his availability to carry out the requirements of the regulations.

3. The marine chemist is obligated to expand his horizon of knowledge so that he will be able to cope with all the activities and operations with which he will become involved—such as those in ship-breaking, previously mentioned. For your information, a special tri-partite task group organized by the N.F.P.A., of industry, government, and the N.F.P.A., is presently meeting to formulate an educational paper on the practical aspects of shipbreaking. It will be distributed to industry, to the marine chemists, and to our Bureau staff.

4. We suggest that both management and labor exercise a more vigorous interest and participation in the various safety training courses, particularly those dealing with the duties of the competent person.

The advantage of having trained personnel, especially to deal with the areas of fire and explosion, and toxic hazards, is now well recognized by the employers who have cooperated in these courses. They find that the trained supervisors have been extremely useful as connecting links between the marine chemists and the men doing the work.

5. Greater care should be exercised in the recording of test results, and issuance of instructors to control the hazards in the work environment. The MAR-9 log, required by the regulations is designed to provide this record. This form is available from the local Bureau field office nearest you. The competent person should occasionally be checked out by the employer as to whether he is adequately and properly carrying out the requirements of the regulations pertaining to him. Our field staff is presently doing the same during their inspections of the work locations and work procedures.

**Regulations Related to Exposures to Toxic Materials**

Before control measures can be exercised against toxic contaminants, the contaminants themselves must be identified. To do this, the ingredients in the work materials must be known.

Although in most instances the flammable and toxic properties of the common materials are known, little or no knowledge is possessed of the hazardous ingredients in a significant number of work materials.

This immediately suggests that the first step that should be taken is to identify the
hazardous ingredients in the work materials, such as cadmium or zinc coated steels in the construction or repair materials category, fluoride coated welding rods in the process materials category, and methyl ethyl ketone solvent in the application materials category.

We are therefore, in the near future, referring to industry, labor, and other interested parties proposed language for amendments to the regulations that will, in effect, require that none of the hazardous construction, process, or application materials shall be used unless the employer obtains information from the manufacturers or other sources that will enable him to exercise the proper controls over these hazards.

It may be well, at this junction, to remind you that in April, 1964, the Bureau proposed amendments to the shipyard regulations which provided for periodic medical tests of employees exposed to hazardous atmospheric contaminants, such as metallic fumes and free silica. Management, through the Shipbuilders Council has taken a firm position against them, while labor has submitted some inconclusive comments. As of this time, the matter is still open for discussion. Future evidence and development in this area may suggest a new course of action.

Regulations Related to Tripping, Slipping, and Falling

The regulations related to the number one accident type in shipyards, viz., tripping, slipping, and falling, are those that deal with scaffolding, protection of openings, housekeeping, safety belts and life lines, ladders, and walking and working surfaces.

The following conditions and practices which have violated these regulations are cited for your guidance:

1. Partially dismantled scaffolding was left in that condition for a short period of time. Another craft, using the scaffolding without the knowledge of the workman dismantling it, was injured. The remedy is to rope off, or by some other method, deny access to the partially dismantled structure.

2. Back rails, which had been removed to permit passage of some bulky materials, were not reinstalled, and resulted in a serious injury to an employee who intended to use the scaffolding for only a short period of time. The answer is to replace back rails as soon as the material handling is completed. Extreme caution should be exercised while the rails are down.

3. Guard rails were not erected around openings in the tween decks because they were not being used in the work operation. Nevertheless, one of the workmen fell to his death through one of these openings. The guide to follow is to guard openings in the work area, even though they are not directly involved in the work operation.

4. Hoses, electrical lines, welding leads, and air ducting were scrambled together with many useless hoses and leads, which resulted in a loss of identity of the ones in use. Several deaths were incurred in two distinct cases: one involving misidentification of an oxygen and acetylene hose, and another involving confusion in tracing an electrical power lead. Three guides are suggested: One, hoses, leads and other sources should be pulled whenever those no longer in use are confusing identification of those in use. Two, some system should be used, such as a mark, tag, or color, whereby a welder or burner, for instance, can trace and identify his lead or hose. Three, leads, hoses, etc. should be led in an orderly arrangement and supported by some suspension or support device.

In a recent inspection trip to Bath Iron Works, Bath, Maine, I saw an ingenious, swivel suspension hook arrangement for supporting hoses, leads, etc., promoting good housekeeping and permitting the tracing of individual lines.

5. Safety belts and life lines were not used by employees working on the top level of a staging float, and resulted in several drownings. No thought was given to the float suddenly surging on the back wash of a passing tug. The answer is to supply safety belts and life lines to the men on the top levels of the staging, while others exposed to falling into the water should wear buoyant work vests.

6. Hand lines of other means were not used to handle materials from one level to another. Instead, they were carried in the arms, and resulted in slips and falls which injured several employees and resulted in the death of another.

In this situation the reason for the unsafe act can easily be understood. Carrying materials in the hands and arms while negotiating a ladder is a common practice, but it